Observations of the Annular Solar Eclipse of March 14–15, 1858.

Observed at Bath, by C. H. Weston, Esq.

The sky which had been clear in the early part of the morning began afterwards to exhibit a greasy character, and became cloudy at the commencement of the eclipse, so that only a hasty and useless view of the first contact could be obtained. Subsequently the clouds lost their cumulus and assumed a misty form, until a widely-spread misty cloud covered the upper regions. These continuous misty clouds evidently resulted from the constant impinging of the under portion of the higher and colder current (then blowing from about the N.N.E.) upon the upper part of the warmer lower current from the W.N.W., and this state of things lasted until after the eclipse.

The only observations which I have to make must therefore bear rather upon the temperature and weight of the atmosphere. During the eclipse I used two thermometers whose range previous experiments had proved to coincide very accurately. The bulb of one was *blackened*, while the other was left untouched. The former had a south aspect, and the latter a northern. Their ranges were respectively as follows:

Black Bulb.		White Bulb.	
h m	°	h m	°
11 32	56·5	11 34	48·5
37	56·25	38	48·5
50	52·75	50	48·0
12 15	51·0	12 17	47·25
30	50·0	27	46·66
36	49·75	...	...
46	48·75	50	46·25
1 0	48·75	1 0	46·0
20	48·0	20	45·5
37	48·0	33	45·75
45	48·25	47	46·0
2 11	50·5	2 13	47·0

My barometer stood thus:

20^{m} before the first contact	29·182	
Greatest obscuration	29·116	Depression ·066
20^{m} after the last contact	29·192	

The diminution of light during the greatest obscuration may have caused a little error in reading off, but not in the least to affect the great fact of its lowest depression at that time. I should also state that I have not corrected the heights of the column of mercury for the sea-level, because the position of my residence (not far from 500 feet above the sea-level) does not touch the *relative* values of those heights.

On examining the above tables we find,

1. That from the commencement of the eclipse, the temperature of the atmosphere (correctly given by the white bulb thermometer with a northern aspect) regularly decreased to the period of greatest obscuration.

2. That the black bulb thermometer with a southern aspect (which had reference to the sun's radiating power) decreased in a similar ratio.

3. That the barometer showed analogous variation.

It is, indeed, observable from the thermometer-tables that the greatest depressions were not strictly coincident with the greatest obscuration of the sun. This circumstance, however, is not only what might *à priori* have been reasonably expected, but what also has actually been observed in a former solar eclipse.

I will only add that the atmosphere assumed during the greatest darkness a lurid character, and towards the distant horizon it passed from an olive to a yellowish tint, or rather olive-yellowish tint. The first range of hills stood out in black relief, but the more distant were misty. Rooks, which pass our house daily and return in the evening, now flew home during the obscuration, and one neighbour heard the cock crow, as the light beginning to return gave the appearance of a second dawn.

Bath, Sion Place, March 19.

Observed at Calne, Wiltshire, by W. and J. Simms, Esqs.

In the hope of seeing the annular phase of the solar eclipse on the 15th of this month, we went to Calne, in Wiltshire, one of the places according to the Ordnance Map through which the central line of the eclipse would pass.

Our telescopes were of 30 inches focal length, with magnifying powers of 46 and 72 times respectively, we had also other eyepieces of sufficiently low power to show a considerable margin round the entire disk of the sun. We likewise carried with us an aneroid, of the correct action of which we had previously satisfied ourselves, and three thermometers graduated to Fahrenheit's scale.

At the commencement of the eclipse the sun was seen through a thin film of cloud, and was generally visible with a greater or less degree of brilliancy, until about three-fourths were eclipsed.

The moon's edge, which we saw very distinctly and free from undulations, exhibited great irregularities, and at one part in particular a mountain was observed, the summit of which was much above the general edge; on one side it rose at a moderate angle, and on the other abruptly from a considerable depression.

The sun shone out brightly during the occultation of a large group of spots, which were surrounded by extensive penumbræ. The spots retained their forms and their sharpness of outline perfectly unchanged, even to contact with the moon's edge, so far, however, as our optical means enabled us to judge.

As the eclipse advanced, the sun became obscured by clouds, the landscape gradually, but almost imperceptibly, darkened until about five minutes before the formation of the annulus, when the increase of the gloom became more and more apparent every second.

At this time a number of lambs, which had been at play in a meadow before us, suddenly gave up their sport, and crowded closely together with their dams.

The extreme darkness lasted very few seconds, perhaps not exceeding four, and the return of a considerable degree of light was instantaneous. During the greatest darkness which came, not as evening approaches, but suddenly and palpably, we took especial notice of the landscape. The extreme distance had assumed a deep purple hue, vapour had condensed and was suspended over the valley, objects near to us were singularly dark, but nevertheless perfectly well defined, whilst the relative distance of all objects appeared quite unchanged.

The clouds quickly passed away, and at $1^h\ 5^m$ we saw the narrow crescent of light, too late, however, to afford us the smallest gratification.

During the eclipse the barometer fell from 29·928 to 29·903. At $1^h\ 5^m$ it had risen to 29·920, but continued to fall subsequently. The temperature by a thermometer exposed to the sun was at the beginning of the eclipse 57°·9, and at $12^h\ 55^m$ it was 50°·5. The temperature in the shade was 54°·0 at the beginning of the eclipse, and at $12^h\ 55^m$ it was 50°·2. At $1^h\ 5^m$ it was 50°·8, which was the last observation we made.

138 *Fleet Street, March* 24.

Observed at Somerton, Oxford, by J. Slatter, Esq.

Place of Observation.—The site chosen was a piece of high ground above the village of Somerton, in the county of Oxford, on the site of the old hall, about 450 feet above the level of the sea, as determined by comparison with the barometer observations at the Radcliffe Observatory, and half a mile north of the central track of the eclipse.

Telescope Observations.—Scarce any use could be made of the telescope. The sun was visible only three or four times by glimpses during the progress of the eclipse.

Observations for Temperature and Humidity.—The thermometers used were a wet-and-dry bulb by Barrow, hung on the northern face of the wall, at the distance of a few inches from it; and a similar pair by Newman, of which the dry bulb was blackened and exposed in the telescope stand facing the south. The bulb was quite open at $11^h\ 45^m$ A.M. It showed a temperature of 51°·3, which declined to 48°·0 at the time of the height of the eclipse, after which it rose to 51° at $2^h\ 15^m$ P.M. The readings of the wet bulb show a decided, though slight increase of humidity

immediately following the centre of the eclipse; but the clouded state of the sun and the nature of the weather prevented this from being a remarkable feature.

General Observations.—At $0^h\ 10^m$, Oxford mean time, the light was that of a dull November day.

At $0^h\ 45^m$, light sensibly diminished, but still considerable; flame of lamp much brighter: daylight estimated equal to half what it was ten minutes ago.

I now endeavoured to gain some definite estimate of the amount of light by shadows cast from the lamp. The result of these is given below.

From $0^h\ 50^m$, the light rapidly decreased till $0^h\ 54^m$, which was the commencement of the darkest phase. The light certainly began to return again within 30^s, probably 20^s; so that the time estimated as the centre of the eclipse will, all corrections duly allowed for, be $0^h\ 59^m\ 7^s$, G.M.T.

The most noticeable fact, however, was that, whilst the darkness came on very gradually, the return to daylight was apparently sudden. I am inclined to attribute this to physiological causes connected with the eye. The darkness comes on whilst the iris is contracted. As the light wanes, the iris distends; and the returning light, falling on a fully dilated pupil, affects the eye more strongly than the same amount of light did previously to the darkness.

The dark phase was plainly to be distinguished from that which went before and followed.

Measures of the Light at the Height of the Eclipse.—1. At $1\frac{1}{2}$ minute before the time of greatest obscuration, I held a foot-rule to the glass of the lantern. I found that at 12 inches distance the sunlight was still so strong that the lantern cast no circle of light on the paper held parallel to the glass. It was, however, perceptible at a distance of 9 inches. Whilst my pencil, held before it, cast a shadow at no greater distance than one inch.

2. At the time of the greatest darkness the lantern cast a very perceptible light, and the shadow was made at a distance of 8 inches from the paper.

3. One minute later, when the darkest phase had passed about 30^s, all things being as before, a shadow was obtained at a distance of 3 inches from the paper.

The same evening being cloudy, though the clouds were not so dense as during the eclipse at $6^h\ 4^m$ P.M., the light was less than at the time of the first experiment, and about equal to that which marked the third trial; whilst at 9^m past 6, I obtained the same shadows as during the height of the eclipse.* At this

* These trials were made in a large window facing the south, upon a table pushed up within a foot of it; the lantern being recessed behind the curtain; as it was during the eclipse in a hole of the wall. In both cases the full light from the southern sky was allowed to shine freely at right angles to the cone of rays from the lamp.

time the sun's centre was 1° 35′ below the horizon. I had found no difficulty in writing down my observations during the period of greatest darkness. The same evening I was obliged to light my candle to write on at $6^h\ 24^m$, P.M.; at that time the sun was 3° 55′ below the horizon.

Rose Hill, Oxford, March 15, 1858.

Observed at Edinburgh and Brentwood, by Prof. C. P. Smyth and his Assistants.

(1.) Having prepared, through the assistants of the Edinburgh Observatory and myself, to occupy a station in England (Brentwood, in Essex), as well as that on the Calton Hill, I have a few remarks to offer on what was seen at either place, though clouds prevented anything important being instrumentally observed.

