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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THEORETICAL MECHANICS.

Cours de Mécanique Rationnelle et Experimentale, spécialement écrit pour les physiciens et les ingénieurs, conforme au programme du certificat de mécanique rationnelle. By Prof. H. Bouasse. Pp. 692. (Paris: Ch. Delagrave, n.d.) Price 20 francs.

A NOTICEABLE feature of this treatise on theoretical mechanics is the large number of practical examples discussed. The majority of these are of a physical rather than an engineering character, some of them dealing with physical apparatus. Investigations of oscillations under various conditions occupy a considerable part of the book. The author claims mechanics as a branch of physics, the first chapter of physics, and aims at supplying a treatise of the kind which is likely to be useful to those whose interest in the subject depends on its applications to practical physical questions. He protests against the unpractical character of the French treatises on the subject written by mathematicians, and of the questions asked in examinations.

To a considerable extent the book fulfils its aim. It contains a great deal of information (including some useful fragments of mathematics connected only incidentally with mechanics), and it is for the most part written in a pleasant, lucid style, slightly marred by occasional eccentricities. As much of the theory is included as is generally needed for practical use, no attempt being made to restrict the use of mathematical methods. There are, however, some slips. An important one, which should puzzle a reader unacquainted with the subject, occurs in the investigation of Euler's equations. Occasionally also the methods adopted are clumsy or unduly ponderous.

A case of ponderous treatment of theory occurs in so simple a matter as the investigation of the composition of angular velocities. The author hints at reasons, not fully explained, which appear to him to make it desirable, "in order to avoid all difficulty," to derive the composition of angular velocities from the study of a succession of finite angular displacements.

He goes on to discuss the theory of this at considerable length, a rather tiresome procedure.

Now the meaning of the composition of simultaneous motions is not a very easy thing to understand, and ought to be a matter for clear definition. Without a definition, expressed or implied, it is unintelligible. Prof. Bouasse does not give a definition of it, but he implies that the resultant motion is to be calculated from the limiting case of successive displacements when these are small. Such a method of treatment is not uncommon, but surely the method afforded by the consideration of relative motions taking place simultaneously is preferable. In the case of angular velocities, the mounting of a body in gimbals provides the mechanism which is needed for a clear conception of the composition, the angular velocity of the body being the resultant of its angular velocity relative to an intermediate base and the angular velocity of this base relative to the final one. The difference between the two methods of treatment is not solely one of style. The resultant is given by either method, and an experienced reader would pay no attention to any other feature of the arrangement adopted. But inexperienced readers, for whom the more elementary parts of a book like this must be intended, might reasonably be puzzled by perceiving that successive displacements do not give results identical in all respects with what is proposed. The path of a point of the moving body remains a zigzag up to the limit, and if the length of this path were the thing to be calculated the method of successive displacements would not give a correct result. If the limit of successive displacements is to be regarded as the definition of the composition, it ought to be a correct method for calculating everything about the motion.

It might be expected that a professor of physics, who regards mechanics as a branch of his subject, would give some attention in detail to the physical laws which form the basis of his calculations. Our author, however, frankly ridicules the idea of questioning the truth of them, and does not even take the trouble to state them correctly. He professes to deal with the subject from the beginning, but any reader

who had no previous knowledge of it would be bewildered. No pure mathematician could be more careless as to what the equations which he desires to write down are based upon, or show less interest in the question whether the results to which they lead are verified. Moreover, he does not explicitly refer to the base, relative to which the motions studied are reckoned, according to the theory which he is using, or appear to take any interest in the remarkable fact that the observed motions of bodies define such a base, which presumably has some relation to other physical phenomena. The only occasion on which he attempts to deal with the foundations of the subject is in connection with the law of action and reaction in statics, the treatment of which is clumsy and unconvincing, perhaps even unintelligible.

