R. Verrilli

FOREWORD

by KARL TERZAGHI, Hon.M.Am.Soc.C.E., M.Inst.C.E.

Professor of the Practice of Civil Engineering, Harvard University, Cambridge, Mass.

Géotechnique is intended to become a clearing house for significant information in the fields of soil mechanics and engineering geology. Both fields are so interdependent that it would be an idle question to ask which one is more important. This fact is aptly expressed by the name of the journal.

Since *Géotechnique* has no predecessor, a glance at the historic development of its subjects is indicated. Both soil mechanics and engineering geology originated in the eighteenth century. Yet, until the years immediately preceding the first world war, there was practically no contact between them and little progress was made. Hence, during this period neither one rendered the engineering profession more than a nominal service.

Soil mechanics started with the publication of Coulomb's theory of earth pressure on retaining walls in 1776. This was a brilliant beginning. Yet during the following century practically no further progress was made. The investigations remained more or less limited to refining the methods of computing the earth pressure of dry, clean, cohesionless sand on the back of retaining walls. Since such backfill material is rarely encountered in practice, the number of publications on this subject is utterly out of proportion to its practical importance. In engineering practice most of the construction difficulties and accidents are caused by the pressure exerted by percolating water and these pressures received no consideration. Hence the theories were of little avail to the engineer who has to cope with realities. They were practised mostly in the classroom.

Engineering geology can be traced back to William Smith (1769-1839), known as the "Father of British Geology." Yet, though Smith himself was a civil engineer, the adaptation of geology to engineering made very little headway for almost a century. The geological study of the site for proposed constructions furnished an inventory of the materials which would be encountered during excavation, but little or no attention was paid to the factors, such as shearing resistance, permeability and compressibility, which determine the reaction of the subsurface materials to the changes produced by excavation or loading.

At the beginning of the twentieth century, when the scope and the magnitude of construction operations started to increase at an unprecedented pace, the hazards increased proportionately, and the weakness of the traditional methods of estimating earth pressures and bearing capacity could no longer be ignored. Therefore, between 1910 and 1915, attempts were made to establish more reliable procedures independently and almost simultaneously in various parts of Europe and in the United States.

The empirical basis of the existing methods was so utterly inadequate that all the investigators had to start from scratch. The immediate task consisted in establishing the

*

fundamental principles of soil behaviour. To achieve this end it was necessary to develop methods for determining the significant soil properties and for solving the problems of earthwork engineering by means of the known laws of mechanics and hydraulics. The design of structures rests on a similar groundwork. Hence one may conclude that soil mechanics is merely an outgrowth of two well-established branches of engineering science—the testing of materials and applied mechanics. So far as the principles are concerned the conclusion is correct. The difference resides in the practical applications.

The designer of bridges and other structures deals with man-made materials with well-defined properties. Nevertheless, he is expected to provide for a factor of safety of 3 or even 4. By contrast, in earthwork engineering the designer has to deal with bodies of earth with a complex structure and the properties of the material may vary from point to point. To obtain an accurate knowledge of the properties of such bodies is impracticable. More often than not this knowledge is highly inadequate. Yet economic considerations require that the factor of safety of the foundations should not exceed that of the structure and in other fields of earthwork engineering it is by no means uncommon that the design must be made on the basis of a factor of safety of 1.5. These requirements call for continuous vigilance during the process of construction. On account of the inevitable uncertainty involved in the fundamental design assumptions, the conception on which the design is based is often no more than a crude working hypothesis; and if the hypothesis is incorrect, failure may ensue. Hence, in earthwork engineering, success depends primarily on a clear perception of the uncertainties involved in the fundamental assumptions and on intelligently planned and conscientiously executed observations during construction. If the observations show that the real soil and seepage conditions are very different from what they were believed to be, the design must be changed before it is too late. These are the essential functions of soil mechanics in engineering practice. The rôle of exact science in this practice is much more closely related to its rôle in the art of medicine than to its rôle in bridge design or in mechanical engineering. This fact determines the relative importance of the different branches of geotechnology.

During the last decade, theory and the techniques of sampling and testing have advanced far beyond immediate practical needs, whereas our knowledge of the difference between the behaviour of soils in the field and in the laboratory has lagged behind. Therefore, at the present time, a well-documented case history should be given as much weight as ten ingenious theories and the results of laboratory investigations should not receive too much attention unless the validity of the conclusions has been demonstrated by adequate field observations on full-sized structures.

In the realm of sedimentary geology, important advances have been made, but, from an engineering point of view, too little attention has been paid to the details of the structure of water-, ice- and wind-laid deposits. Graphic records of such details are urgently needed as an aid in the step from borehole records to the soil profile.

In the realm of rock geology the term "shale" continues to be a source of confusion and this state will persist until the engineering reports on shale behaviour are habitually accompanied by test data and adequate geological information. Other topics which call for attention are the subsidence above mine workings and the pressure on tunnel supports. Progress in both lines depends on the correlation between geological data, the results of accurate measurements in the field, and those of petrographic and experimental studies on representative samples.

In order to increase the educational value of the journal the editors plan to publish from time to time abstracts of meritorious older papers dealing with problems in earthwork and foundation engineering. In this connection, attention should be called to the papers dealing with unstable slopes and difficult tunnelling conditions, which appeared during the early nineteenth century in various engineering periodicals. Some of these papers reveal an amazing gift for observation and a deep intuitive insight into soil behaviour. When theory invaded the field of civil engineering our analytical faculties began to develop partly at the expense of our capacity for observation. In the field of geotechnology, this is a very serious matter. Therefore, the educational value of the outstanding achievements of these bygone generations of engineers can hardly be overemphasized.

The functions of the editors of a journal are similar to those of the conductor of an orchestra. If the editors of *Géotechnique* succeed in assigning to each of the different branches of geotechnology the place it deserves at the present time in the complex structure of earthwork and foundation engineering, they will arouse the interest of the practising engineer and encourage his co-operation, which is vital.

No less than seventy years ago, F. M. Stapff, Chief Geologist on the St. Gotthard tunnel, published the following comment on the activities of the engineers he knew: "Every civil engineer is engaged in experimental geology without being conscious of this fact and without being spoiled by the recognition of the benefits which the science of geology has derived from his activities."

Since soil mechanics has prepared the tools which are required to get the full benefit out of geological information, the practical value of the data secured in the field by the joint efforts of engineer and geologist will steadily increase. If *Géotechnique* becomes a clearing house for information with proper emphasis on such data, it may open up prolific sources of vital geotechnical information and earn the gratitude of every practising civil engineer.