

students in civil engineering by actual demonstrations in the laboratory or lecture room, it is not considered advisable to devote the time necessary for each student to run through complete tests as is done by students in the laboratories devoted to the testing of structural materials. In two to five afternoons all the fundamental tests employed in the examination of bituminous and non-bituminous road materials could be demonstrated before a group of from twenty-five to thirty men if the laboratory equipment was properly arranged and the work well planned out. Two to three afternoons would suffice if the testing of bituminous materials were covered in a course given by the department of chemistry. Unfortunately, at the present time very few instructors in chemistry are familiar with bituminous materials, hence the methods of testing will have to be worked up by civil engineering instructors. Eventually some of the time now given by the department of chemistry to carbon compounds or quantitative analysis in courses for civil engineering students can be profitably devoted to the chemistry of bituminous materials.

A limited number of inspection trips covering the economics of highway location, and the construction and maintenance of various types of roads and pavements will be of value.

The time devoted to road or street surveys in some institutions, in addition to the regular work in railroad surveying and general surveying, is of questionable merit. Although there are many problems in highway surveying which are different from those encountered in other branches of surveying, it is doubtful if it is necessary or expedient to use up valuable time on this work considering the number of subjects which it is necessary to include in a broad course in civil engineering. The speaker's experience with civil engineering graduates who have worked under him on highway work has led to the belief that a graduate in civil engineering, who has had a good course in railroad surveying and in railroad curves, together with a comprehensive course in highway engineering, as outlined above, is admirably equipped to occupy the minor positions in a field party on highway surveys. In these positions he may acquire, either through advanced study or special instruction, the information and practice necessary to occupy the position of chief of party and the higher positions in the highway department connected with the bureau of surveys. It is, however, advisable in certain instances, where practicable, to divide the time devoted to railroad surveying so that a highway survey outside built-up districts may be added to the course together with the preparation of plans, cross-sections and estimates.

In further consideration of the special training which will be of benefit to those entering the field of highway engineering, the educational plans which have been evolved to elevate the profession and to equip men thoroughly for this field of engineering work, foreign practice will be given consideration first.

Great Britain affords an illustration of one method by which well trained highway engineers may, under favorable circumstances, be secured. Fortunately for the British engineer, his position in highway work is much more permanent than in the United States. There are several reasons why such is the case. Among others may be mentioned the recognition by the British public that the principle of continuity in office of capable engineers results generally in economical and efficacious construction and maintenance of public works. Those American engineers who visited Great Britain at the time of the Brussels International Road Congress in 1910 will, without doubt, find the majority of the prominent highway engineers of England occupying the same positions or higher positions when they attend the Third International Road Congress to be held in London in 1913.

This is not a long period, but could the same observation be made in regard to the personnel of many of our great state highway departments for a similar period? It should be stated, however, that the subordinate positions in the United States being, in many cases, under civil service regulation are more permanent than those effected by political exigencies. This condition of permanency of position of high officials in Great Britain means that it is possible for young men who are attracted to highway engineering to enter the department of some county or municipal engineer, and, proving capable, to acquire a valuable experience under the continued leadership of an able engineer. In this position a young man of the right calibre, by hard work, including a large amount of home study, may equip himself for the highest positions in highway work in Great Britain. Another safeguard of the British engineer, and an incentive to highway engineers in embryo, is the admirable practice which has been adopted in many cases requiring that applicants for a certain class of positions shall hold certain grades of membership in the Society of Municipal and County Engineers and in other cases certain grades of membership in the Institution of Civil Engineers of Great Britain.

France offers an entirely different type of training for men who are going to enter the field of highway engineering. All the important positions in this branch of the public service are occupied by picked men especially educated and trained for the service. After a preliminary general service covering as a final period that comparable with the four years high school training in this country, men of high standing are admitted to the Ecole Polytechnique, the course in which is practically two years in length. Upon graduation from this school, the men of high standing are allowed to select one of the several national schools, provided openings exist, in which they will secure special training for the public service in a given field. Those who enter the Ecole Nationale des Ponts et Chaussées devote three years to a general course in civil engineering under the leadership of engineers of the highest grade in the Department des Ponts et Chaussées de France. During the vacations these men are allotted to service on the construction of roads and bridges in various parts of France. It is evident that the training thus obtained is admirable and that the personnel of the engineering staff of the department of roads and bridges of France is exceptionally high.

In America, while in some cases an attempt has been made to give as special instruction in highway engineering a four years undergraduate course in this subject, this method has not given particular satisfaction for the reason previously noted. Excellent work has been done by many universities in several parts of the country in giving extension courses to groups of men interested in various phases of highway improvement. Very little advanced work, however, has been done through the medium of the American university. The United States Office of Public Roads has evolved a scheme by which men may secure a certain amount of advanced instruction and training in that part of highway engineering dealing with highways outside of built-up districts. This plan is to place the student engineers in the charge of men in the service of the Office in various parts of the country on different kinds of highway work. When it is impossible to work in the field, the men do a certain amount of office work at Washington, receiving instruction by means of lectures on certain phases of highway engineering and also do laboratory work on the testing of both bituminous and non-bituminous road materials.

In 1911, through the generosity of Charles Henry Davis, president of the National Highways Association, there was founded at Columbia University a graduate course in highway engineering. The object in founding this course was