

form of graphite or simply intermixed carbon. Prof. Akerman holds that carbon exists in iron in three different forms which may be distinguished; other well-known metallurgists confirm his views.

The following chapters, on iron *versus* steel for structural uses, and the stability of iron, are apparently ably written, and are recommended for the consideration of experts. The article on occlusion of gases in iron and steel is up to date. The researches of Graham, Deville, and Troost are quoted, and prominently those of Dr. Muller, to which latter the author appears to attach some importance. Iron, however, occludes other elements just as it does hydrogen—such as zinc, cadmium, magnesium, &c.; the same may be said even of carbon during the cementation process. Dr. Muller's method of collecting the gas by drilling gives no information as regards the gas actually occluded, which latter, it is evident, can only be extracted by heating in vacuum, as recommended by Prof. Roberts-Austen, and practised by Graham and Troost, also recently worked by Parry, Stead, and other chemists.

JOHN PARRY.

THE THEORY OF LIGHT.

The Theory of Light. By Thomas Preston. (London: Macmillan and Co., 1890.)

MR. PRESTON has written a valuable book on an important subject, one which will, as he hopes, be suited to the reading of junior students, and yet sufficiently full to meet the requirements of many who desire a more special acquaintance with the subject. At the same time it is difficult to avoid expressing the wish that he had carried the mathematical development of some parts of his subject a little further, and, if space required it, had omitted some of the more elementary details; though the work, within the limits laid down, is so well done, that criticism may seem ungenerous.

The historical method adopted in some parts of the book adds greatly to its interest, and the account given of the development of the subject, from the days of the Greek philosophers to the present time, will lead many to study the original sources of Mr. Preston's information with profit to themselves. It is a good thing for us to read how the first masters of the subject expressed themselves; to know what were the difficulties they felt, and what the problems which appeared important to their minds. We, who, thanks to Young and Fresnel, have had the difficulties that surrounded the wave theory in the time of Newton cleared away, are less apt than we might be at recognizing their magnitude, and at grasping the ingenuity and skill with which Newton treated the emission hypothesis, and the marvellous manner in which, in his hands, it was made to explain many of the phenomena of light.

In the earlier chapters of the book, after an explanation of the rectilinear propagation of light, a good deal of space is devoted to the explanation of phenomena usually dealt with under geometrical optics. The ordinary formulæ for prisms and lenses are deduced from the principle that the time from a point to its image is the same by all paths possible for the light—a principle which, in Lord Rayleigh's hands, has led to important results in the theory of optical instruments.

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The argument given by Lord Rayleigh in his article in the "Encyclopædia Britannica," for showing that the effect of a wave is equivalent to half that of the first Huyghens zone, and that the phase of the disturbance is a quarter-period behind that from the pole, might with advantage have been given in greater fulness in Article 54 (the reference at the end of that article should be to Art. 154, Ex. 3).

The book is very complete so far as it goes, but the limits imposed by the author on himself do not allow him to show any very great originality in treating his subject, at least until we come to chapter ix., section iii., where he deals with the graphic method of solving problems in diffraction. In this section Cornu's beautiful method is employed, and many problems, usually only solved by analysis, are completely worked out by it.

The analytical solutions are, perhaps, a little hardly dealt with, as the methods of evaluating Fresnel's integrals given by himself, Gilbert, and Knochenhauer, only appear as examples. The theory of the diffraction gratings strikes us as being also rather brief. Rowland's concave gratings are best treated from the consideration that the waves from all the bright spaces arrive in the same phase. Possibly Bessel's functions are outside the limits of the mathematical treatment allowed by the author: if not, a reference to them would improve the treatment of the diffraction problems arising out of the case of a circular aperture.

Fresnel's theory of double refraction is given clearly in chapter xii., and the difficulties of finding a dynamical explanation of it are well stated. It is here, however, and in the chapter on the dynamical theory of reflection and refraction, that we think the limitation of the mathematical development unfortunate. The elementary theory of elastic solids is given sufficiently for optical purposes in several works accessible to students. The author might easily, if he had liked, have introduced a few pages of it in his own book. He would then have been able to give and discuss the theories of refraction and double refraction of both Green and Neumann, or McCullagh, and thus have added greatly to the value of the work.

The book is brought up to date in a satisfactory manner. The last chapter contains an account of the modern work on the electro-magnetic theory of light, including the recent experiments of Hertz.

ENGLISH PATENT LAW.

The Law and Practice of Letters Patent for Inventions; with the Patents Acts and Rules annotated, and the International Convention, a Full Collection of Statutes, Forms, and Precedents, and an Outline of Foreign and Colonial Patent Laws, &c. By Lewis Edmunds, D.Sc., (Lond.), F.C.S., F.G.S., of the Inner Temple, Esq., Barrister-at-Law; assisted by A. Wood Renton, M.A., LL.B., of Gray's Inn, Esq., Barrister-at-Law. (London: Stevens and Sons, Limited.)

THIS is a work of considerable pretensions. We see by his preface that Mr. Edmunds claims to have produced a comprehensive treatise, dealing exhaustively with Patent law and practice, and when we mention that the book runs, in this its first edition, to upwards of 900