about 15 : For we ſaw formerly that EH is 1/4 of FG, and that FG is = r2/i2 × AP3/2AC2, and therefore EG = r2/i2 × AP3/8AC2. This being made = AP/55, gives us AP = √[8i2AC2/55r2,which is nearly AC/4, and correſponds to an aperture of 30⁰ diameter, if *r* be to *i* as 3 to 2.

Sir Isaac Newton was therefore well entitled to ſay, that it was quite needless to attempt figures which ſhould have leſs aberration than ſpherical ones, while the confuſion pro­duced by the chromatic diſperſion remained uncorrected. Since the indiſtinctneſs is as the ſquares of the diameters of the circles of aberration, the diſproportion is quite beyond our imagination, even when Newton has made ſuch a liberal allowance to the chromatic diſperſion. But it muſt be ac­knowledged, that he has not attended to the diſtribution of the light in the circle of ſpherical aberration, and has haſtily ſuppoſed it to be like the diſtribution of the coloured light, indefinitely rare in the margin, and denſer in the centre.

We are indebted to Father Boſcovich for the elegant de­termination of this diſtribution, which we have given in the article Optics. From this it appears, that the light in the margin of the circle of ſpherical aberration, inſtead oſ be­ing incomparably rarer than in the ſpaces between it and the centre, is incomparably denſer. The indiſtinctneſs therefore produced by the interſection of theſe luminous circumferences is vaſtly great, and increaſes the whole in­diſtinctneſs exceedingly. By a groſs calculation which we made, it appears to be increaſed at leaſt 500 times. The proportional indiſtinctneſs therefore, inſtead of being 19002 to I, is only 19002/500, or nearly 7220 to 1 ; a proportion ſtill ſufficiently great to warrant Newton’s preference of the re­flecting teleſcope oſ his invention. And we may now observe, that the reflecting teleſcope has even a great advan­tage over a refracting one of the ſame focal diſtance, with respect to its ſpherical aberration : For we have ſeen (Cor. 2.) that the lateral aberration is r2/i2 × AV3/2CV2. This for a plano-convex glaſs is nearly 9/4 × AV3/2CV2. And the diameter of the circle of aberration is one-fourth oſ this, or 9/16 × AV3/2CV2.

In like manner, the lateral aberration of a concave mirror is AV3/2CV2; and the diameter of the circle of diſperſion is AV3/8CV2; and therefore if the ſurfaces were portions of the ſame ſphere, the diameter of the circle of aberration of re­fracted rays would be to that of the circle of aberration of reflected rays as 9/16 to 1/4, or as 9 to 4. But when the re­fracting and reflecting surfaces, in the poſition here conſidered, have the ſame focal diſtance, the radius of the refrac­ting ſurface is four times that of the reflecting ſurface. The proportion of the diameters of the circles of ſpherical aber­ration is that of 9 × 42 to 4, or of 144 to 4, or 36 to 1. The diſtinctneſs therefore oſ the reflector is 36 × 36, or 1296 times greater than that of a plano-convex lens (pla­ced with the plane side next the diſtant object) of the ſame breadth and focal diſtance, and will therefore admit of a much greater magnifying power. This companion is in­deed made in circumſtances moſt favourable to the reflector, becauſe this is the very worſt poſition of a plano-convex lens. But we have not as yet learned the aberration in any other poſition. In another poſition the refraction and conſequent aberration of both ſurfaces are complicated.

Before we proceed to the consideration of this very diffi­cult ſubject, we may deduce from what has been already demonſtrated ſeveral general rules and maxims in the conſtruction of teleſcopes, which will explain (to ſuch readers as do not wiſh to enter more deeply into the ſubject), and juſtify the proportion which long practice of the beſt artists has ſanctioned.

Indiſtinctneſs proceeds from the commixture of the cir­cles of aberration on the retina of the eye : For any one s*ensible* point of the retina, being the centre of a circle of aberration, will at once be affected by the admixture of the rays of as many different pencils of light as there are ſenſible points in the area of that circle, and will convey to the mind a mixed ſenſation of as many viſible points of the ob­ject. This number will be as the area of the circle of aber­rations, whatever be the ſize of a ſensible point of the reti­na. Now in viſion with teleſcopes, the diameter of the circle of aberration on the retina is as the *apparent* magni­tude of the diameter of the correſponding circle in the fo­cus of the eye-glass; that is, as the angle ſubtended by this diameter at the centre of the eye-glaſs ; that is, as the dia­meter itſelf directly, and as the focal diſtance of the eye- glaſs inverſely. And the area of that circle on the retina is as the area of the circle in the focus of the eye-glass di­rectly, and as the ſquare of the focal diſtance of the eye- glaſs inverſely. And this is the meaſure of the apparent indiſtinctneſs.

*Cor.* In all sorts of teleſcopes, and alſo in compound microſcopes, an object is ſeen equally diſtinct when the focal diſtance of the eye-glasses are proportional to the diame­ters oſ the circles of aberration in the focus of the object- glaſs.

Here we do not conſider the trifling alteration which well conſtructed eye-glaſſes may add to the indiſtinctneſs of the firſt image.

In refracting teleſcopes, the apparent indiſtinctneſs is as the area of the object-glaſs directly, and as the ſquare of the focal diſtance of the eye-glaſs inverſely. For it has been ſhown, that the area of the circle of diſperſion is as the area of the object-glaſs, and that the ſpherical aberration is in­significant when compared with this.

Therefore, to make reflecting teleſcopes equally diſtinct, the diameter of the object-glaſs muſt be proportional to the focal diſtance of the eye-glaſs.

But in reflecting teleſcopes, the indiſtinctneſs is as the ſixth power of the aperture of the object-glaſs directly, and as the fourth power of the focal diſtance of the object-glass and ſquare of the focal diſtance of the eye-glaſs inverſely. This is evident from the dimenſions of the circle of aberration, which was found proportional to *AV3/CV2.*

Therefore, to have them equally diſtinct, the cubes of the apertures muſt be proportional to the ſquares of the fo­cal diſtance multiplied by the focal diſtance of the eye- glaſs.

By theſe rules, and a ſtandard teleſcope of approved goodneſs, an artiſt can always proportion the parts of any inſtrument he wiſhes to conſtruct. Mr Huyghens made one, of which the object-glaſs had 30 feet focal diſtance and three inches diameter. The eye-glaſs had 3,3 inches focal diſtance. And its performance was found ſuperior to any which he had ſeen ; nor did this appear owing to any chance goodneſs of the object-glaſs, becauſe he found others equally good which were conſtructed on ſimilar proportions. This has therefore been adopted as a ſtandard.

It does not at firſt appear how there can be any difficul-