

II. *Optical Experiments made in the Beginning of August 1728, before the President and several Members of the Royal Society, and other Gentlemen of several Nations, upon Occasion of Signior Rizzetti's Opticks, with an Account of the said Book, By J. T. Desaguliers, L. L. D. and F. R. S.*

SOME Time in the Year 1722, Signior *Gizlanzoni*, an *Italian* Gentleman, shew'd me a Paper of Signior *John Rizzetti*, wherein he denied the different Refrangibility of the Rays of Light, because an Experiment mentioned in *Sir Isaac Newton's Opticks* (B. I. Prop. I. Exp. 2.) concerning an oblong Paper painted half blue and half red (whose Image projected by a Lens upon a white Paper at a considerable Distance became distinct in its blue half, nearer the Lens than in its red-half) had not succeeded with him, tho' after many Trials. *Sir Isaac Newton* being acquainted with this, desired me to repeat his Experiment above-mentioned, which I did at my own House, before him and Signior *Gizlanzoni* and some other Persons, who were satisfied with the Success of it, according to *Sir Isaac Newton's* Assertion. Afterwards on the 13th of *December 1722*, I again repeated the Experiment before the *Royal Society*, with the same Success, the full Account of which is printed in the *Philosophical Transactions*, Number 374. After this, Signior *Gizlanzoni* read me a Letter from Signior *Rizzetti*, wherein he said; "He wanted to know whether the
" Expe-

“ Experiment would succeed, if the Paper was turned
 “ so as to bring the red Half in the Place of the blue
 “ one ; and that if it succeeded then, yet he would
 “ not acquiesce, but he should have something still to
 “ object against it. And further, that he wanted to
 “ know what could be said to several other Objections
 “ (i think there were twelve in the Paper shewed me)
 “ against many more of Sir *Isaac Newton's* Optical
 “ Experiments, the greatest Part of which he said,
 “ he had found to succeed differently from what
 “ Sir *Isaac* had related ; and would not allow the
 “ Consequences to be just, which were drawn from
 “ the other Experiments which he had found to agree
 “ with his Trials”. Upon this I acquainted Signior
 “ *Gizlanzoni* in a Letter, which I desired him to com-
 “ municate to Signior *Rizzetti* ; “ that as” Signior
 “ *Rizzetti* had put the Issue of the Dispute upon the
 “ Success of an Experiment, which after repeated Trials
 “ had succeeded contrary to his Opinion, he ought to
 “ acknowledge his Mistake ; and then I should willingly
 “ repeat all the other Experiments which he had called
 “ in Question, and endeavour to remove his other Diffi-
 “ culties. That if it was Truth and not Victory which
 “ he contended for, I did not doubt but he would com-
 “ ply with me, in what I insisted upon ; and then I should
 “ be ready to make any Experiment, or clear up any Dif-
 “ ficulty relating to the Doctrine of Colours, in the best
 “ manner I could”. But I never heard any more from
 Signior *Rizzetti* ; but was told by others that he was
 very angry at Signior *Gizlanzoni*, and said he was
 got into Sir *Isaac Newton's* Party.

Now at last Signior *Rizzetti* has published a Book,
 entituled *De Luminis Affectionibus Specimen Physico-*
mathematicum,

mathematicum, dedicated to Cardinal *Polignac*, and printed at *Treviso* and *Venice*, 1727, which being presented to the *Royal Society*, and by the Society recommended to me to give an Account of it, I hope no Body will blame me for making a faithful Report.

The Author in his Preface, and throughout the whole Book, in a most arrogant manner, has insulted the greatest Philosopher that this or any other Age ever bred, triumphing in what he thinks the Mistakes of Sir *Isaac Newton* and his own Discoveries. Had he modestly related the Facts as they appeared to him, and his Reasons for drawing Consequences different from those of Sir *Isaac Newton*, the World might have thought him urged on by the Love of Truth in his *ten Years Labours*,* and his Errors might have been excused according to what he says in his Preface *Si fortè decipior, haud turpis est in re Physico-mathematica error, & magnis se quisque tuetur exemplis*. Neither would his Fame have been the less (if he had been right in his Experiments and Reasonings) for treating his Adversaries in a civil Manner, and really doing what he says at the End of his Preface “*Placita quidem authorum laceffo; at ipsos tamen autores obsequio & veneratione prosequor*”: For ill Manners can never be excused by what he calls *Philosophica Libertas*. Now nothing less than owning, *that a greedy Desire of Fame, and an Obstinacy to maintain what he once laid down as his Opinion, misled him so far, can excuse him to the learned World*. We hear indeed in a Letter from Sir *Thomas Dereham* to Sir *Hans Sloane*, President of the *Royal Society*, that now Signior *Rizzetti* alledges, “That he was

* See Preface, p. 38.

“ deceived in his Experiments, by Reason of the Badness of his Prisms which he had from *Venice*”; but this is but a partial Acknowledgment of his Error, and only satisfactory to such as have not read his Book, and are likewise unacquainted with Sir *Isaac Newton*'s Opticks. For Signior *Rizzetti* in the 37th and 38th Pages of his Preface has these Words—“ *Ut suosmet oculos consulant, omnes quidem possunt mea Experimenta iterare; at si primo intuitu deficit, qui expectatur, eventus; statim me falsitatis non arguant (ut vir celebris dicitur nimia festinatione fecisse); sed prius omnes meorum experimentorum limitationes notent: Si ad has enim attenderint; non pingui Minerva, non trigonis imperfectis [ut alii dicitant] sed accurata diligentia, & instrumentis idoneis me in hujusmodi res incubuisse etiam adversarii, vel inviti fatebuntur*”. As to Sir *Isaac Newton*'s Experiments, a great many of those which Signior *Rizzetti* calls in Question may be performed with very ordinary Prisms: And of that Sort are those which I made since the Publication of the Book in the Beginning of last *August*, at my own House, before the President and several Members of the *Royal Society*, and some foreign Gentlemen. But before I give an Account of the Experiments, I beg Leave to quote some of Signior *Rizzetti*'s Expressions against Sir *Isaac Newton*, otherwise I may be thought guilty of the very Fault which I have laid to his Charge.

Preface, Page 13. “ *Miratus sum quod acutissimus Newtonus ignoraverit Lumen album aliter a Trigono, & aliter a lente dispergi.*” Who ever read Sir *Isaac Newton*'s Opticks, that can be of this Opinion, except our Author? Preface, Page 81.—

“ *Theoria*

“ *Theoria in qua tot Hypotheses sunt, quot expli-*
 “ *canda Phenomena*”. When it is well known that
 Sir *Isaac Newton* did not make Hypotheses to ex-
 plain, but deduced plain Consequences from *Phænomena*.
 In the Book, Page 55 he says of *Richter*us his Ad-
 versary—“ *Si diversam colorum refrangibilitatem*
 “ *garriendo tueri deliberat*”,—and of Sir *Isaac*—
 “ *Si Newtonus hallucinatus est, quia in uno experi-*
 “ *mentorū genere fallaciis unici ac difficillimi in-*
 “ *dulsit; nos antequam consequentias eliciamus,*
 “ *discimus omnia ejusdem generis experimenta*
 “ *peragrarē, a facilioribus incipiendo.*” Page 76.
 speaking of Sir *Isaac*—“ *Nunc igitur confidentius*
 “ *affirmo, quod equidem plures, quam debuerat con-*
 “ *sequentias ex Phænomenis auctor collegit.*” Page
 90. “ *Quis aufisset canonem tanti viri impugnare,*
 “ *cum cesserunt omnes, qui hactenus eum veluti*
 “ *trutina expenderunt, &c.*” Page 91. “ This Ex-
 “ pression is particularly remarkable—“ *Newtonus*
 “ *hoc argumentandi modo videtur fecisse ut Lesbii,*
 “ *qui, cum ades ad Regulam minime accomoda-*
 “ *rentur, Regulam ad ades accomodarunt*”.

I cannot pass by what he says of *Richter*us in p. 100,
 “ because it is so applicable to himself, *Richter*um
 “ *admonui, ut Marte suo, quod omiserunt alii per-*
 “ *ficeret; is autem, sprete admonitione, videre*
 “ *quod a natura agatur, sed eam potius agere vult,*
 “ *quod sibi videtur agendum.*” Page 127. “ *Cum*
 “ *hæc auctor in medium ferat, parum in iis exper-*
 “ *tus esse videtur, quæ in poliendis vitris occurrunt.*”

Not to be tedious in such unpleasant Quotations, I
 proceed to give a short Account of the Book it self, to
 shew how much Pains some People can take to be in the

Wrong,

Wrong, there being no Experiment of Sir *Isaac's* called in Question but what is true, and no Consequence different from Sir *Isaac's* in those Experiments which he found to succeed, but what is false; as may be evident to any one who reads Sir *Isaac Newton's* Opticks with Attention enough to understand them; and has proper Instruments and sufficient Dexterity and Accuracy to perform the Experiments.

