

THE TEACHING OF MECHANICS

AMONG the many functions which had to be cancelled when hostilities broke out between Germany and Poland was a discussion, due to be held by the British Association at Dundee on September 2, on "The Teaching of Mechanics". This subject holds a peculiar position in the curriculum, lying as it does in the region between physics and mathematics, and having the character both of a severely academic subject and of a cultural one.

The opener would have been Prof. E. A. Milne, who proposed to consider the teaching of the subject to schoolboys, undergraduates, and research workers in turn; in the first stage, experiment should be dominant. It is not surprising, in view of Prof. Milne's own work and experience, that he should suggest that in the third stage, the tacit assumptions of the existence of rigid bodies and of the uniform flow of time should be subjected to criticism. He also offers the suggestion that the logical unsatisfactoriness of quantum mechanics may be due to want of interest in the foundations of mechanics among those who work on the subject.

With Prof. Milne's views we may compare those of Prof. R. Peierls, who was to have been the closing speaker, and who remarked to the present writer that he was sufficiently new to the task of teaching mechanics to feel an interest in its problems and technique. He finds it difficult to steer a true course between the Scylla of special examples and the Charybdis of general theorems, and he feels also that 'statics-and-dynamics' takes up too much time, to the exclusion of elasticity, hydrodynamics and even electricity and optics. On detailed points, he would like to see more use made of dimensional arguments, and the asymptotic solutions of problems (a plea which the writer heartily supports), whilst Prof. Milne stresses in particular the value of vectorial methods as developed by S. Chapman.

The two papers to have been given between these were both by teachers in schools. Mr. K. S. Snell, of Harrow, feels that in the general introduction, to be taken by all boys, experiment should be fundamental, and the appeal to phenomena of daily life should be frequent. This introduction would thus satisfy those who demand cultural value in the subject. For the other course, to be taken afterwards by boys who intend to specialize in science subjects, Mr. Snell feels that the order should be reversed, the subject being developed mathematically, and the deductions checked by experiment. This is, of course, the line followed in much of the historical development of the subject, and allows far fewer principles to be used than the alternative method where experiment is made basic at each step.

It was fitting that at a meeting held in Dundee one of the speakers should represent Scottish schools, and this role was filled by Dr. G. P. Tarrant, of Edinburgh, who, in addition to suggesting methods of teaching, had some specific grievances to mention. He points out that the content of Scottish education has failed to adapt itself to the modern world as rapidly as has that of England. Science there is still tolerated rather than encouraged, so that in the Higher Certificate examinations, Latin or geography

or history or book-keeping or art is a whole subject, but physics or chemistry or biology is a half subject. Naturally the school course is designed to meet the examination requirements, and it becomes necessary to teach 'electricity' without mentioning electromagnetic induction, motors or moving-coil instruments and thereby deprives the subject of any value to the boy who does not specialize later. In mechanics itself, the syllabus omits the laws of momentum or any consideration of rotation, and even excludes simple harmonic motion from its consideration of kinematics. In fact, the Scottish pupil does about half the science subjects, and does each of them about half as thoroughly as the English pupil. Hence part of Dr. Tarrant's address would have been devoted to a plea for overhauling the scheme of teaching and examining science subjects in Scotland. The present writer would, however, remark that Scotch engineers are known all over the world as sound and reliable men in general, and therefore that it would seem desirable to consider (a) whether mechanics is less important to engineers than teachers believe, or (b) whether mechanics can easily be learned later in life, in which case the school syllabus is less important to future specialists than we have assumed.

The other part of Dr. Tarrant's address showed how, in spite of difficulties, mechanics can be made a 'live' subject. By means of Meccano models of roof trusses and the like, problems of moments can be visualized, and the difficulties of three dimensions removed. The same method illustrates the triangle of forces clearly and visually. When the stage of calculation is reached, the human being makes an interesting subject. It requires no difficult mathematics, for example, to show on mechanical principles that the requirements for the high jump are: (1) long legs; (2) powerful swing with the free leg and with the arms, while the take-off leg is still bent; (3) a straightening of the original forward tilt of the body, then a straightening of the take-off leg, and finally a jump with the toe, the whole being so timed that the arms and legs acquire their upward momentum before the lift of the centre of gravity commences, and so that they are brought to rest relative to the body at the exact instant that the toe leaves contact with the ground; (4) a style of crossing the bar which keeps the centre of gravity very low on the bar and the head above the buttocks. Like Prof. Peierls, Dr. Tarrant introduces the dimensional argument, and uses it, for example, to show that a very small animal needs relatively more food than a big one, merely to keep warm, and explains therefore why small animals are not indigenous to the arctic or antarctic regions.

Had the meeting taken place, it was the hope of the organizers that the contributions to the free discussion following these papers would have been not the least valuable part, but it is hoped that the slight outline here given of the contents of some of the papers may at least stimulate those who would have discussed the matter, to consider it again for themselves and perhaps to try out different methods of teaching, the results of which can be reported at a more suitable time.

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