The Engineering Geologist

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History and Applicability of Geologic Engineering

George D. Roberts*

Editor's Note: The following article by George D. Roberts was written a number of years ago for a symposium on engineering geology held under the auspices of the foundation engineering firm of Dames & Moore. It is your editor's opinion that this article can be read from time to time to remind us of our responsibilities and major objectives as engineering geologists.

INTRODUCTION

One of the most important responsibilities of the civil engineer is to design his structure so as to take full advantage of the natural conditions at the construction site. Failure to fully consider the natural conditions and the effects that the construction will have on the natural regime in the site area will almost invariably result in higher construction costs or higher maintenance costs. It may sometimes even lead to the failure of the structure. Although the following remarks apply principally to major construction projects, they are applicable, to a lesser degree, to other construction, such as buildings.

Today, the civil engineer has two main approaches for determining the natural conditions at a site during the investigation, design, and construction stages of the project. Both methods have been considerably improved during the last 30 years. This is in keeping with the technological revolution that has occurred within the heavy construction industry during the same period of time. One method, the "Geological-and-Knowledge-of-Precedents" approach, is probably as old as the civil engineering profession itself, even though it may have been called a different name. The other, the "Laboratory Analysis-and-Numerical" approach of soil mechanics, has gained its present stature largely within the past 30 years.

Like any useful new tool, soil mechanics is all too often regarded as the panacea for the shortcomings of the older approach. Judgment and experience, however, demonstrate that even with the proper combination and mutual assistance of the two approaches, the designing engineer is seldom furnished with all the information that he should have.

The following discussion outlines what the geological engineer can and should contribute to subsurface planning and construction. Its purpose is to invite attention to a branch of engineering which has received so little publicity that the benefits it can provide are occasionally overlooked.

*At the time this article was written, George D. Roberts was a Consultant in the San Francisco office of Dames & Moore. He is now Chief Geologist for the Huntsville Division of the Corps of Engineers at Huntsville, Alabama.

GROWTH OF GEOLOGICAL ENGINEERING

One of the fathers of modern geological thinking was an English civil engineer, William Smith, who recognized the orderly natural processes which formed the sedimentary strata exposed in the canals he constructed in the eighteenth century. He was the first engineer known to have recorded the geology systematically, although others undoubtedly preceded him. He prepared geologic maps, and made use of the natural site conditions to benefit his construction plans and procedures. Yet, it is only within the last 30 years that most experienced civil engineers have developed a general appreciation of the need and value of the Geological Engineer.

Until about 1930, only the more astute civil engineers requested special geological assistance in locating and planning major construction projects; the others relied on their own observations and their knowledge of precedents. We must remember that things moved at a slower pace in those days, and engineers had more time to develop their plans on projects that were generally much smaller than those undertaken today. An interesting comment regarding the importance of having

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Minutes of Management Board Meetings in Atlantic City in 1969

Richard E. Gray, Secretary

November 10, 1969 Meeting

The following were present at the meeting November 10, 1969: W. H. Stuart, H. G. Hershey, H. A. Coombs, G. A. Kiersch*, D. H. MacDonald*, R. E. Gray, G. W. Prescott*, E. B. Eckel*, E. T. Cleaves.

Program—1969 Annual Meeting

G. W. Prescott, the program representative, reported on preparations for the Division sponsored program. He recommended (1) an early check of facilities, (2) a selection of a topic a year before the meeting, (3) acceptance of papers for presentation even if they have been given at another meeting, (4) having a numbr of invited papers to insure an adequate program, and (5) an alternate program representative.

A list of authors and papers presented in the Division sponsored sessions is reprinted at the end of this article.

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*Present for only a part of the meeting.

Geologic Engineering . . .

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sufficient time was made by Ira B. Joralemon during a recent interview[1]:

> "Thought has been the chief casualty of modern technique. It used to be that we had lots of time to think over what we had seen—on trains or boats or in a horse-drawn stage or during a few days' ride on a good horse or mule. Time spent on the return home from an examination let the observations sink in. It was often the most fruitful part of the trip.
>
> "Now a plane takes the geologist almost anywhere in the world in a few hours, and a jeep completes the frantic rush. An examination that used to take several weeks can now be finished in a few days. The mania for speed affects the client, too, and he demands an immediate report, with no time given to let the mental computing machine whirl its cogs for a few days until all the applicable past experience has come to mind. The result is often a hasty conclusion that is wrong."

Also, adequate geological assistance was hard to obtain because geologists belonged to one of the following two groups: (1) the academic and scientific geologists, (2) those engaged in mining or petroleum activities. The members of the first group seldom exhibited the hard-headed practical drive toward essential facts which characterized the engineers who employed them. On the other hand, the mining and petroleum geologists seldom had either the time or the inclination to work outside their regular fields. Of course, there were exceptions in the academic and scientific group, such as Charles P. Berkey, Kirk Bryan, Karl Terzaghi, and many others.