Our Author (tho' he professes himself an Enemy to Hypotheses) begins his very first Proposition with a Demonstration drawn from a false Hypothesis; for he supposes every Beam of Light to be as a Parallelogram of some Breadth like a Ribbon, as if the Rays cohered together like the longitudinal Threads of the Ribbon; then considering a narrow Side of the Parallelogram (which he calls the Section of the Beam) as an inflexible Line, he takes a great deal of Pains to draw a Consequence from it, which Experiments shew to be false; namely, that Light passes with more Difficulty through a dense, than through a rare Medium. He affirms, "That white Light never affords Colours by Reflexion."

That the Union of all Kind of Rays do not make
"white."

"That Light reflected from a *white* Object,
"and seen through a dark Medium, becomes *yellow*
"or *red*, as the Medium is stronger or weaker;
"that *black* seen through a lucid Medium appears *blue*
"or *violet*; and *green* he says is made from a
black } Object seen } lucid } then thro' a { dark } Medium.
white } first thro' a } dark, } { lucid }

"That some Light passing through a refracting
"Medium is dispersed, which he calls *more than re-*
"fracted, and so produces Colours."

In order to support his Hypotheses of *Mediums like Veils to alter the Colours of Objects looked at*, “ he considers (Preface, Page 31.) the Images in the Eye as an Object looked at, which would be supposing other Organs of Vision to look into the Eyes” — whereas the Pictures of external Objects shewn upon the back Part of an Eye placed in an Hole in the Window of a dark Room, are only such to those who see the Experiment; but in the Animal who sees, those Pictures are a great Number of small Blows or Impressions made upon the Fibres of the *Retina* by the Impulse of many Rays collected in the Vertices of the Cones of Light within the Eye, corresponding with so many other Cones which proceed from the visible Points of external Objects, and make, what Opticians call Pencils of Rays.

“ That the Resistance of Water from its Tenacity is greater than from its Density.

“ That since a small Thread, half *blue* and half *red*, is seen distinctly by the naked Eye, that Phænomenon overthrows the Doctrine of *different Refrangibility*.” But here the Author does not consider, that the Focus of the Eye is so short that the Distance of the distinct Base of the *blue* and the *red* Image of such Threads is not equal to the Thickness of the *Retina*.

“ That the Experiment of the two-coloured Paper projecting its Image through a Lens (which I repeated in the Manner above-mentioned, in the Year 1722) did sometimes succeed with him, and sometimes not; and therefore that it did not prove the different Refrangibility of Rays: But the different Place of the distinct Base of the *blue* and the *red* Image, was to be ascribed to the different Inclination

“ tion of the Parts of the painted Paper to the Sur-
 “ face of the Lens.” But in my Account of the Ex-
 periment in the *Philosophical Transactions*, I men-
 tioned particularly that the Axis of the Lens was per-
 pendicular to the Image of the Card, and therefore
 there could be no different Obliquity, as is objected.
 “ That though he found the *Spectrum* of Colours
 “ produced by the Prism in a dark Room to shorten by
 “ Degrees, and at last become round and colourless
 “ (that is *white*) when viewed by another Prism, in
 “ the same manner that Sir *Isaac Newton* had made
 “ the Experiment; yet it did not convince him of the
 “ different Refrangibility of the Rays; because when
 “ he had caused an Image to be painted upon a Paper
 “ like the *Spectrum* from the Prism, and enlightened it
 “ by the direct Light of the Sun, it did not become
 “ round and white when viewed through a Prism as
 “ the other *Spectrum* did.” But he did not consider
 the Imperfection of Painters Colours, nor remember
 that the Surfaces of Bodies, whether of a natural, or a
 painted or died Colour (such as he calls *permanent Co-*
lours) when exposed to any coloured Light, will re-
 flect that Colour which falls upon them, and appear to
 be of no other, only that they will seem most vivid in
 that Colour which they bear in open Day; and
 therefore that if the Sun’s Light consists of Rays dif-
 ferently refrangible and producing different Colours
 (according to Sir *Isaac Newton*) the Prism must sepa-
 rate the Light reflected from every one of the painted
 Colours, and could not bring them together, because
 they were by no means simple Colours. If therefore
 he had reasoned right, the first Experiment would have
 proved Sir *Isaac*’s Doctrine, and the last would have

confirm'd it. And if in his own Experiment he had looked at the painted *Spectrum* successively holding the refracting Angle of the Prism upwards, and then downwards with the same Inclination (or, what is easier, turned the *Spectrum* upside down, the Prism remaining fix'd) he would have seen his *Spectrum* shorter in one Case than in the other.

“ That Sir *Isaac Newton's* 8th Experiment of P. I. B. II. (in which the prismatick *red* and *blue* falling successively on the same Place of a Book, have a different Focus in projecting their Image through a Lens) is inconclusive; and rejects *Richter's* Answer, viz. *That the Colours reflected from the Book, as it has a rough Surface, fall always with the same Inclination upon the Lens, in whatever Direction they came from the Prism to the Book* — — — adding, That he had acquainted *Richter's*, that *permanent* Colours enlighten'd by direct Light in any different Inclination, always fell upon the Lens with the same Inclination; but apparent Colours, which were produced by Refraction with a Prism, differed from permanent Colours in their Incidence: But that *Richter's* had purposely concealed it.”

N.B. It is not likely he would have concealed it, if it had been true.

“ That Monsieur *Marriotte's* Experiments disprove the different Refrangibility of Colours”; though, if he had read with Attention and Impartiality the Account of the Experiments which I made before the *Royal Society* by their Order on that Occasion (*Phil. Transf.* Numb. 348.) he might have been convinced as well as several Gentlemen of the *French Royal*

Academy, who had seen Monsieur *Marriotte* make his Experiments, and acknowledged themselves satisfied when they saw me repeat those of Sir *Isaac* in the Year 1715.

“ That in the first Experiment of Sir *Isaac* (Book I. Part II.) He never could destroy any one Colour, the rest remaining ; and that with a larger Obstacle he could destroy the *yellow* and *blue*, but not the *yellow* and *green* — could bring the *green*, not the *yellow*, to be next to the Shadow—and could leave the *green* only remaining, but not the *yellow*.” This is an easie Experiment ; but Inaccuracy and a very bad Prism, and Prejudice towards an Hypothesis, or against an Adversary, may mislead a Man strangely.

“ That when the Colours produced by the Prism, and afterwards united by the Lens, produce *white* upon a Paper in the Focus, no Inclination of the Paper will tinge the white Spot with Colours”.

“ That a *yellow* Paper in the *blue* Light appears *green*, as does also a *blue* Paper in the *yellow* Light.” — But not when the Room is well darken'd, and the Light homogeneal.

“ That Sir *Isaac Newton* asserts falsely, that Light immersing into a Parallelipiped, and then emerging out of it, produces no Colours.”

“ That the 6th Experiment of Part I. Book I. of Sir *Isaac* is true ; but no different Refrangibility of Rays is prov'd by it, though the Colours coming successively from the first Prism to the second with the same Incidence, are carried to different Heights by the last Prism.” Now the Consequence is so plain here, that this is, after my Lord *Bacon's* Manner, called an *Experimentum Crucis*.

I should

I should go on with my Account of this Book, if it could be of any Use either to vindicate Sir *Isaac Newton*, or to convince the Author and his Adherents, if he has any. But Sir *Isaac's* Opticks need neither Defence nor Explanation. And when the Author is in the Humour to be convinced, *ten Months* well employed in reading Sir *Isaac's* Book, will make him amends for his *ten Years* prejudiced Examination.

I beg Leave now to give the particular Description of a few Experiments I made upon this Occasion, some of which are exactly as Sir *Isaac Newton* made them: Some are his, but made something differently, and some altogether my own.

EXPERIMENT I. FIG. I.

