XIII. *Account of an Iconantidiptic Telescope, invented by Mr.* Jeaurat, *of the Academy of Sciences of Paris. Communicated by* John Hyacinth de Magellans, *F. R. S.*

Read January 19, 1778.

MR. JEAURAT, of the Royal Academy of Sciences of Paris, having discovered a construction of the Iconantidiptic Telescope, thought proper to communicate to the Royal Society of London a short description of this new invention.

This Telescope is called the Iconantidiptic Heliometer, because it produces two images of the objects, the one in a direct position, and the other reversed. These two images,

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Construction d'une lunette Iconantidyptique inventée par Mr. Jeaurat, *de l'Academie Royale des Sciences de* Paris.

M. JEAURAT, de l'Academie Royale de Paris, ayant imaginé une construction de lunette Iconantidyptique, croit devoir communiquer à la Societé Royale de Londres l'exposition succinte de cette nouvelle invention.

La lunette est appellée Heliometre Iconantidyptique parce qu'elle represente deux images des objets, l'une dans une situation droite et l'autre dans une situation images, of opposite situation to each other, are exactly of the same size, and produce the effect of shewing the stars as entering at once both on the right and left sides of the Telescope. The first coincidence of the two images on the side of each other gives the passage of the first limb; the exact coincidence of the two images upon one another gives the passage of the center of the star; and the last coincidence of the two images at the side of each other gives the passage of the second edge: from whence it follows, that we not only observe as usual the passage of the two sides of the disk of a star, but also the direct passage of the center of the star: an observation which could not before be made in a direct manner. Besides, it may observed, that this invention obviates the difficulty of illuminating the threads of the Telescope in observing very

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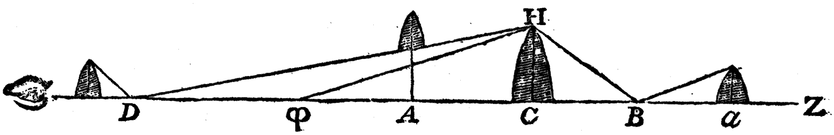
tion renversée. Ces deux images de situation opposée l'une à l'autre sont exactement de la même graudeur et produisent l'effet de voir tout à la fois entrer les astres par la droite et par la gauche de la lunette. La premiere coincidence des deux images à coté l'une de l'autre donne le passage du premier bord, la coincidence exacte des deux images l'une sur l'autre donne le passage du centre de l'astre, et la derniere coincidence des deux images l'une à coté de l'autre donne le passage du second bord, d'où il suit que non seulement on observe comme à l'ordinaire le passage des deux bord du disque d'un astre, mais aussi le passage direct du centre de l'astre: observation qui n'a jusq'à present pû se faire d'une maniere directe. D'ailleurs on remarquera que cette invention supplée a la difficulté d'éclairer les fils de la lunette lorsqu'il est question d'observer de très petites etoiles, car avec cette

 construction

very ſmall ſtars, for in this conſtruction there is no occaſion to ſee the threads.

The following is the conſtruction of this Iconantidiptic Teleſcope, which I have already made uſe of, and which appears to be proper for obſervations made in the plane of the Meridian.



That the ſolution may be applicable to Teleſcopes, it is proper that AD=AZ, *a*B=*a*Z.

Then put AD=F the focal diſtance of the lens A,

*a*B=*f* the focal diſtance of the lens *a*,

*a*A=F−*f*,

AB=*a*A−*a*B=F−2*f*,

BC

conſtruction on n'a pas beſoin de voir les fils.

Voici la conſtruction de cette lunette Iconantidyptique dont je me ſuis deja ſervie et qui me paroit commode pour les obſervation faites dans le plan du Meridien.

Pour que la ſolution ſoit auſſi appliquable aux oculaires il convient que AD=AZ, *a*B=*a*Z.

Alors on fera AD=F foyer de la lentille A,

*a*B=*f* foyer de la lentille *a*,

*a*A=F−*f*,

AB=*a*A−*a*B=F−2*f*,

BC

BC $= x$,

CD $= y$,

φ the focal diſtance of the lens C.

Hence $\begin{cases} BD = AD + AB = 2 \times \overline{F - f}, \\ BD = BC + CD = x + y. \end{cases}$

The two values of BD evidently give, 1ſt, $x + y = 2 \times \overline{F - f}$.

That the image B, given by the lens a, be ſeen at the diſtance BC: and that the direction of the ray BHD may form a relative focus in D, whoſe diſtance may be equivalent to AD, it is neceſſary that $aB \times CD = AD \times BC$, namely, 2dly, $fy = Fx$.

That the object B, ſeen in the direction BH, may form a focus in D, it is neceſſary that the focal diſtance of the lens

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BC $= x$,

CD $= y$,

φ foyer de la lentille C.