With the decrease in need for mining engineers and geological engineers during the years of the "Great Depression," many such practical men were employed by the Federal Government in the investigation, planning and construction of major dams and appurtenant facilities in the development of river systems. This relatively small group so quickly demonstrated the value of their contributions that men with similar training soon became an integral part of most large civil engineering organizations. Today few, if any, experienced engineers working on major construction projects would consider proceeding with the preparation of their plans and construction without the continuous assistance of competent geological engineers. Many experienced engineers also frequently insist on geological assistance even on small jobs. Here the geologist's contributions are seldom as beneficial as on larger projects, such as industrial complexes, heavy construction projects, etc.

Shortly before the services of geological engineers began to be generally appreciated, another geologist and mechanical engineer, Karl Terzaghi, developed and published his techniques which led to the numerical approach of soil mechanics. This in turn started an unprecedented boom in a segment of the civil engineering profession. Unfortunately today, too many inexperienced engineers believe that they can solve almost any problem by the laboratory analysis and the numerical approach. In contrast, many others have observed the coincident rise in the number of construction failures. Particularly during the latter years of his life, Terzaghi tried to dispel such a blind confidence in the mathematical approach which he never practiced. He stopped teaching soil mechanics and limited his lectures to the subject of engineering geology. In one of his last important publications[2] he wrote as follows:

> ". . . The failure of the Malpasset Dam and various catastrophic rock slides on slopes above the portals of pressure tunnels have aroused the concern of public building authorities. Consequently, they have become more and more reluctant to issue permits to construct on rock unless the applicants demonstrate by means of stability computations that the proposed structure will not cause a rock failure. Yet, in connection with foundations on rock, as well as on soil, natural conditions may preclude the possibility of securing all the data required for predicting the performance of the real foundation material by analytical or any other methods. If a stability computation is required under these conditions, it is necessarily based on assumptions which have little in common with reality. Such computations do more harm than good because they divert the designer's attention from the inevitable but important gaps in his knowledge of the unweathered rock . . ."

In his last interview, Terzaghi re-emphasized the principles stated in the introduction to "Soil Mechanics in Engineering Practice" by Terzaghi and Peck. These principles are often overlooked and all too many inexperienced engineers consider this book to be a handbook which it clearly was never intended to be.

We should all recognize that the best solution of a problem is seldom obtained solely by use of either the geological approach or the soil mechanics approach but rather by a combination of the two, which is then reviewed for precedents. Dr. Peck has aptly stated this in his paper entitled, "Art and Science in Subsurface Engineering"[3]:

> ". . . We would do well to recall and examine the attributes necessary for the successful practice of subsurface engineering. These are at least three: knowledge of precedents, familiarity with soil mechanics, and a working knowledge of geology. Of these a knowledge of precedents is by far the most important."

FUNCTIONS OF THE GEOLOGICAL ENGINEER

For the geological engineer to make proper contributions, he should first be well briefed on the proposed construction. He should then make a field reconnaissance, or study, of the proposed construction site and the surrounding area. In many instances, it will be desirable for him to review available geological literature. Whenever possible, he should review design and construction precedents and then discuss his preliminary findings, and their probable effects on the proposed project, with the designer. He should then prepare a reasonable but flexible program of subsurface investigation based on his predictions as to the probable subsurface conditions resulting from his studies. The accuracy of such preliminary geologic predictions should constantly be checked and refined as the investigation proceeds.

The writer found it to be very essential to plot numerous cross-sections, showing the probable subsurface conditions to

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[1] Ira B. Joralemon, "An Interview by Henry Carlisle." Mining Engineering Magazine, September 1964, page 1.

[2] Karl Terzaghi, "Stability of Steep Slopes on Hard Unweathered Rock." Geotechnique, December 1962.

[3] Ralph B. Peck, "Art and Science in Subsurface Engineering." Geotechnique, March 1962.

THE ENGINEERING GEOLOGIST

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Geologic Engineering . . .

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scale before the expensive boring starts. As each boring progresses, the accuracy of the predicted conditions should be continuously refined and corrected. Such drawings cost very little, yet they are very useful in deciding:

(1) Whether the boring in progress was planned to be too shallow or too deep.
(2) Whether correlation of the subsurface conditions between the borings is possible.
(3) When sufficient information has been obtained.

Above all, these drawings assist in exposing many of the significant foundation details and gaps in the subsurface information. This permits changing the boring program in time to obtain the additional information required.

