

N<sup>o</sup>. XIX.*Astronomical Observations, Communicated by DAVID RIT-  
TENHOUSE.*

*Observations of a lunar Eclipse, Nov. 2d, 1789, and of the transit of Mercury over the Sun's disk. Nov. 5th the same year, made at the University of William and Mary, By the Revd DR. JAMES MADISON.*

Read Feb.  
4th, 1791.

AS the observatory in which the transit instrument had been formerly placed, was not, at this time, rebuilt, I was not enabled to attend to the going of the time-keeper, by means of such observations as I wished to have made. I therefore had recourse to correspondent double altitudes, taken with a sextant. In taking them, treacle was used, which not only gave a well defined image of the sun, but was of sufficient consistency to prevent undulation, especially as the observations were made in a room, where the wind could have but little effect. From the great care employed, I think the time and rate of the clock were known with very considerable accuracy.

Nov. 2d, A mean of the corresponding altitudes taken this day, made the clock 17', 17" slower than apparent time; to which  $9\frac{1}{2}$ " being added for change of declination in the half interval, hence the clock was slow of the sun,

17' 26" 30'''

## Observations of the lunar Eclipse.

	H.	App. Time,
Penumbra--thought to touch the ) at	6	8 46
Eclipse begins, - - - - -	6	21 0
Tycho begins to immerge - - - - -	6	38 45
wholly immersed - - - - -	6	43 "
		Shadow

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	App. Time:
	H. ' "
Shadow reaches mare nectaris	7 34 0
Tycho begins to emerge,	7 57 44
wholly emerged,	8 1 26
End of the Eclipse.	8 30 0

These observations were made with an achromatic telescope, magnifying about 60.—The immersion and emersion of tycho were particularly noted, as those times may be more accurately ascertained, than either the beginning or end of a lunar eclipse.—The weather was remarkably favourable for astronomical observations.

November 3d. Cloudy no Observations could be made.

November 4th Corresponding altitudes.

A. M.	P. M.		' "
8 23 52	3 0 16	Clock flow by each observations,	} 17 56
25 34	50 35	- - -	17 55 30
27 15	56 55	- - -	17 55
8 29 35	2 54 36	- - -	17 54 30
31 12	52 50	- - -	17 55
32 34	51 16	- - -	17 55
8	2		
36 24	47 54	- - -	17 56
38 10	46 1	- - -	17 54 30
A mean of the above observations, =			17 55 11
Add equal for $\frac{1}{2}$ Interval, =			- 9 30

Hence the clock at apparent noon was flow of the ☉

November 5th, Corresponding Altitudes.

A. M.	P. M.		' "
8 34 39	2 38 54	Clock two flow,	18 11 30
36 14	41 5	- - -	18 15 30
			8

8	40 43	2 45 12	-	-	'	"	"
	42 32	47 15	-	-	18	11	30
	44 30	48 58	-	-	18	11	30
					18	18	
A mean, =					<hr/>		
Equal of $\frac{1}{2}$ interval, = +					18	13	36
					<hr/>		
					9		
					<hr/>		
					18	22	36

Hence the clock was slow of the,  $\odot$   
 It appears that the clock, by comparing the observations, lost, between the 2d. and 4th.  $38'' 11'''$  or  $19''$  per day, and between the 4th. and 5th.  $17'' 55'''$  or  $18''$ .—Hence we may conclude that its rate of going was regular, and that it lost  $18'' \frac{1}{2}$  in 24 hours. The following observations were corrected accordingly, and reduced to apparent time.

*Observations of the Transit of Mercury.*

The 1st internal contact, was not seen. When I first discovered  $\delta$ , he was somewhat advanced upon the sun's limb, and had an oval appearance, the longer axis directed towards the body of the sun.—But at  $8^h. 3'. 10''$  The planet suddenly assumed a round figure, and the first internal contact was accordingly noted.

The 2d, internal contact,

12. 53 42.

The 2d, external contact could not be determined with any tolerable accuracy on account of the remarkable undulatory motion which appeared upon the sun's limb, soon after the 2d internal contact. Mercury disappeared to me, at,  $12^h 55' 2''$ . I made use of an achromatic, magnifying about 150.