I prepared a Box of about three Foot high, and one Foot wide within (whose Shape was a truncated Pyramid) in the following Manner. I painted the Inside of it black, and in the back Part, one Foot above the Base, made a square Hole of three Inches in Width (whose Section is *rr*) to receive a Piece *R* shutting close with a Rabbet or Shoulder, whose Surface coming through the Hole was wholly covered with the painted Paper, on which the Experiment was to be made. Over against *rr*, in the fore Part of the Box, was a Door to open with a Tube in it, four Inches wide and five Inches long, whose Section is *e, f, g, h*, that two Candles set on the Places *i, k*, to enlighten the Paper at *rr*, might throw no direct Light out of the Box, whose Section is represented at *a b c d*. Then having made the Room perfectly dark, I fixed the Box upon a Table, that it might remain in one Place; at the Distance of
eight

eight Foot from rr , I fixed the Lens LL , of four Foot Focus, in a Frame upon another Table, with its Axis going through the Middle of rr : At the Distance of about eight Foot beyond the Lens, I set up the Skreen or Square of white Paper S . Having put into the Hole rr a stiff Paper, painted with Vermillion, and wrapped four Times and an half with black Silk (as represented by R), that Paper enlighten'd by the Candles at i, k , the Image of the red Paper was projected upon the Skreen at ρ , and when the most distinct Place was found, the Skreen was fixed: Then a Paper painted with Ultramarine being fixed in the Hole rr , the Image of it was so indistinct at ρ , that the Images of the black Silks could not be seen; but holding a Piece of Paper close to the Skreen, and bringing it forward, at about $\frac{1}{4}$ of an Inch from the Skreen, the Representation of the Silks began to appear on the blue Image; but it was most distinct at an Inch and $\frac{3}{4}$, or at ZZ ; so that there was $1\frac{3}{4}$ Inch between the distinct Base of the *red*, and that of the blue Paper. But what has led several People into an Error in making this nice Experiment, is the Depth of the Focus of the Rays in both Cases; for though the red Image was most distinct at ρ , yet the Representation of the black Silks might just be perceived by a good Eye when the Skreen was moved backwards or forwards $\frac{1}{4}$ of an Inch: The blue Image which was stronger had its Silks visible an Inch on either Side of ZZ ; so that in a Paper half red and half blue, painted with these Colours, one might have seen the Silks (though faintly) upon the two Images at once, and have been thereby deceived: But $\frac{1}{4}$ of an Inch beyond the Place common to both, the *red* alone would have appeared distinct; and an
Inch

Inch short of the said Place, the blue Image most distinct, and distinct alone ; that is an Inch and $\frac{1}{4}$ nearer the Glass. Instead of *Vermilion* the red Paper may be painted with *Carmin* or *Lake*, but it will not do so well, as was then tried ; nor does *Prussian Blue* do so well as *Ultramarine*. The best Way is to heighten the *Vermilion* with a little *Carmin*, and the *Ultramarine* (which has too much *white*) with *Indigo* ; and then there will be a Space between the two distinct Bases where both the Images will be indistinct. N. B. I made the Experiment with such Colours, in the Year 1722 ; but now I used no Mixtures, that any Body else might repeat the Experiment.

The second Figure represents the Box with one Side out, whose Place is $\delta db B$; eg is the Hole for the Tube in the Door of the Foreside, $x \delta cd$; rr the Hole in the Back to receive the Piece R with its painted Paper.

The third Figure is the Box open before, with the Candles and Paper in it, the same Parts being marked with the same Letters as in the other Figures.

N. B. I made the Experiment in this Manner, because Signior *Rizzetti* attributed the different *Foci* of the Colours to different Inclinations, which could not be alledged here ; the *red* and *blue* being, as he had desired, successively fixed in the very same Place : And he says (Page 64.) *addidi permanentes colores a lumine directo diversa inclinatione illustratos constante Inclinatione in lentem incidere*. Nay, more than this was performed in the Experiment ; for as the Candles were fixed, the Light fell upon the painted Paper always with the same Incidence.

EXPERIMENT II.

Instead of the red or blue Paper at 11 (*Fig. 1, 2, and 3,*) I fixed upon the Piece R, a Paper half *red*, and half *blue*, as R B (*Fig. 4.*) then over the Hole in the fore Part of the Box represented by *e g* (*Fig. 2.*) I fixed a square Plate *x d c d* (*Fig. 4.*) with an oblong Hole in it four Inches long in its Horizontal Position, and one Inch deep, through which one might see the parti-coloured Paper, as if it was only of the Bigness and Figure of this Aperture, and strongly enlighten'd by the Candles hid in the Box; the rest of the Room being very dark. N. B. *I made this Preparation, because Rizzetti objects to Sir Isaac Newton's first Experiment of the first Book, that the black Cloth beyond the parti-coloured Paper, was not colourless, and therefore the Experiment was not decisive as particularly relating to the Paper.*

R B (*Fig. 5.*) is the Paper contracted in Length and Breadth by the Aperture of the Plate, which Paper being looked at, at the Distance of five Foot, by the Prism 1, appeared as drawn at *r b*. The Prism being removed to 2, at the Distance of ten Foot, shewed the Paper as at *r b*. And when it was at 3 (at the Distance of fifteen Foot) the Paper appeared as *p β*. In these three Cases the blue *b, b,* and *β* appeared lower than the red *r, r, p,* the refracting Angle of the Prism being downwards. When the refracting Angle was held upwards, as at 5, then the *Blue B* was raised higher than the *red R*; but if due Care be not taken, in turning the Prism, a Reflection may be mistaken for a Refraction, as at 4; and then indeed the *Red*

M m m m

and

and *Blue* will be equally raised as at T. This must have been Signior *Rizzetti's* Mistake, when (in *Page 38.*) he says that one Colour was raised higher than the other by two Lines, at ten Foot Distance, but not at all at five Foot ; for several of the Persons present at my Experiments, made the same Mistake at first before they could perform the Experiment in manner above-mentioned ; which they at last did, and found the Colours separated most at the greatest, and least at the least Distance. This mistaking a Reflection for a Refraction, has been the Occasion of several more Errors, and Difficulties to be met with in Signior *Rizzetti's* Book.

EXPERIMENT III. FIG. VI.

A Candle K, reflected from the Surface A B of the Prism A B C, appeared very faintly to the Eye at E, as a weak Image at k ; because the Rays incident at I, pass most of them through the Prism, and go on to R, separating from one another according to their different Degrees of Refrangibility ; whilst a few of them are reflected to the Eye in the Direction I E.

But if the Prism be in the Position A C B (*Fig. 7.*) most of the Rays of the Candle K, incident at I, on the Plane A B (after having passed perpendicularly through the Plane B C) are reflected, and passing perpendicularly through A C, go into the Eye at E, which sees a very strong Image of the Candle at k, whilst very few Rays go down to R to produce Colours.

This shews that the Rays of Light pass with more Facility through Glass (a dense) than through the Air (a rare) Medium ; contrary to *Rizzetti's* Assertion.

E X P E R I M E N T I V . F I G . V I I I .

To make this more evident, and compare together the Facilities with which Light passes through the two Mediums, I took a Cube of Glass of three Inches the Side, $A a b B d D C$, whose Section is $A B C D$, and looking upon it from E to see by Reflection the Candle K , I saw two Images of it; one at k very faint, and reflected from the upper Surface $A B$, and the other at x very strong, and reflected from the lower Surface $C D$. Now it is evident, that the Vividness (or Brightness) of the Image x , is to the Vividness of the Image k ; as the Facility with which the Rays, in these Circumstances pass through the Glass, or through the Air: and those are easily compared, because both the Images are seen at once.

E X P E R I M E N T V . F I G . I X .

The Line $P I$ being perpendicular to the reflecting Plane $A B$ of the Triangle $A C B$, I brought the Candle K by Degrees so near to P , as to diminish very much the Angle of Incidence $K I P$, which made the Image or Appearance of the Candle at k , become fainter by Degrees, and at last as faint as in *Fig. 6*.

E X P E R I M E N T V I . F I G . X .

Having made the Experiment as at *Fig. 7*, I pressed another Prism $D F G$, close to the Prism $A B C$, and when I squeezed them together but gently, some of the

M m m m 2

the

the Rays from the Candle R, passed through the lower Prism, and falling upon a Paper at R, made a reddish Spot ; but when I squeezed them very hard, the Spot became much wider, white in the Middle, and only tinged with Red about the Edges : At the same Time the Eye saw a black Spot in the Image of the Candle at *k* ; and a Stander-by looking obliquely at the Place I (where the Glasses touched) saw, as it were, a little Hole through the Prisms as big as the Spot *k*. But if the Prisms be pressed together but gently, then all the other Phænomena disappear, except the first little Spot at R, as in Fig. 11.

When the Candle is seen by Reflection from the lower Surface of a Prism, as in the 7th, 9th and 10th Figures, the Rays pass quite through that Surface, and are turned up again by the Attraction of it in Curve Lines so as to re-enter the Prism, and then (going out again through the Surface A C) go up to the Eye at E. In this Case the most refrangible Rays, being the most easily inflected, make the least Curves, whose Vertices are nearer the Glass than those of the greater Curves made by the least refrangible Rays. This is proved by Experiment 6, where the under Prism only attracts down from the Reflection of the upper Prism, the Red making Rays as in *Fig. 11.* where the Plate of Air between the Prisms is of some small Thickness. But when the Prisms, whose Surfaces are a little convex, are pressed hard together, the lower Prism is near enough to attract Rays of a great Degree of Refrangibility ; and therefore the Spot then becomes white in the Middle ; and only red about the Edges, which are produced by such Parts of the lower Prism as are not so near the upper Prism.