The practical, well-balanced approach to foundation problems requires a well-balanced knowledge of precedents and a good working knowledge of design and construction procedures, soil mechanics, and geological engineering. Since few, if indeed any, are competent in all of these fields, it behooves us to obtain the best available assistance and work in close cooperation. Although the best use of the combined talents mentioned above will materially reduce the element of uncertainty in subsurface construction, all the risks cannot be eliminated. These risks can, however, be eliminated almost entirely if the excavation and the foundations are checked by a competent observer. Such observations will nearly always identify the significant details which were not revealed during the subsurface investigations in time to devise corrective procedures at a moderate cost.

To provide this kind of service the geological engineer must, of necessity, completely understand the ramifications of the engineer's problems. Unless he does and can volunteer all applicable information, he is either not performing his duty or is expecting the designing engineer to do this important portion of his work for him. To perform his functions properly, the geological engineer should be well acquainted with the various aspects of the design concept and should follow through on his recommendations regarding the design and construction requirements. He should then keep abreast of the construction for the fourfold purpose of: (1) detecting subsurface details which were not recognized during the subsurface investigation but are exposed as the excavation progresses; (2) if such details will adversely affect the structure, he should advise the engineer and assist in devising schemes to overcome them; (3) protect the owner from unjustified claims based on "changed conditions" on the part of the construction contractor; (4) learn what mistakes he made in the investigation so that they will not be repeated.

CONCLUSION

Although the geological approach yields its maximum benefits in connection with large projects, it more than pays for itself even on buildings in well-developed areas where, not infrequently, it will be found that unnecessarily expensive foundation design methods are inherited from the past generation.

Subsurface investigations made without the benefit of geologic studies overlook the three crucial aids available to the engineer. In effect, such explorations are about as effective as attempting to utilize a tripod with only two legs. Over 20 percent of the technical graduates in our firm have degrees in geology or closely associated fields. A more general use of their services will benefit them, our civil engineers, and our clients, and will avoid, to a large extent, the troubles inherent in the use of a two-legged tripod.

National Symposium on Data and Instrumentation in Water Quality Management Scheduled July 21-23

The universal application of the science of water will be discussed by Charles Robinove, who has been associated with the NASA Earth Resources Program, at the luncheon meeting of the National Symposium on Data and Instrumentation to be held at Madison, Wisconsin, July 22.

Robinove will relate knowledge of hydrology gained from space exploration to some of the water problems facing earth.

The Conference of State Sanitary Engineers, with 16 other professional societies as cosponsors, has scheduled the National Symposium on Data and Instrumentation for Water Quality Management at the University of Wisconsin in Madison, Wisconsin, July 21-23, 1970.

The contribution that collection and use of data can make to bettering earth's environment is the central theme of the symposium. The group will discuss experiences, reveal needed developments, and make recommendations relating to the use of data associated with water quality management.

The actual transmission of data from the files of a water resources agency via teletype to the symposium site and the interchange and utilization of the data by State and Federal agencies will be demonstrated.

Papers To Be Presented

The following papers will be presented at the July 21 and 22 general sessions: "Water Quality Management Information Systems—The Key to Cleaner Waters"; "Coordination—A Key to Effective Data Management"; "Basic Data Requirements to Evaluate Water Pollution and Quality Control Programs"; "Experiences with Automation in Remote Sampling and Analysis of Surface Waters"; "A Systems Approach to Water Quality Data Management"; "Lessons to be Learned in Collecting Valid Data"; "Forecasting of Water Quality in the Delaware Estuary."

There will be six concurrent panel meetings in the afternoon, July 21 and 22, on the following topics: Need for Data in Managing Water Quality; Systems Approach to Water Quality Planning and Operation; Remote Collection, Sampling, Measurement and Handling of Water Quality Data; Evaluation and Interpretation of Water Quality Data; Effective Use of Data; and Using Computers as a Tool in Water Quality Management. The type of papers to be delivered by the six panelists for each topic is indicated by the following titles: "Need for Water Quality Data in Planning for Development of Water Resources"; "Preliminary National Network of Water Quality Sensors for Satellite Relay"; "Compatibility of Systems and Interchange of Data"; "A Water Quality Storage and Retrieval System for Regional Application"; "Design of an Automatic Monitoring System"; "New York State Automatic Water Quality Monitoring System"; "Errors to Avoid in Water Quality Collection and Sampling"; "On the Analysis and Use of Water Quality Data"; "A Water Quality Index—Do We Dare?"; "Application of Electronic Monitors to River Quality Forecasting"; "Mini Computers and Water Quality Management"; "Potential Benefits of Water Quality Management Programs Which Stress Integration of Automatic Monitoring and Mathematical Modeling with the Electronic Computer."

Information pertaining to housing, registration fee, program, social events, and other details can be obtained by writing to: Mr. James E. Kerrigan, Assistant Director, Water Resources Center, University of Wisconsin, Madison, Wisconsin 53706, Phone 608-262-3577.

Management Board . . .

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Future Programs

W. H. Stuart suggested the possibility of the Association of Engineering Geologists holding its meetings in conjunction with the Engineering Geology Division at the GSA Annual Meeting.

W. H. Stuart reported that prior approval of the GSA Council is not required to hold a symposium.

Election

Results of the election for the 1970 Management Board were as follows: Chairman, H. G. Hershey; Chairman-Elect, H. A. Coombs; Secretary-Treasurer, R. E. Gray; Councilor, C. S. Content.

E. B. Burwell, Jr., Memorial Award

First recipient was Lloyd B. Underwood for his paper ("Classification and Identification of Shales," ASCE **Proceedings,** Vol. 93, SM6, November 1967). S. S. Philbrick presented the award at the Division luncheon. Mrs. Burwell was present as guest of the Division.

Rules were modified in the last year to give the Committee Chairman a vote in selecting a recipient for the award.

GSA has invited the EGD Burwell Awards Committee to operate as a subcommittee of the GSA Honors and Awards Committee. It was agreed to accept this invitation.

S. S. Philbrick and W. H. Irwin have completed their one-year terms.

R. E. Gray suggested simplifying paper work of the Committee. He is to modify rules and submit them and a Form of Nomination to H. G. Hershey for approval. Date for selection must also be revised in order for recipient to be submitted to GSA Council at its spring meeting.

AGI Board

W. H. Stuart reported Division representation on the AGI Board is not possible. He suggested the Division Chairman receive agenda of Board meetings from GSA so that appropriate comments can be made to GSA representatives before Board meetings. W. H. Stuart is to request GSA Executive Secretary, E. B. Eckel, to follow this procedure.

Publications

E. B. Eckel, Editor of The Geological Society of America, suggested that symposium organizers be appointed as associate editors to facilitate publication of symposium papers.

G. A. Kiersch reported he had told speakers in the symposium titled "Dynamic Problems in Engineering Geology" that there were no plans for immediate publication. He will ask speakers about publication and if they agree, he will serve as Associate Editor.

The New York Water Supply Paper is in the hands of the Ad Hoc Editorial Committee.

Case History Volume #7 was issued in March 1969 and **Reviews in Engineering Geology #2** was issued in the spring of 1969.

Seven manuscripts for a volume on Engineering Seismology are being processed and should be submitted to the Editor soon after the annual meeting. W. H. Stuart is to notify E. B. Eckel that this is to be a regular Case Histories Volume and not Volume 1 of Case Histories in Engineering Seismology.

W. M. Adams will edit a second group of manuscripts now being collected by the Engineering Seismology Committee.

A. B. Cleaves is working on Case Histories #8, Engineering Geology in the Tropics.

D. H. MacDonald and R. F. Legget will edit a Case Histories Volume on Engineering Geology in Cold Climates.

S. C. Sargent and R. E. Whitla are organizing material for the Reference List.

Intersociety Committee on Rock Mechanics

L. B. James, Division Representative, has been in Central America and will submit a report when he returns. Appointment expires in June 1970, and ICRM Bylaws do not permi reappointment. George Kiersch, Mel Friedman, and C. S. Robinson have been suggested as candidates for appointment to ICRM at the expiration of L. B. James's term.

American Society of Photogrammetry

An Interpretation and Remote Sensing Division (IRSD) was established in June 1969. H. G. Hershey is to write J. R. Van Lopik, asking him to proceed with negotiations to establish a joint EGD-IRSD Committee to insure cooperation and interchange between the organizations and to arrange joint technical programs.

Newsletter

Editor Underwood is to be commended for a fine job. Significant Management Board actions, such as modification of the Long-Range Planning Committee, are to be reported.

Membership

Notice is to be put in GSA Division newsletters indicating how GSA members can affiliate with EGD.

Joint GSA-ASCE Committee

W. H. Stuart's suggestion that future appointments to this committee be for three years was agreed on, and W. H. Stuart will recommend this to the GSA Council.

The one-year term of H. F. Ferguson ends in June 1970; G. A. Kiersch's term also ends in June 1970.

G. A. Kiersch recommended that Committee be restructured to give GSA a larger role.

The original membership consisted of three ASCE members and two GSA members, with the Chairman being an ASCE member.

R. E. Gray (an ASCE member and Secretary of the Committee) reported that current membership is nine, including two EGD representatives. Six of the nine are GSA members. EGD is responsible for expenses of their representatives. ASCE pays expenses of five members.

The question of increasing EGD representation from two to five members came up in 1961. S. S. Philbrick did not feel an increase in membership was necessary. Also, since the ASCE representatives on the Committee were also members of GSA, it was decided not to increase EGD representation.

R. E. Gray is to discuss, with the Executive Committee of Soil Mechanics and Foundations Division of ASCE, the modification of the Committee by reducing ASCE membership.

