

ice is retreating, a mass of it may be insulated; as this melts, the superincumbent material tends to slip towards the edges, and thus to form a ring of *débris*, by which, after the ice has disappeared, a hollow is inclosed. Dr. Wright also adopts the opinion, maintained by Prof. Claypole, the late Prof. H. C. Lewis, and others, that one effect of the advance of this great mass of ice was to obstruct the flow of all rivers which take a northerly course, and thus to convert their valleys into lakes.

But into a discussion of this interesting question, and of the cause of the glacial epoch, to which a considerable space is devoted, we must not now enter. We must also pass over the questions relating to the date of the glacial epoch and its relation to the first appearance of men, merely stating that Dr. Wright inclines to regard the latter as pre-glacial, but the former as less remote than is generally supposed. It must suffice to say that he appears to be a careful observer, and generally a cautious reasoner, though slightly too prone to quote the remarks of others without due criticism; so that, on the whole, his book presents us with a good summary of the results of investigations into the glacial geology of North America, and will be valuable for purposes of reference on this side of the Atlantic.

T. G. BONNEY.

THE TOTAL REFLECTOMETER AND THE REFRACTOMETER FOR CHEMISTS.

Das Totalreflectometer und das Refractometer für Chemiker, ihre Verwendung in der Krystalloptik und zur Untersuchung der Lichtbrechung von Flüssigkeiten. Von Dr. C. Pulfrich, Privatdocenten an der Universität Bonn, und Assistenten des physikalischen Instituts. With 4 Lithographic Plates and 45 Figures in the Text. (Leipzig: W. Engelmann, 1890.)

THIS book contains an exhaustive account of one of the latest devices in physical optics for investigating the refractive power of uniaxial and biaxial crystals. The idea of making use of the principle of total reflection for this purpose is not new. Wollaston, at the beginning of the century, brought forward a method in which the crystal plate under examination was attached to a glass prism; but, owing to the experimental difficulties involved in this process, it met with little practical application. The instrument constructed by Kohlrausch in 1878, in which the crystal plate was immersed in a strongly refractive liquid, was a distinct advance, and has been much used. Within the last ten years, also, Wollaston's apparatus has been considerably improved by Fussner and Liebisch. Both these instruments, however, have still many inconveniences, and it is the claim of the author that the method which he has devised, and which forms the subject of the present work, is free from these.

To give some idea of this method, without entering into practical details, it will be sufficient to state that it consists essentially in the replacement of the prism of the Wollaston instrument by a glass cylinder, to the upper plane surface of which the crystal plate is attached. The cylinder can be rotated about its long axis, so that the refractive phenomena in all azimuths can be observed. This is the distinguishing feature which forms the chief advantage of the new method. Thus, by illuminating the crystal plate

from the side at grazing incidence, and slowly rotating the cylinder, the whole extent of the limiting curves of total reflection comes under observation. By a special method of illumination from all sides the limiting curves may be received on a screen beneath the cylinder and made visible to a number of observers; e.g. in the case of a uniaxial crystal the appearance on the screen will be the sectional curves of the wave-surface, a circle and an ellipse corresponding to the ordinary and extraordinary rays.

The method was first suggested by the author four years ago. The object of the present work is to give a complete account of the series of measurements and observations which have been made with the instrument since that time with a view to testing its usefulness and trustworthiness. After some preliminary observations on the theoretical principles involved in the method of total reflection, the author gives a detailed description of the construction of the new instrument and the methods of observation by which it is possible in a single crystal section to ascertain the position of the axes of elasticity, to measure the optic axial angle for different colours, and to determine the principal refractive indices. Of special interest is the section on the appearances in the direction of the optic axes of biaxial crystals. Observations made on a plate of asparagine, cut parallel to the optic axial plane, showed distinctly the effects due to the internal and external conical refraction, thus supplementing Lloyd's experiments in demonstrating the general correctness of the Fresnel wave-surface. The last section of the book deals with the refraction of liquids, and contains a description of the refractometer for chemists, which is a simplified form of the total reflectometer, in which a prism replaces the cylinder. Altogether, a perusal of the work leaves the impression that the invention of this ingenious and yet comparatively simple method for investigating the refractive power of doubly refractive media marks a decided advance in physical science; and the author appears to have quite substantiated his claim to have made the total reflection method, which has long been recognized as theoretically the most promising, also a thoroughly practical one.

G. T. P.

A WEATHER RECORD OF THE FOURTEENTH CENTURY.

Consideraciones temperiei pro 7 annis, per Magistrem Wilhelmum Merle, socium domus de Merton. Reproduced and Translated under the supervision of G. J. Symons, F.R.S. (London: Edward Stanford, 1891.)

I N January 1337, barely forty-five years after the death of Roger Bacon, and ten years after the accession of King Edward the Third, William Merle, a Fellow of Merton College, and Rector of Driby, in Lincolnshire, commenced a journal of the current weather as experienced partly at his rectory "in Lyndesay, near the north-east coast," and partly at Oxford. This journal he continued month by month for seven years, or up to three years before his death, the notices of the last four years being considerably amplified over the earlier entries; and the original manuscript, still preserved in the Bodleian Library, has now, thanks to the initiation of Mr.