There

There are two Circumstances in the 6th Experiment, which disprove *Rizzetti's* Assertion (Page 125) *viz.* That there is a sensible Reflection even where Glasses touch; for when the Prisms touch at I *Fig. 10*, the black Spot appearing in the Image of the Candle *k* shews that there is at I a Deficiency of those Rays, which, coming from the Middle of the Candle, used to be reflected up to the Eye at E, and therefore that A B the reflecting Surface of the upper Prism ceases to reflect in a little Space round about I where the upper Surface D F of the under Prism touches it; the Rays, which before were reflected, now going down to make the Spot at R. The other Circumstance is this; that whereas a Paper at *k* is invisible to an Eye at E by the Interposition of the Prism D F G; when another Prism A C B is laid over it and pressed hard, there appears to be an Hole of about $\frac{1}{2}$ of an Inch (more or less in Diameter as the prismatical Surfaces are more or less flat) thro' which the Paper at *k* becomes visible; this being the Place of Contact where the Reflection downwards (of the Surface D F) ceases.

This happens because those Rays, which (coming from the Candle K) were bent in Curves under the Surface A B of the upper Prism about several Points near I, are by the Nearness of the Surface D F of the lower Prism brought down to R, instead of being turned up again to the Eye at E; whilst those Rays, which (coming from the Paper at *k* thro' the Surface G F of the lower Prism, and passing thro' the upper Surface of it F D) were bent in Curves about several Points near I, are prevented from turning down again to R, and are brought

brought up to the Eye at E, which consequently must see a round Part of the Paper at *k*, just as big as the Place of Contact, which appears like an Hole ; or as if the two Prisms being changed to a Parallelopiped, were covered with a dark Paper that had only a small Hole in it.

But to make this more evident, especially to such as are not well acquainted with Sir *Isaac Newton's* Opticks, I beg Leave to explain the Manner of the bending of the Rays where they are refracted or reflected.

Of the Bending of the Rays in their Refraction.

Let DD (Fig 12) represent a dense Medium (as Glass) whose Surface is GG, and AA a rare Medium (as Air). Now let us suppose a Power to extend all over the Surface GG, acting from AA towards DD in Lines perpendicular to the Surface GG, very strong in Contact, but insensible at a very small Distance from the said Surface, which we will call the *Attraction of the Surface GG*, without considering whether it be any real Virtue in the said Surface, or the Action of a Medium impelling towards it. Let Lines 11, 22, 33, such as express the Lines in which the Attraction exerts it self, and the Line MM (extremely near to GG) the Limits of the Attraction, beyond which it cannot affect a Ray of Light. Let the Ray of Light R*a* moving from a rare Medium into a Dense in the Direction R*r*, come towards the Surface GG in such an Angle that it may be refracted. When the Ray comes to *a*, by the Attraction at *a* it will be acted upon
in

in the Line ab , and (by the known Laws of Mechanics) be turned out of the Way into the Direction aa , instead of ar : When it is got to b , being acted upon in the Direction $b4$, its new Direction will become bb : At c , by the Power acting in the Line $c5$, it will change its Direction to cc ; and lastly, at d it will go into the Glass in the Line dd , continuing in that straight Line whilst it moves in that Medium.

Now if the Lines $11, 22, 33, n, c, b, a$, be infinitely near (as they must be supposed to be) the Ray, instead of being broken into the several straight Lines ab, bc , and cd , will be bent into the Curve $abcd$; and the emergent Ray dd will make the same Angle with the Incident Ray Rr as if the Refraction had been made at once at the Point n , which Point may be considered as in the Surface GG , because MM has been supposed extremely near that Surface: Then also may Refractions be considered in gross, and Rays trac'd, in all Optical Propositions, as if there were no such Curve as what we have been describing.

Again, let D (*Fig. 13*) represent the dense Medium or Glass, and A the rare Medium or Air; Ra a Ray of Light coming out of the dense Medium into the Rare, in the Direction Rr , in which it may be refracted (as for Example, in an Angle of 30 Degrees with the Perpendicular Pa). Let MM be the Line which limits the Attraction of the Surface GG , which Attraction is exerted in Lines tending perpendicularly from MM to GG . As soon as the Ray of Light has emerged at a , it is attracted in the Direction aP , and therefore diverted from the Line ar , into the new Direction aa ; at b , it is turned into the Line bb ; at c , into the Line cc ; and at d , in-

d , into the Line $d d$; so that the emergent Ray will be $d d$, as if the Refraction had been performed in the Point n , and that Point was in the Surface $G G$, without any Curve at $a b c d$; and all the rest as we considered it before, with this Difference only, *viz.* That the Ray is bent just as it comes out (or rather when it is come out) of the dense Medium; whereas before we considered its Bending before it came into it.

Of the Bending of Rays in Reflection.

But if the Ray $R a$ (*Fig. 14*) coming out of Glass into Air, should come in such a Direction as to be wholly reflected, as it will do when the Angle $R a P$ is of 45 Degrees; I say the Reflection will not be made at the Surface $G G$, nor above it in the Glass; but under the said Surface, in the Air, or even in a Vacuum, or any Medium less dense, or rather less refractive than Glass.

MM represents the Limits of the Attraction of the Glass exerted in a Direction from MM to $G G$ perpendicularly, as we said before.

The Ray $R a$, moving in the Direction $R r$, at its Emerision at a , is, for the Reasons before given, turned into the Direction $a a$; then at b , into the Direction $b b$; at c , into the Direction $c c$; at d , into the Direction $d d$; at e , into the Direction $e e$; and at f , into the Direction $f f$ parallel to $G G$; then at g , the Ray is again turned towards the Glass, by whose Attraction changing successively into all the Directions $g g$, $i i$, $k k$, and ll ; at last it re-enters the Glass in the Direction $m m$ making
the

the same Angle with the Perpendicular $m p$ that $R a$ made with $a P$. Now as the Lines perpendicular to $G G$ drawn from $M M$ are infinitely near, the Line $a b c d e f g h i k l m$ must be a Curve; and as $M M$ and $G G$ are extremely near, the Vertex of the Curve (whose Tangent is $f f$ parallel to $G G$) will be so near the Point I , as to be considered as co-inciding with it, when we compare the Angle of Incidence with that of Reflection; then also will the Space between the Parallels $p m$ and $P a$ be so far diminished, that those two Lines may be looked upon as co-inciding, the Angles $m m p$ and $R a P$ being equal, whether the three Points m, I, a , co-incide or not.

For these Reasons, for common Use, one may consider the Reflection from the under Surface of the Glass as made at once in that Surface at the Point I . But when we examine Things strictly, Experiments as well as the above Reasoning, will shew, that there is such a Curve as we have mentioned. See Experiment VI. *Fig.* 10 and 11; and we shall mention others.

N. B. If any Point of the Curve $a b c$, &c. between a and f , fall below (or beyond the Line $M M$, the Ray will then go on in a straight Line Tangent to the Curve in that Point where it leaves the Line $M M$.

Now let us suppose $M e d c b a r M$ (in the same *Fig.*) to be Glass, or any other dense Medium, and $m p P R$ Air, or any other rare Medium, and $R a a$ Ray of Light moving in the rare Medium towards the dense Medium in the Direction $R a$ towards r ; if instead of an Attraction at the Surface of the Glass

$N n n n$

$M M,$

MM, there be supposed a repellent Force, whose Limits are GG; then will the Ray by the Repulsion of the Surface MM be bent into the Curve *abcd efgh iklm* in the same Manner as we shewed it would be under the Surface GG, when GpPG was considered as a dense Medium. Hence it follows that a Ray moving in the Air, is reflected from a specular Surface of Glass, or any other Mirrour, opake or diaphanous, without touching the said Surface.

N. B. *That the same Power may, under different Circumstances, attract to and repel from the same Surface, shall be made out in the remaining Part of this Paper; but now taking such a Power for granted, we will proceed in considering the Flexure of Rays of Light.*

Let us suppose a Prism ACB (*Fig. 15*) to have the attracting Power of its inferior Surface extend as far as the Line *mm*; if another Prism GDF (the attracting Force of whose upper Surface extends as far as *nn*) be brought very near to the first Prism; where the attracting Powers of the Prisms interfere, they will destroy one another, because they act in contrary Directions; and thereby the Limits of Attraction of each of the Surfaces will be contracted; the Power of AB extending no farther than *nn*, and that of DF no farther than *mm*, whilst the Space *nnmm* loses all the Force that it had (and would have upon the Removal of either Prism) to turn a Ray of Light, moving obliquely, out of its Direction.

