Subsidence and Chemical Precipitation, Sterilization, Contact Beds, Septic Tanks, Continuous Filtration, Agricultural Value of Sewage Effluents, Distribution of Sewage upon Filters, Treatment of Trade Effluents.

These chapters are most interesting reading, being a very full compilation of the results that have been obtained during the past ten years in England. The data they contain is most valuable, but it seems as though too little attention had been paid to the order in which the results are given. Facts relating to the same process are separated from each other, and it is too often necessary to refer to the index to obtain a knowledge of all the data concerning any one process. The only process that has been rather overlooked is Intermittent Filtration, only three pages in all being devoted to the subject. This is to be regretted, as not only was "Intermittent Filtration" the first of the modern bacterial methods, but also the first to show that sewage could be purified on a practical scale by means of bacteria, and it is a method that has, in many places, given excellent results.

It is also to be wished that the author had more often given his personal opinion on the value of the experiments described, for the value of experiments depends on the character of the work, and one has very often to change the opinion formed from reading an account of a process of sewage treatment, after visiting the plant and investigating for himself the methods by which the data were obtained.

A decisive proof, however, of the value of the book taken as a whole, is the fact that it is only a little over a year since the first edition was published, and it can truly be said that it is a book which is essential to every one engaged or interested in the problem of sewage treatment. LEONARD P. KINNICUTT.

THE ELEMENTS OF PHYSICAL CHEMISTRY. BY HARRY C. JONES, Associate Professor of Physical Chemistry in the Johns Hopkins University. New York : The Macmillan Company. 1902. Price, $4.00.

The importance of physical chemistry, not only as a remarkably fruitful separate branch of science, but also as a most valuable aid in the investigation of problems in many other branches of natural science, such as chemistry proper, physics, geology, biology, physiology, medicine, is now becoming recognized so universally, that the time may be said to be near or to have already been reached, when no student of science in any one of the above subjects can afford to neglect the study of physical chemistry in his preparation for his future profession. The demand on colleges and universities for adequate instruction in physical chemistry for many classes of students is bound to increase very rapidly. Such a book as the one written by Professor Jones will aid very much in enabling the student to take up the subject with comparatively little difficulty; it presents every side of the subject in a style notably clear and simple; it is sufficiently elementary to form an excellent introduction to physical chemistry and sufficiently thorough, both in the treatment and in its references, to show the student what books and literature he must consult in order to study any particular subject more thoroughly. In this way the book may be said to occupy a place between such other notable works on physical chemistry available for English readers, as Walker's "Introduction to Physical Chemistry," which is somewhat more elementary in character than the present work, and Nernst's "Theoretical Chemistry," and Ostwald's "Outlines of General Chemistry," which are rather more advanced. Professor Jones' book presupposes a knowledge of college physics and chemistry, inorganic and organic; elementary calculus would be necessary in order to follow very closely certain parts of the book, but it is not absolutely essential for an intelligent grasp of the general subject; for a complete mastery of the book and its subject, a knowledge of calculus would be indispensable. The work is designed for students in the later stages of their college work and the earlier part of their university career.

The brief, but carefully prepared, historical sketches introducing many of the chapters, as, for instance, the one on "Chemical Dynamics and Equilibrium," and the great number of references to original papers form excellent features of the book. The marked enthusiasm with which the author writes as a worker in the field, is bound to interest the student in the subject as a living one, with many vital problems yet to be solved. In view of this undeniable gain in stimulating the interest of the intelligent reader, the somewhat disproportionate prominence given the author's own work, considering the general character of the book, may be considered as pardonable. It is rather surprising, for instance, in glancing over the index as a condensed illustration of this point, to find the name of our greatest American investigator in the realm even of the "new" physical chemistry, J. Willard Gibbs, entirely missing (he is named once, with honor, on page 491); and it is, perhaps, somewhat amusing to find in the same index the author's name referred to about twice as often as van't Hoff's, whereas in Nernst's "Theoretische Chemie" the proportion is as 25 to 1 in favor of the great discoverer of the relations between osmotic pressure and gas pressure. But, as stated, the stimulating effect of the breezy enthusiasm of the author may be said to offset this fault.