Observations.

(2.) At Edinburgh little was seen except for a short time about $0^h\ 15^m$ P.M. Then the 6-inch equatoreal in its dome converted into a camera, threw an optical image of the sun, some 4 inches in diameter, on a white screen, with the moon's edge transiting over a fine group of spots. This edge had no proper serration or protuberance; but, equally with the sun's limb, was boiling, and broken into numerous undulations, travelling, as it were, along most industriously; and presenting the usual appearance of the border of the sun when looked at with a high magnifying power in a tremulous atmosphere.

(3.) The mural circle thermometer, in its usual position, well protected from radiation of all sorts, gave the following readings at the undermentioned times:—

h m	Fahr. °	h m	Fahr. °
11 45	46·1	1 5	45·9
0 0	46·0	1 20	45·9
0 15	46·1	1 35	45·8
0 30	46·2	1 50	45·9
1 0	45·9	2 5	46·0

(4.) At Brentwood all the middle part of the eclipse was seen by the naked eye, though through driving clouds, nimbi and cirrostrati, the whole of the time. The effect of a dense part of the cloud in decreasing irradiation, and of a rare part in increasing it, was very remarkable, the solar crescent being made alternately thin and thick.

(5.) When the eclipse was at its maximum, and the sun reduced to so thin a line (estimated at its centre to be 30″ in diameter), that a bystander involuntarily exclaimed, "Why it's going to be a total eclipse," there was nothing like darkness, only a gloom, and which hardly decreased the visibility, partly, perhaps, because it improved the definition, of distant things.

(6.) Almost immediately after the exclamation mentioned

above, I perceived a strange fluctuation of the light in the region of illumined cloud which kept constantly about the sun in a patch about a degree to a degree and a half broad, notwithstanding the rapid passage of the semi-transparent clouds across. I was not at the moment thinking of the "flickering lights" seen near the totality of former eclipses, but the appearance instantly brought them to mind; and I called attention twice, at an interval of some five or seven seconds, to what seemed to me the startling coming forward and going back of the light of the solar crescent and the illumined mist round about it. The clouds dimmed the sun too much to permit me to see any shadows of things close at hand, and I had for the same reason some time before given up the attempt to look for crescent images in the shade of a large laurel-tree; I speak, therefore, only of what I saw looking direct at the sun with the naked eye. The circumstances of observation were evidently bad to detect anything cosmical in the nature of the light coming from the narrow uneclipsed solar crescent; but the manifestation which took place was so very different from anything that had appeared up to that moment, and from anything immediately dependent on the transverse motion of the clouds, that I was startled to a degree.

(7.) When still almost transfixed with astonishment at the pulsations of light from the luminous solar region, the line of cusps began visibly to alter. Though prepared for the computed rate of motion, I was unprepared to realise to the feelings such rapidity of change in any celestial things as then followed; it was more like a steering-wheel going round in the hand of a strong sailor, than any of the proper motions ever witnessed in the sky by men; and it seemed at the same time to be the very *ne plus ultra* of astronomical signals for small differences of longitude, from the vastness of the measurable change in a second of time.

Conclusions.

(8.) *Of the darkness produced.* Having seen a total eclipse under nearly the same circumstances of cloud as this large eclipse, I can testify to the truth and sufficiency of a remark by the Astronomer Royal with reference chiefly to the eclipse of 1842—viz., that there is all the difference in the world between a total, and a merely large eclipse; and that as long as there is the least visible portion of solar surface left outstanding, nothing like night supervenes. When that last part goes, and the large eclipse becomes a total one, then, whether the sky be clear or clouded, real darkness suddenly comes down, and wants no nice observation or prepared attention to perceive it. With reference to the clearing away of the small degree of darkness that was produced, having struck myself, as well as bystanders, as having been more rapid than its coming on, I can only consider it as an error of the senses, similarly with the reputed large size of the moon near the horizon; and the effect is easily referable to the optical nerves being more sensible to an increase than a diminution of light; for,

on turning up a gas-burner in a room previously dark, the eyes are positively pained, while, on turning it down, no such consequence follows.

(9.) *Of Baily's beads.* Though these phenomena themselves were not seen, others, throwing light on their nature and mode of production, were. Thus, the Rev. Baden Powell has suggested that they are effects of irradiation of the sun's light acting on the serrated edge of the moon, and intensified by the increase of the sun's light from circumference to centre, as well as by the "mottling" of every part of his disk. That such intensifying of the depth of minute serratures of the moon's limb would follow from such cause, I have recently found well indicated, by viewing with a telescope an artificial eclipse of a lime-ball in various degrees of incandescence, by the edge of a round file; and it is also witnessed to by the particulars described in our No. 4; while No. 2, again, shows, altogether independent of such a cause, though both may exist together, that when the solar crescent is reduced to a line of light of less diameter than the telescopic disturbances and undulations witnessed on the sun and moon's limb, it could not but be visibly broken up into a series of separate particles of light. This effect, dependent on Newton's "tremours of the atmosphere," may be further modified by those imperfections of telescopes which make one instrument exhibit a star as a different form of light to what it appears in another, and both of them make it different to what it should appear seen through no atmosphere and a perfect telescope; and in the same way, a friend with very bad eyes, according to his own free confession, tells me, that in a recent voyage to North America, when he daily watched the sunset, he observed that the instant the lowest point of the sun's lower limb touched the sea-line, the whole of that limb instantly shot across the intervening space, and gave the lower half of the sun completely vertical sides.

(10.) In the phenomena of Baily's beads, as described by various former observers, and allowed by them to set most provoking limits to the degree of accuracy with which the instant of formation or rupture of the annulus be observed, there may be mixed up the effects of all the sources indicated above. If the first thereof be cosmical and irremediable, the second, or the effect of the tremours of the atmosphere, the most certainly present of them all, admits of great alleviation, by raising the telescope up a mountain's side into the rarer regions of the atmosphere; as may be so powerfully done in the approaching total eclipse of next September on the Peruvian Andes. After having myself tried the mountain experiment and found it successful, I may be disposed to overrate it; yet when I saw that the clouds—which over all Great Britain so completely covered the heavens on the day of the late eclipse, and defeated the best intentions of thousands of well-appointed observers—were only some 3 to 5000 feet above the level of the sea, and would therefore have in no way interfered with an observer at such a height as could easily

be commanded in Teneriffe, I could only think of what advantage might follow to many other exact telescopic observations in Astronomy, were one observer at least maintained *above* the clouds.

April 9, 1858.

Observed at Haddenham, near Thame, by the Rev. W. R. Dawes.

Having decided on viewing the eclipse from my own observatory, I employed an excellent $7\frac{1}{4}$-inch object-glass recently received from Mr. Alvan Clark. It is mounted on my Munich equatoreal stand.

The sun was clouded at the time of first contact; but in about one minute afterwards it became visible through thin clouds. The edge of the moon advancing upon the sun was usually very tranquil and sharply defined. Magnifying power employed 97.

The steadiness and distinctness of the image induced me to pay especial attention to the appearance of well-marked *pores*, and small bright spots, or *luculi*, on the sun's surface, as the moon approached and occulted them. Keeping my eye steadily upon them, I was able, in numerous instances, to note whether the edge of the moon produced any dimness or distortion, or change of place as it touched and passed over them. The same close attention was bestowed upon the best-defined portions of the extremely delicate network connected with the magnificent mass of solar spots; which was just completely occulted by the moon when the clouds thickened, and the sun was seen no more till after the eclipse terminated.

The result of this careful scrutiny was, that in no instance was either a bright or a dark object affected by the vicinity or contact of the moon's edge previously to its occultation. No dark shade adhering to its edge was seen on the bright parts, nor was any bright line visible on the dark parts, as they successively disappeared. No distortion, or tremour, or projection, was perceived in any of the numerous objects thus examined during the fifty minutes of visibility.

At the greatest obscuration the darkness was not greater than occasionally happens before a heavy storm; but the aspect of surrounding objects, both near and remote, was certainly very peculiar; the prevailing tint being *purplish* or a *deep lilac*. The larks, which were previously very merry, ceased their songs for about a quarter of an hour, and an unusual and solemn quietness prevailed during that period.

The increase of light seemed to be remarkably more rapid than had been its decrease; and in five or six minutes after the greatest obscuration, the existence of so large an eclipse would scarcely have been suspected. Yet there was no apparent corresponding difference in the density of the clouds, which were almost uniformly distributed.

Haddenham, near Thame, 1858, *April* 8.

Observed at 138 Fleet Street, by W. Simms, Jun. Esq.

Having intended to observe with the sextant the distance between the points of the bright cusps as soon as formed, I made preparation for doing so at the commencement of the eclipse, being just then engaged upon measuring the sun's diameter, with a view to obtain the index-error of the instrument.

The sky was very clear at the time, and the first contact of the moon's limb well seen. This occurred at $23^h\ 41^m\ 34^s$ approximately (observed by Mr. F. W. Simms).

I frequently watched the progress of the moon's disk over the sun, with a 30-inch telescope of $2\frac{1}{4}$ inches aperture, power 65; and during the time the sky remained clear could detect no difference between the density of the dark sky and the moon's surface, a tolerably dark shade being required for the eye to bear the light of the sun.