$\begin{cases} BD = AD + AB = 2(F - f), \\ BD = BC + CD = x + y. \end{cases}$

Les deux valeurs de BD donnent evidement, 1°, $x + y = 2(F - f)$.

Pour que l'image B, donnée par la lentille a, ſoit vue à la diſtance BC: et pour que la direction du raion BHD forme un foyer relatif en D, dont le foyer equivalent ſoit AD; il faut (voyez l'optique de SMITH de la Traduction de l'Abbé ROCHON, p. 278. art. 245.) dis-je que $aB \times CD = AD \times BC$ ſavoir, 2°, $fy = Fx$.

Pour que l'objet B vû ſelon la direction BH, forme un foyer en D, il faut que le lens C (namely, the diſtance φ) have this condition, $\varphi \times BD = BC \times CD$, *viz.* 3dly, $2\varphi \times \overline{F-f} = xy$.

From theſe three conditions, *viz.*
$$\begin{cases} 1^\circ & x+y = 2 \times \overline{F-f}, \\ 2^\circ & fy = Fx, \\ 3^\circ & 2\varphi \times \overline{F-f} = xy, \end{cases}$$
we eaſily and inconteſtably find what follows:

$BC = x = \frac{2f \times \overline{F-f}}{F+f}$ the diſt. from the focus B to the lens CH,

$CD = y = \frac{2F \times \overline{F-f}}{F+f}$ the diſt. of the relative focus D, with reſpect to the two lenſes *a* and C,

$\varphi = \frac{2Ff \times \overline{F-f}}{\overline{F+f}|^2}$ the focal diſtance of the lens C.

This ſolution juſt found is general; but to adapt it to a particular caſe, which may be proper for practice, I ſhall inveſtigate what relation ought to take place between the diſtances F and f when φ is $= f$. This ſuppoſition

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le foyer de la lentille C (ſavoir le foyer φ) ait cette condition ci $\varphi \times BD = BC \times CD$ ſavoir, 3°, $2\varphi(F-f) = xy$.

Avec ces trois conditions, ſavoir,
$$\begin{cases} 1^\circ & x+y = 2(F-f), \\ 2^\circ & fy = Fx, \\ 3^\circ & 2\varphi(F-f) = xy, \end{cases}$$
on trouve facile et inconteſtablement ce qui ſuit.

$BC = x = \frac{2f(F-f)}{F+f}$ diſtance du foyer B à la lentille CH.

$CD = y = \frac{2f(F-f)}{F+f}$ le foyer relatif D, à l'égard des deux lentilles *a* et C.

$\varphi = \frac{2Ff(F-f)}{(F+f)^2}$ foyer de la lentille C.

Cette ſolution qu'on vient de trouver eſt generale. Mais afin d'adopter un cas particulier, qui ſoit commode à pratiquer, je vais chercher les rapports, que doivent fition gives $\phi = \frac{2Ff \times \overline{F-f}}{\overline{F-f}|^{2}} = f$; from which we eafily and inconteftably extract the relation fought, *videlicet*, $F = \sqrt{5+2} \times f$; or this, which comes to the fame thing, $f = (\sqrt{5-2}) \times F$.

But $\left\{ \begin{array}{l} \sqrt{5}+2 = 4{,}2361 \\ \sqrt{5}-2 = 0{,}2361 \end{array} \right\}$ Therefore for the cafe in which $\phi = f$, we have $\left\{ \begin{array}{l} F = 4{,}2361 f \\ f = 0{,}2361 F \end{array} \right\}$ The relation of the focal dift.

The

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doivent avoir entre eux les foyers F et f dans le cas où l'on auroit $\phi = f$. Cette fuppofition donne $\phi = \frac{2Ff(F-f)}{(F+f)^{2}} = f$; d'où l'on tire facilement et inconteftament le rapport cherché que voici $F = (\sqrt{5}+2)f$; ou bien celui ci qui revient au même que le precedent $f = (\sqrt{5}-2)F$.

Mais $\left\{ \begin{array}{l} \sqrt{5}+2 = 4{,}2361 \\ \sqrt{5}-2 = 0{,}2361 \end{array} \right\}$ donc pour les cas où $\phi = f$, on a $\left\{ \begin{array}{l} F = 4{,}2361 f \\ f = 0{,}2361 F \end{array} \right\}$ rapport des foyers.

Application

The Application of the general Formula to the particular case of the equal lenses a *and* c.

