der that the extreme colours which are ſeparated by the firſt lens may be rendered parallel by the ſecond ; we have ſhown already that *n* and *n'* are proportional to the radii of the equivivalent isoſceles lenses, being the halves of theſe radii. They are therefore (in theſe ſmall refractions) inverſely proportional to the angles formed by the ſurfaces at the edges of the lenſes. *n'* may therefore be taken for the angle of the firſt lens, and *n* for that of the ſecond. Now the ſmall refraction by a prism, whoſe angle (alſo ſmall) is n', is *m* —I × n'. The diſperſive power being now ſubſtituted for the refractive power, we have for this refraction of the priſm *dm × n'.* This muſt be deſtroyed by the op­poſite refraction of the other priſm *dm' × n.* Therefore *dm d m' r ...*

*dm × n' = dm'* × n, or ~ —, In like manner, this effect will be produced by three lenſes if ~ + π∣ ' + be = o, &c.

*ri,*

Laſtly, the errors ariſing from the ſpherical figure, which we expressed by —R2 (q+q') be corrected if *q* + q'. be = c. We are therefore to diſcover the adjuſtments of the quantities employed in the preceding formulae, which will inſure theſe conditions. It will render the proceſs more perſpicuous if we collect into one view the significations of our various ſymbols, and the principal equations which we are to employ.

1. The ratios to unity of the sines of mean incidence in the different media are: *m, m', m''.*

2. The ratio of the differences of the sines of *dm* the extremes: ~T~7⅛ = u.

3. The ratio (m —I)/(m' — I): = c

4. The radii of the ſurfaces *a, b; a', b; a", b".*

5. The principal focal diſtances, or the focal diſtances of parallel central rays: p, p'*, p'' .*

6. The focal diſtance of the compound lens: P.

7. The diſtance of the radiant point, or of the focus of incident rays on each lens: r, r', r''.

8. The focal diſtance of the rays refracted by each lens: f, f', f''.

9. The focal diſtance of rays refracted by the compound lens: F.

10. The half breadth of the lens: *e.*

Alſo the following ſubsidiary values :

I. i i, i i *i* 1 i r

*lf n~'a~"b',n^al~b,i7P~f~~'b'r'*

*m—*I *(m 3 2m2-j-m m* -f∙ 2 3nj1-4-m

2\* 2 —-j ——— I — \_■ 4\* 2 " I hm∙

*a m ∖ni an an rta*

And *q'* and q'' muſt be formed in the ſame manner from *m', a', n', r'* ; and from *m'', a", n'', r",* as *q* is formed from m, *a, n, r.*

3. Alſo, becauſe in the caſe of an object-glaſs, r is infi­nitely great, the laſt term I/r in all the values of I/f, I/f', I/f'', I/r', I/r'', will vaniſh, and we ſhall alſo have F = P.

Therefore in a double object-glaſs I/P = —~∣ *~~if~~>*

*m"—1: m'—*1

And in a triple object-glaſs I/P = ∙—— + —+ *m—i.* I i I. ~> = J+i⅛

Alſo, in a double object-glaſs, the correction of ſpherical aberration requires *q + q'* = *v.*

And a triple object-glaſs requires *q + q' + q'' = v.* For the whole error is multiplied by F2, and by I/2 e2 ; and there­fore the equation which corrects this error may be divided, by F2 I/2 e2.

This equation in the preceding column, 11th line from the bottom, giving the value of *q, q', q", may* be much simplified as follows: In the ſirſt place, they may be divided by *m, m'*, or *m'',* by applying them properly to the terms within the parenthesis, and expunging them from the denominator of the general factors m,m ;—

This does not alter the values of *q, q',* and *q''.* In the ſecond place the whole equations may be afterwards divided by *m'—* I. This will give the values of , -73—, and —7,

*o m —* I *m* —— 1 w — I

which will ſtill be equal to nothing if *q* + q' *+ q''* be equal to nothing.

This diviſion reduces the general factor (m' — I)/m of *q'* to I/m'. And in the equation for *q* we obtain, in place of the general factor(m — I)/m, the factor (m — I)/(m' — I), or *c.* This will alſo be the factor of the value of *q''* when the third lens is of the ſame ſubſtance with the firſt, as is generally the caſe. And, in the third place, since the rays incident on the firſt lens are parallel, all the terms vaniſh from the value of *q* in which I/r is found, and there remain only the three firſt,

*m3 2 m1 + to m* 4- 2

viz. — 7 J j—.

m *an an*

Performing theſe operations, we have

*q\_ fm2 2m+l m + 2∖e1*

*m!—*I C u 3 *an1 "\* ma2n)* 2

*q' \_ ∕ffl'1 2m'+l* m'4-2 3m'-H 4(^-⅜-ι)

*m'—*ι-∖s'3 *aln,i + m'a'\*n, r'n'2 m,a'rln'^°*

3 *m!* 2 *eτ*

*m'rl3n' JT*

*q'' \_ ∕mr* 2m÷I J ffi-f-2 ι3m+l∙ 4(≡+<) .

*m'—* 1 “ *C ∖Di a" «.'? + m"a"1n"+ P n"i + m"d'r"d' +"*

3 m + 2 ∖ et

m" *r"1n')* 2

Let us now apply this inveſtigation to the conſtruction of an object-glaſs ; and we ſhall begin with a double lens.

*Construction of a Double Achromatic Object-glaſs.*

Here we have to determine four radii *a, b, a',* and *b'.* Make n = I. This greatly simplifies the calculus, by exter­minating it from all the denominators. This gives for the equation = o, the equation dm + dm'/n', or dm =

dm' , I *dm* Alſo we have r', the focal diſtance of the light incident on the ſecond lens, the ſame with the principal focal diſtance *p* of the firſt lens (neglecting the interval, if any). Now I/p = *———y* which in the preſent caſe is ≡ *m—*I. Alſo is *= — u (m' — I),* and I/P = m — I — u(m' — I) = u'.

7 *tL*

Make theſe ſubſtitutions in the values of ; —T

*m—*-1 *m'*—I

and we obtain the following equation: