

equally distant from all the Colours, so that it might be equally illuminated by them all it appeared white. And in this last situation of the Paper, if some Colours were intercepted, the Paper lost its white Colour, and appeared of the Colour of the rest of the Light which was not intercepted. So then the Paper was illuminated with Lights of various Colours, namely, red, yellow, green, blue and violet, and every part of the Light retained its proper Colour, until it was incident on the Paper, and became reflected thence to the Eye ; so that if it had been either alone (the rest of the Light being intercepted) or if it had abounded most and been predominant in the Light reflected from the Paper, it would have tinged the Paper with its own Colour ; and yet being mixed with the rest of the Colours in a due proportion, it made the Paper look white, and therefore by a composition with the rest produced that Colour. The several parts of the coloured Light reflected from the Spectrum, whilst they are propagated from thence thro' the Air, do perpetually retain their proper Colours, because wherever they fall upon the Eyes of any Spectator, they make the several parts of the Spectrum to appear under their proper Colours. They retain therefore their proper Colours when they fall upon the Paper V, and so by the confusion and perfect mixture of those Colours compound the whiteness of the Light reflected from thence.

## E X P E R. X.

Let that Spectrum or solar Image P T fall now upon *Fig. 6.*  
 the Lens M N above four Inches broad, and about six  
 N 2 Feet

Feet distant from the Prism ABC, and so figured that it may cause the coloured Light which divergeth from the Prism to converge and meet again at its Focus G, about six or eight Feet distant from the Lens, and there to fall perpendicularly upon a white Paper DE. And if you move this Paper to and fro, you will perceive that near the Lens, as at *de*, the whole solar Image (suppose at *pt*) will appear upon it intently coloured after the manner above-explained, and that by receding from the Lens those Colours will perpetually come towards one another, and by mixing more and more dilute one another continually, until at length the Paper come to the Focus G, where by a perfect mixture they will wholly vanish and be converted into whiteness, the whole Light appearing now upon the Paper like a little white Circle. And afterwards by receding further from the Lens, the rays which before converged will now cross one another in the Focus G, and diverge from thence, and thereby make the Colours to appear again, but yet in a contrary order; suppose at *de*, where the red *t* is now above which before was below, and the violet *p* is below which before was above.

Let us now stop the Paper at the Focus G where the Light appears totally white and circular, and let us consider its whiteness. I say, that this is composed of the converging Colours. For if any of those Colours be intercepted at the Lens, the whiteness will cease and degenerate into that Colour which ariseth from the composition of the other Colours which are not intercepted. And then if the intercepted Colours be let pass and fall upon that compound Colour, they mix with it, and by their mixture restore the whiteness.

So

So if the violet, blue and green be intercepted, the remaining yellow, orange and red will compound upon the Paper an orange, and then if the intercepted Colours be let pass they will fall upon this compounded orange, and together with it decompose a white. So also if the red and violet be intercepted, the remaining yellow, green and blue, will compound a green upon the Paper, and then the red and violet being let pass will fall upon this green, and together with it decompose a white. And that in this composition of white the several rays do not suffer any change in their colorific qualities by acting upon one another, but are only mixed, and by a mixture of their Colours produce white, may further appear by these Arguments.

If the Paper be placed beyond the Focus G, suppose at  $d^e$ , and then the red Colour at the Lens be alternately intercepted, and let pass again, the violet Colour on the Paper will not suffer any change thereby, as it ought to do if the several sorts of rays acted upon one another in the Focus G, where they cross. Neither will the red upon the Paper be changed by any alternate stopping, and letting pass the violet which crosseth it.

And if the Paper be placed at the Focus G, and the white round Image at G be viewed through the Prism HIK, and by the refraction of that Prism be translated to the place rv, and there appear tinged with various Colours, namely, the violet at v and red at r, and others between, and then the red Colour at the Lens be often stopt and let pass by turns, the red at r will accordingly disappear and return as often, but the violet at v will not thereby suffer any change. And so by stopping and letting pass alternately the blue at the  
Lens,

Lens, the blue at r will accordingly disappear and return, without any change made in the red at r. The red therefore depends on one sort of rays, and the blue on another sort, which in the Focus G where they are commixt do not act on one another. And there is the same reason of the other Colours.

I considered further, that when the most refrangible rays P p, and the least refrangible ones T t, are by converging inclined to one another, the Paper, if held very oblique to those rays in the Focus G, might reflect one sort of them more copiously than the other sort, and by that means the reflected Light would be tinged in that Focus with the Colour of the predominant rays, provided those rays severally retained their Colours or colorific qualities in the composition of white made by them in that Focus. But if they did not retain them in that white, but became all of them severally endued there with a disposition to strike the sense with the perception of white, then they could never lose their whiteness by such reflexions. I inclined therefore the Paper to the rays very obliquely, as in the second Experiment of this Book, that the most refrangible rays might be more copiously reflected than the rest, and the whiteness at length changed successively into blue, indico and violet. Then I inclined it the contrary way, that the most refrangible rays might be more copious in the reflected Light than the rest, and the whiteness turned successively to yellow, orange and red.