International Association of Engineering Geologists

W. H. Stuart is to obtain information from H. A. Coombs, about the meeting in Paris, September 1969.

SPE Section of AIME

J. C. Manning (Bakersfield, California) was appointed as liaison with SPE's Geological Engineering and Geohydrology Committee for 1970.

Environmental Geology Center

If funded, the Center will be located in Denver. E. Dobrovolny has been appointed by GSA as liaison to the EGC.

Papers Presented Wednesday Morning, November 12, 1969

John M. Kellberg and Samuel C. Sargent, Cochairmen

Terry R. West: Subsurface Investigation for a Power Transmission Line in Northwestern Indiana

Adrian E. Richards, W. F. Bryant and G. H. Keller: In-Place Shear Strength Measured in Abyssal Plain Sediments, Gulf of Mexico

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2nd Congress of International Society for Rock Mechanics Will Be in Belgrade

The 2nd Congress of the International Society for Rock Mechanics will be held in Belgrade, September 21-26, 1970 with the following agenda:

1. **Intrinsic properties of rock masses:** e.g., natural stresses, heterogeneity, anisotropy, discontinuity.
2. **Deformability of rock masses:** mechanism and character of deformations, effects of loading and time.
3. **Mechanical resistance of rock masses:** to compression, tension and shearing. Problems of rock failure.
4. **Underground works:** indued state of stresses, deformation, underground stresses due to mining, interaction between rock masses and supports or lining.
5. **Comminution:** physical and mechanical bases of comminution, drilling, blasting, crushing, grinding, abrasion.
6. **Improvement of the properties of rock masses:** grouting, drainage, bolting, etc.
7. **Stability of natural and excavation slopes:** permanent and temporary.
8. **Behavior of rock masses as structural foundations:** including deformation and seismic effects of reservoir loading.

Within the Agenda two lectures will be included: Achievements and Contribution of Yugoslav Specialists in the Field of Rock Mechanics, and Yugoslavia as an Earthquake Area.

The 2nd Congress will include: working sessions, study tours, receptions, excursions introduced in the working sessions and post-congress excursions and special program for accompanying persons.

Anyone interested in rock mechanics and its application may take part in the 2nd Congress.

Official languages of the Congress are: English, French, and German. Simultaneous translation service will be provided during the Congress.

Registration Fees

Registration fees are $80 for members of the I.S.R.M., $120 for non-members, $40 for accompanying persons.

Payment of the registration fee entitles all participants and accompanying persons to take part in all program events, except the post-congress excursions. All participants, but not the accompanying persons, will receive a set of the Congress proceedings.

Participants from countries which have clearing agreement with Yugoslavia should pay their fees in clearing dollars.

Excursions

Two types of excursions are planned: first, those within the working sessions, free of charge; and second, the post-congress excursions.

1. On Wednesday, September 23, the following tours are planned: "Djerdap" tour—Beograd, Kladovo, Djerdap; "Bor" tour—Beograd, Bor, Beograd; "Kolubara" tour—Beograd, Lazarevac, Beograd; "Fruška" gora tour—Beograd, Novi Sad, Beograd; "Manasija" tour—Beograd, Manasija, Beograd; "Sumadija" tour—Beograd, Topola, Kragujebac, Beograd.

2. Post-congress excursions are Bosnia–Adriatic Sea, 8 days; Serbia–Macedonia, 7 days; Serbia–South Adriatic, 5 days; Bosnia–South Adriatic, 5 days; Croatia and Slovenia, 5 days.

Costs of these excursions are not included in the registration fee.

Exhibitions

There will be two special exhibitions from September 19-28, 1970:

1. Exhibition of field and laboratory equipment and instruments used in Rock Mechanics will take place on the exhibition grounds, about 800 m from the Congress Hall.

2. Exhibition of books, journals, and periodicals will take place in the entrance hall of the Trade Union House where the Congress takes place.

Registration date for exhibitions is April 1, 1970. Display costs are due exhibitors.

All the correspondence concerning the 2nd Congress of the International Society for Rock Mechanics should be addressed to: Sekretarijat 2. kongresa Medjunarodnog društva za mechaniku stena, Institut za vodoprivredu "Jaroslav Cerni," Bulevar vojvode Mišića 43, Poštanski fah 530, Beograd, Jugoslavija.

World-Wide Information Service Available in Geotechnical Abstracts

GEOTECHNICAL ABSTRACTS is a new service of literature documentation for soil mechanics, foundation engineering, rock mechanics and engineering geology under the sponsorship of the International Society for Soil Mechanics and Foundation Engineering. It will provide a regular world-wide information service starting in January 1970, and is the result of the efforts of ISSMFE (International Society for Soil Mechanics and Foundation Engineering) over a great many years to keep up with the progress in the relevant fields. It is to be hoped that **Geotechnical Abstracts** will become a link between experts in these fields in every part of the world.

The monthly issue will contain about 144 abstracts. **Geotechnical Abstracts** may be used simply as a journal to be scanned for items of interest. The abstracts are arranged according to the preliminary International Geotechnical Classification System (IGC). A subject and an author index will be prepared annually for those who are unable to maintain a more detailed retrieval system. The IGC should also serve the user who collects abstracts in a card file. For this purpose, a cardboard edition is available, and a set of guide cards for the principal groups and the main divisions of the IGC will be provided. The technique of "coordinate indexing" may also be applied by using the key word at the bottom of each card, which are taken from the "Geotechnical Thesaurus." This means that uniterm cards, peek-a-boo cards, or even computers may be used according to the equipment available to the subscribers.

The subscription rate, calculated on a nonprofit basis, is comparatively low and should enable many individual scientists and engineers to subscribe. Two editions are available: One printed on paper, and the other printed on cards at the same annual subscription rate of DM 126, plus postage. Subscription orders should be sent to: German National Society of Soil Mechanics and Foundation Engineering, 35a Kronprinzenstrasse, Essen, Germany.

Geodex Retrieval System serves as a matching adjunct to **Geotechnical Abstracts.** It is based on coordinate indexing and the use of key words. Swift retrieval of **Geotechnical Abstracts** is assured by means of some 300 punched key word cards, which are searched manually, using a simple and highly efficient optical coincidence technique. A typical search takes less than 10 minutes. Every 4 months the system is updated with a new card deck to keep your retrieval system current.

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Management Board . . .

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David B. Duane: Sand and Gravel Deposits in the Nearshore Continental Shelf, Sandy Hook to Cape May, New Jersey

John Vecchioli: Deep-Well Recharge with Treated Sewage Water at Bay Park, Long Island, New York—Early Findings

Todd H. Riddle and Emery T. Cleaves, Cochairmen

George W. White: Anatomy of Till Deposits—Engineering Implications

Howard A. Coombs: Mossyrock Dam Site, Cowlitz River, Washington

Peter Hart: Curtain Grouting Through an Embankment—Alvin R. Bush Dam

Marvin D. Simmons: Utilization of Piezometers in Remedial Grouting —Wolf Creek Dam

Bennett L. Smith: A Comparison of Percussion Drilled and Diamond Drilled Borings in Grouting the Upper Reservoir of the Yards Creek Hydroelectric Pumped Storage Project, Northern New Jersey

Papers Presented Wednesday Afternoon, November 12, 1969

Dynamic Problems in Engineering Geology

Engineering Geology Division-ASCE Joint Committee Symposium

George A. Kiersch and Ronald C. Hirschfeld, Cochairmen

M. G. Bonilla: Some Engineering Geology Aspects of Surface Faulting and Related Tectonic Movements

Michael E. Huffman, R. G. Scott, P. J. Lorens, and Lawrence B. James: Geologic Investigation of Landslides along the Middle Fork Eel River, California

William I. Gardner: Seismic Events Related to Newly Built Reservoirs

Richard J. Holt and V. J. Murphy: The In Situ Measurement of Compressional and Shear Wave Velocities for Use in Foundation Design

Thomas A. Wilkinson and J. D. Guertin: American Falls—Preservation and Enhancement Study

Shailer S. Philbrick: Horizontal Configuration and the Rate of Erosion of Niagara Falls

The next Joint GSA-ASCE committee sponsored session will be at the 1971 ASCE Meeting in Phoenix, Arizona. The subject is "Geologic Aspects of Subsurface Waste Disposal," and the program is as follows:

Sanitary Land Fills: Member of Environmental Geology Section, Illinois State Geological Survey, Urbana, Illinois

Deep Well Waste Disposal: Dr. Neilson Rudd, Geo-Engineering Laboratories, Inc., Mt. Vernoo, Illinois

Radioactive Waste Disposal: Dr. W. C. McClain, Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee

The Rocky Mountain Arsenal Well and the Denver Earthquakes: Dr. H. K. van Poollen, Colorado School of Mines, Golden, Colorado

Richard E. Gray, Secretary of the Engineering Geology Division, has been appointed by ASCE as Chairman of the Joint GSA-ASCE Committee on Engineering Geology.

November 11, 1969 Meeting

Present at the meeting November 11, 1969 were: H. G. Hershey, W. H. Stuart, H. A. Coombs, R. E. Gray, H. E. Ferguson, E. T. Cleaves.

Program Representative—1970 Annual Meeting

H. J. Pincus (Department of Geology, University of Wisconsin, Milwaukee, Wisconsin 53021, Phone 414-228-4561) was appointed as Program Representative for the 1970 GSA Annual Meetings in Milwaukee. A symposium on Rapid Excavation is planned. The Chairman is to suggest that the Program Representative limit the symposium to one-half day. Participants in the symposium should be asked to submit their papers for a symposium volume.