Mr. Andrews, professor of mathematics, with a reflector made by short, and with a magnifying power of 90—made the following observations.

The 2d internal contact	-	-	12 <sup>h</sup> 53'' 48''
2d external contact	-	-	12 55 19

The

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The same undulatory appearance was not seen in the reflector, and therefore the 2d external contact observed by it, may be more relied upon—The times of our observations were taken from the same clock, but noted in different rooms—The day was remarkably favourable, being clear, and sufficiently calm.

By *D. Rittenhouse*, at Philadelphia,

Lat.  $39^{\circ} 57' 10''$ . Long. west of Greenwich  $5^{\text{h}} 0' 35''$ .  
November, 2d, 1789. Moon eclipsed

Beginning	6 <sup>h</sup> 12'	} P. M. mean time
End at	8: 20	
Digits eclipsed,	4 $\frac{1}{2}$	

Transit of Mercury November 5th, 1789.

First external contact	7 <sup>h</sup> 51' 50"	} A. M. } } Meantime
Internal	7 53 20	
Second internal contact	12 43 24	} P. M. }
End of the transit	12 45 4	

The undulation of the sun's limb was so great that no micrometer measures could be taken with accuracy, but the least distance of the centers seemed to be  $7' 15''$ .

October 22, 1790. Moon eclipsed

Beginning at	5 <sup>h</sup> 41' +"	} P. M. mean time
Beginning of total darkness	6. 49. 9	
End of total darkness	8. 30. 16	
End of the eclipse	9. 37. 25	

November 6th, 1790. Sun eclipsed.

Beginning at	12 <sup>h</sup> 2' 55"	} P. M. mean time.
End at	2. 1 54	

If this eclipsed be computed from Mayer's tables it will be found advanced  $33''$ , at the time set down above for the beginning, and by Mason's new tables  $29''$ . And it is certain that an eclipse must make some progress before it will be perceived by the most attentive observer. The end was no doubt observed with more accuracy, and at that time

Mayer's tables give the limbs separated 8", and Mason's the eclipse still remaining 6". Therefore Mason's tables represent both the beginning and end of this eclipse more accurately than Mayer's, but the difference is very little. Mr. Mason has placed the moon's nodes 51", more forward, but this eclipse will be better represented by retaining the place of the node as given by Mayer.

Transit of Mercury, observed at Washington College November 5th, 1789. By the Rev. Dr. *William Smith*.

N. B. The clock was cleaned and set a going P. M. November 4th, its rate of going, as to mean time, uncertain; but at sun rise November 5th, as nearly as could be guessed, it was about 2'. 30" faster than apparent time.

External contact 8<sup>h</sup>. 3'. 50" } A. M.

Internal 8. 5. 0 } Magnifying power 95.

Micrometer measures of nearest limbs.

	h	'	Inch.	16ths.	20ths.	30ths.	'	"
9.	19	= 0.	6.	1.	19.	= 6.	4	
	54	= 0.	9.	0.	0.	= 7.	57	
10.	31	= 1.	0.	0.	0	= 8.	50	
	53	= 0.	9.	1.	9	= 8.	23	
11.	38	= 0.	7.	0.	6	= 6.	17	
12.	0	= 0.	5.	0.	20	= 4.	46	

Second internal contact 12<sup>h</sup>. 55'. 10" } P. M.

Total egress 12. 56. 35 } Magnifying power 130.

☉'s diameter at 12. 15. = 3 6 1 = = 32 14.5

Annular Eclipse of the Sun, April 3d, 1791. Observed at Philadelphia, by *D. Rittenhouse*.

Beginning (sun just above the horizon) }

about - - - 5<sup>h</sup>. 45'. 30" }

Ring formed nearly, at 6. 50. 30 } A. M.

The ring broken 6. 54. 47 } Mean time.

End of the eclipse, 8. 7. 2 }

At the middle of the eclipse the ring was nearly twice as broad at the south side as at the north side.

N<sup>o</sup>.

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