tended over the space within σ lies between two constants greater than 0. All the usual results with respect to the series follow immediately. But uniformity and rigor have been sacrificed, for it is explicitly stated that the question of the proof of the above theorem is left open. In Poincaré's work it is derived on the basis of certain "Poincaré transformations," without appeal to Dirichlet's principle, and E. R. Neumann's work deserves credit for crystallizing the difficulty of the situation in this one theorem, particularly in view of the fact that for a large class of surfaces it has been proven (Korn : Lehrbuch der Potentialtheorie, I, pages 241 and 245), and further generalization is probably possible.

The results desired by the Jablonowski Gesellschaft have on the other hand since been attained in a more far reaching manner through Fredholm's work, especially in its application by J. Plemelj (*Monatshefte für Mathematik und Physik*, volume 15, 1904). The matter of convergence is completely settled and interest in the work of the more immediate followers of Poincaré becomes historical in its nature, with the important exception of certain studies of the behavoir with respect to continuity of surface distributions and their derivatives, upon which the Fredholm method for the potential problems also depends. The present work is of value in both respects and is moreover to be commended for its style and arrangement.

O. D. KELLOGG.

Vorlesungen über mathematische Näherungsmethoden. By Dr.
OTTO BIERMANN. Braunschweig, Friedrich Vieweg und
Sohn, 1905. 227 pp.

"In recent years much has been done to meet the requirements of those who find it necessary to make use of mathematical methods, and it is therefore surprising that as yet no book exists which treats of methods of approximation in mathematics in clear and concise form and so as not to require much preliminary mathematical knowledge." This, the first sentence of the preface, indicates clearly the object with which the book under review was written. We may say at once that it fulfills this object admirably.

The book is divided into six parts treating respectively of : I, calculation with exact and approximate numbers ; II, numerical computation in higher analysis ; III, the approximate

solution of equations; IV, interpolation and the calculus of finite differences; V, application of the methods of interpolation to approximate quadrature and cubature; VI, certain mathematical instruments. It is indeed a startling fact that until now there should be no book devoted to a connected exposition of these topics. Much of the material here collected can of course be found elsewhere. The use of infinite series in numerical calculations (II) is discussed in works on higher algebra and in books devoted exclusively to such series; graphical methods for solving equations (V) are treated in many books on algebra and the theory of equations; we have treatises, large and small, on the calculus of finite differences and methods of interpolation; and approximate methods of integration are discussed more or less adequately in many of the standard texts on the calculus. But that a connected treatment of such topics is desirable needs no argument.

Now that such a treatment exists, however, an argument in the opposite direction presents itself forcefully: we need more of the material of this little treatise in our elementary textbooks. Much of what is contained in part I, on computation with approximate numbers — obtained from measurement, or from exact numbers by approximate processes of calculation — should be contained in our texts on trigonometry, where the student first meets seriously the problem of numerical computation with approximate data. It is manifestly absurd to carry out the computation of the hypotenuse of a right-angled triangle to three decimal places when the two sides have been measured only to within the nearest tenth. Yet such things are done continually in the majority of our present texts. We believe also that the graphical and other approximate solutions of equations and approximate methods of integration should receive more adequate treatment than is usually accorded them in our elementary courses. If the answer is made that there is no time for such things, we would suggest that it might be worth while either to sacrifice some of the topics of more special theoretical interest, or to establish separate short courses on "approximate methods" covering some such ground as does the text under review.

Returning to the latter, the combination of clearness and simplicity of presentation with rigor of treatment is admirably done. The stickler for mathematical precision will find little to criticise, while the seeker for "practical" information will

find the text unencumbered with logical subtleties. Much of the contents, moreover, is of recent date, as is evidenced by the numerous references to journals.

                                                    J. W. YOUNG.

La Statique Chimique Basée sur les deux Principes Fondamentaux de la Thermodynamique. Par E. ARIÈS. Paris, A. Hermann, 1904. viii + 251 pp.

THAT the investigations of Willard Gibbs on the purely theoretical side of physical chemistry have taken a vital place in recent French researches whether on the theoretical or practical side of the subject is due partly to the seed sown long ago by the pioneer Massieu and later assiduously cultivated by Duhem, partly to the translations of Gibbs's memoirs by Le Chatelier and Brunhes, and partly no doubt to the Frenchman's natural admiration and love for a logically developed theory. Ariès in his work on chemical statics shows traces of Massieu, of Duhem, and particularly of Gibbs. In fact, although his notation is not at all that of Gibbs, his ideas are by his own admission largely taken from him.

The book under review is an excellent account of the more important results of the theory of chemical equilibrium. As such books are not numerous and as the original memoirs of Gibbs are not always easy reading, Ariès's volume cannot help but be a very useful addition to the literature of the subject. After presenting the fundamentals of the theory, the author takes up in separate chapters several different applications. We may mention : Change of state and analogous phenomena, some types of dissociation, solutions, monovariant systems, the separation of mixed liquids, mixed gases in equilibrium with mixed liquids, perfect gases, the law of Dalton and Gibbs's principle, dilute solutions, and osmosis.

From this partial list of the subjects treated it will appear that we have here a tolerably complete and systematic account of those parts of theoretical physical chemistry which are likely to be of greatest use to the reader. It is well to mention that in many instances the illustrations and discussions of the author may serve as elucidations of parts of Gibbs's work which on account of their very generality are difficult of comprehension. In particular we should like to call attention to the theory of gaseous equilibria and the principle of Gibbs, chapters XII and