his wishes. On July 20, I had the pleasure of visiting Mr. De La Rue at his station at Riva Bellosa; and, in admiring his observing establishment, I was much struck with the importance of his elaborate preliminary arrangements, in providing a first-class instrument, and carefully training his assistants; to which preparations his success is entirely to be attributed. On July 21, I, with my party, quitted the house of our most hospitable friend Mr. Bennison, for Vitoria, where I had the advantage of meeting Professor Mädler and M. Hermann Goldschmidt. I received here a telegraphic invitation from the Spanish Government, conveyed personally by the Secretary of the Governor of Viscaya, to join an Eclipse Congress at Madrid: the distance, however, and the pressure of home engagements, made it impossible for me to accept it. On July 22, we were again welcomed by our unwearied friend Mr. Vignoles, at Bilbao.

At our landing from the Himalaya, on July 9, it had been arranged that the ship should leave Santander for her return on the evening of July 23, and leave Bilbao on July 24. It now appeared, however, that the great festival of St. Jago, the patron saint of Spain, occurring on July 25, was to be celebrated by a bull-fight at Santander. In order to show our respect to a people from whom we had received so many marks of kindness, as well as to secure a longer time for collecting instruments, &c., the ship, at my request, was detained at Santander till the night of July 25, by which time all the Santander party had come on board. She lay the whole of July 26 in the roads of Bilbao, visited by many of the inhabitants. The Bilbao observers joined on that evening, and the vessel sailed immediately. We had left a few of our party, who proposed to return by land; their places were occupied by Mr. Vignoles, M. Montesino, Professor Chevalier, Mr. Wilson, and Professor von Weyer.

Many were the accounts of success and of misfortune to be told. It was matter of universal sorrow that the best friend of the expedition, Mr. Vignoles, had failed to see the eclipse. The Bilbao party had, for the most part, been successful; the Santander party, for the most part, were unsuccessful. Among these we were sorry to learn that our respected Fellow, Mr. Lassell, was to be numbered. After a most agreeable voyage, we anchored at Spithead about 4 P.M. on July 28, and landed in time for the railway-train which reached London on the evening of that day.

An account of the phenomena of the total eclipse as observed, under very favourable circumstances, at Burgos, was received from T. C. Janson.

Eclipse of the Sun, July 18, 1860. Observed at the Royal Observatory, Greenwich.

(*Communicated by the Astronomer Royal.*)

Observer.	Mean Solar Time of Observation. First Contact. h m s	Last Contact. h m s
M.	1 39 26·4 (*a*)	3 54 2·8 (*b*)
G.	1 39 30 (*c*)	3 53 57 (*d*)
D.	1 39 30·0 (*e*)	3 54 6·7 (*f*)
E.	1 39 34·0 (*g*)	3 54 1·0
J. C.	1 39 24·6 (*h*)	3 54 7·2 (*i*)

(*a*), (*h*), The time noted is that at which the sun's limb was first indented by a prominence in the moon. (*b*), (*f*), (*i*), Satisfactory. (*c*), Considered within a second of the truth. (*d*), Not so accurate as the observation of the first contact. (*e*), The moon's limb very mountainous at the point of contact. (*g*), Two or three seconds previously to the time noted, the sun's limb was indented by two prominences.

The initials M., G., D., E., and J. C., are those of Mr. Main, Mr. Glaisher, Mr. Dunkin, Mr. Ellis, and Mr. Carpenter.

The following accounts of the Eclipse, as observed in England, have also been received:—

Eclipse of the Sun, July 18, 1860.

Observed at Greenwich Hospital, by John Riddle, Esq.

The eclipse had commenced some seconds before it was observed at $1^h\ 39^m\ 55^s$.

The approach of the moon's limb to the spots marked in the diagram was well marked; the observations remarkably satisfactory.

Spot.	h m s
No. 2. The first with which the limb came in contact, disappeared at	1 53 47·5
No. 3. First contact with large spot in Group A	1 55 4
No. 4. Extremity of large spot disappeared	1 55 37
No. 5. Disappearance of spot	1 56 36
No. 6. Final disappearance of penumbra	1 56 43
No. 7. Disappeared at	2 1 43
No. 8. ,, ...	2 2 6·5
No. 9. ,, ...	2 2 25
No. 10. Well-defined small spot	2 6 24·5
No. 11. ,, ,, ...	2 25 15·5

A faint group followed, but offered no salient points for observation with the telescope employed.

