violet rays, and DF : Df = Dρ : Du : 27 nearly, or in a given ratio.

The problem is therefore reduced to this, “ To draw from a point D in the line CG a line Dr, which ſhall be cut by the lines PR and PV in the given ratio.

The following conſtruction naturally offers itſelf : Make GM : gM in the given ratio, and draw MK parallel to Pg. Through *any* point D of CG draw the ſtraight line PDK, cutting MK in K. Join GK, and draw Dρ parallel to KG. This will ſolve the problem ; and, drawing ρF perpendicular to the axis, we ſhall have F for the focus of the lens RD for parallel red rays.

The demonſtration is evident : for MK being parallel to Pg, we have GM : gM = GK : HK, = ρD : uD, = FDfD, in the ratio required.

This problem admits of an infinity of ſolutions ; becauſe the point D may be taken anywhere in the line CG. It may therefore be ſubjected to ſuch conditions as may pro­duce other advantages.

1. It may be reſtricted by the magnifying power, or by the diviſion which we chooſe to make of the whole refrac­tion which produces this magnifying power. Thus, if we have reſolved to diminiſh the aberrations by making the two refractions equal, we have determined the angle RrD. Therefore draw GK, making the angle MGK equal to that which the emergent pencil muſt make with the axis, in order to produce this magnifying power. Then draw MK parallel to Pg, meeting GK in K. Then draw PK, cutting the axis in D, and Dρ parallel to GK, and ρF per­pendicular to the axis. D is the place, and DF the focal diſtance of the eye-glaſs.

2. Particular circumſtances may cauſe us to fix on a par­ticular place D, and we only want the focal diſtance. In this caſe the firſt conſtruction ſuſſices.

3. We may have determined on a certain focal diſtance DF, and the place muſt be determined. In this caſe let

GF : Fρ = I : tan. G

Eρ : fu = I : m, m being = 27/28

fu : fg = tan. g : I

then GF: fg = tan. g : m tan. G

then GF — fg : GF = tan. g — m tan. G : tan. g

or Gg + Ff : GF = tan. g — m tan. G : tan g;

and GF - Gg + Ef ((tan. g)/(tan. g — m. tan. G)), and is therefore given, and the place of F is determined ; and ſince FD is given by ſuppoſition, D is determined.

The application of this problem to our purpoſe is diffi­cult, if we take it in the moſt general terms ; but the na­ture of the thing makes ſuch limitations that it becomes very eaſy. In the caſe of the dispersion of light, the angle GPg is ſo ſmall that MK may be drawn parallel to PG without any ſenſible error. If the ray OP were parallel to CG, then G would be the focus of the lens PC, and the point M would fall on C ; becauſe the focal diſtance of red rays is to that of violet rays in the ſame proportion for every lens, and therefore CG : *Cg =* DF : Df. Now, in a teleſcope which magnifies conſiderably, the angle at the object-glaſs is very ſmall, and CG hardly exceeds the focal diſtance ; and CG is to *Cg* very nearly in the ſame proportion of 28 to 27. We may therefore draw through C (fig. 15. B) a line CK parallel to PG : then draw GK perpendicular to the axis of the lenſes, and join PK' ; draw K'BE parallel to CG, cutting PK in B ; draw BHI parallel to GK, cutting GK' in H : Join HD and PK. It is evident that CG is biſected in F', and that KB = 2F'D : alſo K'H : HG = K'B : BE, = CD : DG. Therefore DH is parallel to CK', or to PG. But becauſe PF = F K , PD is — DB, = IH = HB. Therefore ρD = HB, and FD = K'B, = 2F'D ; and FD is biſected in F’. Therefore CD = (CG + FD)/2.

That is, in order that the eye-glaſs RD may correct the diſperſion of the field-glaſs PC, *the distance between them must be equal to the half ſum of their focal distances* very nearly. More exactly, *the distance between them must be equal to the half ſum of the focal distance of the eye-glaſs, and the distance at which the field-glaſs would form an image of the object-glaſs.* For the point G is the focus to which a ray coming from the centre of the object-glaſs is refracted by the field-glaſs.

This is a very ſimple ſolution of this important problem. Huyghens’s eye-piece correſponds with it exactly. If in­deed the diſperſion at P is not entirely produced by the re­fraction, but perhaps combined with ſome previous disperſion, the point M (fig. 15. A) will not coincide with C, (fig. 15. B), and we ſhall have GC to GM, as the natural diſperſion at P to the diſperſion which really obtains there. This may deſtroy the equation CD = (CG + FD)/2.

Thus, in a manner rather unexpected, have we freed the eye-glasses from the greateſt part of the effect of diſperſion. We may do it entirely by puſhing the eye-glaſs a little nearer to the field-glaſs. This will render the violet rays a little divergent from the red, ſo as to produce a perfect pic­ture at the bottom of the eye. But by doing ſo we have hurt the diſtinctneſs of the whole picture, becauſe F is not in the focus of RD. We remedy this by drawing both glasſes out a little, and the teleſcope is made perfect.

This improvement cannot be applied to the conſtruction of quadrant teleſcopes, ſuch as fig. 14. B. Mr Ramſden has attempted it, however, in a very ingenious way, which merits a place here, and is alſo inſtructive in another way. The field-glaſs HD (fig. 14. B) is a plano-convex, with its plane side next the image GF. It is placed very near this image. The conſequence of this dispoſition is, that the image GF produces a vertical image *gf,* which is much less convex towards the glaſs. He then places a lens on the point C, where the red ray would croſs the axis. The vio­let ray will paſs on the other side of it. If the focal di­ſtance oſ this glaſs be *fc,* the viſion will be diſtinct and free from colour. It has, however, the inconveniency of obli­ging the eye to be cloſe to the glaſs, which is very troubleſome.

This would be a good conſtruction for a magic-lanthorn, or for the object-glaſs of a ſolar microſcope, or indeed of any compound microſcope.

We may preſume that the reader is now pretty familiar with the different circumſtances which muſt be conſidered in the conſtruction of an eye-piece, and proceed to conſider thoſe which muſt be employed to erect the object.

This may be done by placing the lens which receives the light from the object-glaſs in ſuch a manner, that a second image (inverted with reſpect to the firſt) may be formed beyond it, and this may be viewed by an eye-glaſs. Such a conſtruction is repreſented in fig. 16. But, beſides many other defects, it tinges the object prodigiouſly with colour The ray o*d* is diſperſed at *d* into the red ray *dr,* and the violet *dv, v* being farther from the centre than r, the re­fracted ray *vv'* crosses *rr'* both by reaſon of ſpherical aber­ration and its greater refrangibility.

But the common day teleſcope, invented by F. Rherta, has, in this respect, greatly the advantage of the one now described. See Optics, n⁰ 266. The rays of compound light are disperſed at *e* and f*.* (Plate CCCLXIV. fig. 13). The violet ray proceeding from f*,* falls without the red ray at *g,* but is accurately collected with it at the focus E, as we ſhall demonſtrate by and by. Since they croſs each