When the eclipse had pretty far advanced, probably about a fifth of the sun's diameter being covered, a thin cloud or haze spread itself over the sky, and an exceedingly light neutral tint shade was sufficient; I then distinctly saw the moon's edge for a distance of about five minutes beyond the sun's limb, the moon's surface being also of a different shade from the sky beyond, reminding me of the colour of the dark surface at the time of the time of the young moon.

The thin haze soon after this rapidly changed to a dark cloud over the whole of the sky, and rendered further observation impossible.

The lune was just seen through a break in the cloud at the time of the greatest obscuration, and also at a few intervals afterwards; but not sufficiently for any observation to be obtained. The amount of daylight was quite sufficient for the thermometers to be read without any difficulty, even at the darkest period; but the air was decidedly chilly to the feelings.

I read the wet-and-dry bulb thermometers, and Mr. Henry Simms the standard barometer, the results are given below:—

Time. d h m	Dry Bulb. °	Wet Bulb. °	Barometer, reduced to 32°.
14 22 0	49·3	44·3	
22 30	50·8	44·9	
23 0	51·7	45·3	29·883
23 41	53·2	45·9	
15 0 0	52·9	46·0	29·892
0 30	51·2	45·0	29·907
1 0	50·0	44·4	29·907
1 15	50·5	45·0	
1 30	50·9	45·3	29·906
2 0	51·2	46·2	29·906
3 0	51·0	47·4	29·906

Observed in the Garden of R. Wafford Eve, Esq. M.D., High Street, Deptford, with his 30-inch achromatic telescope, by J. W. Breen, Esq.

Before the beginning of the eclipse, solar spots were carefully looked for, to assist in determining the connexion between them, or the faculæ usually present in their neighbourhood, and the phenomena of the rose-coloured prominences. A well-defined group of spots, with penumbræ, was seen, as represented in the accompanying sketch.* Owing to the clouds, the first contact could not be observed; and when the sun was seen at $11^h\ 45^m$, it was already indented by the moon's limb, close to which the solar surface seemed brighter than in the centre, probably by contrast with the dark lunar disk. At this time the cusps appeared to project beyond the sun's limb, particularly the cusp towards the sun's eastern edge, which jutted forward like a point of light—such as a star appears in the telescope during the daytime. Although much interrupted by passing clouds, irregularities were observed along the moon's limb at $12^h\ 4^m$, which were best seen towards the eastern cusp. By $12^h\ 20^m$ these appearances were not so conspicuous; and the cusps, though well defined, did not seem to project, as previously noticed. The sky, till $12^h\ 30^m$, was completely obscured by clouds, which presented, as the gloom increased, the same lowering appearance as those seen on a thoroughly rainy day. The coloured glasses were now abandoned, and not used again. At $12^h\ 33^m$ the moon's limb was passing over the solar spots. Whilst this was taking place, their definition, as seen through the cirrus clouds, underwent no change; and as the moon's hard outline moved onwards, they gradually disappeared from the view. At the time of greatest obscuration, the loss of light, though very small, was sensible; yet distant objects could be perceived as easily as upon any dull day; and their appearance was scarcely as much affected as it would have been by the shades of evening.

The Thermometer.

	h	m	°	h	m	°
At	12	0	51·0	12	36	49·7
	12	12	50·7	1	5	49·1
	12	25	50·3	2	12	50·9

I was confirmed in the foregoing impression by Dr. Eve, who was present the whole time.

Observed at Leyton, by J. G. Barclay, Esq.

I made preparations for watching any changes of temperature that might occur, and the state of atmospheric damp and dryness, by placing dry-and-wet bulb thermometers in the shade, and black

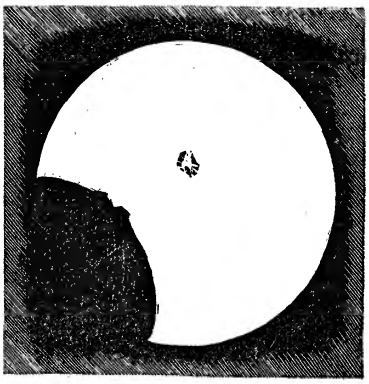
* The author here refers to a fine group of spots which was visible on the day of the eclipse near the centre of the solar disk.

bulb and plane glass exposed to the full rays of the sun, but the speedy and total obscuration of that luminary prevented any satisfactory results being obtained. The barometer was also carefully watched throughout the time of the eclipse, and exhibited the following progressive rise in the mercury until 12 o'clock, when it became stationary :—

9½ A.M.	29·80	12½ A.M.	29·85
10	29·81	1	29·85
10½	29·83	1½	29·85
11	29·84	2	29·85
11½	29·84	2½	29·85
12	29·85		

In order to prevent the fracture of the dark glasses of the eyepieces of my telescope by the concentrated heat of the sun's rays, I prepared rings of paste-board, which were placed within the dew-cap, reducing the aperture of the object-glass from 7½ inches clear, to 6½, 5½, 4 and 3½, with the intention of removing them one by one, as the sun became more and more obscured. As, however, my observation extended over a period of about 25 minutes only, I had not occasion to admit more light than the first ring of 3½ inches aperture permitted.

The first contact occurred in the midst of a heavy cloud, and I was consequently unable to test the time. As the moon advanced over the disk of the sun, an unevenness of outline was observable along the upper or western limb (as seen in the equatoreal). This increased as the outline of the moon enlarged, and at about 12^h 10^m P.M., when a total obscuration by clouds took place, it presented an appearance very similar to the accompanying sketch. One very prominent conical elevation was striking, followed by a depression apparently lower than the regular curve of the moon's figure, then two distinct minor elevations occurred, the whole rugged outline occupying about one-third of that portion of the moon visible on the disk of the sun. The eastern or lower limb of the moon was apparently a portion of a regular circle, but wavy with atmospheric disturbance. I could discover no difference whatever between the colour of the pure blue sky and that part occupied by the orb of the moon.



There was a very beautiful system of spots visible on the surface of the sun all the morning, which bore minute examination with higher powers. That used to observe the eclipse was 40.

At the period of greatest obscuration I left the observatory, and looked round the neighbouring fields, but could not detect any very peculiar appearances in nature, further than may frequently be observed on the approach of a heavy hanging thunder-cloud, especially towards the afternoon or evening of a summer's day. The air was remarkably still, a brisk N.N.W. wind which had been blowing all the morning having entirely subsided soon after midday.

My observatory is situated at Leyton, Essex, in

Lat. 51° 34′ 33″ N. Long. 14ˢ W.

Leyton, 31st March.

Observed at Hartwell Observatory, by Admiral W. H. Smyth.

Though the late eclipse, as a whole, is regarded as a "failure," still there are so many disjointed observations, that a fair estimation of the phenomenon may be made. And I therefore offer one of them.

For a complete attack of this eclipse, it was previously arranged that I should remain at the Hartwell Observatory, there to measure the cusps and take every advantage of the equatoreal instrument, while Dr. Lee, and Mr. Isaac Fletcher, who had kindly volunteered his aid to me, repaired to Towcester, in Northamptonshire, in order to watch the phenomena over the central annular line of the eclipse.

The morning of the 15th opened as finely as possible, and I went early to map the solar spots and arrange the minor matters; but before 10 A.M. the wind freshened up from the north-west, and the whole sky was overcast. At about $11^m\ 35^s$, the clouds became fleecy, so as to reveal the luminary, although a driving scud was passing over its surface. The telescope—with reduced aperture and a positive micrometer eye-piece of 62—was now pointed to the place where the moon would approach the solar orb in the inverted field; and while catching a firmish gaze, a tremulous motion of the sun's disk, followed by a faint dark line, announced the commencement of the eclipse's first contact, at $23^h\ 8^m\ 25^s$ sidereal time. As the line strengthened, masses of cumuli again got the mastery; but a little after noon it partially cleared, and the moon was finely seen approaching a remarkable group of spots beyond the centre in the north-following quadrant of the solar disk, the nearest of which she occulted exactly at $23^h\ 49^m\ 56^s$, sidereal time. The cusps were then very acute, and the lunar limb sharp and smooth. Soon after this, it again clouded over, and we saw no more of the eclipse.

Towards the central time of the phenomenon, the atmosphere assumed a dense leaden-violet tinge, resembling the coming-on of a squall or a thunder-storm; but it was never too dark for my reading the hour-circle of the equatoreal without artificial light.

The barometer, thermometer, and hygrometer, were carefully noted, and due attention paid to other particulars not necessary to be detailed in this communication.

Meanwhile, Dr. Lee and Mr. Fletcher occupied their stations at Towcester, where, according to the reports now before me, the weather was even worse than at Hartwell. This occasioned an alteration of plan; and it was agreed that Mr. Fletcher should ascend the church steeple to notice effects on the surrounding parts, while Dr. Lee, and his assistant, Mr. T. Horton, remained with the instruments and noted the atmospheric ranges, which were carefully recorded at settled intervals between 11^h A.M. and $2^h\ 30^m$ P.M. There is, however, nothing like being ready; for while Mr. Fletcher was on the steeple, suddenly the clouds opened, and he very distinctly saw the interesting effect of irradiation—the solar light impinging on the lunar edge so as to intermingle the dark and the bright limbs, and thus, under certain circumstances, produced the so-called "Baily's Beads."

St. John's Lodge, Aylesbury, 17th March.

Observed at Cardington, Bedford, by Mr. M'Laren.

