No. II.

Astronomical Observations, &c. communicated by Andrew Ellicott, Esq.—Read Nov. 16th, 1810.

Lancaster, Nov. 14th, 1810.

I BELIEVE none of the following observations have as yet been communicated to the Philosophical Society.

Observations on the Eclipse of the Moon, Jan. 4th, 1806.

The beginning of the eclipse could not be observed, the Moon being covered by clouds. The end was observed as follows:

Moon's limb visible through the penumbra at	8h	15′	0″	Apparent time.
Moon's limb clear of the penumbra at -	8	17	12	

Observations on the Eclipses of Jupiter's Satellites.

1806	July 5th	Emersion of the	3d	Satellite observed at	7h	53′	17″	Mean time.
	Do.	do.	2d	do.	10	44	7	
	Aug. 5th	do.	1st	do.	11	21	15	
	6th	do.	2d	do.	10	20	18	
	21st	do.	1st	do.	9	40	42	
	Sept. 6th	do.	1st	do.	8	0	44	
	13th	do.	1st	do.	9	56	21	

1807 July 31st at 9h 53′ 18″ the 2d Satellite of Jupiter was observed emerging from behind the body of the planet, but was not completely emerged till 9h 57′ 37″. Jupiter was so near the opposition, that neither the immersion into, nor emersion out of, the shadow could be observed.

	Sept. 15th	Immersion of the	3d	Satellite observed at	8h	33′	13″	Mean time.
		Emersion	do.	do.	12	7	12	
	Oct. 11th	do.	1st	do.	7	48	59	
1810	Oct. 30th	Immersion	2d	do.	10	57	22	
	Nov. 6th	do.	1st	do.	8	40	16	

Observations made at Lancaster on the Comet of 1807.

The first sight I had of this Comet, was on the evening of the 22d of September; but being severely indisposed, I was not able to make any observations on it till the 5th of October.

The observations were all made with a small sextant of six inches radius, graduated by Ramsden, and are communicated more as a curiosity, to show what degree of confidence may be placed in an instrument of that size and construction, than from their positive accuracy and utility.

October 5th—6h 55′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		228°	10′	26″
	N. polar dist.		83	22	31
	Long.	7s	13	42	8
	Lat. N.		23	36	40
October 6th—6h 42′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		229°	11′	14″
	N. polar dist.		82	26	47
	Long.	7s	14	27	51
	Lat. N.		24	47	26
October 7th—6h 39′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		230°	11′	33″
	N. polar dist.		81	30	57
	Long.	7s	15	13	36
	Lat. N.		25	57	59
October 8th—6h 49′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		231°	14′	25″
	N. polar dist.		80	37	42
	Long.	7s	16	3	27
	Lat. N.		27	6	34
October 10th—6h 44′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		233°	17′	29″
	N. polar dist.		78	52	39
	Long.	7s	17	42	34
	Lat. N.		29	21	1
October 11th—6h 51′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		234°	17′	15′
	N. polar dist.		77	58	38
	Long.	7s	18	30	41
	Lat. N.		30	29	6
October 13th—6h 38′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		236°	16′	22″
	N. polar dist.		76	17	54
	Long.	7s	20	10	35
	Lat. N.		32	36	54
October 14th—6h 29′, by the distance of the Comet from *Arcturus*, and *α Lyræ*.	A. R. of the Comet		237°	16′	44″
	N. polar dist.		75	30	15
	Long.	7s	21	3	16
	Lat. N.		33	38	9

Same day, at 6h 42′, by the distance of the Comet from *α Lyræ*, and *α Coro. Borealis.*	A. R. of the Comet		237°	17′	24″
	N. polar dist.		75	30	22
	Long.	7s	21	4	1
	Lat. N.		33	38	12

The above two observations, being on different stars, agree as nearly as could reasonably be expected, considering the size of the sextant.

