

XXXII. *Account of a Comet.* By Mr. Herschel, F. R. S.;  
*communicated by Dr. Watson, Jun. of Bath, F. R. S.*

Read April 26, 1781.

ON Tuesday the 13th of March, between ten and eleven in the evening, while I was examining the small stars in the neighbourhood of H Geminorum, I perceived one that appeared visibly larger than the rest: being struck with its uncommon magnitude, I compared it to H Geminorum and the small star in the quartile between Auriga and Gemini, and finding it so much larger than either of them, suspected it to be a comet.

I was then engaged in a series of observations on the parallax of the fixed stars, which I hope soon to have the honour of laying before the Royal Society; and those observations requiring very high powers, I had ready at hand the several magnifiers of 227, 460, 932, 1536, 2010, &c. all which I have successfully used upon that occasion. The power I had on when I first saw the comet was 227. From experience I knew that the diameters of the fixed stars are not proportionally magnified with higher powers, as the planets are; therefore I now put on the powers of 460 and 932, and found the diameter of the comet increased in proportion to the power, as it ought to be, on a supposition of its not being a fixed star, while the diameters of the stars to which I compared it were not increased  
in

in the same ratio. Moreover, the comet being magnified much beyond what its light would admit of, appeared hazy and ill-defined with these great powers, while the stars preserved that lustre and distinctness which from many thousand observations I knew they would retain. The sequel has shewn that my surmises were well founded, this proving to be the Comet we have lately observed.

I have reduced all my observations upon this Comet to the following tables. The first contains the measures of the gradual increase of the Comet's diameter. The micrometers I used, when every circumstance is favourable, will measure extremely small angles, such as do not exceed a few seconds, true to 6, 8, or 10 thirds at most; and in the worst situations true to 20 or 30 thirds: I have therefore given the measures of the Comet's diameter in seconds and thirds. And the parts of my micrometer being thus reduced, I have also given all the rest of the measures in the same manner; though in large distances, such as one, two, or three minutes, so great an exactness, for several reasons, is not pretended to.

TABLE I. Measures of the Comet's diameter\*.

Days.	" "	" "	Powers.
March 17	2	53	932. 460.
19	2	59	932. 460.
21	3	38	460.
28	4	7	932
—	3	58	227
29	4	7	227 rather too small a measure.
—	4	25	227 seems right.
April 2	4	25	227
6	4	53	227
15	5	11	227
—	5	20	227 very good; not liable to half a second of error.
18	5	2	227 true to 12''' or 18''' at most.

Having measured the diameter of the Comet with such high power as 932 and 460, it may not be amiss to make one observation on this subject, lest it should be misapprehended that I pretend to a distinct power of such magnitude upon all celestial objects in general. By experience I have found, that the aberration or indistinctness occasioned by magnifying much, provided the object be still left sufficiently distinct, is rather to be put up with, than the power to be reduced, when the angles to be measured are extremely small. The reason of this may, perhaps, be that a small error of judgement, to which we are always liable, is of great consequence with a low power, as bearing a considerable proportion to the diameter of the object;

\* There are several optical deceptions which may affect the measures of objects that subtend extremely small angles. Thus I have found, by experience, that a very small object will appear something less in a telescope when we see it first than when we become familiar with it. There is also a deflection of light upon the wires when they are nearly shut; but as none of these deceptions are well enough understood to apply a correction, I leave them affected with them.

whereas

whereas with a higher power the proportion of this error to the whole becomes much less, and the measure more exact, even after we have made allowance for a small additional error occasioned by the want of that perfect distinctness which is required for other purposes. However, to enter deeply into an explanation of this would lead me to speak of the causes of the aberration of rays in the focus of an object speculum, of which there are some that are seldom taken into consideration by opticians, and indeed are such as cannot be calculated; but this not being my present purpose, suffice it to observe, that the method is justified by experience.

When the diameter of the Comet was increased to about  $4''$ , I thought it advisable to lessen the power with which I measured; and, as I made use of two different micrometers, as well as eye-glasses, I took a measure with both of them. The agreement of the micrometers to  $9'''$  is no small proof of the goodness of the observations of the 28th of March, and very properly connects the measures of the high powers with those that were made with 227.