As in the case of the rest of physics, there are two ways of looking at mechanics, each of which has its own proper place. One is to regard all parts of the subject as coordinated by means of a generalisation which is as comprehensive as possible. The other is to aim rather at isolating the points involved in the subject, so that any degree of independence which they possess may be recognised, and so that it may as much as possible be seen how far the most precisely ascertained results carry us, and whether a doubt cast on any particular doctrine affects the whole foundation of the subject or not. Though the attainment of the former is the constant aim of scientific study, the latter is the proper attitude in which to approach it, and it seems to be a mistake to write the first chapter of physics in a different spirit.

W. H. M.

CANNIZZARO'S COURSE OF CHEMICAL PHILOSOPHY.

Sketch of a Course of Chemical Philosophy. By Stanislaò Cannizzaro (1858). Alembic Club reprints, No. 18. Pp. iv+55. (Edinburgh: The Alembic Club, 1910.)

THE Alembic Club have done well at this juncture to publish a translation of Cannizzaro's famous letter to De Luca—a letter which, to use Davy's phrase in connection with an equally memorable pronouncement, acted like an alarm-bell on Europe. Indeed, now that he has joined the majority, no more fitting monument to the perspicacity and genius of the great Italian chemist could be conceived than the publication, in the form of an admirably executed translation, of that statement of doctrine which astonished and ultimately convinced the chemical world of the mid-Victorian epoch.

To the chemists of the present age it is hardly possible to convey an idea of the profound sensation which this letter created. The effect was immediate and irresistible. At that time the name of Cannizzaro was hardly known beyond a limited circle of French and Italian men of science. With the appearance of the message came the conviction that a Daniel had come to judgment—that a prophet and a law-giver had arisen amongst us. The middle period of the last century was a time of political ferment

and social unrest, and here and there it culminated in revolution. It was equally a period of disturbance and upset in other spheres of human activity than politics and sociology. In chemistry, more perhaps than in the case of any other science at that time, the old order was changing, but the process was destructive rather than constructive. Old faiths were being undermined and thrown down, but the new dogmas had not stability enough to supplant them.

Cannizzaro's letter appeared at what, in the cantphrase, is termed the psychological moment. It brought order, method, and arrangement into what hitherto had been a mass of inconsistency and contradiction. Its logic was so clear, its appeal to history and to well-ascertained fact so irrefutable, its statement of proof so admirably marshalled, that criticism was silenced, and the doubter disarmed. Before a decade had passed its principles were everywhere accepted, and it is not too much to say that Cannizzaro effected a revolution in chemical thought as momentous in its way as the revolution he was subsequently concerned in bringing about in the political development of Italy.

To the student of chemistry it would be superfluous to enter into an analysis of Cannizzaro's letter, as its principles are now intimately woven into the web of modern chemical doctrine. Indeed, so indissolubly associated is the fundamental basis of Cannizzaro's chemical philosophy with the chemical philosophy of to-day that the statement of these principles, or of the course of argument upon which they are based, would have the semblance of a platitude. But we can assure the student that, however familiar he may be with the outcome of the doctrine with which the name of Cannizzaro will be imperishably connected, he will read with admiration and delight the *pronunciamento* in which the Genoese chemist makes known to his friend and colleague, and through him to the world, the dogma of what was henceforth to be the new chemistry—with admiration for the extraordinary perspicacity and conviction of its argument, and with delight at the simplicity and force of its statement.

T.

PRUNING OF FRUIT TREES.

Fruit Tree Pruning. A Practical Text-book for Fruit-growers working under the Climatic and Economic Conditions prevailing in Temperate Australia. By George Quinn. Pp. vi+230. (Adelaide, Australia: R. E. E. Rogers, Acting Government Printer, 1910.) Price 1s. 3d.

THE pruning of fruit trees is an operation that demands, on the part of the operator, first, an intimate knowledge of the natural habits of the particular trees, and, in the second place, considerable experience of the general results which follow a proper system of pruning. Unfortunately, every gardener and amateur who cultivates ever so few trees gets the conviction that, come what will, he must prune, and, if he is ignorant of the methods, nevertheless he mutilates the branches and imagines that his trees will respond satisfactorily to the treatment given