



XXVI. Description of a burning mirror, by means of which we may reflect and fix on any object, whether at rest or in motion, the solar rays in as great a quantity as we please. Translated from the French

F. Peyrard

To cite this article: F. Peyrard (1811) XXVI. Description of a burning mirror, by means of which we may reflect and fix on any object, whether at rest or in motion, the solar rays in as great a quantity as we please. Translated from the French , Philosophical Magazine Series 1, 37:154, 133-146, DOI: [10.1080/14786441108563256](https://doi.org/10.1080/14786441108563256)

To link to this article: <http://dx.doi.org/10.1080/14786441108563256>



Published online: 18 May 2009.



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which happened on February 17th. The observed place, which he has done me the honour to communicate, agrees with surprising exactness to the computed one deduced from the last and most improved elements. Mr. Groombridge, I believe, is the only astronomer in this country who has observed this opposition.

XXVI. *Description of a Burning Mirror, by means of which we may reflect and fix on any Object, whether at Rest or in Motion, the solar Rays in as great a Quantity as we please. By F. PEYRARD, Professor of Mathematics in the Bonaparte Lyceum. Translated from the French.*

Report made to the Class of Physical and Mathematical Sciences of the French Institute on the above Subject.

M. PEYRARD, who has recently published an elegant translation of the works of Archimedes, naturally turned his attention to the way in which that great geometrician is said to have set fire to the fleet of Marcellus before Syracuse. The ancients and the authors of the middle age assert that he employed a burning mirror; but none of them enter into details ample enough to give us an exact knowledge of his process. Anthemius, who in the sixth century built the church of St. Sophia at Constantinople, and who seems to have been an excellent architect, suggested an assemblage of plain mirrors which might produce the same effect with the mirror of Archimedes. Since that period, Kircher, who perhaps was not acquainted with the works of Anthemius, proposed something similar. Finally, within these few years, M. de Buffon contrived a burning mirror composed of 168 plain glasses, and every person is acquainted with his experiments on the subject. The above three processes, which are all closely alike, are attended with serious inconveniences:

In order that a mirror may reflect upon one point the rays of the sun, regarded as parallel to each other, we know that its reflecting surface ought to form part of that of a paraboloid of revolution, the axis of which is parallel to the rays of light, and the focus of which is a point of union. If the mirror should be composed of a great number of plain mirrors of a middling size, the planes of these last ought to be parallel, each to the tangent plane at the surface of the paraboloid, at the point where it is cut by the corresponding vector ray. Now, in virtue of the sun's motion, the position of the axis of the paraboloid changes in a very rapid

manner. It is necessary, therefore, if the form of the mirror be invariable, that this mirror should turn entirely with the sun around the focus; which appears impracticable: and if the elements of which it is composed are moveable, independently of each other, each of these plain elements must turn in such a way as to be constantly perpendicular to the straight line, which divides into two equal parts the angle formed by the ray of the sun and the corresponding vector ray.

It seems difficult to give to the elementary mirrors the motion in question, by means of a machine, less perhaps on account of the changes of declination of the sun rendering the machine complicated, than because the dilatation of the metallic rods which would transmit the motion, might change in a remarkable and unforeseen manner the directions of the elementary mirrors, and because the inevitable shakings would give to these mirrors a vibratory motion, which would keep the individual images in a perpetual agitation.

There remains therefore no other reasonable method of composing a burning lens of several plain mirrors, than to confide each of them to a person individually instructed how to keep it in the position in which it ought to be in order to reflect the image of the sun on any determinate point, and to vary this position conformably to the motion of the sun. But M. Peyrard truly observes, that this method is attended with an inconvenience which completely opposes its success. It is very easy, in truth, for a single attentive person, conveniently placed, to direct on a given point the image of the sun reflected by a mirror of middling size, and to keep it there in spite of the motion of the sun: nay, the difficulty would not be great for three or four persons to do the same thing at once. But if 50, 100, or 200 persons were to form in this manner a burning focus, as none of them could distinguish the image which he sends from that which is sent by the others,—if a single one among those images was removed from the focus, each of the performers would wish to ascertain if it was his: an agitation and confusion would hence ensue, which would hinder the focus from being formed. It is this inconvenience which M. Peyrard has set about remedying, and he obviates it in a very ingenious manner. With this view he furnishes each of his mirrors with a simple apparatus which we shall now describe.