October 24th—6h 41′, by the distance of the Comet from *α Lyræ*, and *α Coro. Borealis.*	A. R. of the Comet		247°	2′	35″
	N. polar dist.		67	53	30
	Long.	8s	0	6	45
	Lat. N.		43	31	0

October 26th—6h 37′, by the distance of the Comet from *α Lyræ*, and *α Coro. Borealis.*	A. R. of the Comet		248°	56′	31″
	N. polar dist.		66	35	32
	Long.	8s	2	16	34
	Lat. N.		44	52	43

October 31st—7h 2′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ.*	A. R. of the Comet		253°	59′	9″
	N. polar dist.		63	20	49
	Long.	8s	7	58	23
	Lat. N.		48	53	47

This observation is marked "*doubtful*" in my journal.

November 1st—6h 28′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ.*	A. R. of the Comet		254°	57′	47″
	N polar dist.		62	42	32
	Long.	8s	9	7	49
	Lat. N.		49	40	16

November 7th—6h 33′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ.*	A. R. of the Comet		261°	6′	26″
	N. polar dist.		59	11	22
	Long.	8s	16	59	9
	Lat. N.		53	52	12

November 13th—6h 23′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ.*	A. R of the Comet		267°	25′	58″
	N. polar dist.		56	2	59
	Long.	8s	26	2	44
	Lat. N.		57	24	0

November 18th—6h 15′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ.*	A. R. of the Comet		272°	54′	38″
	N. polar dist.		53	42	49
	Long.	9s	4	38	52
	Lat. N.		59	37	51

November 19th—6h 3′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ.*	A. R. of the Comet		273°	57′	1″
	N. polar dist.		53	17	29
	Long.	9s	6	20	36
	Lat. N.		60	0	38

November 21st—6h 28′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ.*	A. R. of the Comet		276°	10′	37″
	N. polar dist.		52	26	52
	Long.	9s	10	4	11
	Lat. N.		60	47	54

Same day, and same time, by the distance of the Comet from *α Lyræ*, and *α Cygni*.	A. R. of the Comet		276°	9′	41″
	N polar dist.		52	26	6
	Long.	9s	10	3	47
	Lat. N.		60	48	44

Same day, and same time, by the distance of the Comet from *α Aquilæ*, and *α Cygni*.	A. R. of the Comet		276°	10′	22″
	N polar dist.		52	27	0
	Long.	9s	10	3	45
	Lat. N.		60	47	47

These three observations of the 21st of November, made on different stars, are reduced to the same time: the distances were all taken between 6^h 18′ and 6^h 36′: the greatest difference is in the latitude, which amounts to but 57″.

November 22d—6h 15′, by the distance of the Comet from *α Lyræ*, and *α Cygni*.	A. R. of the Comet		277°	16′	58″
	N. polar dist.		52	4	0
	Long.	9s	11	56	51
	Lat. N.		61	5	34

Same day, same time, by the distance of the Comet from *α Lyræ*, and *α Aquilæ*.	A. R. of the Comet		277°	16′	40″
	N. polar dist.		52	3	34
	Long.	9s	11	55	51
	Lat. N.		61	6	3

Same day, same time, by the distance of the Comet from *α Aquilæ*, and *α Cygni*.	A. R of the Comet		277°	16′	32″
	N. polar dist.		52	3	12
	Long.	9s	11	55	42
	Lat. N.		61	6	20

These three observations of the 22d, on different stars, are reduced to the same time, as in the foregoing case: the distances were all taken between 6^h 1′ and 6^h 29′: the greatest difference is in the longitude, which amounts to 1′ 9″.

November 24th—6h 11′, by the distance of the Comet from *α Lyræ*, and *α Aquilæ*.	A. R. of the Comet		279°	30′	6″
	N. polar dist.		51	16	48
	Long.	9s	15	44	58
	Lat. N.		61	39	47

Same day, same time, by the distance of the Comet from *α Lyræ*, and *α Cygni*.	A. R. of the Comet		279°	30′	0″
	N. polar dist.		51	15	57
	Long.	9s	15	44	44
	Lat. N.		61	40	37

Same day, same time, by the distance of the Comet from *α Cygni*, and *α Aquilæ*.	A. R. of the Comet		279°	30′	24″
	N. polar dist.		51	16	38
	Long.	9s	15	45	12
	Lat. N.		61	39	55

These three observations on different stars, are reduced to the same time, as in the preceding cases: the distances were all taken between 5^h 58′ and 6^h 24′: the greatest difference is in the N. polar dist. which is but 51″.