TABLE II. Distance of the Comet from certain telescopic fixed stars which I have marked  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$ ,  $\zeta$ .

Mar. 13	10 30	from $\alpha$ ,	2 48 0	by pretty exact estimation true to 20".
17	11 0	fig. 1*.	0 41 58	by the micrometer and power 227.
18	7 20		1 0 35	
—	9 16		1 6 59	
—	10 55		1 10 40	
19	7 4		1 46 40	
—	10 42		1 51 23	
21	10 0		3 39 46	
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24	8 12	from $\beta$ ,	2 55 39	true to 4 or 5", an indifferent observation.
—	10 58	fig. 2.	2 53 4	true to 4 or 5".
25	7 24		2 12 46	true to 2 or 3".
—	9 47		2 14 18	
26	10 43		1 48 3	true to 2 or 3".
28	7 46		2 55 49	true to 4 or 5".
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29	8 50	from $\gamma$ .	2 20 51	true to 2".
30	7 55	fig. 3.	1 28 48	true to 2 or 3".
Apr. 1	7 45		2 39 20	
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6	8 50	from $\delta$ .	2 51 23	
		fig. 4.		
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15	10 18	from $\epsilon$ .	4 27 57	estimated by the field, true to 5 or 6".
16	7 50	fig. 5.	3 9 14	by the micrometer, true to 3 or 4".
—	10 47		2 50 56	true to 3 or 4".
18	8 18		3 18 4	} mean 3' 17", true to 1" or 1½".
—	—		3 15 57	
<hr/>				
—	8 50	from $\zeta$ ,	2 24 57	
19	8 38	fig. 6.	3 2 5	true to 3 or 4".

\* The figures are drawn upon a scale of 80 seconds to one inch.

TABLE III. Angle of position of the Comet with regard to the parallel of declination of the same telescopic fixed stars measured by a micrometer, of which I have given the description, and a magnifying power of 278. See fig. 1. 2. 3. 4. 5. 6.

D. H. M.		°	'	
Mar. 13 10 30	B <sub>a</sub> Comet,	0	0	} by superficial estimation, liable to an error of 10 or 12 degrees.
17 11 0	A <sub>a</sub> Comet,	89	56	
18 8 20	fig. 1*.	56	39	by the micrometer.
— 9 24		41	33	true to 1°.
19 7 23		29	47	true to 1°.
21 10 10		11	46	true to 4 or 5°.
— 11 48		12	14	
24 8 23	B <sub>β</sub> Comet,	38	39	true to 2 or 3°.
— 11 4	fig. 2.	36	14	true to 3 or 4°, air very tremulous.
25 7 33		53	18	
— 9 55	A <sub>β</sub> Comet.	56	32	liable to a considerable error.
26 10 55		87	0	true to 2 or 3°.
28 7 58		28	51	true to 3 or 4°.
29 9 25	B <sub>γ</sub> Comet,	32	19	true to 1 or 2°.
30 8 25	fig. 3.	72	14	true to 3 or 4°.
Apr. 1 7 55		A <sub>γ</sub> Comet,	28	51
— — —		27	14	more exact,
6 8 28	B <sub>δ</sub> Comet,	84	42	true to less than 2°
	fig. 4.			
15 10 27	B <sub>ε</sub> Comet,	29	9	true to 2 or 3°.
16 8 1	fig. 5.	49	11	true to 1°.
— 10 55		50	47	true to 1½ or 2½°.
18 8 31	A <sub>ε</sub> Comet,	47	9	} very well taken, } 47°, true to less than 1°.
— — —		46	35	
— 9 8	B <sub>ζ</sub> Comet,	82	39	
19 8 56	A <sub>ζ</sub> Comet,	48	18	} 49° 3', true to 1°.
— — —		49	48	
— 10 45		47	30	

\* The angles are drawn true to the measure, without allowing for errors.

*Miscellaneous observations and remarks.*

March 19. The Comet's apparent motion is at present  $2\frac{1}{4}$  seconds *per* hour. It moves according to the order of the signs, and its orbit declines but very little from the ecliptic.