A small glass supported on a trivet, and furnished with two wires which cross each other at the focus of the glass,
may

may be easily directed to any given point. It is kept in this position by two screws. The glass, without changing its direction, is moveable on its axis between two collars, and may be maintained in all its positions around this axis by another screw : it projects outwards from the mirror, which it carries round along with it on its axis, and which, independently of this motion, may turn around a particular axis perpendicular to that of the object glass. We turn the glass on its axis until the particular axis of the mirror is perpendicular to the plane formed by the incident and reflected rays, and we keep it in this position by the screw. Finally, we turn the mirror on its particular axis until the rays reflected are parallel to the axis of the glass, and we are then certain that the image of the sun is upon the object towards which the glass is directed.

The two motions just mentioned are executed one after another, and are susceptible of very great precision. With respect to the first, when the particular axis of the mirror is perpendicular to the plane of the incident and reflected rays, the edge of the frame which is perpendicular to the particular axis of the mirror has a shade which is in a plane parallel to that of the incident and reflected rays, and consequently parallel to the axis of the glass. Thus this shade ought to cut the face of a salient index outside of the glass, in a straight line which is at the same distance from the axis of the glass with the edge of the frame. This straight line being therefore traced on the face of the index, in order to execute the first motion, it is sufficient to turn the glass on its axis until the shadow of the frame of the mirror coincides with the straight line traced on the index ; which is of sufficient precision.

With respect to the second motion, it is clear that when the mirror is placed in such a way that the reflected rays are parallel to the axis of the glass, if upon the particular axis of the mirror, and quite close to the edges of the frame, we have rubbed off the plating of the glass on a small piece, this defect in the plating will produce a shadow which will fall on the middle of the straight line of the index. Therefore this middle point being marked before hand on the index, in order to execute the second motion, it is sufficient to turn the mirror on its particular axis until the shadow of the scratched part falls on this point ; which is equally precise with the first motion.

We see, therefore, that assistants in any number may each direct the image they severally produce on the point indicated for the focus, without being obliged to observe his neighbours. It may be noticed, also, that the motion of the

sun in its diurnal arc is not so rapid, but that one person may direct ten mirrors close to each other; a circumstance which considerably diminishes the expense and labour attending the operation.

We conclude that M. Peyrard has brought the construction of burning glasses composed of several plain mirrors to a perfection which these machines had not hitherto acquired, and which seems to us to be worthy of the attention of the Class.

Signed CHARLES, ROCHON, MONGE,
Paris, 3d August, 1807. Reporter.

The Class approves of the above report, and adopts its conclusions.

4th August, 1807.

Signed DELAMERE,
Perpetual Secretary.

M. Peyrard's Description of his Machine.

This burning mirror consists of an assemblage of plain silvered looking-glasses. Every glass is arranged in the following manner:

An object glass AB (fig. 1, Plate IV.) is moveable on its axis between two collars CC, C'C', which are fixed with a piece of metal DD.

The small aperture of the glass is at A, and the large one at B: two wires cross each other at right angles at the centre of the large aperture.

A screw E acts on the object glass, and keeps it in the position which we wish to give to it.

The object glass is mounted on a stand like a common object glass, so that we may direct its axis towards a given point: two screws F and G retain it in its position.

The middle of the object glass is surmounted by a cylinder M' M', the upper base of which is parallel to the axis of the object glass.

A branch of iron HHH, wrought square, is fixed with the object glass.

A framed looking-glass turns on two pivots MM, OO. The straight line which passes through the centre of the pivots is tangent to the posterior face of the mirror, and perpendicular on the axis of the object glass.

The black trace NN, which is occasioned by the scratch in the plating, is divided into two equal parts by the axis of the mirror.

