Dollond the merited compliment of ſaying, that he was the firſt who made any ſcientific application of this theory to the compound eye-piece for erecting the object. His eye­pieces of five and ſix glasses are very ingenious reduplica­tions of Huyghens’s eye-piece of two glasses, and would pro­bably have ſuperſeded all others, had not his discovery of achromatic object-glaſſes cauſed opticians to conſider the chromatic diſpersion with more attention, and pointed out methods of correcting it in the eye-piece without any com­pound eye-glasses. They have found that this may be more conveniently done with four eye-glaſſes, without ſenſibly diminiſhing the advantages which Huyghens ſhowed to reſult from employing many ſmall refractions inſtead of a leſ­ſer number of great ones. As this is a very curious ſubject, we ſhall give enough for making our readers fully acquaint­ed with it, and content ourſelves with merely mentioning the principles of the other rules for conſtructing an eye­piece.

Such readers as are leſs familiarly acquainted with op­tical diſcuſſions will do well to keep in mind the following conſequences of the general focal theorem (Optics n⁰ 141. Cor. 5).

If AB (fig. 10. B) be a lens, R a radiant point or focus of incident rays, and *a* the focus of parallel rays coming from the oppoſite side ; then,

1. Draw the perpendicular *aa'* to the axis, meeting the incident ray in *a',* and *a'* A to the centre of the lens. The refracted ray BF is parallel to a'A : for R*a'* : a'A (= R*a : a*A) = RB : BF (= RA : AF), which is the focal theorem.

2. An oblique pencil BPb proceeding from any point P which is not in the axis, is collected to the point *f,* where the refracted ray BF cuts the line PAf' drawn from P through the centre of the lens : for P*a'* : a'A = B*f,* which is alſo the focal theorem.

The Galilean teleſcope is ſuſceptible of ſo little improve­ment, that we need not employ any time in illuſtrating its performance.

The ſimple aſtronomical teleſcope is repreſented in fig. 11. The beam of parallel rays, inclined to the axis, is made to converge to a point G, where it forms an image of the low­eſt point of a very diſtant object. Theſe rays decuſſating from G fall on the eye-glaſs ; the ray from the loweſt point B of the object-glaſs falls on the eye-glaſs at *b* ; and the ray from A falls on *a ;* and the ray from the centre O falls on o*.* Theſe rays are rendered parallel, or nearly ſo, by refraction through the eye-glaſs, and take the direction *bi', oI, ai.* If the eye be placed ſo that this pencil of pa­rallel rays may enter it, they converge to a point of the re­tina, and give diſtinct viſion of the loweſt point of the ob­ject. It appears inverted, becauſe the rays by which we ſee its loweſt point come in the direction which in ſimple viſion is connected with the upper point of an object. They come from above, and therefore are thought to proceed from above. We ſee the point as if ſituated in the direc­tion Io*.* In like manner the eye placed at I, ſees the upper point of the object in the direction IP, and its middle in the direction IE. The proper place for the eye is I : if brought much nearer the glaſs, or removed much farther from it, ſome, or the whole, of this extreme pencil of rays will not enter the pupil. It is therefore of importance to determine this point. Becauſe the eye requires parallel rays for diſtinct viſion, it is plain that F muſt be the prin­cipal focus of the eye-glaſs. Therefore, by the common focal theorem (Optics, n⁰ 141. Cor. 5.), OF : OE = OE : OI, or OF : FE = OE : EI.

The magnifying power being meaſured by the magnitude of the viſual angle, compared with the magnitude of the viſual angle with the naked eye, we have oIp/oOp, or oIF/oOF for the meaſure of the magnifying power. This is very nearly = OE/EI, or OF/FI.

As the line OE, joining the centres of the lenſes, and perpendicular to their ſurfaces, is called the axis of the tele­ſcope, ſo the ray OG is called the axis of the oblique pen­cil, being really the axis of the cone of light which has the object-glaſs for its baſe. This ray is through its whole courſe the axis of the oblique pencil ; and when its courſe is determined, the amplification, the field of viſion, the aper­tures of the glasses, are all determined. For this purpoſe we have only to conſider the centre of the object-glaſs as a radical point, and trace the proceſs of a ray from this point through the other glasses : this will be the axis of ſome oblique pencil.

It is evident, therefore, that the field of viſion depends on the breadth of the eye-glaſs. Should we increaſe this, the extreme pencil will paſs through I, becauſe O and I are ſtill the conjugate foci of the eye-glaſs. On the other hand, the angle reſolved on for the extent or field of viſion gives the breadth of the eye-glaſs.

We may here obſerve, by the way, that for all optical inſtruments there muſt be two optical figures conſidered. The firſt ſhows the progreſs of a pencil of rays coming from one point of the object. The various focuſes of this pencil ſhow the places of the different images, real or virtual. Such a figure is formed by the three rays AGai*,* ÓGoI, BG*bi.*

The second ſhows the progreſs of the axes of the different pencils proceeding through the centre of the object-glaſs. The focuſes of this pencil of axes ſhow the places where an image of the object glaſs is formed ; and this pencil deter­mines the field of viſion, the apertures of the lenſes, and the amplification or magnifying power. The three rays OGoI, OFEI, OHPI, form this figure.

See alſo fig. 17. where the progreſs of both ſets of pencils is more diverſified.

The perfection of a teleſcope is to repreſent an object in its proper ſhape, diſtinctly magnified, with a great field of viſion, and sufficiently bright. But there are limits to all theſe qualities; and an increaſe of one of them, for the moſt part, diminiſhes the rest. The brightneſs depends on the aperture of the object-glaſs, and will increaſe in the ſame proportion (becauſe ii' will always be to AB in the pro­portion of EF to FO), till the diameter of the emergent pencil is equal to that of the pupil of the eye. Increaſing the object glass any more, can lend no more light into the eye. But we cannot make the emergent pencil nearly ſo

omit giving a due ſhare of the honour of it to Dr Barrow and Mr James Gregory. The firſt of theſe authors, in his Optical Lectures delivered at Cambridge, has given every propoſition which is employed by Huyghens, and has even proſecuted the matter much further. In particular, his theory of oblique ſlender pencils is of immenſe conſequence to the perfection of teleſcopes, by ſhowing the methods for making the image of an extended ſurface as flat as poſſible. Gregory, too, has given all the fundamental propoſitions in his *Optica Promota.* But Huyghens, by taking the ſubject together, and treating it in a ſyſtem, has greatly simplified it : and his manner of viewing the principal parts of it is incomparably more perſpicuous than the performances of Barrow and Gregory.