

II. *An Eclipse of the Sun, July 14. 1748. observed by the Right Honourable James Earl of Morton, Mr. le Monnier, Royal Astronomer and Member of the Royal Academy of Sciences at Paris, and Mr. Ja. Short, Fellows of the Royal Society.*

Read Dec. 8. 1748. THESE Observations were made at *Aberdour* Castle, belonging to the said Earl, whose Latitude is  $56^{\circ} 4' N$ .

Mr. *le Monnier* having come over from *France* to go to *Scotland*, to observe the annular Eclipse of the Sun, *July 14. 1748.* I was desirous to contribute all that lay in my Power to assist him, and therefore resolv'd to go to *Scotland* with the Right Honourable the Earl of *Morton*, who was so good as to permit us the Honour of accompanying him.

We arriv'd at *Edinburgh* *July 4.* and immediately went to the College, to enquire what Preparations were made there, in consequence of Letters we had wrote before we left *London*; when Mr. *Alexander Monro*, Professor of Anatomy, inform'd us, that, upon Receipt of ours, he had wrote circular Letters to all his Friends in different Parts of the Country, to prepare, in the best manner they could, for the most exact Observation of this Eclipse.

We found that the meridian Mark, which had been settled from Observations, by the late worthy Mr. *Mac Laurin*, was lost, by the taking down of a Chimney, upon which it was fixed; and Mr.  
*Matthew*

*Matthew Stewart*, the present Professor, having no proper Instruments, had not as yet re-established it ; which we hoped to do by an Instrument, which we every Day expected from *London* ; and Mr. *Stewart* having promised to make the best Observation he could, we resolved to set out for *Aberdour*, a Seat of the Earl of *Morton's*, which he readily offered to us, and did us the Honour to accompany us thither himself, having the same Desire and Curiosity to do whatever lay in his Power to contribute to an exact Observation.

*Aberdour* is about 10 Miles almost N. W. of *Edinburgh*. We chose this Place, as being, by the Computations of this Eclipse, at or very near the Southern Limit of the *Annulus*.

In the Castle of *Aberdour*, Lat.  $56^{\circ} 4' N.$  and  $25''$  of Time West of the College of *Edinburgh*, we set up a Clock, *July 9.* and the Weather being cloudy, and our Equal-Altitude Instrument and *Transit* not being yet arrived, we on the 11<sup>th</sup> made use of an Equatorial Telescope of my Lord *Morton's*, to find corresponding Altitudes of the Sun, and at the same time put up a *Gnomon* of 15 Feet high.

Being uneasy that our Instruments were not come to Hand, and resolving to have a Communication with the College of *Edinburgh*, where they had a *Transit* Instrument ; my Lord *Morton* proposed that two Cannon should be fired from the Castle of *Edinburgh*, one precisely at 12 o' Clock, and the other at 5' after 12 on the Day of the Eclipse ; and the different Observers in different Parts of the Country to be advertised of this, and to mark down the precise Time of seeing the Flash, or hearing the  
Sound

Sound of the Cannon; so that, after having made a geographical Map of these different Parts of the Country, and having found the exact Meridian of one Place, we should be enabled to settle the Times of all the rest by the Difference of Meridians found by this Map. This was settled and agreed to on the 12<sup>th</sup>, and an Express sent over to *Edinburgh* with a Letter from my Lord *Morton* to the Lord Justice Clerk, to desire this Favour of General *Bland*, who very readily granted it.

The 13<sup>th</sup> being a clear Day, we took equal Altitudes with the Equatorial Telescope, and found our Clock gained 1' 46'' in two Days, and that the Sun passed the Meridian at 12<sup>h</sup> 7' 6'' by the Clock.

July 14<sup>th</sup> was an exceeding bad Morning both for Wind and Rain; but about 8<sup>h</sup> in the Morning, the Clouds dispersed, and we had a very clear Sun.

In order to observe the Eclipse, my Lord *Morton* made use of a reflecting Telescope, 12 Inches focal Length, magnifying about 40 times. I made use of a reflecting Telescope 4 Feet *Focus*, magnifying about 120 times; both belonging to my Lord *Morton*. Mr. *le Monnier* made use of a retracting Telescope, about 9 Feet *Focus*, which he brought with him from *France*, armed with a Micrometer, made after the Method of Mr. *George Graham*, by the late Mr. *Sisson* at *London*.