The large aperture of the object glass is surmounted with a plate of metal which is fixed with it. Before this plate is a square plate ZZ, on which are traced the straight lines XX, YY, which intersect at right angles. The square
plate

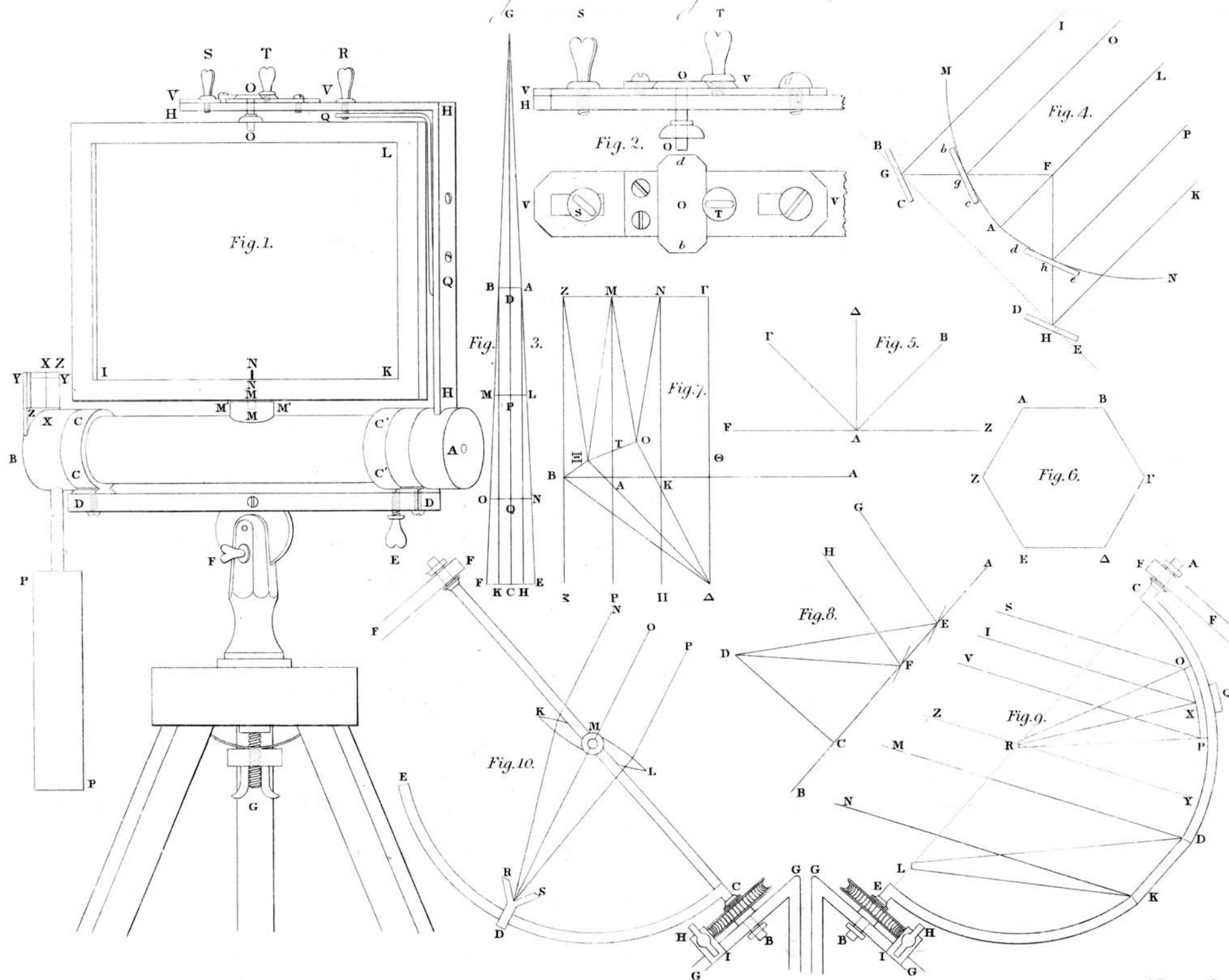


plate has a stalk which traverses a square hole made in the fixed plate. The square plate may be moved from right to left, and lowered or raised : a screw placed behind the fixed plate keeps the moveable plate in the position which we wish to give it.