March 25. The apparent motion of the Comet is accelerating, and its apparent diameter seems to be increasing.

March 28. The diameter is certainly increased, from which we may conclude that the Comet approaches to us.

April 2. This evening at 8 h. 15' the Comet was a little above the line drawn from  $\eta$  to  $\theta$  in fig. 7. This figure is only delineated by the eye, so that no very great exactness in the distances of the stars is to be expected; but I shall take the first opportunity of measuring their respective situations by the micrometer.

April 6. With a magnifying power of 278 times the Comet appeared perfectly sharp upon the edges, and extremely well defined, without the least appearance of any beard or tail.

April 16. Fig. 8. represents the situation of the Comet this evening about nine o'clock, and is only an eye-draught of the telescopic stars.

*Remarks on the path of the Comet.*

We may observe, that the method of tracing out the path of a celestial body by taking its distance from certain stars, and the angle of position with regard to them, cannot be expected to give us a completely just representation of the tract it describes, since even the most careful observations are liable to little errors, both from the remaining imperfections of instruments, though they

they should be the most accurate that can be had, and from the difficulty of taking angles and positions of objects in motion. Add to this a third cause of error, namely, the obscurity of very small telescopic stars that will not permit the field of view so well to be enlightened as we could wish, in order to see the threads of the micrometer perfectly distinct.

This will account for the apparent distortions to be observed in my figures of the Comet's path. Some little irregularity therein may also proceed from different refractions, as they have not been taken into account, though the observations have been made at very different altitudes, where consequently the refractions must have been very different. But though this method may be liable to great inconveniences, the principal of which is, that many parts of the heavens are not sufficiently stored with small stars to give us an opportunity to measure from them, yet the advantages are not less remarkable. Thus we see that it enabled me to distinguish the quantity and direction of the motion of this Comet in a single day (from the 18th to the 19th of March) to a much greater degree of exactness than could have been done in so short a time by a sector or transit instrument; nay even an hour or two, we see, were intervals long enough to shew that it was a moving body, and consequently, had its size not pointed it out as a Comet, the change of place, though so trifling as  $2\frac{1}{4}$  seconds *per* hour, would have been sufficient to occasion the discovery. A gentleman very well known for his remarkable success in detecting Comets \* seems to be well aware of the difficulty to discover a motion in a heavenly body by the common methods when it is so very small; for in a letter he favoured me with, speaking of the Comet, he says: "Rien n'étoit plus difficile que de la reconnoître et je ne puis pas concevoir comment vous avés pu

\* Mons. MESSIER.



“ revenir plusieurs fois sur cette étoile ou Comète ; car absolument il a fallu l'observer plusieurs jours de suite pour s'apercevoir qu'elle avoit un mouvement.”