Mr. *le Monnier* took his Station in the Garden, under the Window of the Room where the Clock was placed; my Lord *Morton* was in the Room next that where the Clock stood; and I was at the Window next the Clock.

Clock.

[ 585 ]

Clock.			True Time.			
h	'	"	h	'	"	
8	55	0	8	47	5	The Eclipse not yet begun. Clouds come on.
8	59	13	8	51	18	Beginning of the Eclipse, found by the following Chord.
9	0	42	8	52	47	First View of the Eclipse, then considerably advanced.
9	2	30	8	54	35	Measured the Chord of the Part eclipsed; which was found equal to the Field of the great Reflector.
10	6	10	9	58	12	The illuminate Part of the Sun, measured by the Mi- crometer, and found = $7'$ $37''\frac{1}{2}$ .
10	45	0	10	37	0	Again measured, and found = $7'$ $37''\frac{1}{2}$ . My Lord <i>Morton</i> judged the Middle of the Eclipse, or nearest Approach to an <i>An- nulus</i> , at $10^h$ $17'$ $54''$ ap- parent Time.
11	52	43	11	44	40	The same Phase or Chord observed as at the Begin- ning, and measured both in the Telescope, as at first, and by the Micrometer, and found = $8'$ $25''$ of a great Circle, as verified by a Base after the Eclipse was over, which gives the End as exact as the Beginning.

Clock.	True Time.	
h ' "	h ' "	
11 56 21	11 48 18	End of the Eclipse by the preceding Chord.

Mr. *le Monnier* measur'd with the Micrometer the apparent equatorial Diameter of the Moon, when she was upon the Sun; which he found =  $29' 47'' \frac{1}{2}$ . He measured also the apparent vertical Diameter of the Sun at Noon; which he found =  $31' 40''$ .

The Micrometer, with which he measured these Diameters, was afterwards verified, by a Base of 2570 Feet, and two Marks, placed at right Angles to its Extremity, at the Distance of 22 Feet from one another.

The Flash of the first Cannon fired from the Castle was seen at  $12^h 3' 4''$  by the Clock; and the Flash of the second Cannon also by the Clock at  $12^h 8' 4''$ . The Eclipse was so nearly annular, that, at the nearest Approach, the Cusps seem'd to want about  $\frac{1}{7}$  of the Moon's Circumference to be joined; yet a brown Light was plainly observed, both by my Lord *Morton* and myself, to proceed or stretch along the Circumference of the Moon, from each of the Cusps, about  $\frac{1}{3}$  of the whole Distance of the Cusps from each Cusp; and there remained about  $\frac{1}{3}$  of the whole Distance of the Cusps not enlightned by this brown Light; so that we were for some time in Suspense whether or not we were to have the Eclipse annular with us. I observed, at the Extremity of this brown Light, which came from the Western Cusp, a larger Quantity of Light, than in any other Place, which at first surprized me; but afterwards

afterwards I imagined it must have proceeded from some Cavity or Valley made by two adjoining Mountains on the Edge or Limb of the Moon. I had often formerly observed Mountains on the Circumference of the Moon, more or less every-where round it, but never saw them so plain as during the Time of this Eclipse; for we had the Air exceeding clear, and free of all Agitation, notwithstanding it blew a perfect Hurricane of Wind, which began about the Middle of the Eclipse; and I remember, in the annular Eclipse of the Sun in the Year 1737. it did the same. The mountainous Inequalities on the Southern Limb of the Moon were particularly remarkable; in some Parts Mountains and Valleys alternately; others extended a considerable Way along the Circumference, and ended almost perpendicularly like a Precipice. My Lord *Morton* was able to see them very easily thro' his small Reflector.

A little after the Middle of the Eclipse, some Clouds, that seemed stationary below the Sun, appeared tinged on their upper Extremities with all the Colours of the Rainbow.

During the greatest Darkeness, some People, who were in the Garden adjoining to the Castle, saw a Star to the East of the Sun; which, when they afterwards told us, and pointed to the Place where they had seen it, we found must have been the Planet *Venus*. This Star, we were afterwards told, was seen also at *Edinburgh*, and other Places, by a great Number of People; but I did not hear of any other Stars being seen. The Darkeness was not great, but the Sky appeared of a faint languid Colour. What is

pretty remarkable, is, Mr. *le Monnier* assured us, that when he looked at the Sun with his naked Eyes during the Middle of the Eclipse, he could observe nothing upon the Sun, but saw the Sun full, tho' faint in his Light. This, I am apt to imagine, may be owing to his being short-sighted.