No. 12 is a large double spot with a well-defined penumbra. Observed in the following order:—

	h	m	s
1. Penumbra, 1st contact	2	36	13·5
2. 1st contact with spot	2	36	30·5
3. Middle space reached	2	36	38·5
4. Extremity of spot disappeared	2	36	56

Next came the small spot marked

	h	m	s
No. 13.	2	37	35·5

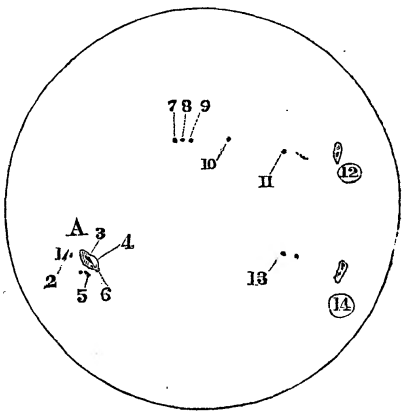
The following small spot was lost.

The larger group marked No. 14 was admirably well defined and observed as follows:—

	h	m	s
1. First contact with penumbra	2	44	40
2. First contact, upper spot	2	45	4
3. Spot disappeared ...	2	45	17·5
4. First contact, lower spot	2	45	33
5. Spot disappeared ...	2	45	45·5
6. Penumbra	2	45	52·5

The reappearances of the spots were confined to the complete reappearance of Group A at $3^h\ 0^m\ 32^s$, observed by Mr. Mugridge; and spot No. 10 at $3^h\ 16^m\ 38^s{\cdot}5$.

Telescope 2 ft. 8 in.; aperture 2·6 in.; power 40.



Sketch of the Spots on the Sun during the Eclipse of the Sun, July 18, 1860.

Greenwich Hospital, July 18, 1860.

Observed at Greenwich, by Rev. Geo. Fisher, M.A. F.R.S.

1. Sextant measures and distances of cusps.
2. Breadth of illumined portion of solar disk at right angles to the line of cusps.
3. Times of commencement and end of eclipse.

Time, Chronometer. h m s	Dist. of Cusps. ′ ″	Time, Chronometer. h m s	Dist. of Cusps. ′ ″
9 46 9	23 15	10 33 17	31 35
9 47 11	23 20	10 35 20	31 25
9 48 52	25 15	10 40 52	31 10
9 50 21	26 15	10 42 8	32 0
9 55 46	26 30	10 43 10	31 15
9 57 1	26 50	10 44 12	32 10
9 58 12	26 55	10 45 10	31 10
9 59 25	27 15	10 55 47	30 15
10 4 54	29 5	10 57 11	30 10
10 6 3	29 30	10 58 25	30 20
10 7 1	28 45	10 59 27	30 30
10 9 0	29 15	11 4 40	29 20
10 14 13	30 20	11 5 52	29 5
10 15 30	30 30	11 7 11	28 15
10 17 37	30 30	11 27 37	19 30
10 22 32	30 30	11 28 55	18 35
10 24 18	31 15	11 30 0	18 20
10 26 17	31 15	11 35 20	13 20
10 27 16	32 0	11 36 41	13 30
10 30 30	31 55	11 37 26	12 45
10 31 57	31 25		

Time, Chronometer. h m s	Greatest Breadth of Illumined Portion of Disk. ′ ″	Time, Chronometer. h m s	Greatest Breadth of Illumined Portion of Disk. ′ ″
10 36 10	5 0	10 49 30	7 30
10 37 48	4 45	11 0 46	12 40
10 39 14	5 0	11 2 5	13 5
10 46 25	7 0	11 3 10	14 0
10 47 35	7 15	11 8 17	16 15

The foregoing measures were taken by myself with an 8-inch sextant at the Greenwich Hospital School Observatory. They are given as read off from the instrument, without the omission of a single observation, and require 34″ to be taken from each for index-error, which was determined with great care before and after the observations.

The times were observed with a chronometer going sidereal time, and require each to be increased by 18^s, the quantity

which the chronometer was slow of sidereal time, as determined by comparisons with the transit-clock before and after observations, both comparisons agreeing.

Although the weather was occasionally cloudy, yet the measures were taken under favourable circumstances, and accord with each other as nearly as can be expected in single sextant observations.