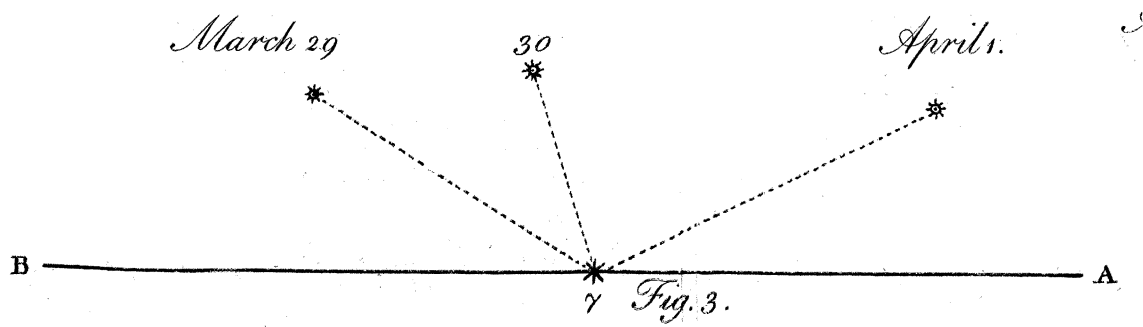
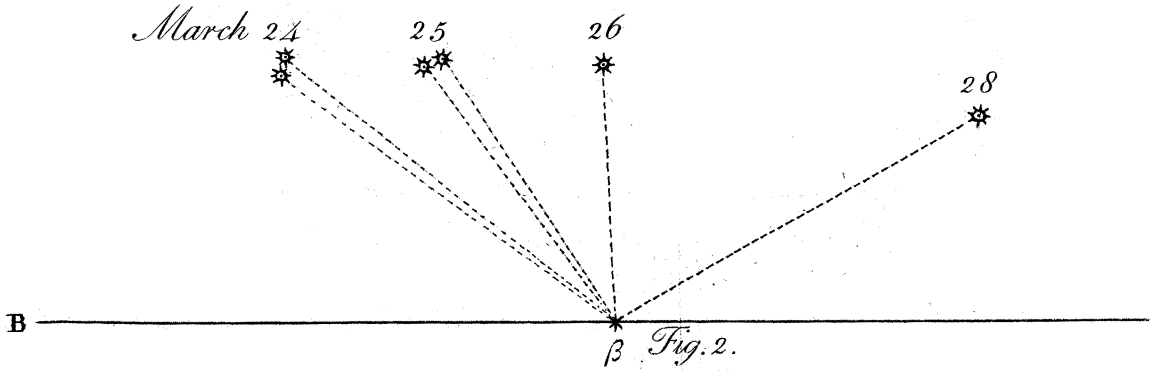
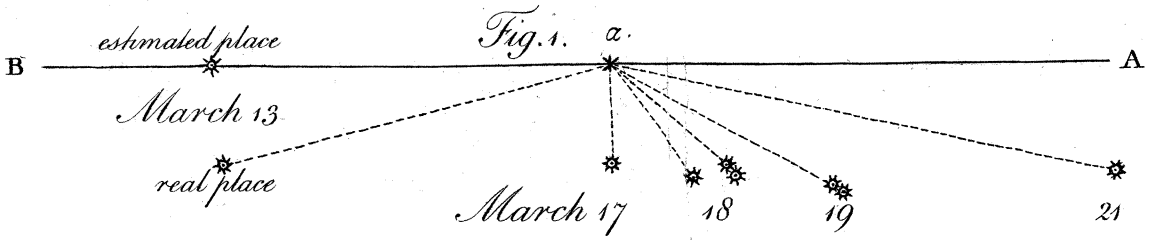
I need not say that I merely point this out as a temporary advantage in the method I have taken ; for as soon as we can have regular, constant, and long continued observations by fixed instruments, the excellence of them is too well known to say any thing upon that subject : for which reason I failed not to give immediate notice of this moving star, and was happy to surrender it to the care of the Astronomer Royal and others, as soon as I found they had begun their observations upon it.

