

and planetary atmospheres, a subject the growth of which now demands a book (still wanting) to itself. Apart from these omissions, the major part of the "Dynamical Theory of Gases" is preserved in this book, often in the same words; but the order is changed, and several interesting interpolations are made, dealing with such subjects as Perrin's experiments on the Brownian motion, and the experimental verification of Maxwell's law of distribution of velocities by Dunoyer, Stern and Gerlach and others. Features in which the book is deficient, by comparison with other recent

treatises (such as those by Loeb or Kennard), are the phenomena of gases at low densities, fluctuations, and the electric and magnetic properties of gases (the word mobility, for example, is not even in the index). It is for the author, however, to determine his own scope, and for the purchaser to decide whether or not he is suited by the result; there can be little doubt that, judged by the text, the book will deservedly succeed, and maintain for many years to come the already long association of the author's name with his present subject.

S. CHAPMAN.

## ELECTRICAL EFFECTS AT CHEMICAL BOUNDARIES

### Electrocapillarity

The Chemistry and Physics of Electrodes and other Charged Surfaces. By Dr. J. A. V. Butler. Pp. x + 208. (London: Methuen and Co., Ltd., 1940). 12s. 6d. net.

**M**ATTER being fundamentally electrical in nature, it is impossible to have two materials of different chemical composition which are not also different in electrical constitution. When different materials come in contact in such a way that electrical forces can produce observable effects, such effects are invariably present. They may arise through the materials being conductors, so that electric current may flow across the boundary, or through the boundary being deformable, so that electrokinetic effects, in the widest sense, may arise. Dr. Butler has neither written a long treatise on the whole vast subject, nor a brief general introduction to it, nor again has he chosen but one particular aspect. The selection of subjects has been made, as he explains in his preface, by avoiding those which he feels to have been adequately treated in other works, and by concentrating chiefly on those in which he has become, through his own researches, most interested. To the general reader, the book will therefore appear to lack balance though not interest. To a student interested in some particular point, it may prove to be informative, stimulating or wholly silent. The reviewer feels, therefore, that his chief task should be to summarize the subjects dealt with.

Although modern work on the response of nerve and muscle tissue to electrical stimuli has been left out of the scope of the book, it is Galvani's early observations on this subject which introduce us to the voltaic pile in the first chapter. This carries us quickly through ideas on the origin of electromotive force to the thermionic work function and quantum mechanics. A condensed chapter on

thermodynamics follows, and then a fuller discussion of the mechanism of reversible potentials.

In the fourth chapter, a general discussion of electrical double layers, the distribution of ions in them, their capacity and experimental methods of studying them, is preceded and followed by a more specialized discussion of electro-capillary curves. The author accepts the letter of Guggenheim's contention that the single potential difference between two phases has no physical meaning, but appears to reject the spirit of it. Classical electrical theory can define potential differences exactly in terms of the work of transfer of abstract electric charges. The abstraction is justified only so long as a process begins and ends in matter of the same kind. In dealing with phase boundaries, we must be concerned frequently with inseparable electrical and chemical transfers: our exploring unit charge must be carried by an atom which is usually more affected by its chemical than by its electrical environment—or perhaps one should say by its micro- than by its macro-electrical environment. The reviewer feels this problem to be so fundamental to the whole subject that he could have wished it to be more explicitly dealt with. The diffuse part of the double layer, where this problem is of less importance, is dealt with again in the next chapter, which is concerned with electrokinetic phenomena in general. The author points out that the Faraday Society's discussion on this subject appeared too late for inclusion of reference to it in these chapters.

The remainder of the book deals with electrode reactions of various kinds. The lion's share of attention is claimed by the confusing subject of over-voltage, which the author has made remarkably intelligible. Deposition of metals and the formation of oxide films are discussed more briefly, and the book concludes with a short account of electrolytic oxidation and reduction.

G. S. HARTLEY.