(*Communicated by S. C. Whitbread, Esq.*)

A fine group of spots, three of sensible magnitude, was visible near the centre of the sun's disk.

	h	m	s	
First contact	11	39	30	G.M.T.
Contact of moon's limb with first small spot ...	12	25	0	
Contact with middle large spot	12	26	10	
Last spot disappeared	12	31	0	

Observed at Ipswich, Suffolk, by C. Stuart, Esq.

On the 7th March, I began taking altitudes of the sun, and continued them at intervals during the week to ascertain the rate of the clock and watch.

The calculated time of the beginning of the eclipse was $23^h\ 48^m\ 6^s$ Ipswich mean time.

At $23^h\ 47^m$ the wavy light seen upon the circumference of the sun was certainly more fluctuating and unsteady at the place where the first contact of the moon with the sun was to take place than at any other part of the sun's edge.

At $23^h\ 48^m$ a small cloud obscured the sun; the eclipse had not then commenced. At $23^h\ 48^m\ 28^s$ the cloud had passed over,

and the eclipse was seen to have begun some seconds; and I have no doubt the contact would have been seen to have taken place at the exact calculated time, and also that the time shown by the clock was correct.

At $23^h\ 43^m$ a prominence, or lunar mountain, was distinctly visible on the lower part of the moon, and upon consulting a map of the moon this evening, I find it is the one named Skickardus.

At $23^h\ 57^m$ the light from the sun was very distinctly seen within the edges, and slightly illuminating the dark body of the moon for a short distance, and had the appearance at its termination of three faint bands or fringes of light parallel with the edge of the moon; my impression at the time was that the solar light was inflected by a rare lunar atmosphere, however doubtful. It was in the light passing inwards along the convex surface of the moon that the before-mentioned lunar mountain was situated; it did not appear to me directly on the edge, but a little inside of it, but still high enough for the top to be beyond the edge, and appear in dark relief upon the sun's disk. I have been in the habit of observing the moon for years under all its phases with achromatic and reflecting telescopes of various sizes and powers, but never was more gratified than on viewing this lunar mountain under such circumstances.

At $0^h\ 29^m\ 26^s$ the moon's limb was in contact with the edge of the first spot; at $0^h\ 30^m\ 24^s$ it was covered; thus giving its bisection $0^h\ 29^m\ 55^s$.

At $0^h\ 34^m\ 35^s$ the moon's limb was in contact with the large group of spots; at $0^h\ 39^m\ 30^s$ the whole group was covered. Clouds prevented the exact time of their reappearance being noted down.

At $0^\circ\ 45^m$ the clouds began to increase, but still were sufficiently broken at intervals to get several good views of the eclipse, particularly at the greatest obscuration, which was seen to much advantage and gratification by very great numbers of persons. At $1^h\ 49^m$ the clouds became one dense mass, and all further observations were at an end.

The telescope I used (which I mounted equatoreally) is an achromatic of 34 inches focal length, and only $1\frac{7}{8}$ inch aperture, with a power of 35; field of view, 50′; but a most excellent defining one, and I used it in preference to another achromatic of $2\frac{3}{4}$ inches aperture and 46 inches focal length, or a 5-foot reflector with a 5-inch aperture.

As the eclipse proceeded, I took some measures with a sextant of the angle between the cusps, but upon examining them since, I think they are too faulty to copy out, and of no value.

Elm Street, Ipswich, Suffolk.

Observed at Burnley, Lancashire, by T. T. Wilkinson, Esq.

1. At the time of commencement the sky was totally obscured, and no hope existed that the eclipse could be seen at any period of its duration.

2. Shortly before 12 o'clock, however, the strata of clouds began to appear less dense, and at $12^h\ 5^m$ the disk of the sun became distinctly visible through the haze. The moon had then obscured a considerable portion of the lower part of the sun's disk.

3. After an interval of about 15 minutes, several openings were formed through the clouds, and an opportunity was afforded for observing the colour of the sky. This at first seemed of a dark purple hue; but it shortly changed into what an artist would probably call a dirty grey. The mixture of purple and grey was most evident round the edges of the openings; whilst the centre of each exhibited a near approach to a deep black, and seemed to project towards the observer from the rest of the opening.

4. At $12^h\ 35^m$ the clouds cleared away from the vicinity of the sun, and for the space of ten or twelve minutes the eclipse was observed at the greatest advantage.

5. From this time ($12^h\ 46^m$) to near the close, the scudding haze occasionally obscured the sun, but at rapid intervals the progress of the eclipse was observed without much interruption or inconvenience. Indeed the hazy clouds served as a medium through which the eclipse could be seen without the use of smoked or coloured glasses; for it was only when these were absent that glasses became necessary. Many of our population observed the eclipse most effectually during the absence of the clouds, by turning their backs upon the sun, and noting his phases as reflected from the apparently dark windows of the shops.

Burnley, Lancashire, March 17.

Observed near Oundle, Northamptonshire, by James Glaisher, Esq. F.R.S.

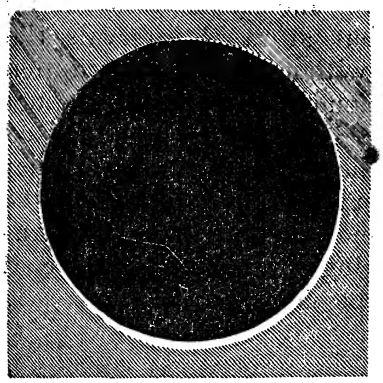
"For the observation of the solar eclipse of March 15, I made choice of Oundle, in Northamptonshire, from its being situated on, or very nearly on, the line of central eclipse as last calculated.

"I was very desirous of obtaining, if possible, a complete set of meteorological and physical observations in addition to those which were purely astronomical. In this I was greatly assisted by having associated with me Mr. Adams, late Assistant-Secretary of the British Meteorological Society, and whose presence with me at the time was of great value, as I could entrust to him with the utmost confidence the readings of the very delicate and accurate thermometers expressly prepared for this occasion, at my

request, by Messrs. Negretti and Zambra. In these observations he was assisted by Mr. Symons; and to the perseverance and care of these two gentlemen I owe the excellent series of meteorological and photometric observations which, during the greatest discouragements of weather, they continued to make from 9^h A.M. to 4^h P.M."

Mr. Glaisher attentively marked the progress of the eclipse, obtaining occasional glimpses of the phenomenon through the openings of the clouds.

"At $0^h\ 59^m\ 50^s$ I again saw the sun tolerably free from clouds; the cusps were still separated by about 70°. From the apparent highest part of the sun, and extending round his circumference to the apparent right hand for a space of 60° nearly, there were a series of bright and dark intervening spaces, irregular in size and distance from each other, evidently caused by the irregularities in that part of the moon's circumference, which was about passing off the sun; the remaining portion of the sun's limb was unbroken. The moon was black, and her limb was separated from that of the sun, at the widest part by a space which I estimated to be about the same as that of the break on the sun's limb, first noticed; viz. from 15″ to 20″; this width gradually tapered off, on approaching the apparent eastern cusp, to the finest possible point, still separated by 70° or 80° from the other cusp, but which space was evidently decreasing by the visible increasing of the lower cusp." (See annexed figure.)



Unfortunately, a little before the completion of the annulus, the interposition of a cloud entirely concealed the sun, and the most interesting feature of the eclipse was thus lost. Mr. Glaisher thus proceeds:—

"As the eclipse progressed, the change in the colour of the sun itself was very marked, the crescent becoming of a pure silvery brightness, like that of Venus after inferior conjunction with the sun. I cannot say the time when this change commenced, but I suppose it to have been gradual; I first noticed the alteration when the crescent was becoming very narrow and fast approaching the calculated time of annularity, when the absence of all yellow in the light must, I think, have struck every one. The illuminating power of the sun, or, I should say, of that part which remained visible, was very considerable even up to the time of the greatest eclipse; and the partial illumination on those objects receiving direct sunlight, when the sun was free from cloud, was much more than might have been supposed commensurate with the small portion of the sun's disk, which remained

uneclipsed. A peculiarity in the appearance of the landscape at this time was the glow of sunlight over objects apparently situated immediately beneath the sun, whilst the horizon all round was enveloped in gloom. This peculiarity was exhibited to the best possible advantage from the view commanded by my position.

"Beyond destroying the peculiar disposition of light and shadow, the interposition of the clouds before the sun had little effect in reducing the amount of light upon the landscape; and when not looking at the sun it was not immediately apparent whether or no the remaining part of his disk was free from clouds. This I attribute, in great part, to the reflexion of light from the screen of clouds, which, partially broken and variable in density, assisted in the dispersion of a considerable amount of light absorbed by them, in the first instance, from the sun itself. This, which I noted at the time, was subsequently confirmed by the photometer scale, as composed of slips of photographic paper exposed at regular intervals for five minutes.

"This scale was commenced at 10^h A.M., and continued onwards till 4^h o'clock. The exposure of the paper and recording of the times of observation was entrusted to Mr. Adams, and through all changes of the weather indicates unmistakably the loss of light due to the eclipse. In since fixing the photographic impressions, it should be borne in mind that the deeper tints have become lighter in the process, whilst the feebler portions marking the occurrences of the greatest phase remain unaltered. The following table contains the result of experiments made by noting the time photographic paper was tinged, and when it came to a definite tint on exposure:

Photometric Observations with Photographic Paper.

