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The Practical Teaching of Science.

THE resumption by the Board of Education of the publication of memoranda prepared for the Office of Special Inquiries and Reports is to be welcomed. Before the war a constant stream of valuable information on educational progress and experiment at home and abroad issued from this source, and if not much more came of each individual contribution than is expected from the reports of most Government inquiries, these memoranda were, in the mass, sensibly affecting educational thought and practice. The war inevitably checked the stream in its course, and it is one more encouraging sign that we are, however slowly and painfully, returning to a time of peaceful development, or at least preparing for such a return, when we note that the stream has begun to flow again.

The recent appearance of a modest pamphlet, in the familiar green paper covers, entitled "Some Experiments in the Teaching of Science and Handwork in Certain Elementary Schools in London,"[1] is of peculiar value at the present moment. It is true that the experiments described were cut short by the war, but it is important that the conclusions to be drawn from them should be studied now, when not only in elementary and central and secondary schools, but also in the new day continuation schools, we are faced by the problem how best to combine efficiency and economy in the effort to stimulate intellectual development through science, not as an isolated study, but as a branch of the humanities. Before 1914 we had tended to give up the idealistic dream that if all schools were fitted up with laboratories, or had access to laboratories, equipped for the academic study of chemistry and physics, progress was assured. The view was winning acceptance that for perhaps most young people the best approach was through the motor activities, through carrying out in practice the general idea of "teaching science by making things," or, in other words, discovering scientific principles by solving practical problems. The idealist had come to earth, and we may hope that if his head remains in air his feet will continue to feel the ground he walks upon.

In the report which we have now before us the claim is made that the experiments carried out in the higher classes of elementary schools and in central schools, the latter of which take young people on to about sixteen years of age, go to show that a scheme of instruction in science which is based largely on handwork, and makes no excessive demand on theory, is far wider in scope than has hitherto been suspected. But the report only confirms the lessons to be drawn from two earlier reports—the invaluable "Manual Instruction in Public Elementary Schools," issued in 1910, and, on a higher plane of studies, the "Report on Science Teaching in Public Schools," issued in 1909—the most striking scheme in which was one where handwork and brainwork went on together.

The claim now definitely made is one which is entitled to respect because it is enunciated, not by any mere theorist spinning theories as he contemplates the ceiling through a cloud of tobacco smoke, but by skilled observers speaking on behalf of actual practitioners in the art of teaching. The principle involved is commended to the earnest consideration of those who are anxiously thinking out what kind of practical rooms and what sort of laboratories are to be installed in the new part-time day continuation schools for young people between the ages of fourteen and sixteen who spend most of their time in the office or workshop and only a precious seven or eight hours a week in school. They have the choice between text-book instruction supplemented by a modicum of experiment in a formal laboratory and practical instruction in a workshop which is equipped with the essential fittings of a laboratory. They may well come to the conclusion that,

[1] Educational Pamphlet No. 36. Pp. 54. (H.M. Stationery Office.) Price 1s. net.

while for those who have before them years for continuous study the former method is to be commended, with those who have but an hour or two a week in which to quicken their scientific appreciation a sound working knowledge of a far wider range of scientific phenomena, *with a bearing upon daily experience,* can be gained under a system which combines the workshop and the laboratory than by the conventional text-book treatment of science.

Such is the problem before us, and a possible solution, stated in their simplest terms. As regards elementary education, the question is settled so far as Governmental authority is concerned by the requirement of the Act of 1918 that every local education authority must make suitable provision for the practical instruction of older children. If this practical instruction is to have an educational significance beyond the mechanical repetition of manipulative exercises, however useful in themselves, then the illustration, the working out in concrete materials, of scientific principles or formulæ must be the very basis. For the older children in elementary schools, and also on the industrial side of central schools, such a compromise between the laboratory and the workshop is inevitable. In county boroughs and urban districts, where large, well-equipped centres are possible, the laboratory and the workshop may be separate rooms, provided that the intimate relation of one to the other is recognised, so that the problem set and illustrated in the laboratory is worked out at the bench, or, conversely, the process employed in the workshop is dissected and its principle revealed in the laboratory.

This is precisely what is going on in the one new type of school which has been evolved in this twentieth century of ours. Junior technical schools are very different from the preparatory trade schools or pre-apprenticeship schools which they are generally supplanting. Their purpose is to give a young person intending at sixteen to take up an apprenticeship in some branch of the engineering or building trades or professions, even architecture or naval architecture, not only a humanistic training in English subjects (and, for the brighter intelligences, in a foreign language), but also a firm foundation in mathematics, in mechanical drawing, and in the abstract principles underlying that branch of applied science popularly known as "mechanics," on which they may build their careers—some going no further than to become the foremen of industry; others, during or at the end of their apprenticeship, proceeding to university courses and becoming the Kelvins and Moultons of the future.

Even in the sphere of adult education which is opening out before us there is scope for work on these comparatively simple and unambitious lines. The intelligent artisan who awakes to deficiencies in his early education and is anxious to improve his scientific equipment will often find the initiation into natural philosophy easier by way of the laboratory workshop than through the lecture theatre and the merely experimental laboratory. But here the argument must not be pressed too far, for the greatest is he who is able on reaching man's estate to venture into strange seas of thought alone, and the man of science is great who approximates to that higher and more abstract ideal.

Vitalism versus Mechanism.

The System of Animate Nature: The Gifford Lectures delivered in the University of St. Andrews in the Years 1915 *and* 1916. By Prof. J. Arthur Thomson. (In two volumes.) Vol. i. Pp. xi+348. Vol. ii. Pp. v+349–687. (London: Williams and Norgate, 1920.) Price 30*s.* net two vols.

THE subject of the Gifford lectures was intended by the founder to be natural theology regarded as a natural science and treated, just as astronomy or chemistry would be, with entire freedom from any prepossessions whatever. This rather difficult task has been attempted by two biologists, Dr. Hans Driesch in 1907–8, and Prof. J. Arthur Thomson in 1915–16. The first of these lecturers tells us that he set out to follow biology along its own path—that is, from its nineteenth-century "naïve realism" towards its transition to "a branch of the philosophy of Nature," and such a progress he accelerated in no small degree by a method of treatment that was both critical and constructive. It was critical inasmuch as it included a penetrating analysis of the nature of the transformations that occur in living substance, thus leading to the rejection of the notion of a peculiar "vital energy form," and—which is equally important—it involved also a thorough criticism of the "pseudo-psychology" that had been employed in the study of animal behaviour. But it was also constructive in that it developed an old concept—that of "entelechy"—deriving from this a series of "psychoids" which were regarded as factors in organogenesis, metabolism, and behaviour. The Drieschian psychoids are not energetic agencies, but they function, as Leibnitz