November 30th—6h 44′, by the distance of the Comet from α *Aquilæ*, and α *Cygni*.	A. R. of the Comet		286°	23′	27″
	N. polar dist.		49	9	10
	Long.	9s	27	46	27
	Lat. N.		62	44	10

Same day, same time, by the distance of the Comet from α *Lyræ*, and α *Aquilæ*.	A. R of the Comet		286°	22′	31″
	N. polar dist.		49	9	24
	Long.	9s	27	45	48
	Lat. N.		62	44	7

The greatest difference between these two observations of the 30th, is in the right ascensions, and amounts to 56″.

December 3d—6h 13′, by the distance of the Comet from α *Aquilæ*, and α *Cygni*.	A. R. of the Comet		289°	48′	16″
	N. polar dist.		48	12	15
	Long.	10s	3	44	46
	Lat. N.		62	57	16

Same day, same time, by the distance of the Comet from α *Lyræ*, and α *Aquilæ*.	A. R. of the Comet		289°	47′	46″
	N. polar dist.		48	12	16
	Long.	10s	3	43	58
	Lat. N.		62	57	58

The greatest difference between the results of the observations of this day, on different stars, is in the longitudes, and amounts to 48″.

The observations on the comet were continued till the evening of the 10th of December; but the meeting of the legislature about that time occasioned so much hurry in the public offices, that the last observations, which were entered on loose papers, were mislaid, and probably lost, for want of time to record them.

Without feeling much partiality in favour of my own observations, I am induced to believe the foregoing may generally be depended upon, as coming within one minute of the truth; which is as near as could be reasonably expected from the size of the instrument I was under the necessity of using.

Various opinions have been suggested respecting the tails of comets; some of them are too absurd to merit attention, and others, though not reasonable, it might be difficult to refute for want of the necessary data. It is a subject on which we are confined to conjecture; but were I to venture an opinion, it would be, that comets are surrounded by a very rare, and luminous atmosphere, and that the tails are produced by the progressive motion of the light, emitted from the sun, propelling this luminous and rare atmosphere, (if it may be so called,) in a direction nearly opposite to the sun. When the comet is very distant from the sun, the effect of his light becomes less, and the attraction of the nucleus diminishes the length of the tail, which probably disappears entirely in the higher parts of the orbit, when the nucleus will be equally surrounded by this luminous and rare matter, as our earth is by its atmosphere; the higher and more rare parts of which I suspect are affected in the same manner, though in an infinitely less degree. Again, if the comets depended wholly on the sun for light, the nucleus of some of them, from their situation with respect to the sun and earth, ought to have appeared almost dichotomized; which I believe has never been observed. The nucleus of the comet of 1807, in the whole progress of my observations, appeared perfectly round.

Note.—All the calculations respecting the right ascension and north polar distance of the comet, were gone over twice, at different times; those of the latitude and longitude, but once, as they are deduced from the others, and may be examined at any time by those who have inclination and leisure.

Lancaster, Nov. 25th, 1810.

[*Read Nov. 28th*, 1810.]

I HERE inclose the formula, which I have used for many years, for calculating the parallax in latitude, and longitude. It is that of Dr. Maskelyne, somewhat abridged, by which the writing of three logs., with a little addition, is dispensed with. I do not think this important problem can be reduced to a shorter or more simple form. I have likewise inclosed an example, with some remarks, being one of the operations for calculating the beginning of the eclipse of the Sun on the 17th of next September: the operation was gone through in 22 minutes with Taylor's logarithms: the example includes all the work and all the figures. The figures 1, 2, 3, 4, in the margin, shew the logs. which are repeated, by which means they may be more readily compared to prevent mistakes: moreover, when the figures are entered in the margin of the operation, there will be no occasion to write down a number, or angle which is repeated, but merely the log. In my practice, I never write down a recurring number, or angle, but merely designate it by a marginal figure. So that in the original work of the inclosed example, nothing appeared on the left side of the logs. but the marginal figures 1, 2, 3, 4, and the signs +, there being no signs —, in the formula. I am sorry to trouble you with trifles, but have at present nothing else to send.

