

MATHEMATICAL METHODS IN PHYSICS.

Sur quelques Progrès récents de la Physique mathématique. Par VITO VOLTERRA, Clark University Lectures of 1909, published by Clark University, 1912. 82 pp.

Drei Vorlesungen über neuere Fortschritte der mathematischen Physik. Von VITO VOLTERRA, mit Zusätzen und Ergänzungen des Verfassers. Deutsch von Dr. ERNST LANELA. Sonderabdruck aus dem *Archiv der Mathematik und Physik*, III. Reihe, Band XXII, Heft 2/3. B. G. Teubner. Leipzig.

Leçons sur l'Intégration des Equations différentielles aux Dérivées partielles. Par VITO VOLTERRA. Professees à Stockholm. Nouveau tirage. Paris, Hermann. 1912. 3 + iv + 83 pp.

The first of these books consists of three lectures delivered at Clark University, and afterwards printed by the University.* They have since appeared in the second form in German in the *Archiv der Mathematik und Physik*, (3), 22 (1914), pages 97–182. In the latter form some of the details omitted in the original are supplied. The third book is a reprint of lectures delivered at Stockholm in 1906. There have been added some corrections, and some bibliographical notes. These lectures are striking examples of the intimate relationship between the advance of mathematics and that of physics.

The fundamental notion of the Stockholm lectures is that the theories of the propagation of heat, of hydrodynamics, elasticity, Newtonian forces, and electromagnetism can all be treated from a single point of view—reducing indeed to differential equations of the same general form but of three types, the facts and the processes used following the types. A good supplementary paper to read along with the first part of the lectures on differential equations, containing examples and more detail, is to be found in the *Annales de l'École Normale*, (3), 24 (1907), page 411. The most interesting part of the lectures is the introduction of the notion, due to Professor Volterra, of *function of a line*. In the fifth lecture this notion appears, and is indeed the guide to a generalization of the

* The volume also contains lectures by Rutherford: "History of the alpha-rays from radio-active substances"; Wood: "The optical properties of metallic vapors"; Barus: "Physical properties of the iron carbides."