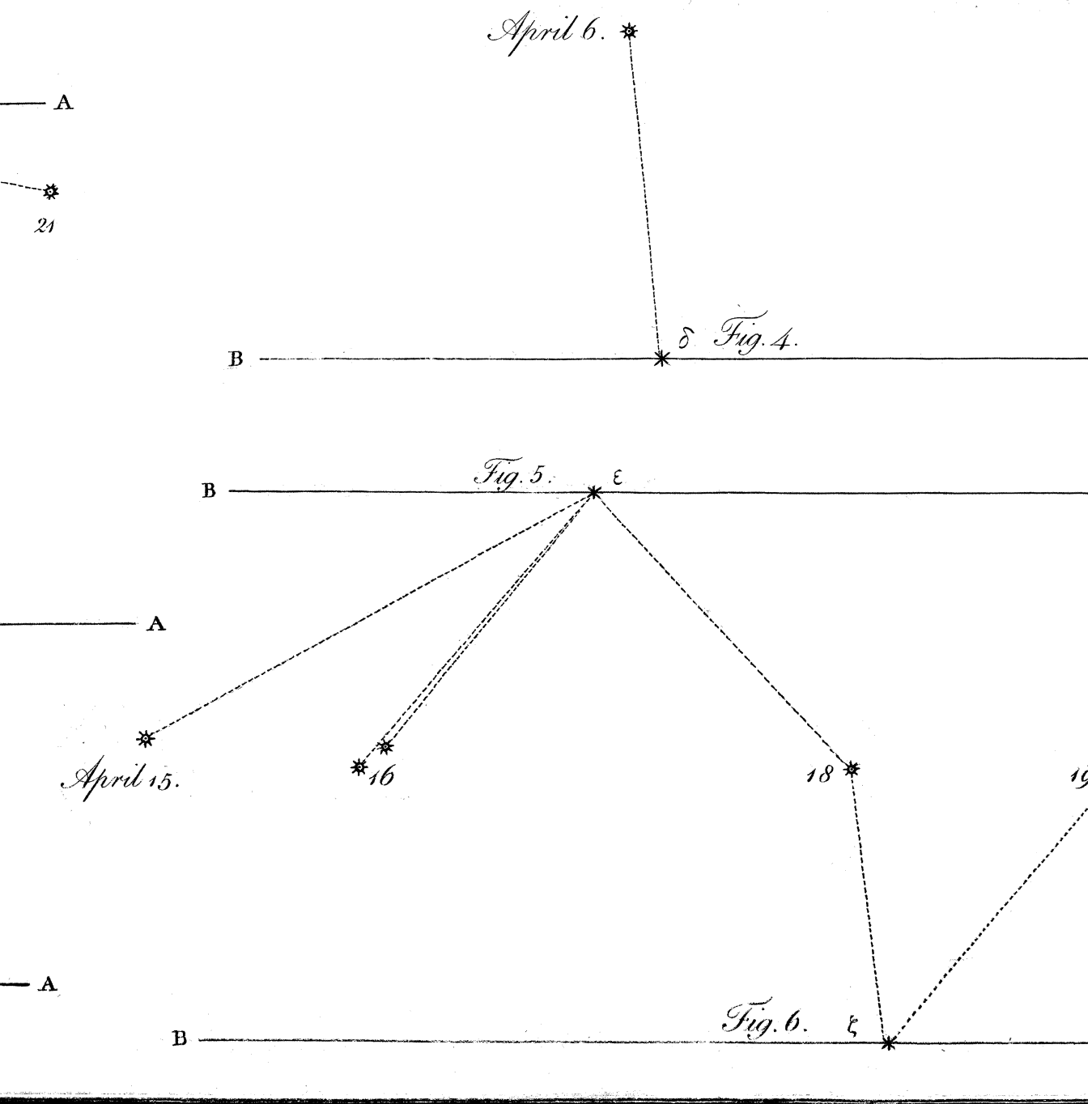
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*Description of a micrometer for taking the angle of position.*

FIG. I. Represents the micrometer inclosed in a turned case of wood, as it is put together, ready to be used with the telescope. A is a little box which holds the eye-glass. B is the piece which covers the inside work, and the box A is screwed into it. C is the body of the micrometer containing the brass work, shewing the index plate *a* projecting at one side, where the case is cut away to receive it. D is a piece, having a screw *b* at the bottom, by means of which the micrometer is fastened to the telescope. To the piece C is given a circular motion, in the manner the horizontal motion is generally given to Gregorian reflectors, by the lower part going through the piece D, where it is held by the screw E, which keeps the two pieces C and D together, but leaves them at liberty to turn upon each other.

Fig. II. Is a section of the case containing the brass work, where may be observed the piece B hollowed out to receive the