My observations on the Comet of 1807, I have had inclosed and sealed up for some time, but have been disappointed in forwarding them till the present opportunity.

Formula for calculating the Parallax in Latitude and Longitude.

Call the Moon's horizontal parallax, h; the altitude of the nonagesimal degree, H; the Moon's true latitude, L; the Moon's distance from the nonagesimal degree, n; the parallax in longitude, P; the parallax in latitude, Q; and the Moon's apparent latitude, l.

(1)	+	log. h	
(2)	+	s. H	reserve c. s. of H (3)
	+	co. ar. c. s. L	
	Sum call A		
	+	s. n	
			= P nearly.
	+	sum A	
	+	s. $n+$P	
			= P sufficiently correct.
(1)	+	h	
(3)	+	c. s. H	
			= Q nearly.
	+	c. s. l	reserve the s. of l (4)
			= 1st part of Q.
(1)	+	h	
(2)	+	s H	
(4)	+	s l	
	+	c. s. n + $\frac{1}{2}$ P	
			= 2d part of Q.

Note.—The 2d part of Q must be added to the 1st part, when the Moon's distance from the north pole of the ecliptic, and from the nonagesimal degree are of a different affection, and taken from it when of the same affection. In eclipses of the Sun it will be too small to need attention.

Moon's horizontal parallax from the Sun corrected 3236″ (h), altitude of the nonagesimal degree 53° 45′ 51″ (H), Moon's true latitude 32′ 54″ N. (L), Moon's distance from the nonagesimal degree 11° 8′ 41″ (n), Moon's apparent latitude (l). Then,

(1)	+ *h* 3236″ -	log. 3.5100085		
(2)	+ s. H 53° 45′ 51″ -	9.9066533	reserve c. s. H 9.7716685 (3)	
	+ co. ar. c. s. L 0 32′ 54″	0.0000199		
			n =	11° 8′ 41″
	Sum call A -	3.4166817	P nearly =	8 24.5
	+ s. *n* 11° 8′ 41″ -	9.2862046		
				11 17 5.5 Moon's ap. dist. from nonag. deg.
	= 504″.5 = 8′ 24″.5 -	2.7028863	= P nearly.	
	Sum A - -	3.4166817		
	+ s. *n* + P 11° 17′ 5″.5	9.2915620		
	= P 510″.7 = 8′ 30″.7	2.7082437	= P sufficiently correct.	
			Moon's true lat. N.	0° 32′ 54″
(1)	+ *h* 3236″ -	3.5100085	— P nearly -	31 52.7
(3)	+ c. s. H 53° 45′ 51″ -	9.7716685		
			Moon's ap. lat. (*l*)	1 1.3
	= 1912″ 8 + 31′ 52″.7	3.2816770	= Q nearly.	
	+ c. s. *l* 1′ 1″.3 -	10.0000000	reserve the s. *l*. 6.4770907 (4)	
	= 1912″.8 = 31′ 52″.7	3.2816770	= 1st part of Q.	
			n =	11° 8′ 41″
(1)	+ *h* 3236″ -	3.5100085	½ P =	4 15.3
(2)	+ s. H 53° 45′ 51″	9.9066533		
(4)	+ s. *l* 0 1′ 1″.3 -	6.4770907	*n* + ½ P	11 12 59.3
	+ s. *n* + ½ P 11° 12′ 59″.3	9.2889562		
	= 0″.15 -	9.1827087	= 2d part of Q.	

1st part of Q	31′ 52″.7	
1d part of Q	.15	
	31 52.55 = Q.	

{ Parallax in long. 8′ 30″.7
{ Do. in lat. 31 52.5

Note 1.—When the apparent latitude of the Moon is small, the subsequent part of the operation will have but little effect on *Q nearly*, or the first value of Q, as may be seen by this example; because the c. s. of the apparent latitude of the Moon being nearly equal to radius, does not sensibly change the value of *Q nearly*. The 2d part of Q may always be omitted in eclipses of the Sun. When the sum of the four logs. of the 2d part of Q fall short of 30.0000000, the 2d part will be the decimal of a second, as in the above example.

Note 2.—*P nearly*, and *Q nearly*, differing a little from P Q, the first are to be considered as approximations.