The commencement and end of the eclipse were also observed under favourable circumstances with a 40-inch equatoreal of 3-inch object-glass, power 45, as follows:—

	Sid. Time. h m s	M. S. Time. h m s
Commencement	9 26 3	1 39 43
End	11 40 37	8 53 54

As a very slight impression upon the sun's limb was made when the time of the commencement was recorded, perhaps about 1 or at most 2 seconds of time might be subtracted from the time here given, making the mean sidereal time of commencement $1^h\ 39^m\ 41^s$, instead of $1^h\ 39^m\ 43^s$.

Latitude 51° 28′ 50″ N.; Longitude $0^s.2$ W.

Greenwich Hospital Schools, July 19, 1860.

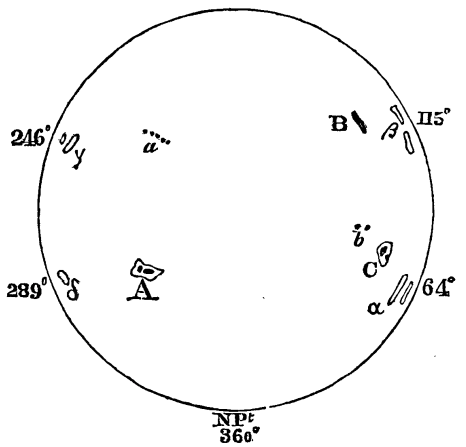
Observed at Maresfield, Sussex, by Captain Noble.

For some two hours prior to the moment of first contact I was occupied in the delineation of the map of the sun, which accompanies this paper, and which represents that luminary at a mean epoch of July 18th, 1^h G.M.T. Reference to the key to the larger drawing will show that I have lettered the three large maculæ in the order of their right ascension, A, B, and C; the minute groups I have called *a* and *b*; and the four most noticeable faculæ are designated α, β, γ, and δ. The chief spot (A) consisted of several umbræ contained in, or surrounded by, one penumbra; and it will be seen that prolongations of this penumbra extended to some, otherwise isolated, minute spots, at some little distance from the main mass. Spot B was of a long oval form, and a curious (dark) break was perceptible, dividing the umbra into two portions; and spot C consisted of two separate ones, surrounded by a single penumbra. The two small groups, *a* and *b*, scarcely demand any notice. With reference to the faculæ, that marked α in the key-map was situated at an angle of about 64° from the true north point, measuring (as in the ordinary position-micrometer) towards the east. It was double, and consisted of two nearly parallel fusiform streaks of light; the smaller, or following, one of which inclined at its higher, or southern part, towards the larger. β was a very confused group of faculæ (with maculæ intermixed) just being brought on to the sun's disk by his rotation; it was at

a position-angle of about 115°. Proceeding onwards, we arrive at γ, another double facula, with a distant resemblance to α. In this case the preceding streak inclined towards the other in a sharp curve; they were about 246° from the north point. Finally, δ, at an angle of 289°, reminded me forcibly of a "Prince Rupert's drop" in its form: it was quite isolated. I may add that I took great pains with the drawing and mapping of the various physical details on account of their possible connexion (that of the faculæ especially) with the "red flames," and trust that the result may be comparable with the observations of those in Spain who witnessed these remarkable appearances, and determined their apparent position on the solar limb.

The Eclipse.—The moment of first contact was, I believe, at $9^h\ 26^m\ 55^s$ L.S.T. = $1^h\ 40^m\ 45^s$ L.M.T. The moon's advancing limb was exceedingly rugged, four high mountains being very conspicuous. It is a curious fact that the moon appeared to have the effect of stilling the undulations of the solar limb at the points where she cut it. At $9^h\ 43^m\ 23^s$ L.S.T. = $1^h\ 57^m\ 0^s{\cdot}3$ L.M.T. the moon's limb centrally covered the group lettered A, and soon afterwards the advance of our satellite disclosed a regular sierra of mountains to the south of those already seen. At $2^h\ 6^m$ L.M.T. I turned the telescope on *Venus*, who was then about 11 hours from her inferior conjunction. She presented an exquisitely beautiful appearance, and her brilliancy was considerably heightened by the relative darkness which prevailed. I send a drawing of the appearance which she exhibited: albeit it is difficult to convey her extreme apparent tenuity faithfully. To return to the sun:—At $10^h\ 24^m\ 18^s$ L.S.T. = $2^h\ 37^m\ 48^s{\cdot}6$ L.M.T. the moon's limb was centrally over spot B, whence it steadily advanced and covered spot C centrally at $10^h\ 32^m\ 33^s$ L.S.T. = $2^h\ 46^m\ 2^s{\cdot}2$ L.M.T.; not the slightest change was remarked in the aspect of the maculæ, as the moon approached them, both umbræ and penumbræ remaining perfectly sharp and crisp up to the lunar limb. For some time after this the effect of the sunlight, as seen with the naked eye, was very remarkable. A dimness and dullness of a lurid tint seemed to overspread the landscape. Something of the sort might have been produced by a dense veil of mist covering the sun, but the continuation of sunshine and the sharpness of the shadows thrown by posts, rails, and trees, at once must have shown, even to a person ignorant of the eclipse, that this curious diminution of light had no reference to any merely atmospheric cause. The effect of comparative darkness was considerably more striking than on the occasion of the larger eclipse of March 15th, 1858; as, on that day, the dense, impenetrable nimbi only conspired with the obscured sun to give the effect of a dull summer evening; whereas, on the present occasion, this odd unearthly light was coexistent with apparently full sunshine. I may add that a curious and instructive effect of irradiation was presented at

