NEW BOOKS.

THE RECENT DEVELOPMENT OF PHYSICAL SCIENCE. BY WILLIAM CECIL DAMPIER WHETHAM, M.A., F.R.S. Philadelphia: P. Blakiston's Son and Co. 1904. Price, $2.00.

Certain recent developments of physical science have taken two distinct directions, belonging to two different schools, with widely different tendencies. In one of these developments electric conduction through gases has been studied, the center of the work being the Cavendish laboratory of the University of Newton, and Clerk-Maxwell and Stokes. This study rests on atomic and molecular conceptions. From Faraday and Hittorf and Kohlrausch and Arrhenius we had learned that the conduction of electricity through solutions depends on the motion of electrically charged particles, called travelers or *ions* by Faraday. Similar is the explanation, recently put forth with confidence, of the conduction of electricity through gases; from this newer side of the subject striking results have been obtained. Electrolysis had suggested the notion of never-divided units of electricity, analogous to atoms of matter; the study of the conduction of electricity in gases is thought to have isolated these undivided units of electricity and to have submitted them to experimental study. These units of electricity have been called electrons by Stoney; and Larmor and Lorentz have developed a theory according to which atoms of matter are composed of electrons combined in varying numbers and different arrangements. Then M. and Mme. Curie added to our knowledge of the properties of atoms by their remarkable discoveries, and Rutherford had accumulated evidence pointing towards the disintegration of certain atoms and their transmutation into other substances.

In such studies we have to do with atomic and molecular conceptions in an extreme form; not only with atoms, but with the structure of atoms and with suggested orbital motions within the atom. But there are important parts of physical science whose methods dispense with the consideration of atomic conceptions. The great doctrine of the dissipation of energy has to do with molecules only in statistical aggregates, and need not inquire as to the parts which make up the aggregate. It is from considerations of available energy that Willard Gibbs has developed the complete theory of physical and chemical equilibrium.

Our author begins his account of recent researches in these two directions with a chapter on the philosophical basis underlying the whole magnificent structure, and asks whether our conceptions are life-like pictures of the reality behind the phenomena. He holds the balance fairly between the laboratory where there is no room nor time for philosophic doubt, and the hours of reflection in which we remember the purely conceptual nature of our scheme of Natural Science.

The second chapter treats of the liquefaction of gases and of the absolute zero of temperature As in the following chapters, principle and method are always prominent in the treatment; these are made easily intelligible with a certainty of touch and a facility which show expository powers of a high order. Our author sums up the interesting story of this chapter with the words, "The whole subject belonged to that branch of physical science which consists in recognizing and overcoming difficulties of manipulation, and, as it were, of asserting by force the superiority of mind over matter."

The following chapter treats of fusion and solidification. Explaining principles from the case of the familiar ice, he describes the methods and results of the study of alloys. The chapter contains a graceful characterization of the work of Willard Gibbs, in addition to another which is quoted from Larmor in the introduction.

In the fourth chapter, which treats of the problems of solutions, is seen how light on the dark places of a science may come from quite another science. The starting point of our present theory of solution was obtained by Pfeffer in a botanical laboratory. Then van't Hoff detected the law to which Pfeffer's measurements conformed, and put the theory on a sound basis. Whetham is perhaps the best known English supporter of modern views as to the nature of solutions, and it would be difficult to find a clearer or more interesting account of it, suited to the wants of the unprofessional reader, but also well worthy of consideration by the adept.

Three succeeding chapters treat of the conduction of electricity through gases, of radio-activity, and of atoms and ether. Not giving unimportant details, but attending chiefly to principles and methods, these 144 pages give what seems to the reviewer the

most interesting, the best balanced, the most successful exposition of these subjects which is accessible to that important fraction of the public which has an intellectual interest in the facts and inferences which are doubtless to add much to our knowledge of the structure of matter. A chapter on astro-physics makes a fitting conclusion to an excellent book. There are nearly forty illustrations, together with portraits of Newton, Lord Kelvin, Willard Gibbs, and van't Hoff.

HIGH-TEMPERATURE MEASUREMENTS. By H. LE CHATELIER AND O. BOUDOUARD. Authorized translation and additions by G. K. BURGESS. Second edition, revised and enlarged. New York: John Wiley and Sons. xiv + 341 pp., 79 figures. Price, $3.00.

It is but little more than four years since Messrs. Le Chatelier and Boudouard published the first independent handbook devoted exclusively to experimental pyrometry, the "Mesure des Températures élévees," Paris, 1900. Mr. Burgess translated this into English a year later, and now, after but a short interval, he finds it necessary to offer a second English edition containing nearly one-third new material. If we may accept this as a kind of barometric indication of the activity in all branches of research at high temperatures, it represents an altogether unprecedented interest in pyrometry and its applications.

The greatest advances in the interval since the first edition are to be found in the greatly increased accuracy with which the fixed points of the high temperature scale are now known, and in the extraordinary progress in optical pyrometry. The boiling-point of sulphur (444.6°) is now established securely within one- or two-tenths of a degree. Dr. Burgess expresses less confidence in the melting-point of gold (1065°) and suggests 5° as the limit of uncertainty. All the higher temperatures are still dependent upon extrapolation, but with several available methods and generally concordant results.

In the concluding chapter the suggestion is made to investigators that greater exactness and greater convenience of determination of the temperatures of common reference will be obtained by substituting the melting-points of chemically pure salts for those of the metals. The salts which are available for such a purpose are of such relatively low density and poor conductivity for heat that the phenomena attending change of state at high