inquiry, expression and servant of that imperious curiosity which in a measure impels all men and women, but with an urgency like destiny literally *drives* men and women of genius, to seek to know and to teach to their fellows whatsoever is worthy in all that has been discovered or thought, spoken and done in the world, and at the same time seeks to extend the empire of understanding endlessly in all directions throughout the infinite domain of the uncharted and unknown." As to research, the author believes in the three-fold organization of a university staff, the administration, the teaching staff, and the research staff. He characterizes his conceptions of the three thus: the great administrator is a man of constructive genius, the great teacher is a source of inspiration, the great investigator is a discloser of the harmonies and invariance hid beneath the surface of seeming disorder and of ceaseless change.

The delightful style of the author, permeated as it is with lofty sentiment, keen appreciation of beauty, wealth of imagery, striking illustrations, wide choice of terms, classical allusion, and warm feeling, makes the reading of these essays on rather abstract philosophical topics a pleasure as well as a profit. Every student of mathematics should read the book and catch the inspiration of enthusiasm for the divine science. "Mathematics is, in many ways, the most precious response that the human spirit has made to the call of the infinite and eternal. It is man's best revelation of the 'Deep Base of the World.'"

JAMES BYRNIE SHAW.

Four Lectures on Mathematics. (Delivered at Columbia University in 1911.) By J. HADAMARD, Member of the Institute, Professor in the Collège de France and in the Ecole Polytechnique, Lecturer in Mathematics and Mathematical Physics in Columbia University for 1911. New York, Columbia University Press, 1915. v + 52 pp.

ALL those who have had the pleasure of hearing Professor Hadamard's lectures have doubtless remarked his unusual facility in opening up wide vistas in the course of a relatively brief discussion. It is natural to expect such a facility to appear at greatest advantage in a set of lectures that are intended to be primarily inspirational, such as the above, and in this case the expectation is amply realized. By the omission of practically all technical details, Professor Hadamard has succeeded in giving a bird's-eye view of some very extensive domains of mathematics in the course of these four lectures.

The first lecture deals with solutions of linear partial differential equations determined by boundary conditions, and the central topics are Cauchy's problem and Dirichlet's problem. The essential differences in nature of these two problems are set forth in clear and elegant fashion, and an illuminating discussion of their relationship to certain important physical problems is given. The lecture closes with a quotation from Poincaré on the service of physics to analysis in furnishing important problems whose solutions can frequently be predicted on physical grounds.

The second lecture deals with contemporary researches in differential, integral, and integro-differential equations. In discussing the solution of Dirichlet's problem by means of integral equations, the writer reminds us that the complete solution of a mathematical problem suggested by a physical problem may only be arrived at after interest in the physical problem has been lost. But at the same time he consoles us by pointing out the compensating feature that the mathematical solution may be of very great use in connection with other physical problems of greater actuality. The rest of the lecture concerns itself mainly with important investigations in differential and integro-differential equations that have been inspired by the consideration of certain physical problems. It is pointed out that under the present hypothesis of the discrete structure of matter, physical problems tend to lead to ordinary differential equations rather than to partial ones.

The third lecture is devoted to a discussion of analysis situs. The essential nature of this important branch of mathematics and its invaluable assistance in developing the theory of certain other branches, is very clearly brought out in brief compass. It is shown that in dealing with certain types of problems, analysis alone is insufficient to resolve all the difficulties without the powerful aid rendered by analysis situs. The rôle of each branch is shown in very illuminating fashion by comparison with a map of a large country given on a series of partial leaves that can only be put together by means of an "assembling table" showing the general disposition of the leaves.

The fourth and final lecture is devoted to elementary solutions of partial differential equations and Green's functions. A brief but comprehensive résumé of recent investigations concerned with these two topics is given. The writer points out that the important difference between the Green's function and the elementary solution of the corresponding differential equation, corresponds to a similar difference between Cauchy's problem and Dirichlet's problem. That is to say the Green's function, like Dirichlet's problem, depends very closely on the form of a certain surface or hypersurface, whereas the elementary solution, like Cauchy's problem, does not. From this fact it is readily seen that considerations of analysis situs will play an important rôle in the study of Green's functions. Hence these functions are related to all the principal topics of the preceding lectures, and therefore, as the writer expresses it, a discussion of them forms an appropriate conclusion.

CHARLES N. MOORE.

Die elliptischen Funktionen und ihre Anwendungen. Erster Teil. By ROBERT FRICKE. Leipzig, B. G. Teubner, 1915. x+500 pp. Price 22 Marks.

THE present volume is the first of a series of three which Dr. Fricke proposes to write on the elliptic functions and their applications. It appeared in October, 1915, and is devoted to the function theoretic and analytic bases of the theory of elliptic functions. One would naturally expect that a treatise on elliptic functions from the pen of Dr. Fricke would follow the lines of thought developed by Klein and his students thirty-odd years ago. Consequently, on turning the pages of the present volume, one is not surprised to be reminded again and again of modes of thought, of formulas, and of geometric diagrams made familiar through the Klein-Fricke Modulfunktionen. Dr. Fricke refers to this when he writes in the preface: " That I should adhere in the main to the methods of presentation, the use of the invariant theory, geometric representation, and so forth, which more than thirty years of close scientific companionship with my teacher and friend F. Klein have made my own, I may regard as self-evident."

The introduction, consisting of 105 pages, is devoted to an exposition of theorems concerning analytic functions of a single complex variable. This material is made to lead up to a statement of the basic problems of the theory of elliptic func-