Lastly, I made an Instrument XY in fashion of a Comb, whose Teeth being in number sixteen were about an Inch and an half broad, and the intervals of the Teeth about two Inches wide. Then by interposing  
suc-

ſucceſſively the Teeth of this Inſtrument near the Lens, I intercepted part of the Colours by the interpoſed Tooth, whilſt the reſt of them went on through the interval of the Teeth to the Paper D E, and there painted a round ſolar Image. But the Paper I had firſt placed ſo, that the Image might appear white as often as the Comb was taken away; and then the Comb being as was ſaid interpoſed, that whitenefs by reaſon of the intercepted part of the Colours at the Lens did always change into the Colour compounded of thoſe Colours which were not intercepted, and that Colour was by the motion of the Comb perpetually varied ſo, that in the paſſing of every Tooth over the Lens all theſe Colours red, yellow, green, blue and purple, did always ſucceed one another. I cauſed therefore all the Teeth to paſs ſucceſſively over the Lens, and when the motion was ſlow, there appeared a perpetual ſucceſſion of the Colours upon the Paper: But if I ſo much accelerated the motion, that the Colours by reaſon of their quick ſucceſſion could not be diſtinguiſhed from one another, the appearance of the ſingle Colours ceaſed. There was no red, no yellow, no green, no blue, nor purple to be ſeen any longer, but from a confuſion of them all there aroſe one uniform white Colour. Of the Light which now by the mixture of all the Colours appeared white, there was no part really white. One part was red, another yellow, a third green, a fourth blue, a fifth purple, and every part retains its proper Colour till it ſtrike the Sensorium. If the impreſſions follow one another ſlowly, ſo that they may be ſeverally perceived, there is made a diſtinct ſentation of all the Colours one after another in a continual ſucceſſion.

But

But if the impressions follow one another so quickly that they cannot be severally perceived, there ariseth out of them all one common sensation, which is neither of this Colour alone nor of that alone, but hath it self indifferently to 'em all, and this is a sensation of whiteness. By the quickness of the successions the impressions of the severall Colours are confounded in the Sensorium, and out of that confusion ariseth a mixt sensation. If a burning Coal be nimbly moved round in a Circle with Gyration continually repeated, the whole Circle will appear like fire; the reason of which is, that the sensation of the Coal in the severall places of that Circle remains imprest on the Sensorium, until the Coal return again to the same place. And so in a quick consecution of the Colours the impression of every Colour remains in the Sensorium, until a revolution of all the Colours be compleated, and that first Colour return again. The impressions therefore of all the successive Colours are at once in the Sensorium, and joyntly stir up a sensation of them all; and so it is manifest by this Experiment, that the commixt impressions of all the Colours do stir up and beget a sensation of white, that is, that whiteness is compounded of all the Colours.

And if the Comb be now taken away, that all the Colours may at once pass from the Lens to the Paper, and be there intermixed, and together reflected thence to the Spectators Eyes; their impressions on the Sensorium being now more subtilly and perfectly commixed there, ought much more to stir up a sensation of whiteness.

You

You may instead of the Lens use two Prisms  $HIK$  and  $LMN$ , which by refracting the coloured Light the contrary way to that of the first refraction, may make the diverging rays converge and meet again in  $G$ , as you see it represented in the seventh Figure. For *Fig. 7.* where they meet and mix they will compose a white Light as when a Lens is used.

### EXPER. XI.

Let the Sun's coloured Image  $PT$  fall upon the Wall *Fig. 8.* of a dark Chamber, as in the third Experiment of the first Book, and let the same be viewed through a Prism  $abc$ , held parallel to the Prism  $ABC$ , by whose refraction that Image was made, and let it now appear lower than before, suppose in the place  $S$  over against the red colour  $T$ . And if you go near to the Image  $PT$ , the Spectrum  $S$  will appear oblong and coloured like the Image  $PT$ ; but if you recede from it, the Colours of the Spectrum  $S$  will be contracted more and more, and at length vanish, that Spectrum  $S$  becoming perfectly round and white; and if you recede yet further, the Colours will emerge again, but in a contrary order. Now that Spectrum  $S$  appears white in that case when the rays of several sorts which converge from the several parts of the Image  $PT$ , to the Prism  $abc$ , are so refracted unequally by it, that in their passage from the Prism to the Eye they may diverge from one and the same point of the Spectrum  $S$ , and so fall afterwards upon one and the same point in the bottom of the Eye, and there be mingled.

O

And

And further, if the Comb be here made use of, by whose Teeth the Colours at the Image P T may be successively intercepted ; the Spectrum S when the Comb is moved slowly will be perpetually tinged with successive Colours : But when by accelerating the motion of the Comb, the succession of the Colours is so quick that they cannot be severally seen, that Spectrum S, by a confused and mixt sensation of them all, will appear white.