The moveable plate ought to be placed in such a way that the straight line XX if prolonged passes by the axis of the object glass, and is parallel to the particular axis of the mirror, and so as that the distance from the straight line YY to the axis of the object glass is equal to the distance from the straight line IK to this same axis. The plate ZZ being so placed, it is evident that the straight line YY will be parallel to IK , and that the straight line drawn from the point at which the axis of the mirror cuts IK to the point at which XX cuts YY , will be parallel to the axis of the object glass.

The piece QQ' is a spring fixed at Q' with the square. This spring is traversed at Q by the screw RQ . On turning this screw, the extremity of the square presses the pivot OO on the frame of the glass.

The square HHH is surmounted by an assemblage of pieces represented in fig. 2. The piece $a b$ and the pivot OO are ranged in an invariable manner. The extremity of the square and the piece VV have a square hole which receives the pivot OO . When we turn the screw T , the piece $a b$ may be moved before or behind; and when we turn the screw S , the piece VV may be moved from right to left with the piece $a b$.

In order to give the axis of the mirror a position perpendicular on the axis of the object glass, and to place the moveable plate ZZ (fig. 1.) in such a manner that the straight line drawn from the point at which the axis of the mirror cuts the line IK , to the point at which XX cuts YY , may be parallel to IK , and finally, in order to place the straight line YY parallel to IK , I act in the following manner :

I place the mirror in such a manner that the straight line IK cuts at right angles the axis of the object glass. I turn the screw T , and bring the lower edge of the frame to be tangent to the circular surface $M'M'$, which is parallel to the axis of the object glass. I afterwards turn the screw T in order to fix the piece $a b$ (fig. 2.) in an invariable manner.

I afterwards direct the axis of the mirror on a point of a plain surface placed at a certain distance. This point must be in the vertical plane which passes by the eye of the observer and by the centre of the sun, and this plane must be perpendicular

perpendicular on the plain surface which we have mentioned. By this point, I draw a horizontal straight line, and setting out from this point, I take a second point which is as far from the first as is the centre of the mirror from the axis of the object glass. I unscrew at S. I turn the object glass on its axis; the mirror also on its particular axis, and I advance or retract the piece VV until the centre of the image reflected falls on the second point. I fix the piece VV. I afterwards place the piece ZZ in such a way that the shadow of the straight line IK falls on the straight line YY, and that the shadow of MM may be divided into two equal parts by the straight line XX, and I fix the piece ZZ.

The mirror being thus mounted, it is evident that, whatever be the point on which we may have directed the axis of the object glass, the shadow of NN, and consequently all the rays reflected by the surface of the mirror, will be parallel to the axis of the object glass, provided the shadow of IK falls on YY, and the shadow of NN is divided into two equal parts by the straight line XX.

The mirror being thus arranged, the following is the method of using it :

In order to bring the image of the sun on any given object, we must first direct the axis of the object glass on any given point of the object; 2dly, turn the object glass on its axis until the shadow of the line IK falls on the line YY; 3dly, turn the mirror on its particular axis until the shadow of the band MM is divided into two equal parts by the straight line XX.

These three operations being finished, it is evident that the image of the sun will fall on the given object; or, to speak more correctly, the centre of the image reflected, instead of being on the point of the object upon which we have directed the axis of the object glass, will be at a distance from it equal to that which is between the centre of the mirror and the axis of the object glass.

If in proportion as the sun advances we take care to keep the shadow of the straight line IK on the straight line YY, and the shadow of NN on the straight line XX, so that the straight line XX may divide the shadow of NN into two equal parts, it is evident that the image will preserve its first position as long as we please.

Let us now suppose that we have a great number of these mirrors; that they are placed by the side of one another in rows above each other; and let us suppose that each of these mirrors is directed by a single individual. It is evident that the images reflected by the mirrors will be brought

brought upon the same object, and that they will remain fixed upon it as long as we please.

I have said that it will require as many persons as there are mirrors ; but it is easy to foresee that a single person might easily direct ten or even twenty mirrors, without having reason to apprehend any displacement of the focus, or the dispersion of the images.

