

the refracted ray, would, in this case, guide it from the centre of the surface to every point in the circumference of the circle, and thus make it a cone. This very curious and unexpected result, which Professor Hamilton thus obtained from the theory, his friend Professor Lloyd verified as an experimental fact. We may notice, also, that Professor Lloyd found the light of the conical pencil to be polarized according to a law of an unusual kind; but one which was easily seen to be in complete accordance with the theory.

8. *Fringes of Shadows*.—The phenomena of the *fringes of shadows* of small holes and groups of holes, which had been the subject of experiment by Fraunhofer, were at a later period carefully observed in a vast variety of cases by M. Schwers of Spires, and published in a separate work,¹⁷ *Beugungs-erscheinungen* (Phenomena of Inflection), 1836. In this Treatise, the author has with great industry and skill calculated the integrals which, as we have seen, are requisite in order to trace the consequences of the theory; and the accordance which he finds between these and the varied and brilliant results of observation is throughout exact. "I shall," says he, in the preface,¹⁸ "prove by the present Treatise, that all inflection-phenomena, through openings of any form, size, and arrangement, are not only explained by the undulation-theory, but that they can be represented by analytical expressions, determining the intensity of the light in any point whatever." And he justly adds, that the undulation-theory accounts for the phenomena of light, as completely as the theory of gravitation does for the facts of the solar system.

9. *Objections to the Theory*.—We have hitherto mentioned only cases in which the undulatory theory was either entirely successful in explaining the facts, or at least hypothetically consistent with them and with itself. But other objections were started, and some difficulties were long considered as very embarrassing. Objections were made to the theory by some English experimenters, as Mr. Potter, Mr. Barton, and others. These appeared in scientific journals, and were afterwards answered in similar publications. The objections depended partly on the measure of the *intensity* of light in the different points of the phenomena (a datum which it is very difficult to obtain with accuracy

¹⁷ *Die Beugungs-erscheinungen, aus dem Fundamental-gesetz der Undulations-Theorie analytisch entwickelt und in Bildern dargestellt*, von F. M. Schwers. Mannheim, 1835.

¹⁸ Dated Speyer, Aug. 1835.