Vector Analysis and the Theory of Relativity. By Francis D. Murnaghan. Baltimore, The Johns Hopkins Press, 1922. x + 122 pp.

This book is a brief exposition of what is commonly called the mathematics of relativity. The term vector analysis is used in a broad sense as equivalent to tensor analysis. Addressing himself primarily to the physicist the author connects up the new concept with those parts of mathematics with which the physicist may be assumed to be familiar. Thus after defining non-metrical n-dimensional space and spreads therein, the subject of tensors is approached through the consideration of integrals over such spreads which are independent of the parameters in terms of which the spread is given. After tensor algebra has been developed, it is applied to the proof of a generalized form of Stokes's lemma.

Metrical space and its attendant tensors are next considered and the relation between tensor analysis and the ordinary vector analysis noted. The resolved part of a tensor in an arbitrary direction is found and application made to a proof of a generalized form of Green's Theorem and to a discussion of Maxwell's equations.

The fifth chapter is a digression which the author advises be omitted in a first reading. It deals with the connection of tensor algebra with integral invariants and application to the statement of Faraday's law of moving circuits. It serves as another example of the fact emphasized in the book, that the methods of tensor analysis are by no means limited in their physical application to the relativity theory.

In the next chapter come covariant differentiation, the Riemann four index symbol, and Einstein's gravitational tensor. And finally the last chapter leads from the general tensor equations for the gravitational tensor to their solution in terms of a particular coordinate system for the field of a single particle and thence to the motion of the perihelion of Mercury and the bending of a light ray which grazes the sun. This jump from the general to the specific, which in so many of the works on relativity seems fraught with danger to life and limb, is here presented with a clarity and definiteness that delights the heart. Frequent examples involving the transformation from rectangular cartesian to space polar coordinates are used to illustrate the tensor analysis.

To the reviewer the approach to the tensor through integrals over a spread which are invariant under all changes of the parameters giving the spread is not as simple and direct as that through the differential properties of the spread. But the book is not an introduction to the relativity theory, and if we assume the reader already introduced to the theory we probably may assume a bowing acquaintanceship with its mathematics, and if this is the case the new point of view here developed will give him added insight into tensor analysis.

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