this time, when any temporary passing cloud enabled the observer to regard the sun with the naked eye, or with a pale tinted glass. Under such circumstances, the moon's limb appeared to cut off scarcely one-third of the solar disk; and it was only on reference to the telescope, or on the employment of a glass sufficiently darkened, that the illusion was dispelled, and it was seen that in reality the sun was more than two-thirds obscured. At $10^h\ 4^m\ 8^s{\cdot}3$ L.S.T. = $3^h\ 1^m\ 29^s{\cdot}7$ L.M.T. spot A was again centrally uncovered; and at $11^h\ 15^m\ 11^s$ L.S.T. = $3^h\ 28^m\ 33^s{\cdot}2$ L.M.T. the lunar limb was just half off spot C. After this, the clouds which had more or less been scattered over the heavens all day, began to close rapidly over the sun, and, consequently, the emergence of spot B, and the moment of last contact of the limbs of the sun and moon, were invisible. I made a despairing effort to observe the last contact with the whole telescopic aperture, and an eye-piece undefended even by a dark glass, but in vain, the clouds were impenetrable! I observed, as usual, with my Ross equatoreal of 4·2 inches aperture. The map was made with an eye-piece magnifying 115 times and wired in squares of 1′ each. The eclipse was viewed with a power of 74, and throughout the whole aperture of the telescope was employed, and a piece of smoked talc placed within the focus of the object-glass; an arrangement which I find affords an exquisite view of the details of the solar disk, and which obviates the necessity for diminishing the area of the object-glass by diaphragms.



Key to Map of the Sun, July 18, 1860.

(at 1 hour G.M.T.)

A, large Spot (or group in one penumbra) preceding. B and C smaller spots following. *a*, minute group of spots nearly S of A. *b*, minute group of spots S P C. *α*, double facula at a position angle of 64°. *β*, group of faculæ (with maculæ intermixed, just coming on to the sun's disk) at an angle of 115°. *γ*, another double facula at 246°. *δ* a facula in the form of a "Prince Rupert's drop," at an angle of 289°. The angles are measured from the north point round by the E, S & W, as in the common position micrometer, and are subject to a probable error of ±1°.

Observed at Uckfield, Sussex, by C. Leeson Prince, Esq.

On the morning of July 18th, 1860, the sky was densely overcast, and some heavy showers fell at intervals before 9 A.M. At 10 A.M. the sky still remained obscured, and it was not until about $10^h\ 40^m$ that a patch of blue sky becoming visible over the Downs, gave some hope that a glimpse of the eclipse might, perhaps, be obtained. At $11^h\ 30^m$ the sky was about half covered by cloud. At noon the whole of the southern sky was almost free from cloud, and, with the exception of an occasional broken cumulus passing before the sun, the sky remained clear till a little past 3 P.M.

The major portion of the phenomenon was seen to great advantage in this latitude. The atmosphere was found to be remarkably diaphanous, and not the slightest tremor could be observed upon the edge of the solar disk. The faculæ and spots were seen beautifully defined.

As a prelude to any notes of the time of contact, I will remark that my observatory is situated 200 feet above the level of the sea, in latitude 50° 58′ 25″ North, and in longitude $0^h\ 0^m\ 24^s{\cdot}3$ East. My equatoreal telescope has an aperture of 6·8 inches, and a focal length of 12 feet.

