

## GENERAL DISCUSSION

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MR. R. F. LEGGET<sup>1</sup> (*by letter*).—This symposium brought together a most useful group of review papers on the methods now in general use for the reconnaissance of soils in place, both by surface and subsurface investigation. When the papers are collected in one volume, as was anticipated at the meeting, there will be generally available to the profession, possibly for the first time in such detail, an up-to-date and comprehensive description of the field investigational methods, and of their application to practical problems, which should today be known to all civil engineers.

In the testing of materials, the source of the materials is clearly an important determinant of their properties. Most of the materials with which ASTM is concerned are man-made, admittedly from natural materials in the first instance, but still subject to the modifying influences of manufacture. Soils are natural materials in the form in which they are used. It is therefore equally important to know something of their origin if only that their testing may be properly appreciated and be fully significant. This symposium presents an admirable survey of the various disciplines which may be used in a study of the origin of and modifying influences upon soils preliminary to their use in engineering.

The emphasis on geology in the symposium is particularly welcome since a basic understanding of the geology of soils is a prerequisite for the proper study of soil mechanics. During another part of the meeting at Atlantic City, the

suggestion was advanced that Committee D-18 on Soils for Engineering Purposes might usefully promote the use of a general geological classification in all engineering soil descriptions. As compared to the almost complete neglect of geology in early soil studies, this suggestion and the emphasis on geology in the symposium were indeed welcome. The paper by Messrs. Abdun-Nur and Dowling, although not specifically related to soil testing, does give a very clear idea of the profound effect of geology upon soil properties.

Geological maps are usually the starting point for geological soil study by engineers, when field examination is not immediately possible. The paper by Mr. Eckel was therefore most welcome and a most suitable starting point for the symposium. The contents of this make clear the great value which geological maps can have to engineers, particularly in connection with soil work. It may be useful to observe that only very rarely will it be possible to obtain or to use geological maps prepared specifically for engineering purposes. In almost every case engineers have to use existing geological maps such as those prepared by the United States Geological Survey and corresponding bodies.

If properly used and interpreted, such maps can be of great assistance. Their limitations, however, must be very clearly realized. For example, the writer suggests with diffidence and yet with unusual emphasis that the concluding sentences in the descriptive notes of Map Units B and G (See Page 11 and 12) are quite unwarranted as deductions from

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engineering maps. Engineers know well that the determination of side slopes for cuts and fills is not a simple matter. Those unfamiliar with geology but yet experienced in excavation work who see such statements as those to which reference is made, are liable to take an extreme view of geological statements in general and this would be most unfortunate.

The techniques to be used in the preparation of geological maps are relatively straightforward and simple and may be found described in any good textbook on field geology. Essentially they depend upon accurate observation and the accumulated experience which can come only from geological studies in the field. Today aerial photographic work is providing a useful supplement (although not a substitute) for such field observation. The papers on the use of aerial photographs and the preparation of soil maps form, therefore, a useful and important part of this symposium.

Little general comment need be made on the papers dealing with geophysical methods of subsurface exploration except to welcome the additional information which they contain regarding the correlation of work of this kind with actual test boring. Such work is soil testing in every sense and can provide the engineer with invaluable information

regarding soil conditions as well as the position of rock surfaces. As was made clear at the meeting, all work of this type must be correlated with a general study of local geology if it is to be fully effective.

The study of geology appears to be a matter of difficulty to those who have not studied it in their earlier years. Reference may therefore usefully be made to a new volume which provides one of the quickest and best introductions to geology which the writer has ever encountered. This book is entitled "The Earth's Crust": its author is Dr. L. Dudley Stamp. It is published by Harraps, London. The supervision of geophysical and test boring work by engineers not well versed in geology would be immeasurably assisted by a brief study of this brilliantly illustrated volume.

With the papers of the Symposium available in the printed records of the Society, engineers will have at hand convenient background material against which to view future work in the field of soil and testing proper. It seems unlikely, therefore, that the need will arise for repetition of a symposium of this kind but the printed record of the proceedings should constitute a valuable addition to the literature of civil engineering.