Time of Exposure.	Paper slightly Tinged in Seconds.	Paper coloured to a certain Tint in Seconds.	Time of Exposure.	Paper slightly Tinged in Seconds.	Paper coloured to a certain Tint in Seconds.
h m	s	s	h m	s	s
10 30 A.M.	10	55	12 0 Noon	5	40
45	22	65	5	7	60
11 0	20	70	10	8	60
15	12	40	15	10	...
30	15	20	20	11	40
35	5	15	25	6	50
40	4	30	30	3	25
45	6	30	35	6	40
50	6	40	40	5	40
55	5	31	45	10	63

Time of Exposure.	Paper slightly Tinged in Seconds.	Paper coloured to a certain Tint in Seconds.	Time of Exposure.	Paper slightly Tinged in Seconds.	Paper coloured to a certain Tint in Seconds.
h m	s	s	h m	s	s
12 50 A.M.	7	45	1 55 P.M.	30	90
55	11	90	2 0	10	60
1 0 P.M.	20	120	5	15	60
5	20	150	10	10	45
10	20	120	15	10	60
15	30	120	20	10	60
20	10	90	25	10	60
25	20	120	30	10	60
30	20	120	45	10	39
35	15	70	3 15	11	40
40	20	90	30	7	43
45	20	90	45	11	50
50	15	75			

From these observations it is evident that a great diminution of light gradually took place, from the commencement of the eclipse up nearly to the time of the middle, when it very rapidly further declined; after the middle of the eclipse had passed, a continuous rain fell, and the clouds were unbroken; nevertheless, the light at first rapidly increased, and afterward with less rapidity, till the end of the eclipse.

The depression of temperature during the eclipse was a little more than 3°.

The temperature of the dew-point was very variable throughout the day. From 9^h A.M. to 10^h A.M. it was about 40°, increased to 46°·8 by $11^h\ 15^m$; decreased to 41° at $11^h\ 40^m$; increased to 45°·3 at $10^h\ 25^m$ P.M.; decreased to 42° at $0^h\ 45^m$; increased quickly to 46° about the middle of the eclipse, and afterwards varied from 42° to 46°.

The degree of humidity had varied from 72 to 92 before the eclipse, increased to 96 at its middle, and varied from 79 to 93 afterwards.

The reading of a blackened bulb thermometer varied considerably in the morning before the eclipse. It will be remembered that the sun shone early in the morning with varied brightness. At $1^h\ 40^m$ its reading was 62°, which gradually declined to 44°·5, the temperature of the air at the middle, and then increased to 52° by the end of the eclipse.

The following table shows the temperature of the air and its hygrometric states from 9^h A.M. to 4^h P.M. For the general discus-

sion of meteorological observations over the country, see Proceedings of the Meteorological Society.

Meteorological Observations at Oundle on March 15, 1858.

Time of Reading.	Thermometer in Shade.		Dew-point.	Elastic Force of Vapour.	Weight of Vapour in a cubic foot of Air.	Short of Saturation.	Degree of Humidity. Sat. 100	Thermometer in Sun.		
	Dry Bulb.	Wet Bulb.						Dry.	Wet.	Black Bulb.
h m	°	°	°	in.	gr.	gr.				
9 0 A.M.	45·3	42·8	40·0	·247	2·8	0·6	82	51·4	48·2	62·0
15	46·1	43·4	40·3	·251	2·9	0·7	81	51·9	47·9	64·3
30	46·4	43·4	40·0	·248	2·9	0·8	80	48·8	45·4	54·6
45	47·0	44·0	40·6	·253	2·9	0·8	79	50·4	46·4	51·5
10 0	47·3	44·0	40·3	·250	2·9	0·9	77	50·8	48·6	56·6
15	48·0	45·0	41·7	·263	3·0	0·8	79	49·7	47·8	56·8
30	48·2	46·1	43·8	·285	3·3	0·5	85	49·6	46·5	56·6
45	49·1	46·4	43·5	·284	3·2	0·8	81	50·3	45·9	57·0
11 0	49·0	47·3	45·4	·305	3·5	0·5	88	49·8	46·9	56·5
15	49·1	48·0	46·8	·321	3·7	0·3	92	49·9	46·1	57·0
30	49·6	46·9	44·0	·289	3·3	0·7	81	50·3	47·2	57·5
35	49·9	46·5	42·9	·277	3·2	0·9	77	51·2	47·2	59·0
40	49·8	45·5	40·9	·257	2·9	1·2	72	51·1	47·2	60·0
45	49·9	46·5	42·9	·277	3·2	0·9	77	51·2	47·1	59·4
50	49·6	46·1	42·4	·271	3·1	1·0	76	50·5	46·8	58·5
55	49·8	46·5	42·8	·276	3·2	0·9	76	50·9	47·0	56·5
12 noon	49·2	46·1	42·8	·276	3·1	0·9	79	50·2	46·6	54·8
5	49·1	46·1	42·9	·277	3·1	0·9	79	50·2	46·6	55·4
10	49·5	46·5	43·3	·281	3·2	0·8	79	50·4	46·8	57·5
15	50·0	46·8	43·4	·282	3·2	1·2	79	51·2	47·4	58·8
20	50·8	47·5	44·0	·290	3·3	0·9	78	52·7	48·9	62·2
25	50·4	47·9	45·3	·303	3·4	0·7	83	52·3	47·9	58·9
30	49·5	46·5	43·3	·281	3·2	0·8	79	50·8	47·8	55·0
35	49·2	46·1	42·8	·276	3·1	0·9	79	49·9	46·2	56·2
40	49·0	46·0	42·8	·276	3·1	0·9	79	49·5	46·0	51·9
45	48·5	45·5	42·2	·270	3·1	0·8	79	48·8	45·5	50·2
50	47·2	45·7	44·1	·290	3·3	0·4	89	48·2	44·8	48·7
55	47·6	45·2	42·5	·272	3·1	0·6	84	47·6	44·2	46·8
1 0	47·4	46·5	45·5	·305	3·5	0·3	94	47·8	43·5	45·1
5	47·1	46·4	45·6	·307	3·5	0·2	95	46·2	43·4	44·4

Time of Reading.	Thermometer in Shade.		Dew-Point.	Elastic Force of Vapour.	Weight of Vapour in a Cubic Foot of Air.	Short of Saturation.	Degree of Humidity, Sat. 100	Thermometer in Sun.		
	Dry Bulb.	Wet Bulb.						Dry.	Wet.	Black Bulb.
h m	°	°	°	in.	gr.	gr.				
1 10 P.M.	47·0	46·5	45·9	·310	3·5	0·2	96	46·2	43·5	44·6
15	47·2	44·6	41·7	·264	3·1	0·7	82	46·5	43·8	45·0
20	47·0	44·0	40·6	·253	2·9	0·8	79	46·8	44·0	45·6
25	46·9	44·5	41·8	·265	3·0	0·7	83	46·5	43·9	46·7
30	47·1	44·9	42·5	·272	3·2	0·5	85	46·8	44·0	47·6
35	47·2	45·0	42·6	·273	3·2	0·6	85	46·7	44·8	48·0
40	47·2	45·1	42·8	·275	3·2	0·5	86	46·7	45·0	48·5
45	47·3	45·2	42·9	·276	3·2	0·6	86	46.8	45·1	48·9
50	47·2	45·1	42·8	·275	3·2	0·5	86	46·7	45·0	48·7
55	47·2	45·1	42·8	·275	3·2	0·5	86	46·1	45·0	48·5
2 0	47·8	46·8	45·7	·308	3·5	0·3	93	46·6	45·6	49·6
5	47·7	46·0	44·1	·289	3·3	0·5	88	47·2	46·2	51·0
10	47·7	46·1	44·3	·291	3·3	0·5	89	46·8	46·0	50·8
15	47·8	46·2	44·4	·293	3·3	0·5	89	47·0	46·6	52·5
20	48·0	46·6	45·1	·299	3·4	0·4	90	47·9	47·8	51·9
25	47·8	46·2	44·4	·293	3·3	0·5	89	46·9	46·8	51·4
30	48·1	46·6	45·0	·298	3·4	0·5	90	47·4	47·1	51·9
45	47·8	46·2	44·4	·293	3·3	0·5	89	46·6	46·1	49·2
3 0	47·9	46·2	44·3	·292	3·3	0·5	88	46·3	46·8	47·5
15	48·4	46·5	44·4	·293	3·3	0·5	87	46·7	46·4	49·1
30	49·0	47·1	45·0	·300	3·4	0·6	87	47·6	47·0	51·1
45	49·0	47·1	45·0	·300	3·4	0·6	87	47·8	46·8	49·4
4 0	49·1	47·3	45·3	·304	3·5	0·5	87	48·2	47·2	50·0

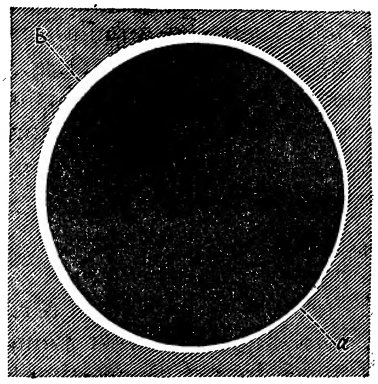
In the evening of March 13 there was a fine display of aurora, seen all-over the country. Auroral light was conspicuous during the evenings of the 14th, 15th, 16th, and 17th.