Now in this Situation of the Prisms, a Ray of Light entering the Surface CB at right Angles, will go through the second Prism also at Right Angles
(not

(not exactly in the same Line, but) in a Line parallel to the Direction of the incident Ray: For Example, let the Ray $R a$ (not refracted at, because perpendicular to, the Surface CB) emerge from the first Prism at a , in the Direction $a r$; its changed Direction at a will become $a a$, and at b , $b b$, or rather the Ray will be inflexed in the Curve ab ; and at b getting out of the Power of the Attraction of the Surface AB , it will (for the Reasons before given) move in a straight Line from b to c , where it will be bent again the contrary Way in the Curve cd of the same kind as ab , and lastly emerge in the Direction $d d$ parallel to the first Direction $R r$. From hence it follows, that when the Prisms are brought so near as to touch, their mutual Attractions destroying each other, the Rays of Light will not be bent, but pass through the two Prisms (which in this Case perform the Office of a Parallelopiped) in the same Direction with which they came into the first Prism, and consequently produce no Colours; contrary to what is affirmed by *Rizzetti* (Page 78, 79, &c.) and when the Rays $R a$ fall obliquely upon the Surface CB , the Effect of their Refraction at their Immersion at S to produce Colours, is taken off by the Refraction which they suffer at their Emerision at z .

EXPERIMENT VII.

I took the Cube of *Fig. 8*, and looking obliquely through it at the Hole of the Window of my dark Chamber (the Sun shining or not shining) the Hole appeared entirely colourless, as did also a Candle,

both appearing fringed with Colours when seen through the Prism. Then holding two Prisms together, as in *Fig. 10*, if the Hole of the dark Chamber be at *k*, it appears white to the Eye at *E*; but if the Angles of the Prisms at *B F* be a little separated, whilst the Points *A D* touch, the Hole will appear coloured: When the Surfaces are separated at *A D*, and touch at *B F*, the Colours appear in an inverted Order; but if the Surfaces *A D* and *B F* are parallel, whether they touch or not, the Hole will appear white.

N. B. In this Case the Prisms must be similar, that the Surface F G may be parallel to A C; otherwise A B and D F must be so inclined to one another as to render A C and F G parallel. Indeed if one of the Prisms be very far removed from the other, the heterogeneous Light which entered in at F G, may be so far spread by the Separation of the differently refrangible Rays, that the Prism A B C will not take it all in; then the Eye behind the second Prism may see Colours, as I suppose Rizzeti did. See Page 79 of his Book.

If the Ray of Light *R a b c d d* (*Fig. 15.*) changing its Direction in the Manner above-mentioned, makes an Angle of about 45 Degrees with the Perpendicular *P a*; upon the removal of the lower Prism, the Ray will be turned up again, as in *Fig. 14*. But if the Angle *P a R* be greater, the Ray will still be turned up again in a Curve, as *a b c d e f*, (*Fig. 16*) notwithstanding the lower Prism is at *D F G*; but if that Prism be brought up closer to the Surface *A B*, the Curves will be destroyed where the Prisms touch, and all the Rays in the Place of Contact brought down through the lower Prism.

THE

THE most refrangible Rays consist of smaller Particles than the least refrangible Rays, and therefore must have least *Momentum*, the Velocity of all the Rays being the same; and consequently are more easily turned out of the Way by Attraction or Repulsion, which makes the Curves made by the purple and violet Rays under the Surface A B, to be less and nearer the said Surface than the Curves made by red and orange Rays.

Suppose a Violet R *a* moving in the Direction R *r* (*Fig. 16.*) to be so bent under the Surface A B, that at the Vertex of the Curve, or where its Tangent *c c* is parallel to A B, there still remains a small Space between the Curve and the Line *n n*, where the Limits of Attraction (contracted by the Proximity of the undermost Prism D F G end) that Ray will be turned up again in the Curve *d e f*, and so reflected in the Line *f f*, the Directions having been successively changed, as in *Fig. 14.* But a red Ray with the same Inclination, would pass on into the lower Prism, as was explained in *Fig. 15.* Because the Momentum of the red Ray being greater than that of the Violet, the same Degree of Attraction could not give it the same Flexure.

This is confirmed by Experiment, for when the lower Prism is not pressed hard against the upper (as in *Fig. 11.*) the Rays brought down to R make a Spot of a Colour made up chiefly of red and orange Rays; but when the Prisms are pressed closer, the Spot grows bigger and perfectly white in its Middle, because all Sorts of Rays are brought down to the Spot; but it is inclosed round with a reddish Border, occasioned by the Parts of the Prism which are very
near,

near, but not in Contact, or at least not near enough to bring down the green, blue, purple and violet Rays. This shews that the Reflection is not made from the interior solid Parts of the Glass, nor from the Parts in the Surface, as *Rizzetti* affirms. But this is made more evident by

EXPERIMENT VIII. *Fig. 17.*

A Candle being in the Position K, the Eye at E, and the Prism at ABC; a strong Image of the Candle was seen at k as in *Fig. 7*. But lifting up a Vessel of Water VSSV till the Surface of the Water VV touched AB the lower Surface of the Prism, the Image of the Candle became almost insensible, as the Eye lost all those Rays which now were attracted into the Water. And for a farther Proof, that the Reflection is made under the Surface and not in it, when the Prism was taken out of the Water, being wet at its lower Surface, or having a *Stratum* of Water (whose Surface was VV *Fig. 18*) under AB, the Image of the Candle did again become vivid, the Rays being turned up again under VV. Indeed the Image, in this Case, though strong, did not appear well defined, by Reason of the Unevenness of the watry Surface VV *Fig. 18*.

I am very well aware that *Rizzetti* may answer here, that what I have said above, does in some Measure favour his Notions; and that the Rays which (in *Fig. 7*, having passed through AB, the lower Surface of the Prism) are turned up again to the Eye at E, do not suffer a Reflection but a new Immersion; for he says, in *Page 125*. — “ Anglus (meaning Sir
“ *Isaac*

“ *Isaac Newton*) secundo subjungit, quod si lumen
 “ in transitu è vitro in aerem obliquius incidat,
 “ quam in angulo graduum 40, illud in totum re-
 “ flectitur. Ego verò respondeo, quod ex iis, quæ
 “ docui in Prop. 4. Cap. 1. elicitur hanc non esse
 “ veram luminis reflectionem, sed potius novam Im-
 “ mersionem ; & ideo nego quod ex isto Phænome-
 “ no sequatur lumen a partibus corporum solidis,
 “ aliquo interjecto intervallo, reflecti.” And a little
 lower, having quoted what Sir *Isaac Newton* says,
 concerning the blue Light, which, coming from one
 Prism obliquely upon the farther Surface of another,
 is wholly reflected, at the same Inclination that the
 red Light is wholly transmitted. — He says, “ Satis
 “ sit iterum respondere, quod in hoc etiam casu est
 “ nova luminis immersio, quæ dicitur ab auctore
 “ reflectio.

But this is only cavilling about Words ; for if the
 Ray of Light, which moving in a dense Medium
 falls obliquely on the Surface common to that and a
 rarer Medium, be turned back again in the dense
 Medium, so as to make the Angle in which it returns
 from the said Surface equal to that in which it came
 to it ; this Return of the Ray may properly be call-
 ed a *Reflection*, whether the Ray be turned back at
 the Point of the Incidence in the Surface, or be car-
 ried about the Point of Incidence in a small Curve,
 whose Consideration may be omitted in tracing the
 Way of a Ray of Light in its Passage, for making of
 optical Machines. Whoever reads the 8th Prop. of
 the 2d Part, Book II. of Sir *Isaac's* Opticks, may very
 easily find that he was not ignorant of the turning
 back of the Ray under the Surface of the Glass be-
 fore

fore it returned into it: And though the Reflection in that Case be not made by impinging on the solid Parts of the Glafs, yet it is owing to them that the Light (acted upon at a Distance) is turned up again, as has been shewn by several of the Experiments abovementioned.

Now let us see how *Rizzetti's* Account of the new Immersion agrees with *Phænomena*.

Let all above the Line P p (*Fig. 19*) be a dense Medium, as Glafs; and all below it a rare Medium, as Air; ABCD is a Beam of Light insensible in Thickness, but of some Breadth, whose Rays cohere to one another, and whose Section or first Line is BC. If the Medium in which BC is, did not change, BC would move parallel to it self in the Lines B*a* and C*d*; but as the End C of the Line BC comes out into a rare Medium, which being of less Resistance to Light (for so he supposes) the Point C moving with more Facility than the Point B describes the Curve CFH, whilst B moving in the dense Medium with more Difficulty, describes the lesser Curve BEG; then the Point C being got to H is re-immersed, and the Line BC being got to HG goes on in the Direction HK GL parallel to itself, drawing the Beam after it in a rectilinear Direction, after Part of it has been bent within the Glafs and Part of it without.

