ty in this matter, becauſe we can always diminiſh the aper­ture of the object-glaſs or ſpeculum till the circle of aberra­tion is as ſmall as we pleaſe. But by diminiſhing this aper­ture, we diminiſh the light in the duplicate ratio of the aperture. Whatever be the aperture, the brightneſs is diminiſhed by the magnifying power, which ſpreads the light over a greater ſurface in the bottom of the eye. The ap­parent brightneſs muſt be as the ſquare of the aperture of the teleſcope directly, and the ſquare of the amplification of the diameter of an object inverſely. Objects therefore will be ſeen equally bright if the apertures of the teleſcopes be as the focal diſtances of the object-glasſes directly, and the focal diſtances of the single eye-glaſs (or eye-glaſs equiva­lent to the eye-piece) inverſely. Therefore, to have tele­ſcopes equally diſtinct and equally bright, we muſt combine theſe proportions with the former. It is needleſs to go far­ther into this subject, becauſe the conſtruction of refracting teleſcopes has been ſo materially changed by the correction of the chromatic aberration, that there can hardly be given any proportion between the object-glaſs and eye-glaſſes. Every thing now depends on the degree in which we can correct the aberrations of the object-glaſs. We have been able ſo far to diminiſh the chromatic aberration, that we can give very great apertures without its becoming ſensible. But this is attended with ſo great an increaſe of the aberration of figure, that this laſt becomes a ſensible quality. A lens which has 30⁰ for its ſemi-aperture, has a circle of aberra­tion equal to its chromatic aberration. Fortunately we can derive from the very method of contrary refractions, which we employ for removing the chromatic aberration, a correc­tion of the other. We are indebted for this contrivance alſo to the illuſtrious Newton.

We call this Newton’s contrivance, becauſe he was the firſt who propoſed a conſtruction of an object-glaſs in which the aberration was corrected by the contrary aberrations of glaſs and water.

Huyghens had indeed ſuppoſed, that our all-wiſe Creator had employed in the eyes of animals many refractions in place of one, in order to make the viſion more diſtinct ; and the invidious detractors from Newton’s fame have catched at this vague conjecture as an indication of his knowledge of the poſſibility of deſtroying the aberration of figure by contrary refractions. But this is very ill-founded. Huyghens has acquired ſufficient reputation by his theory of aberrations. The ſcope of his writing in the paſſage allu­ded to, is to ſhow that, by dividing any intended refraction into parts, and producing a certain convergence to or di­vergence from the axis of an optical inſtrument by means of two or three lenſes inſtead of one, we diminiſh the aberrations four or nine times. This conjecture about the eye was therefore in the natural train of his thoughts. But he did not think of deſtroying the aberration altogether by oppoſite refractions. Newton, in 1669, ſays, that op­ticians need not trouble themſelves about giving figures to their glaſſes other than ſpherical. If this figure were all the obſtacle to the improvement of teleſcopes, he could ſhow them a conſtruction of an object-glaſs having spherical ſurfaces where the aberration is deſtroyed ; and accordingly gives the conſtruction of one composed of glaſs and water, in which this is done completely by means of contrary refrac­tions.

The general principle is this : When the radiant point R (fig. 5. B), or focus of incident rays, and its conjugate focus F of refracted central rays, are on oppoſite ſides of the refracting ſurface or lens V, the conjugate focus *f* of marginal rays is nearer to R than F is. But when the fo­cus of incident rays R lies on the ſame ſide with its conju­gate focus F' for central rays, R'f' is greater than R' F'.

Now fig. 5. C repreſents the contrivance for deſtroying the colour produced at F, the principal focus of the con­vex lens V, of crown glaſs, by means of the contrary refrac­tion of the concave lens *v* of flint glaſs. The incident pa­rallel rays are made to converge to F by the firſt lens. This convergence is diminiſhed, but not entirely deſtroyed, by the concave lens v, and the focus is formed in F. F and F' therefore are conjugate foci of the concave lens. If F be the focus of V for central rays, the marginal rays will be collected at ſome point *f* nearer to the lens. If F be now considered as the focus of light incident on the centre of *v,* and F be the conjugate focus, the marginal ray *p* F would be refracted to ſome point *f'* lying beyond F'. Therefore the marginal ray *pf* may be refracted to F', if the aberration of the concave be properly adjuſted to that of the convex.

This brings us to the most difficult part oſ our ſubject, the compounded aberrations of different ſurfaces. Our li­mits will not give us room for treating this in the ſame ele­mentary and perſpicuous manner that we employed for a single ſurface. We muſt try to do it in a compendious way, which will admit at once the different ſurfaces and the different refractive powers of different ſubſtances. This muſt naturally render the proceſs more complicated ; but we hope to treat the ſubject in a way eaſily comprehended by any perſon moderately acquainted with common algebra; and we truſt that our attempt will be favourably received by an indulgent public, as it is (as far as we know) the on­ly dissertation in our language on the conſtruction of achro­matic inſtruments. We cannot but expreſs our ſurpriſe at this indifference about an invention which has done ſo much honour to our country, and which now conſtitutes a very lucrative branch of its manufacture. Our artiſts infinitely ſurpaſs all the performances of foreigners in this branch, and supply the markets of Europe without any competition; yet it is from the writings on the continent that they de­rive their ſcientific inſtruction, and particularly from the dissertations of Clairaut, who has wonderfully ſimplified the analyſis of optical propoſitions. We ſhall freely borrow from him, and from the writings of Abbé Boſcovich, who has conſiderably improved the firſt views of Clairaut. We recommend the originals to the curious reader. Clairaut’s dissertations are to be found in the Memoirs of the Acade­my of Paris, 1756, &c. ; thoſe of Boſcovich in the Memoirs of the Academy of Bologna, and in his five volumes of *Opuscula,* publiſhed at Baſſano in 1785. To theſe may be added D’Alembert and Euler. The only thing in our lan­guage is the tranſlation of a very imperfect work by Schserfer.

*Lemma* 1. In the right-angled triangle MXS (fig. 6.), of which one side MX is very ſmall in compariſon of either of the others ; the exceſs of the hypothenuſe MS,

MX2 above the ſide XS, is very neary equal to MX2/2MS or to MX2/2XS. For if about the centre S, with the radius SM, we deſcribe the ſemicircle AMO, we have AX × XO = MX2. Now AX = MS — SX, and XO, is nearly equal to 2MS or 2XS ; on the other hand, MS is nearly equal to XS + MX2/2XS; and in like manner MG is nearly equal to MX2/2XG + XG, and MH is nearly equal to MX2/2XH + XH.

Prop. I. Let the ray *m* M, incident on the ſpherical ſur­face AM, converge to G ; that is, let G be the focus of