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—* l)*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* X *n' = dm! × n,* or — = — . In like

*n n'*

*dm* manner, this effect will be produced by three lenses if —

*dm' dm', n*

÷ V + V be = 0, &c·

Lastly, the errors arising from the spherical figure, which we expressed by — R2 *(q* 4- y,), will be corrected if y 4- 7z be = 0. 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

*\_ , dm*

of the extremes *-r-, = u.*

*dm'*

3. The ratio — 1 = *c*.

*m'—* 1

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, ρ', 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"∙*

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 :

1 I\_I\_1 1 \_2. JL-J.\_ 1

*n~a b, n>~ a! n"~af~bf'*

*9 fm3 2rnι + m ,m-{-2* ι 3 rn, 4- *m*

*"~ m* ∖n3 αn2 *' a-n* rir

4(oo + l) 3ιa4-2∖e2 ... , , ,

— r —« I *-x∙* And *q'* and *q''* must be formed *arn τin J & λ a*

in the same manner from *m', a,, n,, r,,∙* and from *nt", 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 1/*r* in all the values of*ff f> ~e* will vanish,' and we shall also have F = P.

Therefore in a double object-glass -i- = 'n ~ - 4. ? \*

=1+1. ■

F p,

And in a triple object-glass -t∙ = 4- w ∣

P *n’ n' ~*

= 1 + 1 + 1

n *ρ'' ~ ρ∙ t p'*

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 1/2 *e2* ; and therefore the equation which corrects this error may be di­vided by F2 1/2 *e2*.

The equation in the l4th line from the bottom of the column, giving the value of *q, q', q'',* may be much simpli­fied as follows : In the first 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 ∖ -, "t ffl~,~ ∙ This does

not alter the values of *q, q',* and *q".* In the second place, the whole equations may afterwards be divided by *m’—* 1. This will give the values of —-—-, - and —’ which will still be equal to nothing if *q* + *q' + q''* be equal to nothing.

I

This division reduces the general factor ——— of *q'* to

— And in the equation for *q* we obtain, in place of the general factor — -, the factor ,~ , or *c.* This will

*o m m' —* 1

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 - is found, and there remain only the *-i, . m3 2mt* 4. *m 1 m* a. 2

first three, viz. -5- !— -4 -i-.

*n∙i ani an*

Performing these operations, we have

*q lm- 2m* -pl *m* -∣- 2∖ *e-*

*m'—* 1 - C ∖n5 *an- ^∣^ ιιιa'n J 2’*

***<f frnfi*** 2m'4-l m'4-2 3m'4-l (4m'4-l)

*m'—* **l^~U3'** *~~a'n'i + rn'a!tn' +* **r'n's m'β'r'n,**

⅛ 4 2⅝ e\*

*+ m'tfin' )* 2’

*g" \_\_ loc 2m* 4- 1 *m* -∣- 2 3m 4. 1 (4m 4- 1)

*m'*—.l^ ∖zim *a"n"\** **∙^m''α''in,'** r''n''8 *+ rn'a"r"n,*

*1 Sm 4- 2∖ e≈*

*+ m''r^in'j* 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 = 1. This greatly simplifies the calculus, by ex­terminating *n* from all the denominators. This gives for *, . dm dm' \_ , . dm'*

the equation — 4. — = 0, the equation *dm* 4 = 0,

*n n' 1 , n'*

*j dm'* I *dm*

or *am =* and - = — —- — *— u.* Also we have

*n’ n' dm'*

*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—-, which in the present case is = *m —* 1. Also - is = — u

1 p *(m'—* 1), and p = *m* — I \_ u *(m'—* 1) = lrl.

Make these substitutions in the values of —~— and *nt—* **1** *~~m~~~~,f £~~*> and we obtain the following equation.