Now if this be true, and P p π be a Prism, I beg to know what becomes of the Line at EF which unites the Rays of the Beam about the Point of Incidence I, when Water is brought to touch the Surface P p, as at AB *Fig. 17*? If it be said that Water making a great Resistance, though not so great as Glafs, the Curve BEG deviates so little from the Line B*a* that the

the Point E comes below I, and the Beam is wholly refracted; I ask whence comes the faint Image at k? If it be answered, that some Part EI of the Line EF (*Fig. 19*) is turned up to the Eye at E (*Fig. 17*;) what becomes of the lateral Cohesion of Light on which *Rizzetti* finds his chief Proposition, and from which he draws his Consequences?

It would be tedious as well as usefess to be particular in shewing all *Rizzetti's* Mistakes; therefore I shall only mention one more Experiment from Sir *Isaac Newton*, which I repeated on Account of what is said in *Rizzetti's* Preface, Page 16, viz. that if (according to Sir *Isaac*) Rays were differently reflexible, Colours must be produced by Reflection from a plane Surface; but this, says our Author, is contrary to Experience. Now this his Assertion is disproved by

EXPERIMENT IX.

As this Experiment was made exactly in Sir *Isaac Newton's* Manner, and with the same Success, I repeat the Account of it in his own Words.

“ Let HFG [in Figure 20] represent a Prism in
 “ the open Air, and S the Eye of the Spectator, view-
 “ ing the Clouds by their Light coming into the Prism
 “ at the plane Side FIGK, and reflected in it by its
 “ Base HEIG, and thence going out through its plane
 “ Side HEFK to the Eye : And when the Prism and
 “ Eye are conveniently placed, so that the Angles of
 “ Incidence and Reflection at the Base may be of about
 “ 40 Degrees, the Spectator will see a Bow MN, of a
 “ blue Colour, running from one End of the Base to
 “ the other, with the concave Side towards him, and
 O o o o “ the

“ the Part of the Base I M N G beyond this Bow will
 “ be brighter than the other Part E M N H on the o-
 “ ther Side of it. Now for understanding the Reason
 “ of it, suppose the Plane A B C to cut the plane Sides
 “ and the Base of the Prism perpendicularly. From
 “ the Eye to the Line B C wherein that Plane cuts the
 “ Base, draw the Lines S p and S t in the Angles S p C
 “ 50 Degrees $\frac{1}{4}$ and S t C 49 Degrees $\frac{1}{2}$, and the
 “ Point p will be the Limit beyond which none of
 “ the most refrangible Rays can pass through the
 “ Base of the Prism, and be refracted, whose Inci-
 “ dence is such that they may be reflected to the
 “ Eye; and the Point t will be the like Limit for
 “ the least refrangible Rays, that is, beyond which
 “ none of them can pass through the Base, whose In-
 “ cidence is such, that by Reflection they may come
 “ to the Eye. And the Point r taken in the middle
 “ Way between p and t , will be the like Limit for
 “ the meanly refrangible Rays. And therefore all
 “ the least refrangible Rays which fall upon the Base
 “ beyond t , that is, between t and B, and can come
 “ from thence to the Eye will be reflected thither :
 “ But on this Side t , that is, between t and C, many
 “ of these Rays will be transmitted through the Base :
 “ And all the most refrangible Rays which fall upon
 “ the Base beyond p , that is, between p and B and can
 “ by Reflection come from thence to the Eye, will be
 “ reflected thither, but every where between p and t ,
 “ many of these Rays will get thro’ the Base and be
 “ refracted; and the same is to be understood of the
 “ meanly refrangible Rays on either Side of the Point
 “ r . Whence it follows, that the Base of the Prism
 “ must every where between t and B by a total Re-
 “ flection

“ flection of all Sorts of Rays to the Eye, look
 “ white and bright. And every where between p
 “ and C, by reason of the Transmission of many
 “ Rays of either Sort, look more pale, obscure and
 “ dark. But at r , and in other Places between p
 “ and t , where all the more refrangible Rays are re-
 “ flected to the Eye, and many of the less refrangi-
 “ gible are transmitted, the Excess of the most re-
 “ frangible in the reflected Light will tinge that Light
 “ with their Colour, which is violet and blue, this
 “ happens by taking the Line $C p r t B$ any where
 “ between the Ends of the Prism $H G$ and $E I$.

If this needs any farther Explanation, let us sup-
 pose $C A B$ the Section of the Prism in *Fig. 20.*
 transferred to *Fig. 21.* at $A C B$. If $R o$ be a red
 Ray inclined to a Perpendicular to $A B$ in an Angle
 of more than 41 or 42 Degrees, it will at its Emer-
 sion under the Surface $A B$ be turned into the Curve
 $o n m i$, and so go up again to the Eye at E ; but a-
 nother red Ray coming in the Direction $r n$ making
 an Angle with the Perpendicular sufficiently less, will
 after its Emersion at n , be only bent so much as
 to be turned out of the Way, and refracted to q , in
 an Angle of Refraction agreeable to the Refrangibi-
 lity of red Light. But $V m$ a violet Ray with the
 same Inclination as the last red one $r n$ shall not be
 refracted, but turned up in the Curve $m i P$, and so
 go to the Eye at E . Another violet Ray $v m$ making
 an Angle something less with the Perpendicular, will
 pass through the Glass, and be refracted in the Line
 $m S$. Upon this Account all that Part of the Base
 of the Prism (of which $A B$ is the Section) between
 A and p will be dark or faint, all that Part between p

and n be tinged with a bluish Colour, and all between o and B of a bright White.

P O S T S C R I P T.

THE Bending of Rays of Light just as they come to be reflected or refracted, may be easily understood by such as are well acquainted with those Properties of Light, which Sir *Isaac Newton* calls their *Fits of easy Reflection*, and *Fits of easy Transmission*; without any Hypothesis, but by Consequences fairly drawn from Experiments and Observations. But as Signior *Rizzetti* does not seem (in his Book) to have the least Notion of those Properties of Light, and the nice Observations on which they are founded; and several other Persons have not Time to read those Parts of the Opticks with sufficient Application; to shew how the same Power of the Surface of a dense Medium may both attract and repel under different Circumstances — I content myself here with giving the Hypothesis, which Sir *Isaac* does before he comes to that Part of his Book where he demonstrates the Fits above-mentioned.

If GG be the Surface of a dense Medium GDDG, on which a Tremor is caused by the Warmth communicated to it by the Rays of Light, so as to give a Wave-like Motion to the Medium immediately next to the Surface GG; as that vibratory Motion is performed, the Medium alternately pushes from the Surface, and returns towards it (as is represented by the Position of the Darts in the

the

the Darts in Figure) and pushes back the Light so as to reflect it when the Vibration is contrary to its Direction, but brings it down to be refracted when the Vibration conspires with the said Motion. See a further Account of this in Sir Isaac Newton's *Opticks*, Book II. Part 3. Proposition 12.

The Persons present at the Experiments above-mentioned, tried them as well as myself, and being satisfied with the Success of them, allowed me to mention it, and make use of their Names in this Account.

Of the ROYAL SOCIETY.

Sir *Hans Sloane*, President.

Dr. *Scheutzer*.

Mr. *Grey*.

Mr. *Georges*.

Mr. *Dugood*.

Other GENTLEMEN.

Colonel *Spotswood*.

Mr. *Haily*.

Mr. *Graham*.