If the object on which we wish to bring the images of the sun was in motion, it would be necessary that each mirror should be directed by two persons : one would be instructed constantly to direct the axis of the object glass on the thing in motion, while the other would be instructed to throw the shadow of the straight line IK on the straight line YY, and the shadow of the pivot NN on the straight line XX, so as that this straight line might divide the shadow of the pivot into two equal parts.

Such is the burning mirror which I have contrived. The construction is very simple ; the method of using it is easy ; and it is beyond doubt, that by its means we may reflect and fix on an object at rest, or in motion, the solar rays, in as great a quantity as we please.

I shall now show what are the effects which my mirror is capable of producing.

Buffon ascertained by several experiments, that the light of the sun reflected by a looking-glass did not lose, at short distances, more than one half by reflection ; that it lost, at great distances, scarcely any of its force from the thickness of the air which it had to pass through ; and that its force was diminished solely in an inverse ratio to the augmentation of the surfaces which it might occupy upon planes perpendicular on the reflected rays*.

This being granted, let us suppose that the glasses of every mirror are each of them five decimetres high and six broad. I take them to be greater in breadth than height, in order that the images reflected may have their height nearly equal to their breadth ; for the rays of the sun being always perpendicular on the axis of every glass, while they are more or less inclined on the line IK, if the height of the glasses was equal to their breadth, when the rays of the sun were not perpendicular on the plane of the glasses, the heights of the images of the sun would be always smaller than their breadths.

In order to calculate with more facility the effects of my mirror, I suppose that the glasses are of a circular form,

* See the Supplement to Buffon's Natural History, 4to edit. Paris 1774, tome i. p. 401 and 405.

having a diameter of five decimetres, and that they receive perpendicularly the solar rays. The images reflected by the glasses of my mirror being larger than the images reflected by these circular glasses, it is evident that my results will be something too small.

The apparent diameter of the sun being 32 minutes, it is evident that every point of a glass reflects a luminous cone, the section of which through the axis forms an angle of 32'.

This being granted, let AB, fig. 3, be the diameter of a circular glass, and let this diameter be five decimetres. Let us suppose that the straight line CD, drawn from the centre of the sun on the centre of this glass, is perpendicular on its plane. By the straight line AB and by the straight line CD let us draw a plane, and let the straight lines AE, BF be the intersections of the secting plane and of the surface of the bundle of light reflected by this glass. If the straight lines EA, FB are prolonged, they will meet in a point G, and form an angle of 32 minutes. In fact, the apparent diameter of the sun being 32 minutes, each point of the glass necessarily reflects a luminous cone, the section of which by the axis forms an angle of 32 minutes. Let the straight line HA be the axis of the luminous cone reflected by the point A of the glass, and the right line KB the axis of the luminous cone reflected by the point B. It is evident that the angles EAH, FBK, will be each 16'. But the angles EAH, FBK, are equal to the angles EGC, FGC, since the three straight lines HA, CG, KB, are parallel; therefore the angle EGF is equal to the sum of the angles EAH, FBK, which are 32'. Therefore the angle EGF is 32'.

It now remains to calculate at what distance from the mirror the image reflected will be double, triple, quadruple, &c. to the surface of the reflecting glass. For this purpose I first calculate the distance GD, making this proportion: tang. AGD : R :: AD : GD; or rather, tang. 16' : R :: 0^{metre},25 : GD; and I find that GD is 53^m,72.

I afterwards try at what distance from the glass the reflected image is double, triple, quadruple, &c. to the surface of the glass. Let us suppose that it is double in LM, triple in NO, quadruple in EF, &c.

In order to find the distances DP, DQ, DC, &c. I conduct myself as follows:

In order to find DP, I form this proportion:

$$\overline{AB}^2 : \overline{LM}^2 :: \overline{GD}^2 : \overline{GP}^2; \text{ or rather } 1 : 2 :: (53^m, 72)^2 : \overline{GP}^2;$$

on account of \overline{AD} being the half of \overline{LM} , when the surface of the glass is the half of the image reflected.