I observed also, about the Middle of the Eclipse, a remarkable large Spot of Light, of an irregular Figure, and of a considerable Brightness, about 7' or 8' within the Limb of the Moon next the Western Cusp. I thought I lost this Light several times; but whether this was owing to my shutting my Eyes, in order to relieve them, or not, I cannot tell. I am told, that the Rev. Mr. *Irwin* at *Elgin* observed the same. When I first perceived it, I called to my Lord *Morton*, who was in the next Room, but he could not see it.

Before the Eclipse began, and during the whole Time of the Eclipse, the Air, as I said before, being exceeding clear, I saw thro' the four Foot Reflector, the Surface of the Sun cover'd with something which I had never observed before; it seem'd to be all irregularly overspread with Light, and a faint Shade, especially towards his equatorial Diameter. This Appearance was so odd, that it is difficult to describe it, so as to give an adequate Idea of what I saw; but if I may be allowed the Expression, it seem'd as it were curdl'd with a bright and more dusky Light or Colour. This Appearance was permanent, and regularly the same; and if in any degree seen before, may have given Rise to *Faculae* having been seen in the Sun; but to me the whole Sun's Body seem'd to be more or less cover'd with it.

I looked





Thermometer still exposed to the Sun,

at 10 <sup>h</sup> 46' 00'', stood at	-	-	-	58 $\frac{1}{2}$
at 10 51 30 at	-	-	-	62
at 10 57 30 at	-	-	-	63 $\frac{1}{2}$
at 11 4 00 at	-	-	-	66
at 11 10 00 at	-	-	-	70
at 11 34 00 at	-	-	-	75 $\frac{1}{4}$

Thermometer replaced in the Shade after this last Observation,

at 12 <sup>h</sup> 54' stood at	-	-	-	60 $\frac{1}{2}$
at 1 28 at	-	-	-	61 $\frac{1}{4}$
at 5 50 at	-	-	-	59
at 7 30 at	-	-	-	58 $\frac{1}{2}$

July 15. Thermometer at 8 <sup>h</sup> a. m. stood at	-	-	-	56
at 9 at	-	-	-	57
at 10 at	-	-	-	60

These Observations were made with a Thermometer of *Fahrenheit's* Scale, the Divisions of which were very sensible. We did not at all perceive or feel any greater Degree of Cold, during the Eclipse, than we felt before it began.

The Weather being very bad at *Edinburgh*, Mr. *Matthew Stewart*, the Professor of Mathematics, could make no Observations of the Eclipse; he only saw the End at 11<sup>h</sup> 50' 34'' true Time; and even then the Sun was somewhat cloudy: He took however the Sun's *Transit* over the Meridian (as then supposed) at 12<sup>h</sup> 7' 42'' by his Clock, and heard the second Cannon fired from the Castle at 12<sup>h</sup> 4' 48'' by the Clock. We afterwards, in a few Days, examined his meridian Mark with a very exact equal Altitude Instrument by  
three

three several correspondent Observations ; and found his Mark 3' 22'' of Time to the West of the true Meridian. The College is about 2500 Feet distant from the Castle Eastward.

The Rev. Mr. *Bryce*, at *Aldiston*, about 6 Miles to the West of *Edinburgh*, Lat.  $55^{\circ} 55\frac{1}{2}'$  N. observed with a reflecting Telescope, 9 Inches *Focus*,

The Beginning of the Eclipse at	8 52 30
Upper Horn or Cusp vertical, at	9 5 0
Hitherto the Western Cusp lower than the Eastern.	
The two Cusps horizontal at	10 13 10
The Western Cusp ascends very fast at	10 14 10
The Western Cusp vertical at	10 16 15
The Cusp which was just now vertical, now becomes East, and about $30^{\circ}$ from the Zenith to the East at	10 17 10
The Middle of the Eclipse as near as he could judge at	10 17 40
The lower Cusp at the <i>Nadir</i> , and very ragged and uneven, at	10 24 45
The same Cusp still in the same Po- sition at	10 32 5
The same Cusp seems to begin to move towards the West at	10 43 35
The Motion of this Cusp scarce sensible at	10 55 45
The other Cusp Middle between the <i>Zenith</i> and the <i>Nadir</i> towards the East at	11 0 25
End of the Eclipse; the Sun being quite clear at	11 48 40

I shall set down the following Observations of this Eclipse just as they came to my Hand when in *Scotland*, without making any other Remark, than that, from the Disagreement amongst themselves, they do not all of them seem to have been made with due Accuracy and Attention; for want, I suppose, of sufficient Practice in this kind of Observations.