Committee Appointments

All committee chairmen and section liaison representatives were reappointed with the following exceptions:

Long-Range Planning. W. H. Stuart, as Past Chairman of the Division, replaces D. H. MacDonald as Committee Chairman. Other members are D. H. MacDonald, R. W. Karpinsky, L. B. James and R. F. Legget.

E. B. Burwell, Jr., Award. Bruce M. Hall was appointed Chairman. S. S. Philbrick is to be reappointed to a three-year term. W. V. Conn (Atlanta, Georgia) is also appointed to three-year term. H. G. Hershey is to notify the appointees. As Chairman, Bruce Hall will represent the Division on the GSA Committee on Honors and Awards.

Joint GSA-ASCE Committee on Engineering Geology. Both Harry Ferguson's one-year appointment and George Kiersch's appointment end in June 1970. Management Board is to send suggestions to the Chairman. John Scott of Ottawa, Canada, was suggested as a possibility.

Intersociety Committee on Rock Mechanics. L. B. James's appointment ends in June 1970. G. A. Kiersch is interested in this appointment.

Nominating Committee

Since Councilor C. S. Content will serve a two-year term, only a Secretary and Chairman-Elect need be selected for 1971. Two appointments were made: W. H. Stuart, Chairman, and E. T. Cleaves.

Management Board members are asked to send suggestions to the Chairman for the appointment of a third member to the Committee.

Reference List Committee

H. G. Hershey to urge S. C. Sargent to finalize this work.

Richard E. Gray
Secretary

OECD Tunnel Conference Planned for June 22-26 in Washington, D.C.

An international conference to advise governments of Member countries on strategies needed to stimulate tunnelling technology is being held by the Organisation for Economic Cooperation and Development on June 22-26, 1970, in Washington, D.C., USA. Attendance will be by invitations to be extended by the participating governments.

The Conference objectives will be to determine what public policies—including research and development—are needed, and what institutional obstacles must be removed, to accelerate the development of improved tunnelling technology. With urban land scarce, and with many urban activities producing side effects that result in a deterioration of the environment, there is a growing need for placing more urban services and facilities underground. Until now, however, high cost and time have imposed constraints on extensive use of the subsurface. Improved technology offers the best promise of reducing these constraints.

The work of the Conference will be based on information gathered by means of a detailed questionnaire, replies to which are being sought from governments of all 22 OECD countries. In their replies, national authorities will consult a cross-section of the professional community both in the public and private sectors: local agencies responsible for public works, consulting-engineer architect firms, contractors, equipment manufacturers, research institutes, laboratories and universities. The results of the international survey will be presented at the Conference in a series of papers.

The Conference preparation has been entrusted to a Steering Committee of government-designated representatives of the following countries: Austria, Belgium, France, Germany, Italy, Japan, Netherlands, Portugal, Sweden, United Kingdom, and the United States. Further details of the conference are available from OECD Division for International Co-operation in Science, 2 rue André Pascal, Paris 16e, France (Phone: 524-8200).

Summer Institute for College Teachers on Physicochemical Soil Behavior Will Be Held June 29 through August 7

The University of Arizona has received a grant from the National Science Foundation in support of a Summer Institute for College Teachers of Civil Engineering, Geological Engineering, or Engineering Geology to be held June 29 through August 7, 1970. The six-week Institute will integrate soil engineering concepts with physicochemical behavior mechanisms to present a unified view of soil behavior. The 24 participants will be selected from other colleges and universities in the United States and Canada.

An unusual feature of the Institute will be the unified approach afforded by parallel presentation of theory with actual participant laboratory investigation using the unique facilities of the Department of Civil Engineering Micro-Materials Laboratory. Each participant will investigate clay soil properties using the Laboratory's electron microscope, X-ray diffractometer, infrared spectrophotometer, differential thermal analyzer, light microscopes, chemical analysis, and other facilities to improve his fundamental understanding of soil behavior.

The Summer Institute will be directed by Professor Richard L. Sloane, Professor of Civil Engineering, with Dr. Raymond N. Yong, Professor of Civil Engineering and Director of the Soil Research Laboratory, McGill University, Montreal, as Associate Director. Both will teach in the Institute assisted by specialists from the Geology Department, the Arizona Bureau of Mines, and eminent lecturers from the University of California, Berkeley, and the Engineering Geology Branch of the U. S. Geological Survey, Menlo Park. Address inquiries to: Professor Richard L. Sloane, Department of Civil Engineering and Engineering Mechanics, College of Engineering, University of Arizona, Tucson, Arizona 85721.