Knowing

Knowing the value of \overline{AP}^2 , I take its square root; from this root I cut off GD, *i. e.* 53^m,72, and I find 22^m,25. Whence I conclude that the image reflected is double the surface of the glass when it is removed 22^m,25.

In order to find the distance DQ, we should make this proportion : 1 : 3 :: (53^m,72)² : \overline{GQ}^2 . In order to find the other distances, we ought to conduct ourselves in a similar manner.

I have calculated these distances, and I find the following results :

The Image being	The distance is
Double	22 ^m ,25
Triple	39 ,33
Quadruple	53 ,72
Quintuple	66 ,41
Sextuple	77 ,86
Septuple	88 ,41
Octuple	98 ,22
Nonuple	107 ,44
Decuple	116 ,16

It is almost unnecessary to say, that these distances would be double, triple, quadruple, &c. if the diameters of my glasses, instead of being five decimetres, were ten, fifteen, twenty, &c. decimetres.

Let us suppose a certain number of my mirrors, and suppose that at a very small distance the images of these mirrors united on the same object are capable of producing a certain degree of heat. It follows, according to the results which I have obtained, that in order to produce the same degree of heat at a distance of 22^m,25, 39^m,33, 53^m,72, &c., we must double, triple, quadruple, &c. the number of mirrors. It also follows, that at one of the distances calculated above, we may produce a heat at least equal to that which would be produced by the heat of the sun, repeated as often as we pleased.

But how many times must we repeat the heat of the sun in order to boil water, set fire to wood, or melt, calcine and evaporate metals, &c.? These questions are not yet resolved. By means of my mirror they might. And in order to gratify in some measure the curiosity of my readers, I shall try to resolve some of these questions, taking as a basis the experiments which Buffon made with his burning mirror.

The glasses of which Buffon's mirror was composed were each six inches high by eight broad. In order to simplify

simplify the calculations, I shall in the first place suppose that, when Buffon made his experiments, each of the glasses of his mirror produced an effect equally great with what would have been done by a circular glass of the same surface, on which the solar rays would fall perpendicularly. I shall afterwards suppose, that all the images reflected by the glasses of his mirror were applied exactly upon each other.

But it is beyond a doubt, that each of the glasses of Buffon's mirror produced an effect smaller than that which would have been produced by a glass on which the solar rays would have fallen perpendicularly; for, the solar rays falling obliquely on the glasses of his mirror, it is evident that the quantity of the rays reflected was smaller than it would have been if the solar rays had fallen perpendicularly on the glasses; and I shall presently show that with Buffon's mirror it is impossible to throw precisely the images of the sun upon each other. It follows therefore, that by taking as a basis the experiments of Buffon, my results will be too great.

On the 23d of March, at mid-day, Buffon at a distance of 66 feet set fire to a plank of tarred beech-wood, with forty glasses, the mirror forming with the sun an angle of nearly 20 degrees of declination, and another of more than 10 degrees of inclination.

On examining the table in a preceding page, we shall find that at this distance the image was quintuple the surface of the mirror. Thus the fifth part of 40 glasses, *i. e.* eight glasses, would have produced the same effect at a very small distance. But at a very small distance the heat of the image reflected is the half of the heat of the sun; therefore, four times the heat of the sun would set fire to a plank of tarred beech-wood. I suppose in this experiment, as well as in those which follow, that the number of glasses only was employed necessary for producing inflammation or fusion.

On the same day, the mirror being placed still more disadvantageously, he set fire to a plank tarred and sulphured 126 feet distant, with 98 glasses.

At this distance, the image reflected was nearly twelve times as large. The heat necessary therefore to set fire to this plank would be the heat of the sun multiplied by $\frac{98}{2 \times 12}$, *i. e.* the heat necessary for that would be equal to four times and $\frac{1}{12}$ the heat of the sun.

On the 10th of April, in the afternoon, with a clear sun, a tarred plank was set fire to at the distance of 150 feet, and

and with 128 glasses. The inflammation was very sudden, and it took place throughout the whole extent of the focus.