## E X P E R. XII.

*Fig. 9.* The Sun shining through a large Prism ABC upon a Comb XY, placed immediately behind the Prism, his Light which passed through the interstices of the Teeth fell upon a white Paper DE. The breadths of the Teeth were equal to their interstices, and seven Teeth together with their interstices took up an Inch in breadth. Now when the Paper was about two or three Inches distant from the Comb, the Light which passed through its several interstices painted so many ranges of Colours kl, mn, op, qr, &c. which were parallel to one another and contiguous, and without any mixture of white. And these ranges of Colours, if the Comb was moved continually up and down with a reciprocal motion, ascended and descended in the Paper, and when the motion of the Comb was so quick, that the Colours could not be distinguished from one another, the whole Paper by their confusion and mixture in the Sensorium appeared white.

Let



Fig. 6.

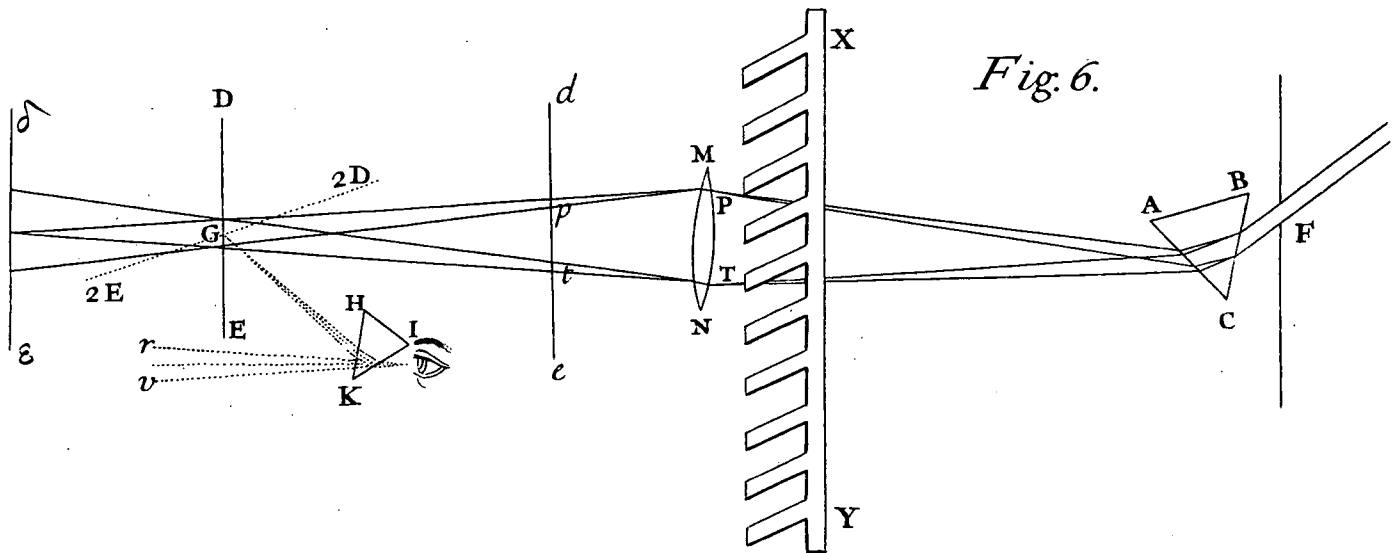


Fig. 7.

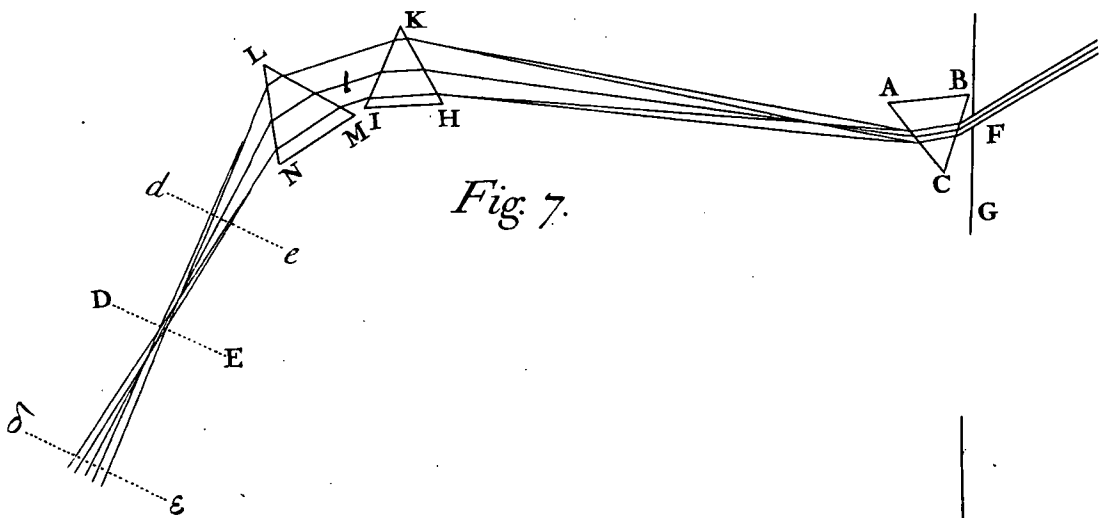


Fig. 8.