Papers on Cold Regions Wanted for Engineering Geology Case Histories

As a part of its continuing series on Engineering Geology Case Histories, the Division has undertaken to publish a volume of case histories from cold regions of the world. Papers are being solicited internationally, and it is hoped to have good coverage of all regions that have to deal with cold weather problems. R. F. Legget and D. H. MacDonald have been appointed editors for this volume, and they are now investigating all known sources of good material for it. If you have any relevant experience you would like to submit for consideration, or if you know of any potential sources of case history material, you are urged to contact either of the following: R. F. Legget, 531 Echo Drive, Ottawa 1, Ontario, Canada; or D. H. MacDonald, Acres Limited, 1259 Dorchester Rd., Niagara Falls, Ontario, Canada.

Contributions to this volume should be concise accounts of actual examples from the field that present features of more than local interest. They should be between 2500 and 7500 words in length and the number of diagrams and photographs should be kept to a necessary minimum.

Publication dates have not yet been established, but if you have anything to contribute or any interest in this subject you are urged to write as soon as possible to either Don MacDonald or Robert Legget.

Symposium on Engineering Geology, Soils Engineering Meets April 1-3

The 8th Annual Symposium on Engineering Geology and Soils Engineering will be held April 1-3, 1970, at the Student Union, Idaho State University, Pocatello, Idaho.

Papers presented at the meeting will be published in a Proceedings volume.

For more information write to: Dr. John F. Cutler, Department of Geology, Idaho State University, Pocatello, Idaho 83201.

GSA Annual Meetings for 1970—Planned for November 11-13 in Milwaukee, Wisconsin

The Eighty-Third Annual Meeting of the Geological Society of America and its Associated Societies will be held November 11-13, 1970, in Milwaukee, famed for its blend of Old World Charm and New World vigor. Located on the shores of Lake Michigan, this industrial city prides itself upon its spirit of "gemütlichkeit." Hospitality and warmth await the visitor, together with the finest in accommodations and gourmet dining and a variety of entertainment: concerts and theater in the new Performing Arts Center, tours of the local breweries, outstanding museums, and sports events. Milwaukee holds a welcome for everyone.

Associated Societies, whose annual meetings will be held in the same facilities concurrently with that of The Geological Society of America, include:

THE PALEONTOLOGICAL SOCIETY (62nd)
THE MINERALOGICAL SOCIETY OF AMERICA (51st)
SOCIETY OF ECONOMIC GEOLOGISTS (51st)
GEOCHEMICAL SOCIETY (15th)
NATIONAL ASSOCIATION OF GEOLOGY TEACHERS (11th)
GEOSCIENCE INFORMATION SOCIETY (5th)

Sheraton-Schroeder Hotel is the Annual Meeting headquarters hotel. With recently decorated banquet and meeting rooms, this is an attractive location for the Society's social events. Facilities at the Milwaukee Auditorium provide ample space for the general meetings and exhibits related to the Society's technical sessions. Additional housing in hotels and motels within walking distance of the Sheraton-Schroeder Hotel and the Milwaukee Auditorium is being arranged.

TRANSPORTATION – A variety of transportation is available to Milwaukee: two airports with national and international service, two railroads, two bus lines, and an auto-ferry from Ludington, Michigan across Lake Michigan to Milwaukee. Additionally, a network of first-class highways and expressways ensures comfortable travel for those driving to the meetings. See the back page of this folder for information regarding schedules.

TECHNICAL PAPERS – (Oral and discussion) abstracts for all papers are due July 1 1970. In addition to the regular oral papers and in place of papers by title, provisions are being made for discussion papers. In contrast to oral papers, discussion papers may have abstracts up to about 1,000 words with provision for line drawings and tables in place of parts of the text. Discussion papers will be discussed informally at the meetings at the time and place designated in the program. No formal presentation or projected illustrations will be presented. This follows the pattern set by the Society's technical sessions at the Atlantic City meetings.

Of special interest are the symposia sponsored by the Joint Technical Program Committee. Symposia on "The Moon," and "Strike-slip Faulting" with emphasis on geology, rock mechanics, and seismology will highlight the program. The several divisions of the Society as well as the Associate Societies also plan symposia for the Milwaukee meetings.

FIELD TRIPS – Several field trips are being organized and are tentatively scheduled as follows:

Baraboo area, geologic history of the Baraboo range, November 9-10;
Cambro-Ordovician Stratigraphy of Southwestern Wisconsin, November 8-10;
Devonian and Mississippian of Iowa classic fossil localities, November 9-10;
Marquette Iron Range, general and economic geology, November 9-10;
Pennsylvanian of East-Central Illinois, sedimentation and stratigraphy, November 9-10;
Pleistocene Geology: Woodfordian and Older Drifts, November 9-10; Two Creeks Forest Bed, November 14;
Water resources of Rock River Valley, November 9-10;
Zinc-lead mining district of Southwestern Wisconsin, underground economic geology and theories of orogenesis, November 9-10.

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