At this distance the image was nearly 15 times as large. The heat necessary, therefore, for setting fire to this plank would be the heat of the sun multiplied by $\frac{128}{2 \times 15}$; *i. e.* the heat necessary would be equal to four times and $\frac{4}{15}$ the heat of the sun.

On the 11th of April, at a distance of 20 feet, and with 21 glasses, a beech plank was set fire to which had been already partly burned.

At this distance the image was nearly double. The heat necessary, therefore, for setting fire to this plank was the heat of the sun multiplied by $\frac{21}{2 \times 2}$, *i. e.* by 5 and $\frac{1}{4}$.

The same day, at the same distance, with twelve glasses, some small combustible substances were set fire to. The heat necessary, therefore, for setting fire to them was the heat of the sun multiplied by 3.

On the same day again, at the same distance, and with 45 glasses, a large pewter flask was melted which weighed about six pounds. The heat necessary, therefore, was the heat of the sun multiplied by $\frac{45}{2 \times 2}$, *i. e.* by 11 and $\frac{1}{4}$.

With 117 glasses, some thin pieces of silver were melted, and a piece of sheet-iron was made red hot. To produce this effect, therefore, there must be a heat equal to that of the sun multiplied by $\frac{117}{2 \times 2}$, *i. e.* by 29 $\frac{1}{4}$.

"By subsequent experiments," says M. Buffon, "I ascertained that the most advantageous distance to make conveniently with these mirrors experiments on the metals, was 40 or 45 feet. The silver plates which I melted at this distance with 224 glasses were very clean, so that it was impossible to ascribe the very abundant smoke which issued from it, to grease or to other substances which the silver might have imbibed, and as those persons persuaded themselves who were witnesses of the experiment: I repeated it however on plates of silver quite new, and had the same effect. The metal smoked very abundantly, sometimes during eight or ten minutes before being melted. I had intended to collect this smoke by means of a head similar to what is used in distillation, and I always regretted that my other occupations prevented me; for this way of extracting water from the metal is perhaps the only one which

which we could employ : and if it is said that this smoke, which appeared to me to be humid, does not contain water, it would at any rate be useful to know what it is, for it may be merely volatilized metal : besides, I am persuaded that, by making the same experiments on gold, we shall see it smoke like silver, perhaps more, perhaps less."

At the distance of 40 feet the image is triple : the heat necessary, therefore, for producing this effect is equal to that of the sun multiplied by $\frac{224}{2 \times 3}$ *i. e.* by 37 and $\frac{1}{3}$.

Thus, by setting out from the imperfect experiments of Buffon, five times the heat of the sun would be more than sufficient for setting fire to tarred planks. I suppose that eight times this heat is sufficient for setting fire to all kinds of wood, and surely so much heat would not be requisite.

It follows from this supposition :

- 1st, That at a distance of 22^m,25, it would require 16 of my glasses to set fire to wood.
- 2d, At a distance of 39^m,33, it would require 24.
- 3d, At a distance of 53^m,72, it would require 32.
- 4th, At a distance of 66^m,41, it would require 40.
- 5th, At a distance of 77^m,86, it would require 48.
- 6th, At a distance of 88^m,41, it would require 56.
- 7th, At a distance of 98^m,22, it would require 64.
- 8th, At a distance of 107^m,44, it would require 72.
- 9th, At a distance of 116^m,16, it would require 80.
- 10th, At a distance of 1250 metres, *i. e.* a quarter of a league, it would require 590*.
- 11th, At half a league, it would require 2262.

If the height and breadth of the glasses became double, triple, quadruple, &c. it is evident that they would inflame at double, triple, quadruple distances. Thus 590 glasses of a metre in height would produce the same effect at half a league, and glasses of two metres in height at one league : but I deceive myself, the effect would be much greater.

If we used glasses of a metre in height, the focus at a distance of a quarter of a league would be 24 metres in height and in breadth. I am of opinion, that with 590 glasses five decimetres high we might reduce to ashes a fleet at the distance of a quarter of a league ; at half a league, with 590 glasses of a metre in height ; and at a league, with 590 glasses two metres in height.