By applying a Dawes eye-piece to a power of 140, I was enabled to use very satisfactorily the whole aperture of the object-glass. The first contact happened exactly at $9^h\ 27^m\ 6^s$ local sidereal time; and I almost immediately observed two remarkable lunar peaks enter upon the sun's disk, and as nearly as possible at the point of contact.

The following notes of time I took with great care:—

	Large Spot. Local Sid. Time.	Spot West of two. Local Sid. Time.	Spot East of two. Local Sid. Time.
	h m s	h m s	h m s
First contact with Penumbra	9 41 47	10 23 53	10 31 52
,, with Spot	9 43 3	10 24 14	10 32 14
Spot occulted	9 43 46	10 24 40	10 33 4
Penumbra occulted	9 44 31	10 24 54	10 33 19

At the time of greatest obscuration the horns of the crescent were particularly sharp and well defined, without the least sign of distortion which could be attributed to a supposed lunar atmosphere. The diminution of light was very considerable, and objects at a short distance appeared enveloped in a grayish blue haze, somewhat similar to the peculiar hue cast upon the landscape on a hot summer day, just after the sun has been obscured by a dense mass of cumulo-stratus cloud threatening a hasty shower. Soon after 3 P.M. clouds gradually came up from the south-west, and from $3^h\ 30^m$ the sun was entirely obscured during the remainder of the eclipse. I imagined that the last contact could not have been seen in this county.

Uckfield, Sussex, Oct. 20, 1860.

Observed at Highbury, by T. W. Burr, Esq.

Being unable to leave England at the time of the Eclipse, I made such observations of the attendant phenomena as the weather permitted. The morning was exceedingly unfavourable, but about noon considerable improvement took place, the sun being visible, though the sky still remained cloudy. From one o'clock to half-past it was very fine, but as the time for the commencement of the eclipse approached the clouds closed and the first contact was lost, the sun not being seen again till $1^h 49^m 31^s$, G.M.T., when the moon had made some progress on its disk. I had intended making a careful diagram from measures of the sun's appearance before the eclipse, upon which its successive phases could have been indicated; but there was no opportunity for doing this work. There were three conspicuous spots, or rather clusters, on the sun's face; one, the largest and most complex, near the south-east limb (as seen in the inverting telescope), and the other two near the north-west and west parts of the disk. Having failed to catch the first impression of the moon's limb on the sun, the next thing was to obtain as many time-observations of the passage over the spots as possible; and the contact of the moon with the penumbra of the first and largest cluster of spots took place at $1^h 54^m 10^s{\cdot}6$ G.M.T. At $1^h 55^m 30^s{\cdot}3$ the largest nucleus of this mass was reached, and by $1^h 56^m 20^s$ the whole of the nuclei in this cluster were covered. The disk being now clear for a considerable space, attention was directed to the appearance of the moon's limb, which was distinctly seen to be very rough and serrated; while both it and the sun's edge were in a state of great undulation, and it was perfectly obvious that had the two disks been concentric, the uneven edge of the moon, with its prominences and depressions exaggerated by the "boiling" and irradiation, would almost certainly have produced the effect of rendering "Baily's beads" visible at the two points of contact. I was also particularly struck at this time ($2^h 25^m$) by seeing a portion of the moon visible beyond the part where it was projected on the sun. This was evident at both places where it cut the disk, but more particularly at the upper cusp. The moon's body was visible for about 4′ from the sun's border, and was seen, not by any light proceeding from it, but by its intense blackness as compared with the sky background. The impression on the eye was not a transient one, but was seen, whenever the eclipse was visible, for half an hour from this time. At $2^h 35^m 51^s{\cdot}5$ the penumbra of the second spot was reached, and by $2^h 36^m 43^s$ the spot and penumbra were covered. Dense clouds then covered the heavens until after the greatest obscuration, and nothing could be noted but the terrestrial appearances. These were sufficiently striking:—a gradual gloom had come over the scenery, the clouds having a lurid character similar to an impending thun-

