⅛ + R-e à\_ + \_5\_\_o

α'i+α' L (1\_Λ)«+1\_Λ-Ρ·

By this equation we are to find -, or the radius of the anterior surface of the flint-glass. The equation is of this form *px2 + qx* + *r* = 0, and we must again make *s* = - and *r — -.* Therefore *t =* -À and *r= f-r^-,*

*P p* C C ∖l — *h*

A ∖

— (1 — Ej. Then, finally,

ι = -⅜i=i=√p'∑∑7.

It may be worth while to take a particular case of this condition. Suppose the crown-glass to be of equal con­vexities on both sides. This has some advantages : we can tell with precision whether the curvatures are precisely equal, by measuring the focal distance of rays reflected back from its posterior surface. These distances will be precisely equal. Now it is of the utmost importance in the construc­tion of an object-glass which is to correct the spherical aberration, that the forms be precisely such as are required by our formulas.

In this case of a lens equally convex on both sides - is α

= — — -. Substitute this value for in the general

. A BCD,-, , A A

equation — —, τ E = 0, and then

*a- a ar^ u'* αt 4

— becomes . Now change all the signs, and we have —,

***II i∙ ci“***

+ --, — E — *T* + ? = θ, by which we are to find *a’.* This

*a* 4-4

i,, m,ml>m i. The,,,==i≤6

*a·' a* l∙360

**0∙6044**

= 0∙38G7, and *r = -*~~ρ^θ~~- = \_ 0∙4444. Then — ⅜ s = 0∙l933 ; ⅛ s2 = 0∙0374 ; and √∣S2-1 = ≡±= 0∙694l ; so that — = 0Ί933 →= 0∙694l. This gives two real roots, viz. 0∙8874, and — 0∙5008. If we take the first, we shall have a convex anterior surface for the flint-glass, and con­sequently a very deep concave for the posterior surface. We therefore take the second or negative root — 0∙5008.

We find as before, by the equation = -i- -f- *u =* 0∙1046, which will give a large value of *b'.*

We had ~ = g>

**4 1 - 1**

and -b---,

and jj- is the same as in the former case, viz. 0·1603.

Having all these reciprocals, we may find *a, b, a’, b',* and P ; and then dividing them by P, we obtain finally

*a* = 0∙3206,

*b* = — 0.3206, α, = — 0∙320l, *b' =* l∙533, .p= 1·

By comparing this object-glass with the former, we may remark, that diminishing *a* a little increases *b,* and in this respect improves the lens. It indeed has diminished *b'*, but this being already considerable, no inconveniencc at­tends the diminution. But we learn, at the same time, that the advantage *must* be very small ; for we cannot di­minish *a* much more, without making it as small as the smallest radius of the object-glass. This proportion is therefore very near the maximum, or best possible ; and we know that in such cases even considerable changes in the radii will make but small changes in the result : for these reasons we are disposed to give a strong preference to the first construction, on account of the other advantages which we showed to attend it.

As another example, we may take a case which is very nearly the general practice of the London artists. The radius of curvature for the anterior surface of the convex crown-glass is 5/6ths of the radius of the posterior surface, so that *h* = 5/6. This being introduced into the determinate equation, gives

*a* = 0∙2938, *a'* = — 0∙3443,

*b = —* 0∙3526, *b=* 1·1474.

As another condition, we may suppose that the second or flint-glass is of a determined form.

This case is solved much in the same manner as the former. Taking Λ to represent the ratio of *a'* and *b',* we have — = ——5∙. This value being substituted in the α, 1 — Λ

■ A B C D , ,1 .

general equation —■ — — — + E — 9, gives us

AB C D n τι.· r

— 4. E — ∙—, r-r — ι 7 = 0∙ fhιs gives for

*αi a '* (1 — *h∕* 1 — *h*

B , 1

the final equation z2 -{- *sx -∣- t* = 0, *s — —,* and *t = —* × (e -(T⅛y- ⅛), and ∣= - ⅛ « =«= *V~i\*-t.*

We might here take the particular case of the flint-glass being equally concave on both sides. Then, because —

2 1

*= — u,* and in the case of equal concavities - = — = *α' n'*

*— u,* it is sufficient to put — « for . This being done,

.. ∙ . A B Cu2 Dm 1 \_ „

the equation becomes -— -U — 4- E =0.

*a* α 4 2

-w∙ ∙ \_ B 1 ∕4Dm-2Cui , τ,∖

1 his gives s = , and i ≡ — ∙ I g -f- E I.

We imagine that these cases are sufficient for showing the management of the general equation ; and the ex­ample of the numerical solution of the first case affords instances of the only niceties which occur in the process, viz. the proper employment of the positive and negative quantities.

We have oftener than once observed, that the formula is not perfectly accurate, and that in very large apertures errors will remain. It is proper, therefore, when we have obtained the form of a compound object-glass, to calculate trigonometrically the progress of the light through it ; and if we find a considerable aberration, either chromatic or spherical, remaining, we must make such changes in the curvatures as will correct it. We have done this for the first example ; and we find, that if the focal distance of the compound object-glass be 100 inches, there remains of the spherical aberration nearly 1/60th of an inch, and the aberration of colour is over corrected above 1/9th of an inch. The first aberration has been diminished about six times, and the other about thirty times. Both of the remaining errors will be diminished by increasing the radius of the inner surfaces. This will diminish the aberration of the crown-glass, and will diminish the dispersion of the flint