* In order to calculate how many glasses are requisite at this distance, we form the following proportion :

$$(53^m, 72^s) : (53^m, 72^s + 1250) :: 1 : x^2.$$

and we find for the fourth term 590 minus a fraction.

Instead

Instead of employing glasses which should be two metres in height, we might employ four glasses of a metre in height, which we might arrange in the same way, and the effect would be the same.

Before concluding, I shall say something of the burning mirrors which have been contrived to produce effects at great distances. Buffon's mirror was the last I know of. This instrument is composed of 168 plain glasses mounted in iron frames. These glasses, which are six inches high by eight broad, are moveable in every direction.

The above mirror has two prominent defects. It requires about half an hour to adjust it, *i. e.* to bring to the same point the 168 images of the sun reflected by the glasses. But the glasses being adjusted by each other, and the images reflected removing every moment from their first positions, it is evident, that when the operation is concluded the images must necessarily have removed from the focus. Hence it follows, that at every second the focus is displaced or enlarged, and loses its activity.

Let us suppose, for a moment, that, the mirror being adjusted, the images of the sun are exactly applied upon each other: I assert, that in this case M. Buffon's mirror has all the properties, and nothing but the properties, of a parabolic mirror composed of plain glasses.

Let us suppose in fact a certain number of plain glasses BC, DE, &c. (fig. 4,) placed as we please, provided their centres GH, &c. reflect the solar rays IG, KH in a point F. By the point F draw the straight line AL parallel to the solar rays IG, KH; on this parallel take a point A on the prolongation of LF, and describe a parabola MAN, the origin of whose axis is the point A, and the focus is the point F.

If this parabola makes a revolution around its axis, it will describe the surface of a parabolic conoid. Let us now suppose that the glasses BC, DE, &c. approach to or remove from the point F by moving parallel to themselves, following the straight lines GF, HF, until they are tangent to the conoid. It is evident that the points of contact will be the centres of the glasses, and that the centres of these glasses placed at *b c, d e* will reflect the solar rays OH, PG, &c. at the point F, in the same manner as they would reflect the solar rays IG, KH, &c. when these glasses were placed at BC, DE, &c. I conclude therefore, that if, Buffon's mirrors being adjusted, the images were exactly applied upon each other, this mirror would have all the properties, and no more than the properties, of a parabolic mirror.

ror composed of plain glasses. But a parabolic mirror only reflects the solar images in a single point, when the axis is directed to the centre of the sun : therefore, in order that the images reflected by M. Buffon's mirror may remain exactly applied on each other, it would be necessary that the axis of the mirror, passing always by the same focus F, should be constantly directed to the centre of the sun. But M. Buffon's mirror remains immoveable during the experiment : thus, in proportion as the sun advances the focus changes place. The mirror in question would therefore have another essential fault, even if the first did not exist.

[To be continued.]

XXVII. Notices respecting New Books.

A Treatise on the Venereal Disease, by JOHN HUNTER ; with an Introduction and Commentary, by JOSEPH ADAMS, M. D. Author of "Observations on Morbid Poisons, &c."

MR. HUNTER's Treatise having already gone through two editions, we should not have thought it necessary to notice a third, were it not for some circumstances which particularly increase our interest in the present performance. The obscurity of that celebrated but almost uneducated author has very much lessened the value of most of his writings. This has rendered an interpreter necessary, an office for which no one could be fitted who was not in frequent habits of conversing with him. Mr. Home may boast advantages of this kind beyond any other person ; but probably on account of the multiplicity of his engagements, the public has received little or no information from him which might lead to an elucidation of the most original parts of Mr. Hunter's discoveries. It is probable, indeed, that having received his education entirely from that source, he may not be aware of those points, which to others who have had fewer advantages are particularly obscure. Hitherto we believe Dr. Adams is the only person who has written with the professed object of illustrating Mr. Hunter : and it is but justice to admit, that since the appearance of the first edition of "*Morbid Poisons*," the opinions of his master have been more generally received, and even his language has become more current.

A new edition of this treatise therefore being called for, we cannot but consider its value much enhanced by the commentaries of such an editor. But the object for which

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