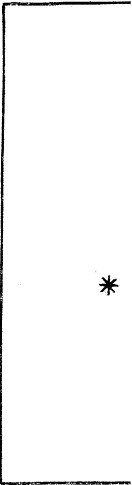
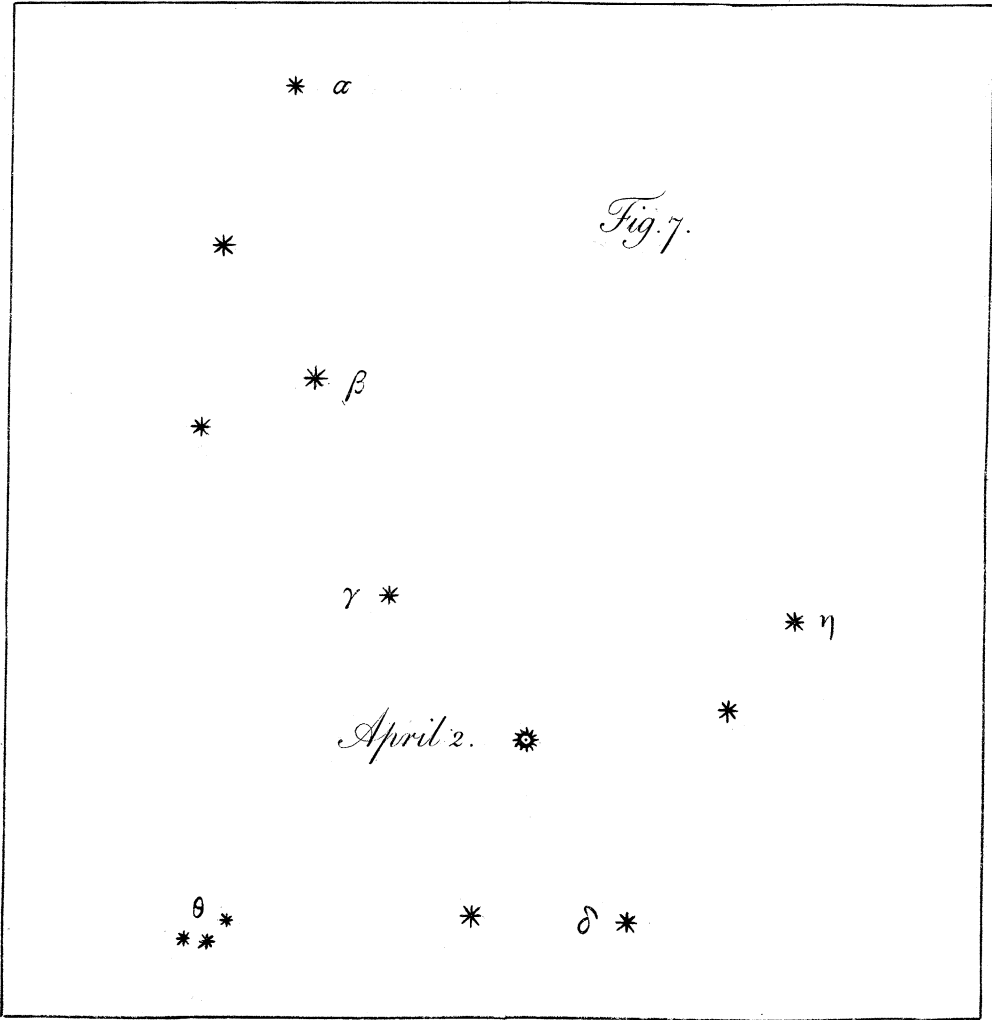
\_\_\_\_\_ A

\_\_\_\_\_ A

19 \*

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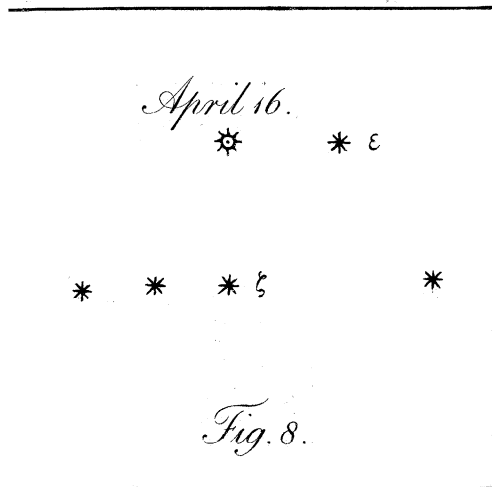


Fig. I.