derstorm ; they were very dark, and seemed lower than usual ; in fact, they gave the impression of a rapid descent on the earth. The wind blew strongly from the south-west, and produced an unpleasant and unusual chilliness. Near the zenith a few breaks showed the sky of a deep indigo hue, while towards the horizon, which was very indistinct, the clouds had a copper-coloured tinge. Birds appeared to be returning to the trees from their excursions, and were noticeably silent during the greatest gloom. By $3^h\ 5^m$ most of these peculiar effects were gone ; the clouds had become light and silvery, the sky between them pale blue, and the wind lowered. The passage of the obscurity from the north-west to the south-east could also be distinctly traced. The temperature now began to rise from the depression it had suffered. During the brightest part of the morning, about $1^h\ 30^m$, the thermometer had reached $71°{\cdot}5$; it fell gradually during the eclipse to $2^h\ 50^m$, when it stood at $61°{\cdot}5$, and afterwards recovered the elevation of $65°$ by four o'clock, when the eclipse was over. The passage of the moon again became visible, and at $2^h\ 58^m\ 29^s{\cdot}9$ a very small spot, below the large one, was uncovered. In another minute the nucleus of the large spot began to emerge, and by $3^h\ 0^m\ 19^s$ was quite clear. At $3^h\ 0^m\ 54^s{\cdot}4$ the penumbra of this cluster was entirely visible. Clouds again intervened, and when they had passed, the second spot was clear ; and at $3^h\ 42^m\ 52^s{\cdot}5$ the nucleus of the third spot appeared. I was very desirous of getting an observation of the time of the last contact, but the clouds deprived me of it. I saw the moon still projected on the sun at $3^h\ 52^m\ 38^s{\cdot}9$, and evidently within a few seconds of leaving it ; but a cloud once more covered them, and when the sun reappeared at $3^h\ 54^m\ 25^s$, the eclipse had passed. My observations were made throughout with my usual instrument, the equatoreal by Ross, of $3\frac{3}{8}$ inches aperture, at first with direct vision and a power of 58 ; but after the largest spot was passed, a Hodgson reflector was used, with a power of 100. The latitude and longitude of my observatory are $51°\ 33'\ 42''{\cdot}1$ N. and $23^s{\cdot}9$ W.

August 1860.

Observed at Haddenham, Bucks, by the Rev. W. R. Dawes.

The solar eclipse of July 18 was observed here under remarkably favourable circumstances until the greatest obscuration was past, when the thin and detached clouds, which had prevailed during the earlier part of the afternoon, thickened so much as completely to obscure the termination of the eclipse.

The first impression on the sun's edge was made by the highest part, near the southern extremity, of the remarkable chain of hills on the moon's eastern limb, named " The D'Alembert Mountains " in the Rev. T. W. Webb's excellent index

map, in his very useful little work entitled *Celestial Objects for Common Telescopes*. During nearly the whole time that the eclipse was visible the image was unusually tranquil, and so distinct, even through the thin stratum of cloud which often covered it, that on my $8\frac{1}{4}$-inch object-glass powers of from 145 to about 520 were employed with excellent effect. The most minute and delicate feathery portions of the penumbra of the large spot in the sun's north-western quadrant were thus brought out with admirable distinctness, and their occultation by the moon's sharply defined edge was most carefully watched. Neither on these, nor on the darker part, (or *umbra*,) of the spot, was the slightest effect produced, either in form or shade, previous to their disappearance.

The moon's limb, just off the disk of the sun and close to it, was repeatedly examined by placing portions of it in a small field of my solar eye-piece, from which the sun was excluded, and using as light a shade as my eye could comfortably bear. No light on any part of the moon's edge could be even suspected.

About the time of the greatest obscuration a very thin cloud near the sun to the south displayed extraordinarily vivid prismatic colours, through a part of which the planet *Venus*, then very nearly at her inferior conjunction, appeared of a delicate pink. This planet was visible through the cloud when the aperture of the finder was reduced to half an inch; and in a clear sky, with an aperture of only $0^{in}\cdot36$, she looked like a semicircular nebula. Her distance from the sun's southern limb was about 5°.

Haddenham, Thame, Nov. 1860.

Communications were also received from—

Mr. F. Morton, at the Wrottesley Observatory. On account of the unfavourable state of the weather the first contact could not be seen, but the last contact was observed to take place at $3^h\ 41^m\ 56^s$, Wrottesley mean time; but as it was seen through the edge of a cloud the time is considered as uncertain to the extent of about one second.

John M. Stodhart, at Dublin; the morning was so cloudy that all idea of telescopic observations was abandoned, and the only observations obtained were of the barometer and thermometer.

C. B. Chalmers, Shanty Bay, County of Simcoe, Canada West. The first and last contacts are stated to have been well observed, and the occultations and emergencies of several spots were also observed, but the times were obtained to minutes only.