the point of view of the principle of relativity, motion cannot be infinitely fast; those interested in these theories may discuss the mechanics founded on the assumption $W = m_0(1 - \sqrt{1 - v^2})$.

It would be useless here to follow in detail the three great sections of the text, namely, equilibrium of an elastic filament, equilibrium of an elastic surface and dynamics of an elastic filament, and equilibrium and motion of a continuous medium; they will be followed in detail by all earnest students of these topics. We prefer here to point out an advantage and a disadvantage of the Cosserats' system. In the main these are those associated with the transfer of any deductive-intuitional physical science to the corresponding formal-deductive mathematical discipline. The gain is in sureness, in freedom from constant doubtful appeal to intuition; a great variety of possible assumptions and corresponding cases may be discussed systematically and accurately from a given uniform point of view. Those who have taught the theory of elasticity will most appreciate this advantage. The loss is in the lessened training of that physical intuition, which is vital for the future success of the young physicist and which can be acquired only by practice in making such various plausible, but not demonstrated, assumptions as are frequent in the theory of elasticity. The simplest explanation of the world already subdued may in the last analysis be mathematically formal; but the subjugation of the regions not yet reached can in the first instance be accomplished only by the imagination.

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SHORTER NOTICES.

Opere Matematiche. By GIULIO CARLO DEI TOSCHI DI FAGNANO. Pubblicate sotto gli Auspici della Società Italiana per il Progresso delle Scienze. Per cura dei Professori Senatore Vito Volterra, Gino Loria, e Donisio Gambioli. Rome, 1912. 3 Vols. 40 lire.

IF we were to select from the great mathematicians of the world a half dozen whose works we might deem worthy of

new editions, or whose scattered monographs deserve to be brought together, it is hardly probable that the name of Fagnano would be in the list. Well known as he was, nevertheless he was hardly one of the world's great builders of science, nor was he one who laid deep its foundations or extended its applications into fields of great importance.

Born of a distinguished family that occupied the Castle of Fagnano for many generations, and that later settled in Senigallia, a family that had provided one pope and many distinguished citizens, the Conte Giulio Carlo early gave evidence of his noble breeding. At the age of ten he cultivated poetry, and soon after he published some philosophical verse on the resurrection. He studied in the Collegio Clementino at Rome, devoting his attention exclusively to letters, philosophy, and theology. Mathematics was not a favorite of his at first, but he seems to have been led to study the science through the philosophy of Leibniz, Wolf, Newton, and Malebranche.

It was in 1718 that Fagnano, then 36 years old, published his best-known memoir, the "Metodo per misurare la lemniscata," a contribution that at once attracted attention and was followed by numerous other essays, most of them appearing in the *Giornale de' Letterati d'Italia*. In 1743 an event happened which led to the collection and amplification of his memoirs, namely, the discovery of the insecurity of the dome of St. Peter's. Pope Benedict XIV, wearied of the discussions among Boscovich, Jacquier, Le Seur, and the Roman architects, and hearing from Monsignore Nicola Antonelli of Senigallia of the abilities of Count Fagnano, sent for him, and was so impressed with his powers that he ordered the publication of his works. This was in 1743, but it was not until 1750 that the Produzioni matematiche actually appeared, and then under circumstances not altogether pleasing with respect to the relations between the author and his patron.

The lemniscate, as is well known, was first described by the Bernoullis in 1694. To them Fagnano gives credit in the opening sentence of his Metodo. His work consisted chiefly in measuring the curve and in first bisecting its quadrant, and then dividing it into $2\cdot2$, $3\cdot2$, and $5\cdot2$ equal parts. It was because of this work that he felt justified in speaking of it as "mia curva," nor can we take exception to this claim as made in the investigations beginning in 1718. It was Euler, how-

ever, to whom the analytic theory is chiefly due (in volume 5 of the *Mémoires de St. Pétersbourg*).

An examination of the Produzioni shows that it is as an algebraist that Fagnano deserves chief recognition. To be sure he devotes a large amount of space to his Teoria generale delle proporzioni geometriche, so much space that few readers will be found who care to master it, but it is in his Applicazione dell' algoritmo nuovo that one finds displayed an interest in the field of mathematics in which Italy stood preeminent from the time of Ferro and Florido. Fagnano's treatment of equations, his ability to handle skilfully the complex number, and his contributions of a *nuova maniera* of handling cubic and quartic equations, are quite as noteworthy as his discoveries in the theory of the lemniscate.

Of the three volumes edited and published with such care by Professors Volterra, Loria, and Gambioli, the first contains Volume I of the Produzioni matematiche, devoted chiefly to geometric proportion and the " new algorism " applied to the treatment of equations. The second contains Volume II of the Produzioni, chiefly concerned with the theory of the triangle, special problems in the calculus, and the lemniscate. The third volume contains Fagnano's other scientific and polemic writings, a large number of his letters, and his biography.

Whether or not one feels that the standing of Fagnano justifies the republication of his memoirs and his *opus magnus* before those of other scientists whose works are out of print, he cannot deny the value of the labor undertaken by the Società Italiana per il Progresso delle Scienze, nor withhold the praise that is so justly due to Professors Volterra, Loria, and Gambioli.

DAVID EUGENE SMITH.

The Method of Archimedes Recently Discovered by Heiberg. A Supplement to the Works of Archimedes, 1897. Edited by Sir THOMAS L. HEATH, K.C.B., Sc.D., F.R.S., Sometime Fellow of Trinity College, Cambridge. Cambridge University Press, 1912. 51 pp. Two shillings and sixpence net.

IT is nearly four years since there appeared in *The Monist* Miss Robinson's translation from the German of the treatise on mechanics by Archimedes discovered by Heiberg in 1906. It was this reviewer's privilege to write a brief introduction to that translation, and all this material appeared in pamphlet