THE TRAINING OF ENGINEERS*

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THE above title does not indicate the whole field which it is proposed to cover in this discussion. Obviously the training of water engineers can only be considered in relation to the more general question of the education of all civil engineers as distinguished from mechanical manufacturing engineers.

It is proposed to consider the subject under two heads: First, the broader question of the education of civil engineers; and second, the amount of specialization necessary for those who intend to practise as waterworks engineers.

In the first branch of the subject the writer confines himself to the training of civil engineers who are intending to practise as consulting, official or executive engineers in connection with railways, harbors, docks, canals, waterworks, sewerage, gasworks, municipal engineering and mining. It is submitted that these branches of the profession should be separately considered and provided for, and should not be included in the mechanical and electrical branches.

Hitherto the engineering departments of the British universities and technical schools have endeavored to make their courses cover all sections of engineering, but there has been a general tendency to make the mechanical side predominant. This no doubt arises from two causes —*viz.*, first, the number of students intended for mechanical work is larger than that of those intending to follow civil engineering; and, second, mechanical engineers have, as a body, been more liberal in their financial support of the modern universities and schools, and have therefore quite rightly been more largely represented than their civil engineer confreres on the governing bodies who appoint the teaching staffs and direct the courses of study.

Early Training

The general sequence of the training of a youth intended to follow the profession of civil engineering should, in my opinion, consist of:—

(1) A good general education at a public school.

(2) Education at a university in the theoretical side of the profession for a period of two years.

(3) An apprenticeship for a period of three years with a civil engineer in active practice.

Dealing with these in the order named: The public school selected should be one having a good "modern side." This is most important. Most public schools still cling to the old idea of a classical education with a modern side as a "side show" and to it are relegated many of the incompetents from the "classical side," together with a few brilliant boys who have gained scholarships but who are intended for a commercial career.

For a boy to be successful as a civil engineer he must have a good general education and, whilst agreeing that Latin and Greek should not be excluded in his early school years, it is in my opinion imperative that those two subjects should be dropped during the last year or two of the boy's school life and his whole energies for that period concentrated on natural science, mathematics (which should be continued at least to include the calculus and the solution of triangles) and two modern languages.

With regard to age limits, it is suggested that the boy should be sent to a good preparatory school at the age of eight or nine, and that the public school training should begin when he is about twelve years old and should continue until he is about seventeen years of age. He should then be capable of passing a matriculation examination at a university.

Technical Theoretical Training

Turning to the technical theoretical training at a university, it is submitted with some confidence that a period of two years should be sufficient to give an average youth a good grounding in the general principles of the subject which are likely to be of use to him in his profession, but this will involve a radical alteration in the system of education at present in vogue. To begin with, the time actually occupied in attending lectures, laboratory work, private study, and preparation of work must be considerably increased. The youth, who would now be over seventeen years old, and at an age when, if not still at college, he would be going to work, must be taught to regard himself as no longer a schoolboy, but a man who has really commenced his life's work, just as much as if he were in an office. To this end ordinary office hours of 9 a.m. to 5.30 p.m. (with an hour for lunch five days a week, and 9.30 a.m. to 1 p.m. on Saturdays), should be kept and strict punctuality and regular attendance should be observed and insisted upon. Evening work of preparation or writing up notes should be imposed at times as a form of overtime, but need not be a regular requirement. The holiday periods would have to be very substantially reduced and brought more into line with the time given to youths in offices. Probably a month in the summer, with a week at Christmas and Easter respectively would be as much time as could be spared if the necessary work is to be accomplished. Further, the time occupied in examinations should be cut down to a minimum, and it is suggested that the course of instruction may well include, as a prominent feature, test-papers on the various subjects taught. This would effect a twofold object—*viz.*, to train students to express their knowledge in writing, and, at the same time, enable the teaching staff to ascertain what progress had been made. By adopting such methods it would not be necessary to hold more than two formal examinations during the course, and these should be of not more than a week each in duration. One such examination should be conducted by the university staff at the end of the first year and the other by examiners appointed by the Institution of Civil Engineers at the completion of the course. The latter body might, with advantage, divide the associate-membership examination into two parts, one theoretical and the other practical. The student should be capable of passing the theoretical part of the examination at the end of his two years' college course.

Scope of Theoretical Instruction

The scope of the theoretical instruction should cover, *inter alia*, the following subjects:—

(1) Chemistry. Elementary, as affecting the materials likely to be used and to enable the student to understand a chemical analysis or formula.

(2) Physics. Elementary, to enable the student to appreciate the meaning of physical expressions.

(3) Geology, as affecting engineering with special reference to hydro-geology.

(4) Surveying instruments, their uses and adjustments.

(5) Strength of materials and methods of testing.

(6) Hydraulics—to be very fully treated.

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