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SCIENTIFIC BOOKS.

The Elements of Physical Chemistry. By HARRY C. JONES. New York, The Macmillan Company, 1902. 14 x 21. Pp. x + 565. Bound, $4.

In this, the most pretentious book on physical chemistry which has appeared in English, the author has not departed from the orthodox German school in arrangement of the subject matter; in the treatment, however, many passages show a style which is peculiarly his own. A brief review will show what he believes should be taught in a university course in physical chemistry.

The reader is introduced to the atom and the molecule—the fundamental ideas of the chemist; the laws of combination, determination of atomic weights and then the periodic law are given in detail. In separate chapters are then discussed the various laws, theories and disconnected facts bearing on the physical properties of pure gases, liquids and solids. There is here given much of the work which, prior to 1885, had engaged the attention of chemical philosophers—the discovery of relations between physical properties and constitution. These chapters will afford interesting reading to many who wonder why the chemist requires all the physics he can obtain. There is little in these chapters, however, illustrative of the use of these properties in analysis.

In the fifth section the subject of solutions is considered. This chapter deals with the classical work of Pfeffer on osmotic pressure, of van't Hoff on the analogy between osmotic and gas pressures, of Raoult on the vapor pressures, the origin of the theory of electrolytic dissociation and the arguments in its favor, and a discussion of properties of dilute solutions.

The thirty pages which are devoted to thermochemistry indicate the development of the subject and give methods and results. Electrochemistry requires and merits four times this space for its treatment, since the remarkable

development which modern physical chemistry has experienced in the past fifteen years has been in very large measure due to advances made in electrochemistry. The explanation of the many conflicting results, such as the conductivities of solutions, electromotive force of primary cells, etc., which the modern theory attempts, makes the section very interesting and instructive—almost comparable to the small text-book of LeBlanc.

The chapter on photochemistry deals with actinometry and gives the results of photochemical measurements and an interesting section on the action of the newly discovered radium and polonium. The next chapter, on chemical dynamics and equilibrium, has among its topics the law of mass action and the phase rule of Gibbs, both of which are of modern development. The idea of chemical affinity and activity as affected by modern theories forms the theme of the final pages.

The author is an ardent supporter of the theory of electrolytic dissociation. He states (p. 299): 'We shall see that this theory is fundamental if we hope to raise chemistry from empiricism to the rank of an exact science.' Such is the unfortunate idea which pervades the work. This theory explains more or less satisfactorily various phenomena connected with dilute solutions, mainly aqueous; but it is extremely unfortunate that the concentrated solutions of our daily experience are ignored. So long as authors of texts on physical chemistry take the position that the part is greater than the whole, so long will critical observers be justified in declaring that the subject may be of theoretical importance only.

The method of presentation calls frequently for forward references which will embarrass the student. The theory of electrolytic dissociation is given before the chapter on electrochemistry, the law of mass action is used before it is presented, critical phenomena discussed apart from the phase rule relation for one-component systems, distillation before two-component, etc. This leads to duplication, examples of which are to be found in paragraphs on the thermochemical and volume-chemical methods.

The discussion of the physical properties of bodies even when presented historically should not be restricted to relations connected with constitution. An extension of this chapter to include more of the properties of gases, such as refractive index, viscosity, thermal and electrical conductivity, etc., would be welcomed. A few paragraphs indicating modern work on solid solutions, isohydric solutions, fused salts, decomposition voltages, alloys, velocities of phase formation, false equilibria, crystallization, etc., would have added materially to the interest and value of the book.

A few of the errors must be noted. Ethyl alcohol and water are not separable by fractional distillation (p. 175). All calcium salts are not more soluble in cold than in hot water (p. 179). The freezing-point of a solvent is not always lowered on the addition of another substance (p. 203). The following statements are open to objection or proof: 'A eutectic is the lowest freezing-mixture of two metals: a cryohydrate is the lowest freezing-mixture of two substances' (p. 222); 'the best conductors of heat energy, however, as compared with the worst hardly exceed the ratio of 100 to 1' (p. 320); 'the potential of the normal electrode is 0.56 volt,' and 'a solution has a smaller vapor pressure than the pure solvent' (p. 499). There is no excuse for having given the Ostwald-Nernst proof of free ions (p. 367) nor for assuming that sodium chloride and potassium nitrate cannot exist together (pp. 506–508).

In some places loose definitions or descriptions are given, *e. g.*, the volume of one gram of hydrogen (p. 326), the silver voltameter (p. 325), unit of resistance (p. 337), concentration of zinc chloride (p. 329), etc.

The apparatus and methods employed in the laboratory are frequently described. Translations of pertinent sections from classical papers are inserted and reference made to some of the prominent contributors to the science, the name of Jones not being forgotten.

'The book will find its public.' In the hands of a discriminating and very careful teacher it may be of considerable value.

H. R. Carveth.