in another point or focus, but will be dispersed over the surface of that little circle, which is therefore called the *circle of chromatic dispersion ;* and the radiant point will be represented by this circle. The neighbouring points are in like manner represented by circles ; and these circles, en­croaching on and mixing with each other, must occasion haziness or confusion, and render the picture indistinct. This indistinctness will be greater in the proportion of the number of circles which are in this manner mixed to­gether. This will be in the proportion of the room that is for them ; that is, in proportion to the area of the circle, or in the duplicate proportion of its diameter. Our first busi­ness therefore is to obtain measures of this diameter, and to mark the connection between it and the aperture and focal distance of the lens.

Let *i* be to *r* as the sine of incidence in glass to the sine of refraction of the red rays ; and let *i* be to *v* as the sine of incidence to the sine of refraction of the violet rays. Then we say, that when the aperture PQ is moderate, *v — r : r + r —* 2*i* = DE : PQ very nearly.

For let DE, which is evidently perpendicular to Vr, meet the parallel incident rays in K and L and the radii of the spherical surface in G and H. It is plain that GPK is equal to the angle of incidence on the posterior or spherical surface of the lens ; and GP*r* and GP*v* are the angles of the refraction of the red and the violet rays ; and that GK, GD, and GE, are very nearly as the sines of those angles, because the angles are supposed to be small. Therefore DE : KD *— v — r : r—i ;* and, by doubling the conse­quents, DE : 2KD = *υ — r* : 2*r* — 2*i*. Also DE : 2KD + DE = υ — *r* : 2r — 2*i* + *v — r = υ — r : r + υ — 2i.* But 2KD + DE is equal to KL or PQ. Therefore we have DE : PQ *= υ — r : r + υ —* 2*i*. *Q. E. D.*

*Cor.* 1. Sir Isaac Newton found, that in common glass the sines of refraction of the red and violet rays were 77 and 78 where the sine of incidence was 50. Hence *v — r* is to *v* + *r —* 2*i* as 1 to 55 ; and the diameter of the smallest circle of dispersion is 1/55th part of that of the lens.

2. In like manner may be determined the circle of disper­sion that will comprehend the rays of any particular colour or set of colours. Thus all the orange and yellow will pass through a circle whose diameter is 1/200th of that of the lens.

3. In different surfaces, or plano-convex lenses, the angles of aberration *r*P*v* are as the breadth PQ directly, and as the focal distance VF inversely ; because any angle DPE is as its subtense DE directly and radius DP inversely. —We call VF the focal distance, because at this distance, or at the point F, the light is most of all constipated. If we examine the focal distance by holding the lens to the sun, we judge it to be where the light is drawn into the smallest spot.

When we reflect that a lens of 51/2 inches in diameter has a circle of dispersion 1/10th of an inch in diameter, we are surprised that it produces any picture of an object that can be distinguished. We should not expect greater distinct­ness from such a lens than would be produced in a camera obscura without a lens, by simply admitting the light through a hole of 1/10th of an inch in diameter. This, we know, would be very hazy and confused. But when we remark the superior vivacity of the yellow and orange light in com­parison with the rest, we may believe that the effect pro­duced by the confusion of the other colours will be much less sensible. But a stronger reason is, that the light is much denser in the middle of the circle of dispersion, and is exceedingly faint towards the margin. This, however, must not be taken for granted ; and we must know distinctly the manner in which the light of different colours is distributed over the circle of chromatic dispersion, before we pretend to pronounce on the immense difference between the indis­tinctness arising from colour and that arising from the sphe­rical figure. We think this the more necessary, seeing that the illustrious discoverer of the chromatic aberration has made a great mistake in the comparison, because he did not consider the distribution of the light in the circle of spherical dispersion. It is therefore proper to investigate the chromatic distribution of the light, and we shall then see that the superiority of the reflecting telescope is in­comparably less than Newton imagined it to be.

Therefore let EB (fig. 2) represent a plano-convex lens, of which C is the cen­tre and C*r* the axis. Let us suppose it to have no spherical aber­ration, but to collect rays occupying its whole surface to single points in the axis. Let a beam of white or compounded light fall perpendicularly on its plane surface. The rays will be so refract­ed by its curved sur­face, that the extreme red rays will be col­lected at *r,* the ex­treme violet rays at *w*, and those of interme­diate refrangibility at intermediate points *o, y, g, b, ρ, v, of* the line *rw,* which is nearly 1/28th of *r*C. The ex­treme red and violet rays will cross each, other at A and D ; and AD will be a sec­tion or diameter of the circle of chromatic dis­persion, and will be about 1/55th of EB. We may suppose *wr* to be bisected in *b,* because *wb* is to *br* very nearly in the ratio of equality (for *rb : rC* = *b*A : *c*E = *b*A : *c*B = *wb : w*C*).* The line *rw* will be a kind of prismatic spectrum, red from *r* to o, orange-co­loured from *o* to *y,* yellow from *y* to *g,* green from *g* to *b*, blue from *b* to *p,* purple from *p* to *v,* and violet from *v* to *w.*

The light in its compound state must be supposed uni­formly dense as it falls upon the lens ; and the same must be said of the rays of any particular colour. Newton sup­poses also, that when a white ray, such as eE, is dispersed into its component coloured rays by refraction at E, it is uniformly spread over the angle DEA. This supposition is indeed gratuitous ; but we have no argument to the con­trary, and may therefore consider it as just. The conse­quence is, that each point *w, v, p, b, &c. of* the spectrum is not only equally luminous, but also illuminates uniformly its corresponding portion of AD ; that is to say, the coat­ing (so to term it) of any particular colour, such as purple, from the point *p,* is uniformly dense in every part of AD on which it falls. In like manner, the colouring of yellow, intercepted by a part of AD in its passage to the point *y,* is uniformly dense in all its parts. But the density of the different colours in AD is extremely different ; for, since the radiation in *w* is equally dense with that in *p,* the density of the violet colouring, which radiates from *w,* and is spread over the whole of AD, must be much less than the density of the purple colouring, which radiates from *p,* and occupies only a part of AD round the circle *b.* These densities must be very nearly in the inverse proportion of *wb2* to *pc2.*