40. *The Computation of the Path of a Ray and the Correction of the Aberrations of a Lens System. Part I.*

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The Computation of the Path of a Ray.

When we design photographic or other complicated lens systems, corrections for the aberrations must be done, and this will only be done satisfactorily after tedious and laborious calculations. Therefore, to simplify the procedure of this calculations is an important problem and if we deal with this problem as below, it will become fairly easy. Theoretically, the choice of parameters may be quite arbitrary, but it will become clear that the most convenient way for our present purpose is the use of (h, θ) in Fig. 1, for it makes the calculation quite easy. For instance, the parameter (s, u) in Fig. 2, which is commonly used to trace the path of a ray, is unsuited for our problem to correct the aberrations, because it makes the computation exceedingly complicated one. Besides, the acceptance of the parameter (h, θ) makes the trigonometrical computation themselves somewhat easier than ordinary method with (s, u). For these reasons, the method of tracing using (h, θ) will be explained at first.

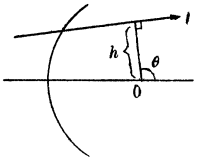

Fig. 1.

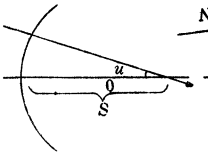

Fig. 2.

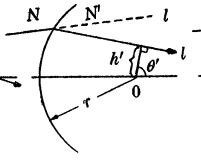

Fig. 3.

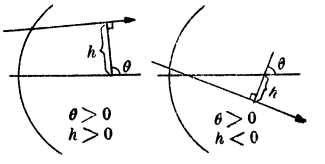

Fig. 4.

In Fig. 1, the symbol h denotes the length of the perpendicular let fall from the centre of the curvature of a refracting surface on the path of a ray and θ denotes the angle between the perpendicular and the optical axis. Then, $l(h, \theta)$ shows the incident ray and $l'(h', \theta')$ the refracted ray respectively (Fig. 3). The sign of h and θ is reckoned as shown in Fig. 4. The radius of curvature r of a surface that presents its convex surface towards incident light is regarded as being positive and that of a surface which is concave to the incident light as negative. N and N' mean the refractive indices of the media and $n = N/N$ (Fig. 3). t