*William Crow* Esquire, at his House of *Netherbyres* near *Haymouth*, Lat.  $55^{\circ} 51'$  N. says,

The Eclipse began at . . . . .	:		8 55 0
Half of the Sun eclipsed at . . . . .			9 50 0
Middle of the Eclipse, $\frac{2}{3}$ of the Sun's Limb		}	10 25 0
cover'd by the Moon at . . . . .			
End of the Eclipse at . . . . .			11 55 0

Mr. *John Mair*, at *Air*, Lat.  $55^{\circ} 30'$  N. says, the Eclipse began at  $8^h 45'$ ; but that, by reason of Clouds, he could make no other particular Observation; only that, by a View he had of the Sun some little Time before the End, he thinks the End of the Eclipse might be about  $11^h 48'$ .

Mr. *Mark*, Teacher of the Mathematics at *Dundee*, Lat.  $56^{\circ} 25'$  N. observed,

The Beginning of the annular Appearance at	10 16 44
End of the annular Appearance at . . . . .	10 23 8

He says, the best Observations make the *Annulus* a small Matter narrower on the upper than lower Side; by which it appears the Centre of the Eclipse was to the Northward of *Dundee*.

Mr.

Mr. *John Stewart*, Profeffor of Mathematics at *Aberdeen*, writes, that, by an Observation made at *Monrofs*, Lat.  $56^{\circ} 41'$ ,

	h	m	s
The annular Appearance began at . . .	10	20	0
<i>Annulus</i> ended at . . .	10	24	30
End of the Eclipse at . . .	11	52	45

And that, by an Observation made at a Place about 18 Miles S. W. of *Aberdeen*,

	h	m	s
The Eclipse began at . . .	8	52	0
Middle at . . .	10	21	0
End at . . .	11	52	0

And that at *Aberdeen*, Lat.  $57^{\circ} 11' N.$

The Eclipse began at . . .	8	55	33
Middle of the Eclipse, and annular Ap- pearance, as near as he could judge, at }	10	23	3
End of the annular Appearance at . . .	10	24	48

He writes also, that he received an Account from Mr. *Reid*, Minister at *New Macchar*, about 7 Miles N. W. of *Aberdeen*, who observed

The Beginning of the annular Appearance at	10	18	28
And the End of the Eclipse at . . .	11	49	3

Mr. *Stewart* fays, that, by comparing his Observation at *Aberdeen* with this of Mr. *Reid's*, he apprehends he is in a Mistake as to his judging of the Middle of the Eclipse, and annular Appearance; and reckons, that the annular Appearance began at *Aberdeen* at  $10^h 19'$ , and ended as above. By which the total Duration of the *Annulus* was  $5' 48''$ ; and the End of the Eclipse at *Aberdeen* was at  $11^h 49' 33''$ .

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The Rev. Mt. *Irwin*, at *Elgin*, Lat.  $57^{\circ} 34'$ , says, the Eastern Limb of the Moon touched or entered on the Western Limb of the Sun at  $8^h 57'$ ; tho' he suspects it began a little sooner (another having taken the Telescope out of his Hand); for when he looked, the Moon was a little advanced on the Disc of the Sun about  $30^{\circ}$  from the *Zenith* of the Sun towards the West.

The Eastern Cusp in the <i>Zenith</i> of the Sun at	9 6 10
Eastern Limb of the Moon reached the } Centre of the Sun at	9 39 0

The <i>Annulus</i> began about $30^{\circ}$ from the <i>Zenith</i> of the Sun Westward at	} 10 20 0
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The *Annulus* appeared most perfect at 10 22 45

Tho', as nearly as he could discern, he thought it a little narrower on the South-west Limb of the Sun, than it was on the opposite Side. From hence it should appear, that the Centre of the Eclipse was to the Southward of *Elgin*.

