definition of the kind of motion constituting a pencil of homogeneous light in the free ether or in atmospheric air had been given by Fresnel. Experimentally the velocity of a wave-motion of this kind was known; it was subsequently ascertained that this speed was not the same in air as in the free ether, the so-called vacuum. It was also known that this speed in an elastic medium, such as the ether was supposed to be, depends upon the density and the rigidity of the medium. But when rays of light—*i.e.*, the wave-motions of the ether—arrive at the surface of liquid or solid bodies, various changes are known to take place. These changes had been to some extent described and brought into measurable terms by experiment, and it had been shown in a general way by Huygens, and more completely by Fresnel, how these observed changes of reflexion, refraction, and dispersion could be translated into the language of the vibratory theory. Complicated and yet very elegant geometrical constructions, at which Fresnel arrived by an intuitive or tentative process,[1] enabled the course of rays inside transparent, doubly-refracting substances, such as crystals, to be calculated; a whole geometry of rays was developed out of these representations; now phenomena

[1] The equation of the wave-surface was not explicitly given by Fresnel himself. M. Verdet says ('Œuvres de Fresnel,' vol. i. p. lxxv): "Fresnel n'a pu lui-même venir à bout de ces difficultés et n'a su obtenir l'équation de la surface de l'onde qu'en la supposant *a priori* du quatrième degré, et calculant la valeur de ses coefficients de manière qu'ils satisfissent à certaines conditions faciles à déduire de la considération des ondes planes normales aux trois plans de symétrie du milieu. Ampère est le premier qui ait effectué le calcul d'une manière rigoureuse." However, "the construction yields the wave-surface in such a way that its singularities are not obvious, and were only remarked by Sir W. R. Hamilton several years after Fresnel's death" (Fletcher, 'The Optical Indicatrix,' p. 31).