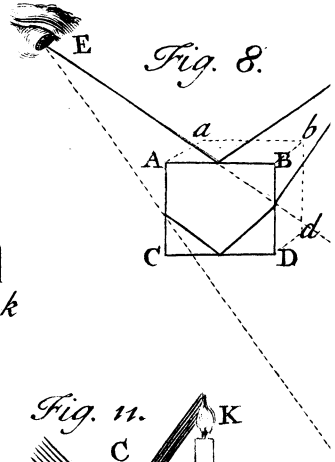
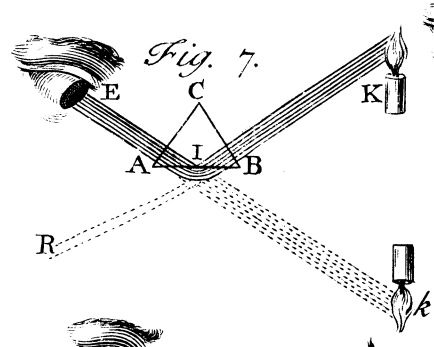
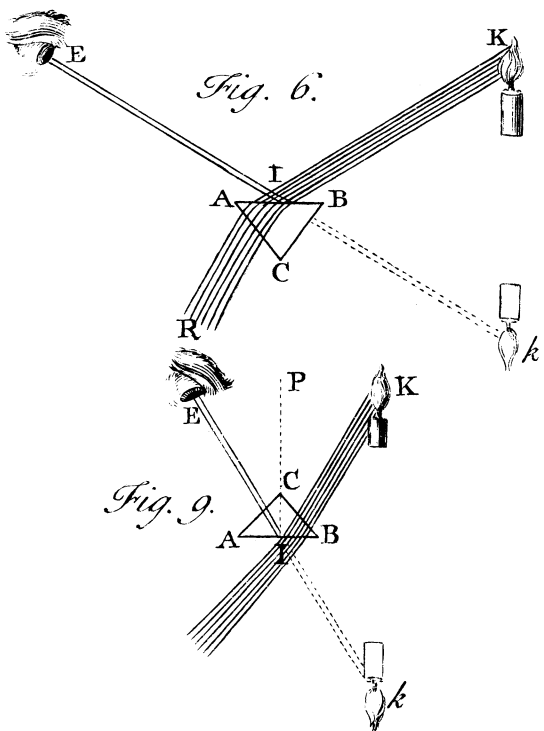
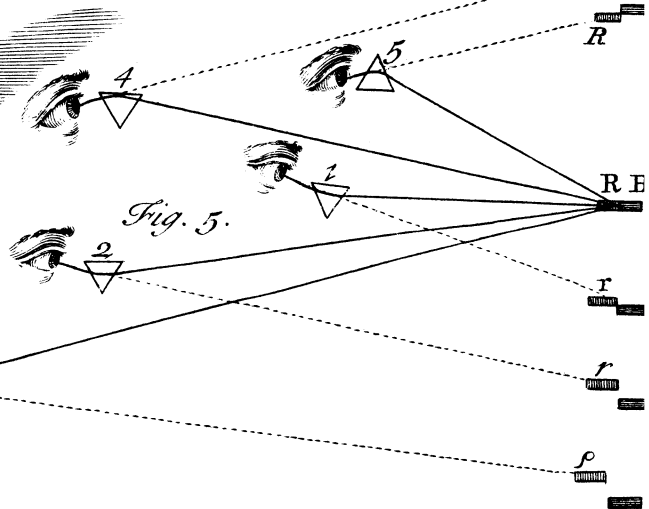
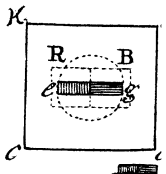
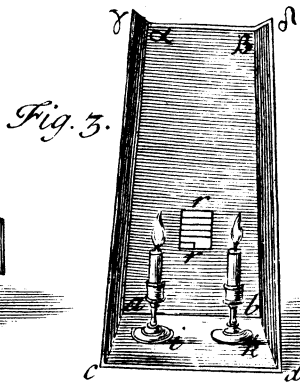
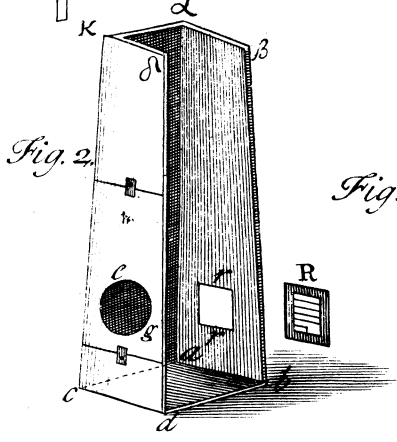
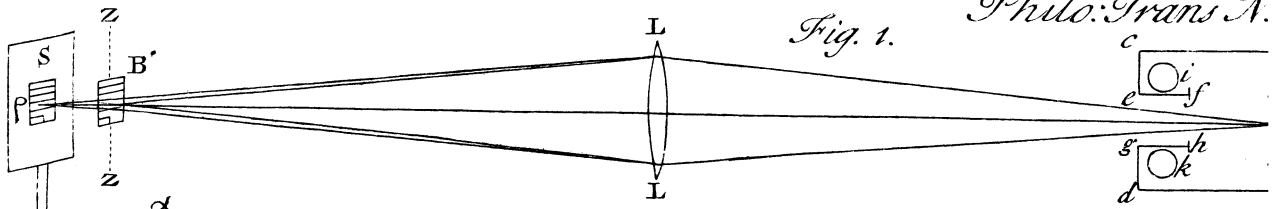
Mr. *Hewet*.

FOREIGNERS.

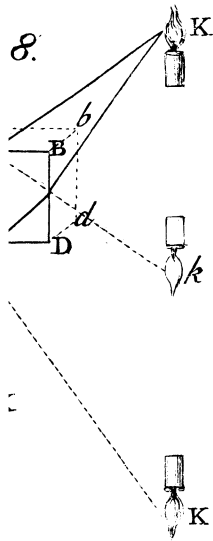
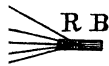
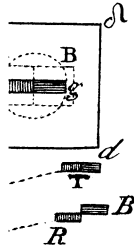
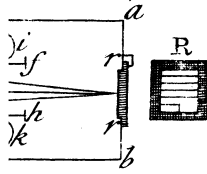
The Abbot *Lercari*, a Nobleman of *Genoa*, Cousin to Cardinal *Lercari*.

The Abbot *Cuzzoni*.

The Abbot *Rolli*, and his Brother.



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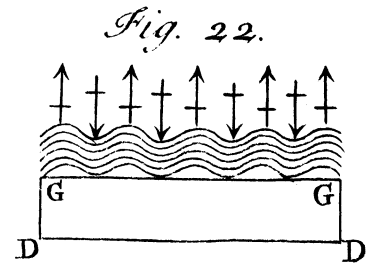
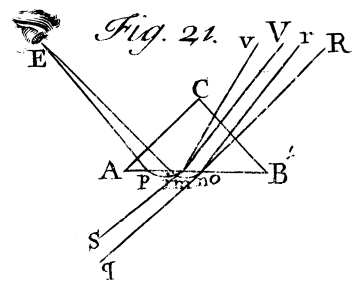
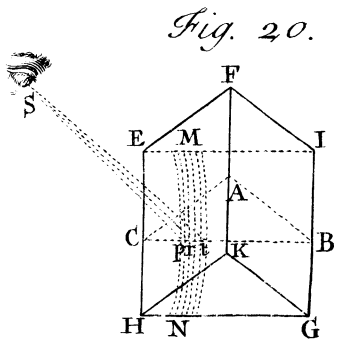
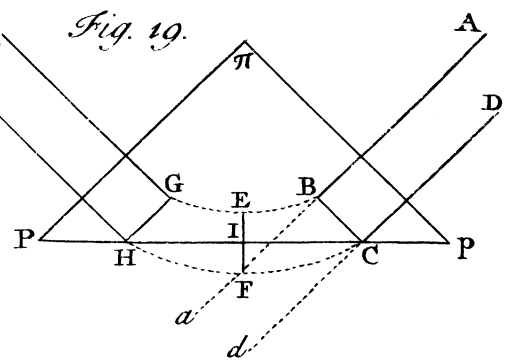
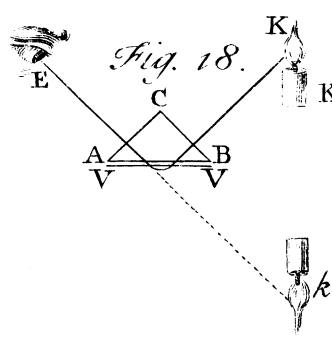
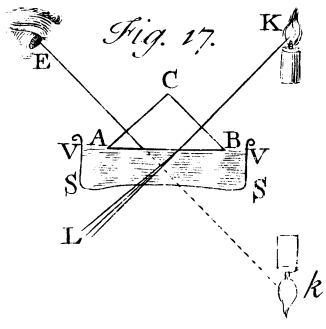
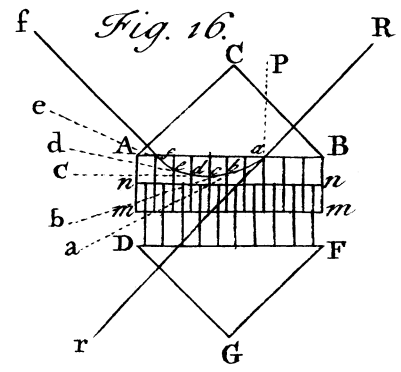
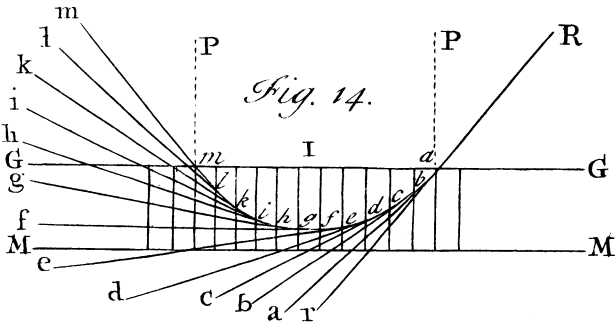
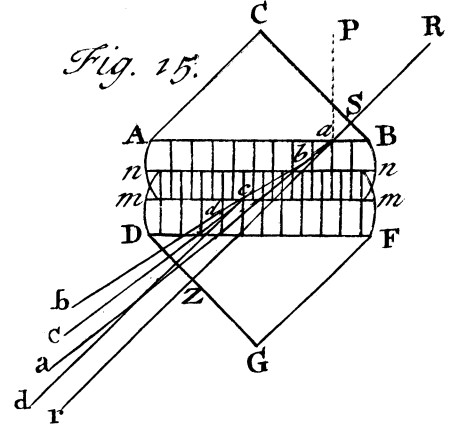
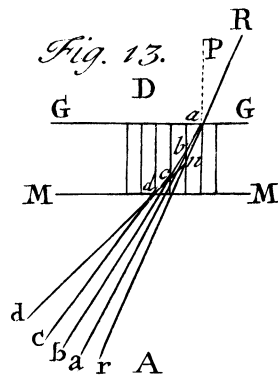
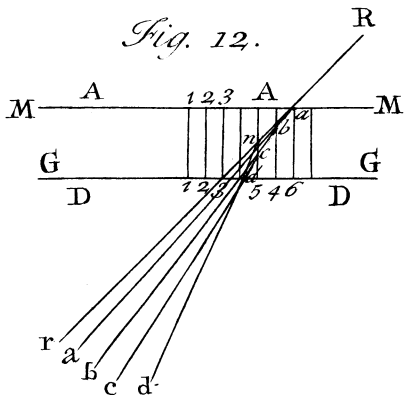