The *Annulus* was observed to break on the South-east Limb of the Sun, about  $30^{\circ}$  from the *Nadir*, at  $10^h 25' 30''$ .

Before the joining of the Cusps of the Sun, as also at the breaking of the *Annulus*, he says, he observed a quick tremulous Motion, and several irregular bright Spots between the Cusps, which disappeared in a few Moments; and he thought the Moon's Body passed quicker about the Time of the *Annulus* (especially as it was forming), than at any other Time during the Eclipse.

Before the Western Limb of the Moon reached the Centre of the Sun's Disc, the Sun was hid under

a Cloud, and continued so, till within some little Time of the End of the Eclipse, which happened at 11<sup>h</sup> 50'.

There was no Cloud all the Time of the Formation of the *Annulus*, or the Duration of it; and he thinks he is pretty right, as to the Time of its Continuance; for both the Formation and Breaking were very sensibly to be observed, and passed in a Moment; affording a very pleasant Sight, by the irregular tremulous Spots of the Sun.

He says, the Darkness, during the *Annulus*, was not so great as a little before and after; and, when greatest, was only somewhat dusky, but observable. Some saw a Star to the East of the Sun; but he saw it not, nor any present with him. He was told of it after his Observation was over.

He says, that, by an Observation taken of the Sun that Day at Noon, he found that his Clock was somewhat less than a Minute faster than the Sun. He says also, that he observed this Eclipse with a Telescope 3 Feet long, and that he had a very good Burning-glass; but that it had little Force, during the *Annulus*, and some short time before and after.

Mr. *Duncan Frazer* writes to Mr. *Monro*, Professor of Anatomy at *Edinburgh*, that he went to the House of *Culloden*, Lat. 57° 29' N. on purpose to observe the Eclipse; it having been said, that the Centre of the Eclipse would pass there; and after having adjusted his Clock by the Regulator-Clock of a Watch-maker at *Inverness*, he observed the Eclipse with a Telescope five Feet long, and found

The Beginning precisely at	. . . . .	8 37 36
Beginning of the <i>Annulus</i> at	. . . . .	10 0 10
End of the <i>Annulus</i> at	. . . . .	10 5 10
End of the Eclipse at	. . . . .	11 29 30

By comparing his Observation with that sent him by Mr. *Irwine* at *Elgin*, he imagines his Clock was not so to true Time, since there is so great a Difference, and more than the Difference of Longitude between the two Places will allow; it being no more than 26 computed Miles, and nearly in the same Parallel of Latitude.

Mr. *Murdock Mackenzie* (who has for some Years past been making a Survey of the Islands of *Orkney*, and whose Abilities for such an Undertaking give us Hopes he will for the future free Navigators of a great many melancholy Disasters, which formerly happened in those Seas, thro' the Want of true Charts) made the following Observation at *Kirkwall* in the Island of *Pomona* in *Orkney*, the Latitude of which is 58° 58' N.

Beginning of the Eclipse about	. . . . .	8 40
End of the Eclipse about	. . . . .	11 37

He says, that, by reason of Clouds, he could not be perfectly exact, as to the precise Time of Beginning or Ending; but adds, that the Beginning cannot be more than 4' wrong, nor the End more than 2'. He says, he is sure he did not see it annular, but that there remained about  $\frac{1}{4}$  or  $\frac{1}{2}$  of the Sun's Circumference intercepted at the Middle of the Eclipse.

*P. S.* It having been an Opinion pretty generally received, that the darker Parts of the Moon's Surface are Water, I take this Opportunity to remark, that though those less lucid Spaces are for the most part, to Appearance, evenly extended Surfaces, when Telescopes of small magnifying Powers are made use of, yet, when they are examined with larger Magnifiers, it is easy to discern on them many Protuberances in a longitudinal Direction; and that these Rifings are really elevated above the common plane Surface, is past all Question, from their projecting Shadows, always opposite to the Sun: Moreover they are of the very same Colour as the Plane they arise from, of the like smooth Surfaces, without any sensible Asperities; and invariably the same, under the like Positions of the Sun to the Moon, at least as far as I have been able to discover in 12 or 15 Years frequent Observations of them.

Ja. Short.