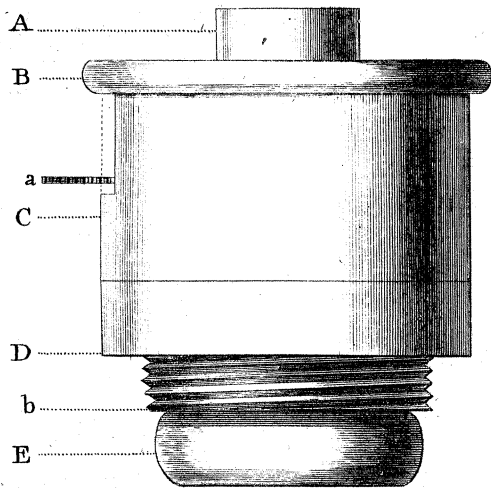


Fig. II.

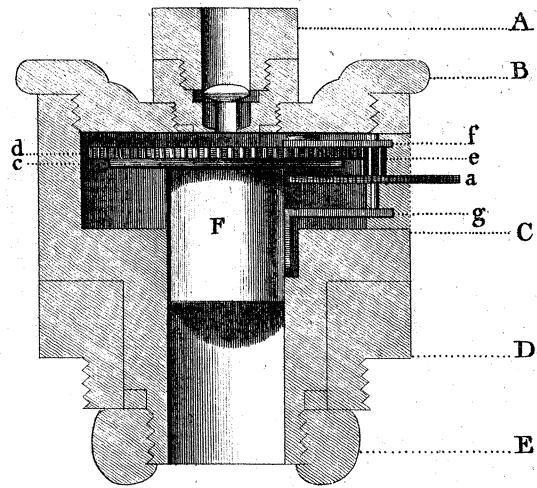


Fig. III.

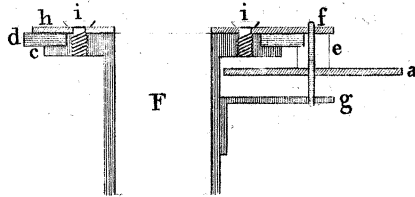
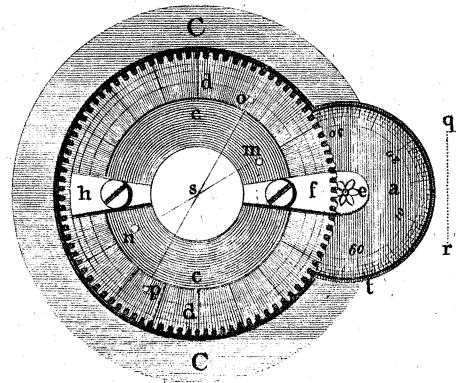


Fig. IV.



box A, which consists of two parts inclosing the eye lens. This figure also shews how the piece C passes through D, and is held by the ring E: the brass work, consisting of a hollow cylinder, a wheel and pinion, and index plate, is there represented in its place. F is the body of the brass work, being a hollow cylinder with a broad rim *c* at the upper end; this rim is partly turned away to make a bed for the wheel *d*. The pinion *e* turns the wheel *d*, and carries the index plate *a*. One of its pivots moves in the arm *f*, screwed upon the upper part of *c*, which arm serves also to confine the wheel *d* to its place upon *c*. The other pivot is held by the arm *g* fastened to F.

Fig. III. Is a plan of the brass work. The wheel *d*, which is in the form of a ring, is laid upon the upper part of F or *c*, and held by two small arms *f* and *b*, screwed down to *e* with the screws *i*, *i*.

Fig. IV. Is a plan of the brass work. *d, d*, is the wheel placed upon the bed or socket of the rim of the cylinder *c, c*, and is held down by the two pieces *f, b*, which are screwed upon *c, c*. The piece *f* projects over the center of the index plate to receive the upper pivot of the pinion *m, n*, is the fixed wire fastened to *c, c*. *o, p*, the moveable wire fastened to the annular wheel *d, d*. The index plate *a* is divided into 60 parts, each sub-divided into two, and milled upon the edge. When the finger is drawn over the milled edge of the index plate from *q* towards *r*, the angle *m, s, o*, will open, and if drawn from *r* towards *q*, it will shut again. The case C, C, must have a sharp corner *t*, which serves as a hand to point out the division on the index plate.