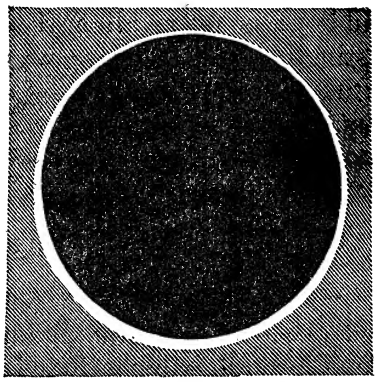
The following are extracts from letters which were addressed to Mr. Glaisher relative to the eclipse, as observed at different places.

Observed at Peterborough, by T. Sopwith, Esq., F.R.S.

"At about one o'clock the sun emerged from behind a dense cloud, and I caught it in my lesser telescope; a low power of twenty sufficing to give clearness to an excellent view of the whole disk. It was at that very moment commencing the annular

form, being narrower at *a*, and wider at B, see annexed figures, in a second or two it assumed, as near as I can judge — and my eye is tolerably correct for geometrical form — the aspect of an





equal line of light all round. I resumed my view before the ring disappeared, and observed the closing of the ring; but whether the low power of telescope or the clouds were the cause I know not, I saw no beads nor anything beyond the formation of a crescent succeeding the annulus, and then came a message that the train had arrived, in which at $1^{h}\ 15^{m}$ P.M. we were to proceed to Newcastle. I made no attempt at observations of temperature, nor even time; nor could I define with accuracy these details, for in truth I knew that Astronomy and Meteorology *were out* in great force. Had I maintained a continuous look the disks would have left their relative positions more clearly on my mind, and had I known how few were to see the actual annular eclipse, I would have taken a very exact chronometer. I was quite at a loss to account for the apparently perfect central position of the moon on the sun, but I think the view of light as I saw it, well defined and not dazzling, was as nearly as possible equal at one period along the entire circumference."

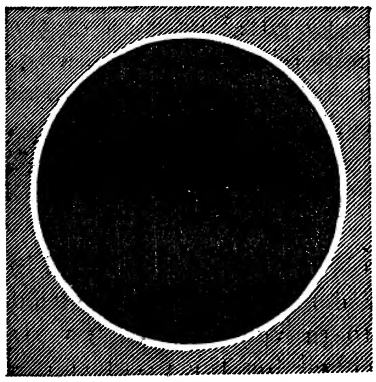
Observed at Peterborough, by Dr. Bowerbank, F.R.S.

"I *did* see the ring during the annular eclipse through a thin stratum of cloud, which was sufficiently dense to render coloured glass unnecessary, but not so dense as to prevent a distinct view of the annulus. As the moment approached for the greatest obscuration I steadily watched its proceeding; and as the moon progressed over the face of the sun, I saw the ring of light run round, as it were, on the side of the sun opposed to my left; and the first thin line like a streak of light appeared at the lower portion of the sun, and in a second or so the ring was of equal thickness at both top and bottom. I do not think, from the commencement to the termination of the annulation, the time could have exceeded three or four seconds; and it appeared to me that when about the middle,

the thickest part of the ring was to my left hand, and the thinnest to my right: but on this point I would not wish to speak with certainty. Our position was the Cathedral yard; and I believe there might have been about thirty persons present, several of whom I know, and know well. Fifteen of us, who formed a group after the middle was over, all agreed that they had seen the annulation distinctly; among these was my friend M. J. J. Fownes, Esq., actuary of the Economic, who had a telescope with him, but who saw no more than we without one. He was on the look-out for Baily's beads. No red flames were seen."

Observed at Peterborough, by Thomas Walker, Esq., M.D.

"I beg to state that on the 15th instant, walking with Mr. and Mrs. Gates on the Stamford Road, in a direction west from Peterborough, we continued, from the time I joined them, about $12^h\ 30^m$, to observe the progress of the eclipse; the strata of cloud not being so dense but that every four or five minutes the sun was visible under this at rare intervals, so brightly as to make the blue spectacles, with which I had provided myself, for a brief space useful, generally, however, the naked eye was more so. We were just about half-a-mile nearly due west from Peterborough, when Mr. Gates remarking that it was about the time of the greatest obscuration, and a break in the passing scud of cloud allowing an unusually good view of the darkened disc, we simultaneously exclaimed, 'The ring is complete!' it was so, and became whilst it so continued so bright that I was in the act of adjusting my blue glass to my eye, when the ring was lost, and the thin crescent appeared on the other side as the eclipse went on.

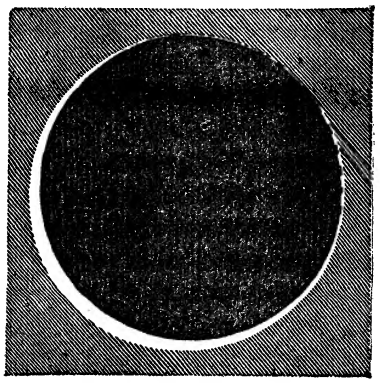


"All I can say is that the ring *was* complete, that it appeared to me of equal breadth all round, see annexed figure, but that, engrossed for the moment with the interest and the beauty of the spectacle, and with our unexpected good fortune in thus witnessing it, I can lay claim to no accuracy of observation as to its perfect equality of width in its whole circumference. The darkness seemed to me that of a cloudy evening, and the birds were chirping and singing more than I should have looked for had it been evening and equally dark."

Observed at Little Bridy, Dorset, by H. S. Eaton, Esq., B.A.

"I have not the slightest doubt that the line of central eclipse passed farther to the east than was anticipated. The eclipse was

seen from a spot about midway between Charmouth and Lyme Regis, $1\frac{1}{4}$ mile E.N.E. of the latter place. Here the ring was *complete.* Baily's beads first appeared on the S.S.W. limb of the sun, the annulus was then formed, continued for about seven or eight seconds; and on its breaking up Baily's beads reappeared on the E.N.E. limb, consequently the upper part of the annulus must have been the broader, although it was not particularly noticed. Baily's beads were formed when about 60° of the circle were wanting. The ring was seen at Charmouth, but from this place eastward as far as Abbotsbury, which is three miles S. by W. of Little Bridy, the sun became visible almost exactly at the time of greatest obscuration. Baily's beads were seen at the lower cusps on the western limb of the sun, but none on the upper limb; about 230° of a circle were formed, and Baily's beads were supposed to occupy 30° more, as in the annexed figure. These numbers, however, are stated with considerable diffidence, as in no case were actual measurements taken."



Second communication from Mr. Eaton, dated April 5th.

"Several persons stationed themselves at a spot one mile west of Lyme on the supposed line of central eclipse; here no annulus was formed, the ring being incomplete on the south-east limb of the sun, while at a distance of three-fourths of a mile farther east, on the outskirts of Lyme, a ring was visible for a moment. From this it appears that the western limit of the annular eclipse passed about half-a-mile to the west of Lyme. I may further add that the eclipse was seen from a high cliff called the Golden Cap, one mile and a half east of Charmouth, and that here the ring seemed of even dimensions. Charmouth is two miles from Lyme, and the Golden Cap rather more than two miles from Charmouth."

Observed at Royston, by Hale Wortham, Esq.

"At Royston the eclipse was pretty fairly visible nearly throughout, and I much regret that I was not at home to see it. One friend of mine (using a small Gregorian reflector without a dark glass at that time) tells me that about 1 o'clock he distinctly saw red bands crossing the upper horn of the crescent, and continuing over about one-third of the bright lune, but he could not trace them as projecting beyond the sun's limb. My mother and another lady, observing with the eye only, noticed a little while before the eclipse was at its greatest phase, a singular

dusky red line down the centre of the bright line. I am disposed to look upon this as an optical delusion (although seen by two persons), but mention it as it may possibly be confirmatory of what some one else has seen. The same ladies also remarked that during the eclipse the clouds surrounding the sun were beautifully tinted with red."

Mr. Glaisher thus concludes his paper:—

"From these accounts it is quite clear that the calculated line for central eclipse by Hansen's Tables is in error. From my own observations in approximate Latitude 52° 30′ N., and estimated Longitude 0° 28′ 20″ W., I was situated very nearly on the northern or western limit of annularity, as I saw the moon's south limb graze along the south limb of the sun. From the observations at Peterborough of Mr. Sopwith, Dr. Bowerbank, Dr. Walker, and many others, it would seem that the central line was not far removed from that city; and from the observations made at Lyme Regis, Charmouth, the Golden Cap, &c., it would seem to have passed about four miles south of the calculated line. Therefore, from all the observations, the most probable line of central eclipse passed a little west of Peterborough, or about four miles south of the calculated line by Hansen's Tables, and about one-fourth of a mile north of the line indicated by Burckhardt's Tables."

Observed at Appleby, Lincolnshire, by J. E. Cross, Esq.

Lat. 53° 37′ 10″ N. Long. $0^h\ 2^m\ 16^s$ West.

The time (Local Mean Time) uncertain to a few seconds.

First contact not observed.

$11^h\ 42^m\ 30^s$. Moon well on sun's limb. Protuberances very visible in the south part of moon's limb; one very large.

$0^h\ 15^m\ 0^s$. The mottled flocculi of the sun's surface seemed to become bordered with darker shades than usual, giving something like the appearance of very dusty lenses.

Soon after the greatest obscuration, as the cusps were quickly wheeling round, saw (at least twice) the point of the south cusp isolated.

The light increased almost immediately, and very rapidly after the moment of greatest obscuration.

Soon after the sun began to show decidedly brighter, I observed a faint crescent of light on the moon inside the solar crescent. (When I say *faint*, I mean faint through the colour shade.) The sun was always too bright to look at when clear of clouds.