Fig. 1.

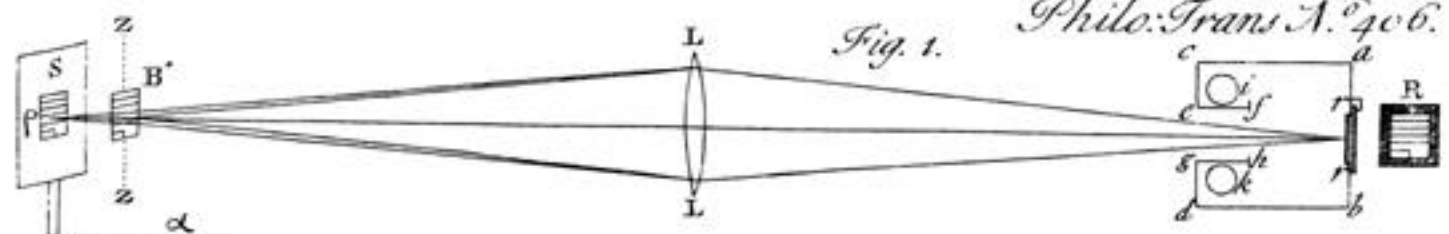


Fig. 2.

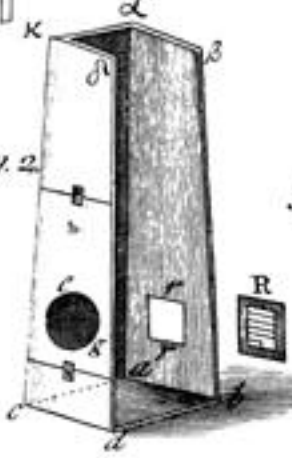


Fig. 3.

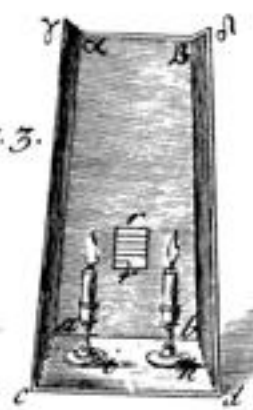


Fig. 4.



Fig. 5.

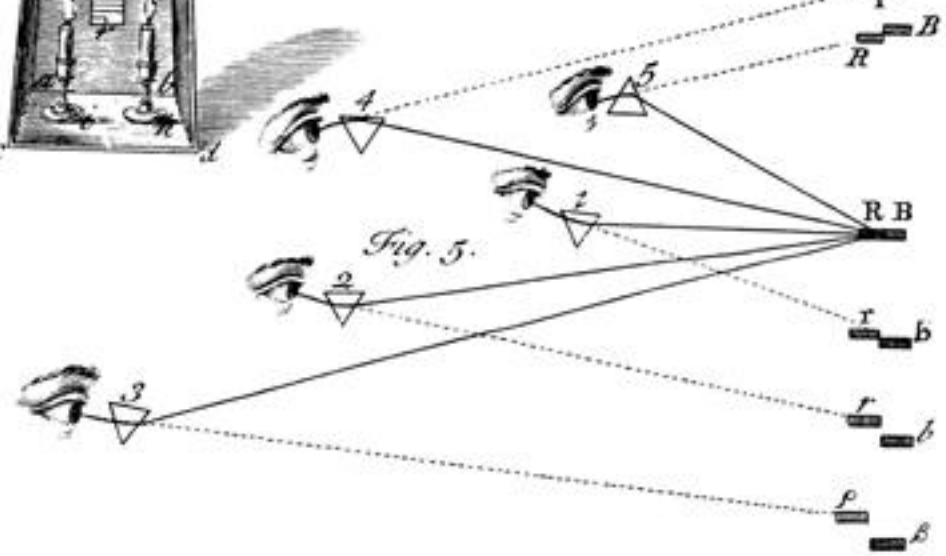


Fig. 6.

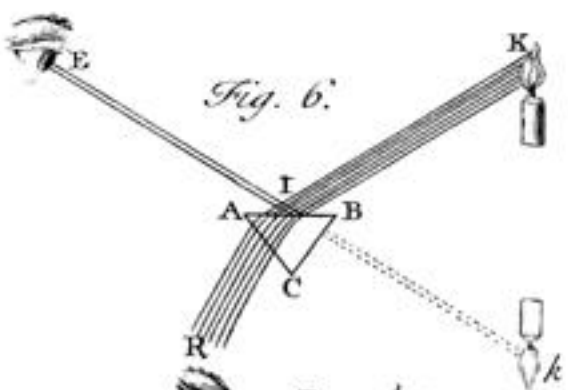


Fig. 7.

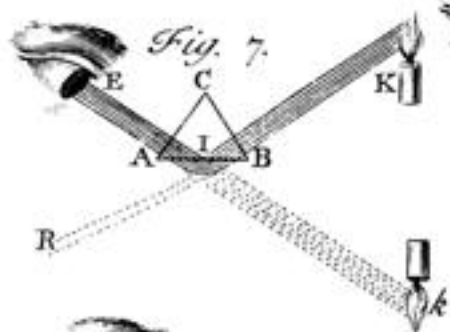


Fig. 8.

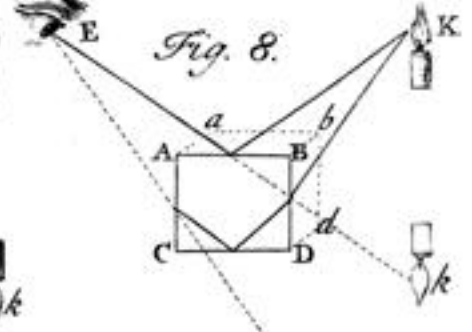


Fig. 9.

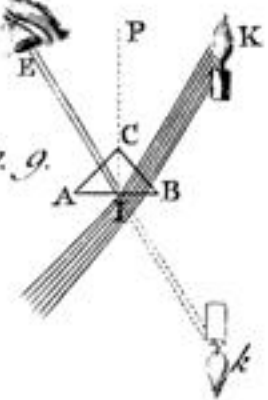


Fig. 10.

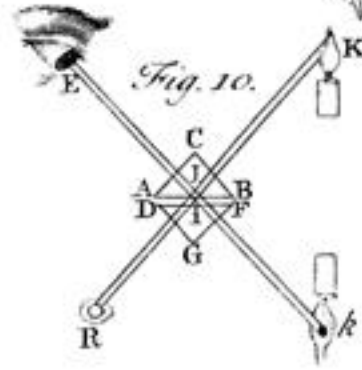


Fig. 11.

