ENGINEERING EDUCATION IN THE UNITED STATES.

Since to this society is entrusted more than to any other agency the future of engineering education in this country, and since we, as a nation, have risen out of the Monroe doctrine and our isolation, and have taken our first step to become one of the number of great powers that assume to direct the course of civilization and decide the destiny of the rest of the world, and since this nation, largely through the work of the engineer, is making rapid progress toward the commercial conquest of the world, the present seems an auspicious occasion in which to study briefly the progress of engineering education.

The century just closing has witnessed a marvelous development in all matters relating to education. Probably the most remarkable feature of the educational history of the century is the extension of opportunities for an education to the common people as a right. To day there is nothing in this country so free as education, and the United States is far in the lead of foreign countries in school attendance, about one fourth of the school population of the world being Americans.

At the beginning of the century there were thirty colleges in the United States, with about 3,000 students, while today there are 472 collegiate institutions with 155,000 students. But the mere increase in numbers is not the most significant feature. The colleges then were of a lower grade than most academies today.

Another important element in the development of education in America has been the magnificent contributions of individuals and of governments to the cause of education.

Technical Education.

Technical education, the application of the sciences to the needs of man, is a growth of this century entirely. Apparently the first technical school in the world was the Ecole Polytechnique in France, established in 1794 to train men for the artillery and engineering corps of the army. In 1835 in Troy, N. Y., was organized the first institution in the world for giving instruction in engineering not military. Apparently at the the time of the founding of this institution the term civil engineering had not been coined. From 1835 to the close of the war only four engineering schools were founded, of which only two were really entitled to the name of engineering. During this time the engineering schools gave but little technical instruction; most of the so-called engineering part of the course consisted of mathematics and elementary science.

In 1862 congress passed an act giving to the several states public lands for the benefit of "instruction in the arts and sciences relating to agriculture and the mechanical arts." Shortly after the close of the civil war many of our engineering schools were organized under this act. This movement has resulted in the establishment ol 64 technical colleges—at least one in each state and territory. Fifty of them give instruction in one or more branches of engineering.

Immense strides have been taken in both the methods and the scope of instruction. At the close of the civil war there were nominally only six institutions giving any grade of instruction in engineering, and for 10 or 15 years thereafter the engineering instruction offered by the best institutions is hardly deserving the name in comparison with that offered by many institutions at the present time. None of it consisted of the principles of scientific engineering nor of the relations of the sciences to engineering problems. Text books were few and poor. The equipment of the schools was inadequate. Then the student went to college to learn details of practice and to fill his notebook with formulas; he was reluctant to give his best efforts to the acquisition of fundamental principles, and to the development of the ability to see straight and reason correctly. Happily now all that is changed, and the schools of America are now affording unexcelled facilities for the acquisition of the fundamentals of an engineering education, and the students are laboring heroically to ground themselves in the principles of scientific engineering.

Opposition of Practical Engineers.

Practitioners twenty-five years ago doubted the value of a technical training for young engineers, and distrusted the engineering graduate, but now general managers and chief engineers prefer technical graduates, since they have been trained in scientific methods of working and have a knowledge of the fundamental principles underlying all engineering practice, and look out upon the world from the viewpoint of a man of science. The national engineering societies now give credit for training in the engineering school toward the requirements for admission to membership. Within recent years, largely, if not mainly, through the influence of the technical schools, engineering has ceased to be traditional and has become scientific.

The technical school met with no welcome from the older colleges and universities. In the beginning the devotee of non-technical subjects was not willing to admit the study of engineering as being upon the same high plane as that of literature, history and philosophy. Now all who know facts are willing to admit that the engineering student secures greater advancement during his college career than any other undergraduate. This result is due to the definiteness of the aim of the engineering student, to the stimulus of professional preparation, and to the nature of the study.

One of the most important advances in engineering education has been the introduction of the laboratory method of instruction. Now all of the better institutions have extensive and well-equipped laboratories fitted up especially for experimental work, in which the student receives instruction of the very highest value. In this respect our American schools are unrivaled in the world. In Europe, particularly in Germany, are some notable and well-equipped engineering laboratories, which have done much to advance engineering science, but these are used by experts in research and commercial work, and not for purposes of instruction. Although our engineering laboratories are maintained primarily for the purposes of instruction, a considerable amount of research work is performed in them. But few, if any, Americans now attend European engineering schools, for it is generally conceded that the American schools, in equipment, methods and scope of instruction are superior to any European schools, at least for American engineers.

The study of engineering is essentially graduate work, and there will probably never be any considerable number who are pursuing engineering studies beyond the present four-year course. But there are sufficient reasons why adequate provisions should be made for the competent and ambitious few who seek graduate instruction in engineering.

The present phenomenal rate of progress in engineering education promises still larger things for the future, and lays upon this society important responsibilities in directing the future development of engineering education in America.

Danger in Over Specialization.

Engineering courses have become so highly specialized that frequently the students of one course receive no instruction in the fundamental technical subjects of the closely allied branches of engineering. This practice is burdensome upon the school and is probably not of the highest advantage to the student. But the colleges are not likely to retrace their steps, and therefore the highly specialized course is a condition to be reckoned with. Should anything be done to prevent further specialization? Some students counteract the effects due to high specialization by remaining a fifth year and pursuing the allied course. Can anything be done to increase the number who do this?

The engineering course of today is so loaded up with required technical and scientific work that the student has little or no time to cultivate those subjects indefinitely, but not improperly, called the "humanities." The engineering students more perhaps than any others need training in such subjects. Those who follow the other learned professions deal constantly in their technical work with the relationships of their