Observed with a refractor $3\frac{1}{2}$ feet focal length, and $2\frac{3}{4}$ inches object-glass narrowed to 2 inches. Power 35; occasionally 80 and 130.

15th March.

Extract of a Letter from Professor Challis to the Secretary accompanying the following Communication.

"I send an instalment of a communication I propose to make to the Royal Astronomical Society respecting the eclipse of March 15, which was better seen at Cambridge than at most places in England. I will send the rest as soon as I can finish. In the meantime I can mention some results that I have arrived at. The times of beginning and ending of the eclipse were both *later* than as predicted in the *Nautical Almanac*. Burckhardt's geocentric R. A. of the moon's centre requires the correction $-2''\cdot9$, and the geocentric N. P. D. $+2''\cdot6$. The semidiameter of the moon in the *Nautical Almanac*, so far as this eclipse as here observed is concerned, requires the correction $-2''\cdot3$. From the above errors of the moon's geocentric place, it follows that the longitudes and latitudes in the *Nautical Almanac* of 1858, p. 467, calculated for the annular phase, require respectively the corrections $+6^s\cdot00$ and $-90''\cdot7$, and consequently that the true line of central phase was to the *south* of that given by Burckhardt's Tables, and distant from it by only one quarter of a mile. It seems to be evident from rude observations that the central line by Hansen's Tables was too far northward.

Observations of the Solar Eclipse of March 15, 1858, *made at the Cambridge Observatory, and Calculation of Results from Observations.* By the Rev. James Challis, M.A., F.R.S., F.R.A.S., Plumian Professor of Astronomy and Experimental Philosophy in the University of Cambridge.

As the annular eclipse of March 15, 1858, which was looked forward to by English astronomers with so much interest, could scarcely be seen at all along the central line, on account of cloudy weather, I have thought it worth while to describe the phenomena of the partial eclipse witnessed at the Cambridge Observatory, where, although the state of the sky was generally unfavourable, intervals more or less clear occurred, which allowed of noting certain physical circumstances, and of taking a few micrometer measures. Having resolved to go myself to Peakirk, a village about six miles north of Peterborough, situated very near to the computed central line, in the hope of witnessing the annular phase, I gave instructions to my senior assistant, Mr. James Breen, to take observations with the Northumberland telescope, aided by Mr. Bowden, the junior assistant. Also I offered to Mr. Hugh Godfray, M.A., of St. John's College, and one of the Esquire Bedells of the University, the use of the 46-inch Dollond, mounted out-of-doors on an equatoreal stand, which had recently been fixed to the stone area south of the dome of the 5-feet equatoreal. Mr. Godfray availed himself of the offer, and the results of his observations, of which he kindly drew up a report, are included in the following account. I propose, first, to give a

statement of the physical observations of the several observers, and then to add the micrometer measures and the calculation of astronomical results.

I. *Observations of Physical Phenomena.*

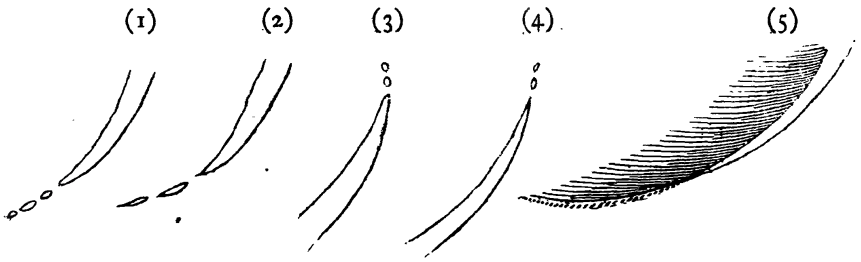
The following observations were recorded by Mr. Breen. Before the commencement of the eclipse dense masses of cumuli cloud were continually passing. The first contact was, however, detected almost immediately after it occurred, and for the next twenty-five minutes the progress of the eclipse was favourably observed. During this interval the irregularities of the moon's limb were very apparent. One remarkable prominence was especially noticed at twenty-five minutes to one o'clock. At eight minutes past noon the sky became densely clouded, and remained so for three-quarters of an hour. At $0^h\ 56^m$, about five minutes before the time of greatest obscuration, the sun appeared again suddenly through breaks in the clouds. The northern cusp was then quite regular and sharp; but the southern cusp, on being brought into the field of view, was found to be broken up into four or five rounded fragments — evidently "Baily's beads." The contiguous portion of the moon was observed to be frequently and deeply indented. The northern cusp was instantly brought again into view, but was found to retain its pointed form. At, however, 52 seconds past 1^h, broken points of light were clearly distinguished at this cusp, and twenty seconds later they were noted as "continually forming." The beads of the same cusp (the other was not again looked at) remained visible until 4^m past one o'clock, when they ceased to appear. By this time the sky had again become cloudy, and it remained so the next twenty minutes.

It was particularly remarked that the beads were continually appearing and disappearing, and changing in size, form and lustre, and that their appearance and disappearance were equally rapid. They generally took an irregularly round form; but on one occasion they appeared oblong, and the extremity of the cusp was an excessively thin line of light, having a much fainter illumination than the rest of the beads. Those on the southern cusp appeared rounder and at more regular intervals than those at the northern. Generally from four to six beads were seen at the same time, but not more. Sometimes a single point of light was isolated at the extremity of the cusp. No change in the colour of the beads was perceptible: they appeared of the same tint as the surface of the sun. No dark strings joining the borders of the sun and moon were once visible. The surface of the moon projected on the sun appeared of a very dark tint as seen without coloured glasses, but was not extremely black. No dark fringe along the sun's border was seen, nor was there any appearance of red-coloured prominences.

At one time, the sun having broken through the clouds for a brief interval with considerable brightness, the northern cusp was

removed entirely out of the field of view, and a prolongation of the moon's limb beyond that of the sun was plainly seen for a few seconds, bounded by a faint and white line of light about 20″ in breadth, which stretched almost across the field of view. Conceiving that this might be a portion of the sun's corona, Mr. Breen immediately looked into the finder of the telescope to see whether the same phenomenon could be perceived round a larger portion of the moon's disk, but the field of view was much too bright to allow of seeing anything of this kind. Excepting at the time of the last observation, when the sun was covered by very thin cloud, there was no occasion to use coloured glasses, the eye being sufficiently protected by the misty cirrus spread over the sky. Baily's beads and the faint prolongation of light beyond the northern cusp were seen without coloured glasses. A Huyghenian eye-piece of power 250 was used.

The following representations are exact copies of sketches made by Mr. Breen in his memorandum-book, immediately after the observations. Nos. (1) and (2) refer to the northern cusp, Nos. (3) and (4) to the southern cusp, and No. (5) to the faint light bordering the moon's limb.



Mr. Breen had no doubt that Baily's beads were due to irregularities on the moon's limb. As the cusp which was looked at longest, and is distinguished above as "northern," was the *retreating* cusp, it was possible, by carefully noticing the indentations of the moon's limb previous to contact with the sun's border, to anticipate the formation of isolated points and irregular ridges of light. Also the length of time during which the beads were visible in the immediate neighbourhood of the cusp is confirmatory of this explanation of their origin.

From five minutes past one o'clock till nearly half-past, the sky was quite overcast: at the latter time it became clear for a few minutes. From about five minutes past two o'clock to the end of the eclipse, the sky was pretty clear, and the final contact was observed with great accuracy.

The following account is extracted from Mr. Godfray's report to me of the observations he made with the 46-inch Dollond, the aperture of which is $3\frac{3}{4}$ inches. "The weather had been favourable up to and for some little time after the commencement of the

eclipse, when clouds, which had gradually accumulated, covered the whole sky; but as they moved at a rapid rate, they gave frequent though faint glimpses of the sun, which could then, on account of the screen thus interposed, be observed quite as well with the naked eye as with glasses. I used an eye-piece of power 75 [which took in the whole of the sun's disk]. The irregularities of the edge of the moon were well defined, but I could not see anything of the moon itself, nor any trace of the limb beyond the cusps, although I looked for it very attentively." Mr. Godfray then states that clouds prevented any observation of the passage of the moon's limb over the sun's spots, which he had intended to notice carefully, for the purpose of seeing whether any distortion of the limb took place. "As the obscuration approached its maximum, the clouds became thinner, and the glimpses of the sun more frequent, and I put on a power of 87 without any coloured class. With this I followed the *advancing* cusp of the sun, which was now reduced to a thin crescent, and I had the gratification of seeing Baily's beads forming themselves one or two at a time—never more than two—in advance of the cusp, and these were successively overtaken by the cusp and merged into it before new ones were formed. The edges of the cusp were well defined but very irregular on the inner side, and the point was blunted when one or two beads were in front. The appearance was precisely what might be expected from the interposition of the mountainous surface of the moon; and I have no doubt that the phenomenon is entirely due to the light of the sun shining through the hollows in the moon's rugged edge. It seemed to me, also, that where the beads were most frequent, the inner edge of the cusp was afterwards most jagged and irregular." Mr. Godfray further remarks that the position of Cambridge was in this instance better adapted in some respects for viewing the beads than a place on the central line, because the phenomenon could be traced in the passage of each cusp over nearly a semicircumference of the moon, whereas on the central line the appearance, though more sudden and striking, would be confined to more limited portions of the moon's border. He estimated the greatest distance the beads were at any time in advance of the cusp to be not more than 2° measured on the sun's limb.

