

FOUR BOOKS ON VECTOR ANALYSIS

1. *Vectorrechnung*. By Jean Spielrein. 2d edition. Stuttgart, Konrad Wittwer, 1926. xvi+434 pp.
2. *Die Vektoranalysis und ihre Anwendung in der theoretischen Physik*, Teil 1: *Die Vektoranalysis*. Teil 2: *Anwendung der Vektoranalysis in der theoretischen Physik*. By W. v. Ignatowsky. 3d edition. Leipzig and Berlin, Teubner, 1926. x+110 pp.+iv+123 pp.
3. *Die ebene Vectorrechnung und ihre Anwendungen in der Wechselstromtechnik*; Teil 1, *Grundlagen*. By Heinrich Kafka. Leipzig and Berlin, Teubner, 1926. viii+132 pp.
4. *Initiation aux Méthodes Vectorielles et aux Applications Géométriques de l'Analyse*. By G. Bouligand and G. Rabaté. Paris, Librairie Vuibert, 1926. viii+215 pp.

A course in vector analysis is now regarded as a necessary part of the training of any student of physics or of applied mathematics. Indeed no one can intelligently study any branch of mathematics without soon meeting the concept which is at the foundation of the whole subject of vector analysis, namely the concept of invariance under certain specified types of transformations. It is the great merit of the modern treatment of tensor analysis that the allowable transformations are kept as general as possible; for most purposes differentiability and reversibility being sufficient. Looked at from this point of view tensor analysis is a *general* vector analysis in the sense of E. H. Moore. It seems, then, to the present reviewer a little unfortunate that the writers of texts on vector analysis still treat in such detail the special vector analysis where the allowable transformations are those from one set of rectangular Cartesian coordinates to another. No doubt the reason given would be a pedagogic one but very often a view from a higher standpoint gives a real understanding that is almost impossible to secure from a lower level.

The first of the books under review is encyclopaedic in character, and can be highly recommended as a reference work rather than as a text. Some idea of its completeness may be gathered from the fact that appended to the book is a "Formelsammlung" in which are listed no less than 881 of the principal results. A rather severe attack of mental indigestion would threaten an immature student who tried to learn his subject from this book. A very valuable feature of the book, which is carefully printed and bound, is a collection of 190 problems with detailed solutions. The following chapter headings will give an idea of the contents.

Elementare Vektoroperationen. Besondere Vektoren. Bezeichnungen. Funktionen skalarer Veränderlichen. Ortsfunktionen. Geometrie der Vektorfelder. Lineare Vektorfunktionen. Affinoralgebra. Affinoranalysis.

The books 2 and 3 are, respectively, nos. 6 and 22 of the valuable series of monographs, known as the "Sammlung Mathematisch-Physikali-

scher Lehrbücher," which is being published under the general editorship of E. Trefftz. Ignatowsky's work is now in its third edition and is well and favorably known. It is not intended to be nearly as complete as Spielrein's work to which it refers for more advanced parts of the subject. The first edition (1909-1910) was reviewed in this Bulletin (vol. 17, pp. 102-104). The changes in the third edition are of a minor character. For a student interested mainly in physical applications this book is one of the best on the subject. Kafka's book is intended principally for students of electrical engineering. Here consideration is restricted to plane vectors and the subject is merely a geometrical consideration of complex variable theory. The electrical engineer has by this time a pretty definitely established mode of treatment; this is very different, at least in matters of detail, from the established method of the mathematician. The present work should be very useful and easy reading for a student beginning the study of functions of a complex variable.

The book by Bouligand and Rabaté is very different from the three already mentioned, reflecting a national difference of emphasis. Here the interest is almost entirely geometrical and the treatment is clear and elementary. We would recommend the work to a student who contemplates a study of Darboux's monumental work on the theory of surfaces, or of Appell's treatise on mechanics. The following chapter headings give a good idea of the contents.

Vecteurs. Produit scalaire et applications. Produit vectoriel. Théorie des moments; systèmes de vecteurs glissants. La dérivation géométrique et la théorie des courbes. Étude intrinsèque des fonctions de point. Problèmes d'intégration aux point de vue géométrique. Théorie des surfaces.

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