The chapter closes with an article on the approximate solution of differential equations by a method of dividing the interval of integration into m equal parts and considering the coefficients constant in each subinterval. Here, as in all other cases, formulas are given for the possible error in the solution.

Throughout the book the important formulas are numbered with Roman numerals and prominently displayed. The author has supplied a correction to formula (X) as given at the bottom of page 41. The fraction $(m+1)\pi/(\lambda\nu M)$ should be inverted.

The reviewer thinks the usefulness of the book would have been increased if the author had worked out one or two simple examples and shown the reader how to apply the more important formulas to concrete problems. Nevertheless, the book constitutes a valuable addition to the literature of analysis and mathematical physics.

J. B. SCARBOROUGH

McCONNELL ON ABSOLUTE CALCULUS

Application of the Absolute Differential Calculus. By A. J. McConnell. London and Glasgow, Blackie and Son, Ltd., 1931. xii+318 pp.

Criticism of this book had best be limited, I think, to the general impression it has made upon me and to my opinion regarding its use as a text in American colleges. In this latter connection I have had a somewhat limited experience, one of my students having studied the book as part of a course in independent reading.

The book is divided into four parts, the first part being devoted to the algebraic preliminaries including such items as the summation convention, coordinate transformations, quadratic forms, tensors, the quotient law of tensors, etc. Part II gives a treatment of the straight line, plane, and cone on the basis of rectangular coordinates; this part also contains a study of affine transformations, including strains and infinitesimal deformations. In Part III we have the differential geometry of curves and surfaces. Part IV contains applications of elementary tensor theory to the dynamics of a particle and rigid bodies, electricity and magnetism, mechanics of continuous media, and ends with a brief account of the special theory of relativity.

An objection which was immediately noticeable to me and one which I do not regard by any means as trivial is McConnell's definition of the tensor (see pp. 2, 20 and 32). McConnell has, in fact, defined the components of a tensor as the tensor itself—the tensor being the object obtained by abstraction from its components with respect to the totality of coordinate systems whose coordinates are related by the underlying family of transformations. Most of us who have written on the subject of tensor analysis have been guilty of using the symbol of the component of the tensor to represent the tensor itself; it is frequently convenient to do this and on one occasion I stated in my writings that this would be done to avoid the multiplicity of symbols which would otherwise arise. Extreme care, however, should always be taken to avoid confusing statements in textbooks intended for elementary students; and a definition of the tensor in which the tensor is confused with its components is hardly excusable in a text on tensor analysis.

Now it seems to me that the primary purpose of an elementary book on tensor analysis should be to give the student an appreciation of the methods and point of view of this subject and that beyond that nothing should be attempted. This should be accomplished by giving the applications of the tensor analysis to geometry and mechanics as McConnell has in fact done; but McConnell has given a mass of detail in connection with this treatment of these subjects which I believe is extremely detrimental to the above mentioned purpose. For example, he has given on page 53 three forms of the equation of the plane, whereas the simplest of these, namely equation (2), would seem to be sufficient. He has undertaken a detailed study of the cases under which two planes are parallel and not parallel; he has then undertaken a similar and even more involved discussion of the case of three planes. This tendency for detail which is characteristic of the book from cover to cover contributes nothing to an essential understanding and appreciation of the applications of the tensor analysis. It is a detriment to the progress of the conscientious student who on his own responsibility attempts to read the book from beginning to end. All students, whether conscientious or otherwise, may expect difficulty in separating the essential from the unessential elements.

In the application of the tensor analysis to geometry it is, in my opinion, extremely desirable to emphasize what may be called the invariant theoretic viewpoint, that is the point of view in accordance with which we regard the study of geometry as the study of those configurations and their associated magnitude which remain invariant under the underlying group of coordinate transformations. On the basis of this point of view we can construct our invariant entities first, by the methods of the tensor analysis, and then inquire later as to their geometrical interpretation. The invariant theoretic viewpoint which is interesting and illuminating in euclidean geometry and which has proved fruitful in recent work on generalized geometries, passes unnoticed by McConnell.

With an instructor of some experience in the subject of tensor analysis, who can in fact make the proper selections and place the emphasis on the proper points, the book should not prove unsatisfactory for class room use. Under other conditions I believed that the book will be unsatisfactory for the above mentioned reasons. The binding and printing are excellent.

T. Y. THOMAS