For the purpose of testing whether the composition of the sun's light remained the same during the phases of the eclipse, Mr. Godfray furnished himself with a variety of coloured wools of different shades, some of which might be expected to approach to the same tint if the constituent parts of the sunlight altered. No such assimilation of the shades was discernible.

Mr. Bowden and Mr. Breen made the following meteorological observations. The barometer readings are corrected for index error and capillarity, and are reduced to 32° Fahr. The blackened bulb thermometer was exposed to the direct rays of the sun.

1858.	Mean Time. h m	Barometer. in.	Thermometers. Dry Bulb. °	Wet Bulb. °	Blackened Bulb. °
March 14	23 5	29·877	49·6	45·3	56·8
	23 43	...	51·7	46·6	56·7
15	0 15	29·893	51·4	45·5	56·7
	0 39	...	49·3	44·6	50·8
	1 4	...	47·7	43·7	49·1
	1 14	29·898	47·8	43·7	...
	1 19	20·903	50·9	45·6	55·3

Both observers remarked that at the time of greatest obscuration the sky was not nearly so gloomy as might have been expected, and scarcely more so than it generally is previous to a heavy shower of rain. Mr. Breen states his impression thus: "When the sun crescent was seen struggling through masses of cloud, it appeared scarcely possible that the considerable amount of light which prevailed could proceed from this slender thread of light." During the greatest obscurity the light was thought to be of a sombre, brownish hue by Mr. Bowden, who also noticed that there was at this time a general stillness, the wind, which had previously been somewhat brisk, being hushed. Birds, that had been heard singing a short time before, continued silent for about ten minutes; a flock of rooks took flight as at eventide; and when the greatest phase was over, the cocks in two neighbouring farm-yards seemed to indicate their perception of the return of light by incessant crowing. The darkness lasted a very short interval.

At Peakirk, where I was situated, the sky was so densely and uniformly clouded that I could not make a single astronomical observation. All requisite preparations were made for the purpose. My son, Mr. James Law Challis, accompanied me to render assistance; and a very commodious position for placing instruments was kindly provided by Mr. James, the clergyman of the parish, both for myself and for three other observers who came well furnished with astronomical means. All that could be done was to take some thermometrical observations, and make a rough estimate of the amount of obscuration. The temperature was recorded by Mr. Challis from two thermometers placed in a window-sill looking eastward, and from a blackened bulb thermometer attached to the telescope stand. The subjoined temperatures in shade are means of the readings of the two thermometers.

Thermometers in Shade.

	Camb. M.T. h m	°		h m	°		h m	°
Mar. 14	23 49	53·9	Mar. 15	0 19	50·6	Mar. 15	0 34	49·7
	59	52·3		24	50·3		39	49·2
15	0 9	51·2		0 29	50·0		0 44	49·0

Thermometers in Shade.

Camb. M.T.								
	h m	o		h m	o		h m	o
Mar. 15	0 49	48·7	Mar. 15	1 11	47·4	Mar. 15	1 41	48·3
	54	48·3		16	47·4		51	48·7
	59	48·0		21	47·5		2 1	49·3
Greatest phase	1 2	47·9		26	47·6		11	49·6
	6	47·5		31	47·8		18	49·7

Blackened Bulb Thermometer.

Camb. M.T.								
	h m	o		h m	o		h m	o
Mar. 14	23 42	53·0	Mar. 15	0 42	49·6	Mar. 15	1 21	47·8
	52	52·5		47	48·9		26	48·4
15	0 2	51·0		52	48·5		31	48·8
	12	51·0		57	48·0		41	49·3
	22	50·9	Greatest phase	1 1	47·5		51	50·1
	27	50·4		6	47·1		2 1	51·3
	32	49·6		11	47·4	Sun just visible	11	51·3
	37	49·2		16	47·6		18	52·2

To obtain a rough estimate of the degree of maximum obscuration, I proceeded as follows. Page 7 of Mr. Hind's Supplement to the Calculation of the Eclipse was held upright and facing the East, and I noted the distance at which the word "Errata" could be just seen to consist of separate letters, and also the distance at which this word could be just seen to be separated by an interval from the words, "In the Nautical Almanac," immediately below it. This was done at the commencement of the eclipse, and precisely at the time of greatest obscuration. The distances in the first case were 47 feet and 32 feet, and in the other 9 feet and 6 feet. The brightness with which the greatest obscuration was thus compared is that of the noon in latitude 53° N. on a day in the middle of March completely and densely overcast. The return of light after the maximum obscurity was apparently very rapid; so much so as to be the subject of general remark. This might possibly be owing in a great measure to the condition the sight had been brought into by the previous continual degradation of light. I repeated the experiment on the word "Errata" as quickly as possible after the greatest obscuration, and obtained a distance of 7 feet; but as the precise time at which the experiment was made was only roughly noted to be 1^m after the first, no exact result can be deduced from it.

Observed at Ochtertyre, Crieff, by Sir William Keith Murray.

The morning of the 15th was very clear from an early hour till 9 A.M., when the sky was completely clouded, and threatened to bar all hope of seeing any portion of the eclipse; but fortunately it cleared up at $11^h\,20^m$, and continued so till 12. The contact of the moon was well seen; and the only phenomena observed

were the limb of the moon slightly illumined by the sun for a short time, and a high mountain on the northern limb of the moon projecting on the sun's disk.

No change was observed in the barometer.

A thermometer, exposed to the sun, fell from 50° to 40°.

There was very little change observed in the light, but a certain twilight appearance was observable, and a sensible chilliness in the air.

An owl was heard to hoot, and the crows seemed disturbed in their flight.

Ochtertyre, 20th March.

A daguerreotype of the eclipse taken at Hinton, near Farringdon, by Mr. Williams, of Regent Street, about half-an-hour before the greatest obscuration, was exhibited at the meeting of the Society. Accompanying the real phenomenon was a mock sun, which appeared in the clouds at the same time. In regard to the latter we find the following remarks by Mr. Williams, in a note which appears in the *Athenæum* of the 24th of April :—

"I do not think that the reflexion could have lasted more than a minute and a quarter or a minute and a half, dense clouds almost immediately obscuring both the sun and its reflexion. The wind was very high, blowing very heavy clouds from the north-west; above them floated other clouds thin and fleecy, moving in an opposite direction; and it was upon these that the reflexion appeared. Drops of rain had fallen occasionally before and at the time of its appearance, and in about half-an-hour afterwards a heavy shower, which lasted more than an hour. For astronomical observations, or for the recording of other instantaneous events, would you permit me to speak in favour of the daguerreotype plate in preference to all other photographic processes? It is quite as sensitive (I think more so) as the most delicate *wet* collodion plate: for sharpness and definition of the result it stands unrivalled, and will retain its exquisite sensitiveness, without deterioration, for twelve hours, or even longer."

Sir John Herschel incidentally alludes to the eclipse in the following passage extracted from a letter to the Editor, dated Collingwood, March 20:—"We got a good sight of the eclipse through cloud in progress and its maximum, but in such brief snatches that I can only say the moon seemed to go over the sun just as a black disk of paper, a little jagged at the edge, goes over a smooth cut white one. Positively no flexure of cusps one way or other. A fine group of spots was passed over. The moon was certainly blacker than the *umbra* of the spots."

At Aberdeen the eclipse was occasionally seen through the clouds; but although Professor Thomson, of King's College, had made arrangements beforehand for observing the various astronomical and meteorological circumstances of the phenomenon, the results were so incomplete in consequence of the unfavourable state of the weather, that he considers their publication in a detailed form would not be attended with any real advantage to science. The following remarks on the meteorological features of the eclipse are contained in a letter to the Editor:—"The eclipse commenced at $11^h\ 45^m\ 29^s$ G. M. T. The barometer exhibited a marked rise from the morning to the afternoon, but this was evidently an effect independent of the obscuration of the solar dise. The rise of temperature in the shade, which would, from the time of day, have been noted till nearly the time of the close of the eclipse, was arrested, the thermometer varying very slightly, if anything marking a decrease. The photometer* (one bulb coloured), which rose from $73\frac{1}{2}°$ at 9 A.M. to 91° about five minutes before the commencement of the eclipse, fell afterwards; but unfortunately cloud and eclipse being mixed up with one another after this, we can only take the numbers to which are appended the words 'cloud passed off.' Thus we have

h	m	°		h	m	°	
9	30	$80\frac{1}{2}$		11	55	86	
11	15	80		12	0	85	
11	20	81		12	5	71	(after a slight cloud)
11	25	87		12	$34\frac{1}{2}$	35	
11	30	87		12	40	34	
11	35	90		1	9	0	
11	40	91		1	10	3	
				1	12	5	

after which, in spite of cloud, an almost uninterrupted rise."

The effect of cloud is thus shown:

h	m	°	
11	45	85	cloud
11	$46\frac{1}{2}$	45	do.
11	50	70	slight do.
11	51	41	cloud
11	55	86	clear

* The instrument, with which the observations were made, is a Leslie's *Photometer*, i. e. a differential thermometer of which one bulb is transparent and the other coloured nearly black; a scale which is attached indicates the difference in level of the fluid in the two branches. The readings are of course of no value, except as a means of comparing the heating power of the sun at different periods. Had the weather during the eclipse been propitious, observations would have been subsequently made on the earliest possible favourable day, so as by comparison to have afforded some estimate of the loss of solar calorific intensity during the eclipse.