Let AD $=$ F, the focal distance of the lens A,

The relation $f = 0,2361$ F, found for the focal distances, gives

$aB = f = 0,2361$ F, the focal dist. of the lenses a and c,

$aA = F - f = 0,7639$ F, the dist. between these lenses,

$AB = F - 2f = 0,5278$ F, distance,

$BD = 2 \times \overline{F - f} = 1,5278$ F, distance,

$BC = \frac{2f \times \overline{F - f}}{F + f} = 0,2918$ F, distance,

$CD = \frac{2F \times \overline{F - f}}{F + f} = 1,2360$ F, distance.

The

Application de la formule generale au cas particulier des lentilles egales a *and* c.

Soit AD $=$ F, foyer de la lentille A,

Le rapport trouvé des foyers $f = 0,2361$ F, donne

$aB = f = 0,2361$ F, foyer des lentilles a and c.

$aA = F - f = 0,7639$ F, distance entre ces lentilles,

$AB = F - 2f = 0,5278$ F, distance,

$BD = 2(F - f) = 1,5728$ F, distance,

$BC = \frac{2f(F - f)}{F + f} = 0,2918$ F, distance,

$CD = \frac{2F(F - f)}{F + f} = 1,2360$ F, distance.

Application

The numerical application of the particular case of the equal lenses a *and* c.

			Ft.	In.
Let	AD = F = 1728 lines,	=	12	0
Then we shall have	aB = 0,2361 F = 408 lines,		2	10
	AB = 0,5278 F = 912 lines,		6	4
	aA = 0,7639 F = 1320 lines,		9	2
	aD = aB + BD = 1,7639 F = 3048 lines,		21	2

It is from this particular case, in which $\varphi = f$, and $f = F \times \sqrt{5} - 2 = 0{,}23607\ F$, that the following table is constructed.

Application numerique du cas particulier des lentilles égales a *et* c.

			P.	P.
Soit	AD = F = 1728 lignes	=	12	0
Alors on aura	aB = 0,2361 F = 408 lignes,		2	10
	AB = 0,5278 F = 912 lignes,		6	4
	aA = 0,7639 F = 1320 lignes,		9	2
	aD = aB + BD = 1,7639 F = 3048 lignes,		21	2

C'est d'après ce cas particulier, où l'on suppose $\varphi = f$, et que $f = F(\sqrt{5} - 2) = 0{,}23607\ F$, qu'est construite la table qui suit.

Focal

Focal distance of the lens A and the equivalent AD.		Focal distances of the lenses a and c, and distance CA from the 2d lens C to the third A.			Distance ac from the first lens a to the second c.			Distance aA from the first lens a to third A.			Whole distance aD.			Distance CD from the 2d lens C to the focus D.		
Fr. ft.	In.	Fr. ft.	In.	Lin.	Fr. ft.	In.	Lin.	Fr. ft.	In.	Lin.	Fr. ft.	In.	Lin.	Fr. ft.	In.	Lin.
0	1	0	0	3	0	0	6	0	0	9	0	1	9	0	1	3
0	2	0	0	6	0	1	1	0	1	6	0	3	6	0	2	6
0	3	0	0	8	0	1	7	0	2	3	0	5	3	0	3	8½
0	4	0	0	11	0	2	1	0	3	1	0	7	1	0	4	11
0	5	0	1	2	0	2	8	0	3	10	0	8	10	0	6	2
0	6	0	1	5	0	3	2	0	4	7	0	10	7	0	7	5
0	7	0	1	8	0	3	8	0	5	4	1	0	4	0	8	8
0	8	0	1	11	0	4	3	0	6	1	1	2	1	0	9	11
0	9	0	2	1½	0	4	9	0	6	10½	1	3	10½	0	11	1
0	10	0	2	4½	0	5	3	0	7	8	1	5	8	1	0	4
0	11	0	2	7	0	5	10	0	8	5	1	7	5	1	1	7
1	0	0	2	10	0	6	4	0	9	2	1	9	2	1	2	10
2	0	0	5	8	1	0	8	1	6	4	3	6	4	2	5	8
3	0	0	8	6	1	7	0	2	3	6	5	3	6	3	8	6
4	0	0	11	4	2	1	4	3	0	8	7	0	8	4	11	4
5	0	1	2	2	2	7	8	3	9	10	8	9	10	6	2	2
6	0	1	5	0	3	2	0	4	7	0	10	7	0	7	5	0
7	0	1	7	10	3	8	4	5	4	2	12	4	2	8	7	10
8	0	1	10	8	4	2	8	6	1	4	14	1	4	9	10	8
9	0	2	1	6	4	9	0	6	10	6	15	10	6	11	1	6
10	0	2	4	4	5	3	4	7	7	8	17	7	8	12	4	4
11	0	2	7	2	5	9	8	8	4	10	19	4	10	13	7	2
12	0	2	10	0	6	4	0	9	2	0	21	2	0	14	10	0