Where much weight is laid—justly—on the extremely important services of the theory of ionization in explaining, qualitatively and quantitatively, in a very simple and beautiful manner any number of otherwise complex phenomena in every field of chemistry, it behooves us, in order to keep the theory above reproach, to be particularly careful not to insist on the adequateness of the theory of ionization in explaining reactions, where experimental facts have been discovered and confirmed that must raise very serious doubts as to the complete correctness of such an explanation. Such a case is Ostwald's beautifully simple theory of indicators.[1]

As the book under discussion, in common with such prominent recent works on physical chemistry as those by Ostwald, Nernst, and Walker, still shows an unquestioning faith in this theory, and no reference to the other side of the problem has been seen in any other text-book, the writer would like to indicate very briefly what the other side is.

According to Ostwald, as is well known, the change of color, in the case of an indicator like phenolphthaleïn, is ascribed to the change simply from the colorless molecular condition,

$$\underbrace{OCOC_6H_4C}_{} - (C_6H_4OH)_2 \qquad (I)$$

to the red negative ion

$$\underbrace{OCOC_6H_4C}_{}.(C_6H_4OH)C_6H_4\bar{O}. \qquad (II)^2$$

[1] Lehrbuch d. allg. Chemie, p. 799 (1891).

[2] Ostwald's "Scientific Foundations of Analytical Chemistry," Jones, p. 260, etc.

Phenolphthaleïn, as a very weak acid, would, indeed, be practically non-ionized in aqueous solution, especially in the presence of even a very small excess of hydrogen ions (from any acid); its alkali salts, undoubtedly would be highly ionized. But nevertheless the change in color is, almost certainly, not due primarily, merely to the change to the ionic condition. As early as 1892, Bernthsen[1] made it appear extremely probable that the color change is really due to a *change* of *constitution* from the colorless lactoïd, form I (with no chromophoric group), to the colored quinoid, form III (with a quinone chromophore),

$$(NaOOC.C_6H_4)(HOC_6H_4)C = C_6H_4 = O. \qquad \text{(III)}$$

This salt is undoubtedly ionized in solution, but the dry molecular, silver salt is also intensely colored (violet), and the change from the colorless to the colored form of phenolphthaleïn is, therefore, primarily due to a change of constitution. This view is in far better accord with our whole knowledge of color in organic compounds than Ostwald's. The strongest evidence that we have in its favor lies in the fact that Nietzki and Burckhardt[2] have prepared *colored* ethers (non-ionizable) of tetrabromphenolphthaleïn,

$$(C_2H_5O_2C.C_6H_4)(HOC_6H_2Br_2)C = C_6H_2Br_2 = O,$$

and

$$(C_2H_5O_2C.C_6H_4)(C_2H_5OC_6H_2Br_2)C = C_6H_2Br_2 = O,$$

with quinoïd molecules and a *colorless* lactoïd ether isomeric with the latter,

$$OCO.C_6H_4C(C_6H_4.OC_2H_5)_2.$$

A similar explanation applies to most, if not all, other indicators. Writers of books on physical chemistry must take into account such facts as those cited above, and as those established by Hantzsch.[3]

Ostwald's theory, admirable in most of its other details, would be in harmony with such facts, and the known general laws governing color in organic compounds, if sensitiveness to a change, for instance, of constitution, *involving a chromophoric group* under the influence of hydrogen or hydroxyl ions were substituted for sensitiveness merely to a change from a molecular to an ionic condition.

JULIUS STIEGLITZ.

[1] *Chem. Ztg.*, p. 1956 (1892).
[2] *Ber. d. chem. Ges.*, **30**, 175 (1897).
[3] *Ibid.*, **32**, 575, 3085, 3109 (1899).