c(im-⅛-τ) *. c(m+ι) v,hml+ι)*

*cmι* ρΏ *\_Δ\_—*L\_2\_

*a ma1 a*

«(m' + a) 4a(zni-H) *tm—1.*

tt(3√-b¾) (m—1)2

*mt 0'*

Arrange theſe terms in order, according as they are factors of I/a2, I/a, I/a'2, I/a', or independent quantities. It puts on this form :

*m a2 ' , ' a m a*

(, , ... 4u(7M'-l-l) *(m—*1)∖ j

“ (2 m 4-j ) — —— ) × \_ \_|\_ſ w24-w1 (3 m

+0 (l,-,)-^√∙- ⅛⅛) ("l-1), = 0.

*, , m*

Let A be the coefficient of I/a2, B that of I/a, C that of I/a'2, D that of I/a', and E the ſum of the independent quantity ; that is, let A be = — , B = *c* (2mff-ι), C = rſk+i), d = (2 m.+"2j \_ F⅛Hrj),

τn v , ' *m* and E = *cm2-j-u2(^m'-j-l) (m —* 1) — *u2 m' 2 —* « (3 m,-∣-2) *(m—* 1 ) \*

*m'*

Our final equation becomes A/a2 — B/a — C/a'2 — D/a' + E = 0.

The coefficients of this equation and the independent quan­tity are all known, from our knowledge of *m, mt dm, dm',* and we are to find the values of *a* and *a',* and from them and *n — I* to find the values of *b* and *b'.*

But it is evidently an indeterminate equation, becauſe there are two unknown quantities ; ſo that there may be an infinity of ſolutions. It muſt be rendered determinate by means of ſome other conditions to which it may be ſubjected. Theſe conditions muſt depend on ſome other circumſtances which may direct our choice.

One circumſtance occurs to us which we think of very great conſequence. In the passage of light from one ſubſtance to another, there is always a conſiderable portion re­flected from the posterior ſurface of the firſt and from the anterior surface of the laſt ; and this reflection is more copious in proportion to the refraction. This loss of light will therefore be diminiſhed by making the internal ſurfaces of the lenſes to coincide ; that is, by making *b = a'.* This will be attended with another advantage. If we put between the glasſes a subſtance of nearly the ſame refracting power, we ſhall not only completely prevent this loſs of light, but we ſhall greatly diminiſh the errors which ariſe from an imper­fect poliſh of the ſurfaces. We have tried this, and find the effect very ſurpriſing. The lens being poliſhed immediately after the figure has been given it, and while it was almoſt impervious to light by reaſon of its roughneſs, which was still ſenſible to the naked eye, performed as well as when finiſhed in the fineſt manner.

N. *B.* This condition, by taking away one refraction, obliges us to increaſe thoſe which remain, and therefore increaſes the ſpherical aberrations. And ſince our formulæ do not fully remove thoſe (by reaſon of the ſmall quantities neglected in the proceſs), it is uncertain whether this con­dition be the moſt eligible. We have, however, no direct argument to the contrary.

Let us ſee what determination this gives us.

In this caſe I/a' = I/b, = I/a — I. For becauſe I/n = I/a — I/b and *n* = 1, we have I + I/b = I/a, and I/b = I/a — I. Therefore I/a'2 = I/a2 — 2/a + I. Therefore, in our final equation, put I/a2 — 2/a + I in place of I/a'2, and I/a in place of I/a', and it becomes 2 4-E -j-D—C≈o.

*a a ,*

Thus have we arrived at a common affected quadratic equation, where I/a is the unknown quantity. It has the common form px1-]-yx-∣-r = 0, where p is = A — C, *q* is equal to 2C — B — D, *r* is equal to E + D — C, and *x* is equal to I/a.

Divide the equation by p*,* and we have x2 + J

*? r*

= 0. Make j =≡ 7 and *t ≈* -, and we have x14-jχ4-f =0.

*P i> \**

This gives us finally I/a ,or x = — ⅜ x j2—Λ

This value of I/a is taken from a ſcale of which the unit *a*

is half the radius of the iſoſceles lens which is equivalent to the firſt lens, or has the ſame local diſtance with it. We muſt then find (on the ſame ſcale) the value of *b, viz.* I/a, which is alſo the value of *a,.* Having obtained *a',* we muſt find *b'* by means of the equation I/n' = I/a' — I/b' and there­fore I/b = I/a' — I/n'. But I/n', = *u.* Therefore 7, = I/a', + *u, = b at n' nma a! ’* -4-m—I. *a i*

Thus is our object glaſs conſtructed ; and we muſt determine its focal diſtance, or its reciprocal I/P. This is = m — I *— u(m'—*I ).

All theſe radii and diſtances are meaſured on a ſcale of which *n* is the unit. But it is more convenient to meaſure every thing by the focal diſtance of the compound object-glaſs. This gives us the proportion which all the diſtances bear to it. Therefore, calling P unity, in order to obtain — on this ſcale, we have only to ſtate the analogy *m —* 1 —*u*

*(m'—O*) ; I = I/a : I/A, and A is the radius of our firſt ſurface meaſured on a ſcale of which P is the unit.

If, in the formula which expresses the final equation for I/a, the value of *t* ſhould be poſitive, and greater than 1/4 s2, the equation has imaginary roots ; and it is not poſſible with the glasses employed, and the conditions affirmed, to correct both the chromatic and ſpherical aberrations.

If *t* is negative and equal to 1/4s2, the radical part of the value is = 0, and I/a = 1/2s. But if it be negative or positive, but leſs than 1/4*s2*, the equation has two real roots, which will give two conſtructions. That is to be preferred which gives the ſmalleſt curvature of the ſurfaces ; becauſe, since in our formulæ which determine the ſpherical aberra­tion some quantities are neglected, theſe quantities are al­