states. This inadequacy of presentation is offset by the addition of an important supplement which Borel himself contributes to the theory of Stieltjes. We regret the omission of the method of Lindelöf. Its dismissal with a half dozen lines and without even a reference to his article in the *Acta Societatis Fennicae* is possibly due to a certain haste in preparation which we have fancied we have detected in several places. While the method of conformal representation (or transformation of the variable) which Lindelöf employs has been applied only to a restricted class of divergent series, it seems probable that it could be developed so as to give a more general theory.

On account of its somewhat abstract character Borel's treatise will probably be of greater interest to the pure mathematician than to the astronomer or student of applied mathematics. Few applications of the various theories have been given, probably because but few applications have yet been made, except in the case of the asymptotic theory of Poincaré. The author leaves us in some uncertainty as to how far his own theory has been carried and applied to differential equations. We hope that in a subsequent edition the important applications will be more fully developed.

We turn now to the little book of Hadamard. This is one of a series of short monographs published under the general title 'Scientia' and devoted to the 'Exposé et développement des questions scientifiques à l'ordre du jour.' The special topic taken up by Hadamard, as has already been stated, is the analytic continuation of a power-series, $a_0+a_1z+a_2z^2+\ldots$. In the consideration of this question two problems of the greatest importance and difficulty present themselves. These are: (1) The determination of the nature and position of the singular points of the analytic function defined by the series, and (2) the calculation of the value of the function at points exterior to the circle of convergence.

Hadamard has had the extremely difficult task of compressing into a few pages what has been done on these problems. In this he has succeeded admirably. It is extraordinary what an amount of information is packed away in the space of one hundred pages. Yet the work is no dry compilation of facts. Nowhere is the skill of the author more fully shown than in the manner in which he has woven his materials together. The theorems are analyzed, their significance is pointed out, and their demonstrations are outlined sufficiently to show the manner in which the subject is treated. Attention should also be called to the excellent bibliography with which the book opens and to which reference is constantly made. In correlating the one hundred and fifty memoirs here included Hadamard has performed a very important service. His admirable report is not suited to the reader who has little acquaintance with the general subject, but to the specialist and investigator it will be invaluable.

E. B. Van Vleck.

The Elementary Principles of Chemistry. By A. V. E. Young, Professor of Chemistry in Northwestern University. New York, D. Appleton & Company. 1901.

This book differs so radically from those in general use that if reviewed at all, it must be at some length. The author has used this method successfully for thirteen years; his object being to instruct the student during the first year by this method, which he calls the quantitative method. He says that its inception is due to Professor Josiah P. Cooke, of Harvard; he believes it 'both scientifically and pedagogically an improvement on prevailing methods.' The presentation of a topic in the text is to be studied by the student after performing the laboratory experiment illustrating the same.

The first 97 pages of the book are devoted to the physical and chemical properties of substances and to simple theoretic chemistry, including the fundamental quantitative laws of chemical action, the gas laws, atomic and molecular theory, kinetic theory of gases, structure and stereoisomerism. The author lays particular stress on the quantitative laws, and also on the laws of Gay Lussac, Dulong and Petit, Mitscherlich and Raoult, as illus-

trating the relation between equivalent weights and certain specific properties. The remainder of the book (147 pages) is 'On the relation between the properties of the elements in general and their combining weights; description of the first twenty-five elements and some of their compounds.' These elements are those comprised in the first three horizontal series of Mendeléeff's chart of the periodic system. The properties of the commoner elements of this selection and their compounds are described in considerable detail. Here the book proper ends. A second part (106 pages) gives the experimental illustrations and instruction in details of laboratory work. The book is illustrated by full-page portraits of many of the chemists and physicists mentioned.

This is indeed a different treatment from that commonly followed. A course in chemistry in which copper, mercury, silver and lead are ignored, while beryllium and cobalt find consideration is not common. Yet this does not prove that it is wrong. The author lays chief stress on general laws. The student's comprehension of a law is based on a roughly quantitative experiment illustrating it which he performs before studying the law. The experiments merit attention; they are well devised and easy to perform. The author illustrates these laws further by the behavior of a number of elements, including important metals, and most of the important acid-forming elements.

It is not the object of a college course in science to form specialists, and the question may be fairly asked whether the mental discipline and the capacity to pursue the study of chemistry afforded by this method are not of equal value, or (as the author believes) of greater value than can be obtained by the prevailing method. To those who agree with the author this book should be welcome.

The book has one grave defect, in omitting all mention of electrolytic dissociation. The author anticipates criticism in a passage on page eight of a pamphlet called 'Suggestions to Teachers' which accompanies the book; he says: 'Some perhaps would wish to include osmotic pressure and the electrical phenomena of conductivity, etc., together with the theory of ionization, but I have judged it impracticable to illustrate these phenomena experimentally without displacing other matter or going beyond the reasonable scope of one year's work.' To this the obvious answer is, that with our present knowledge it would be better to displace other matter, if need be, than to omit anything so fundamental and so easy of illustration as electrolytic dissociation, from a book called 'Elementary Principles of Chemistry.' With the hope that this gap may be filled in the next edition, the reviewer commends Professor Young's book to the attention of college and advanced high school teachers, who will find it suggestive.

E. RENOUF.

Studies in Evolution. By CHARLES EMERSON BEECHER. New York, Charles Scribner's Sons. 1901.

This is a notable volume. It is one of the series of the Bicentennial Publications of Yale University, and consists mainly of reprints of occasional papers selected from previous publications of the Laboratory of Invertebrate Paleontology, Peabody Museum. The most important are those on the structure and development of trilobites, and the 'Studies in the Development of the Brachiopoda.'

The aim of the first essay, 'On the Origin and Significance of Spines,' is an attempt, in the terms of ontogeny, phylogeny and chronology, to apply the general law of evolution to the spines of plants and animals. The discussion is a very interesting one, and we think Dr. Beecher satisfactorily shows from a great number of cases discovered by numerous observers that spines are a characteristic of the old age, both of the individual and of the type. In old age the organism, during the senescence of the type, 'blossoms out with a galaxy of spines, and with further decadence produces extravagant vagaries of spines, but in extreme senility comes the second childhood, with its simple growth and the last feeble infantile exhibit of vital power.'

We are inclined to think that the author is a little too hospitable to Wallace's notion that spines on desert plants may originate from