THE GEOLOGICAL SOCIETY OF AMERICA

# The Engineering Geologist

THE QUARTERLY NEWSLETTER OF THE ENGINEERING GEOLOGY DIVISION OF THE GEOLOGICAL SOCIETY OF AMERICA

Vol. 3, Nos. 1, 2, and 3

September, 1968

## *MESSAGE FROM THE CHAIRMAN*

All Members of the Division will be pleased, I am sure, to see that we have now resumed publication of the Newsletter. Under the editorship of Dick Goodman, our Newsletter got off to a good start in April 1966 and continued on through October 1967, when Dick resigned to take on other duties. The two subsequent issues were missed but again we are publishing under the able guidance of our new Editor Lloyd B. (Spike) Underwood. We are indeed fortunate to have Spike undertake this responsibility for us, and I know that he can count on the support of our Membership in continuing this worthwhile project. Spike is gradually picking up the reins and is actively lining up material for future quarterly issues.

After many delays our other publications are once again beginning to move. As you know, Ed Eckel is the new Editor of the Society and with his new staff at headquarters in Boulder, Colorado, he has made great strides in cleaning up the backlog of unpublished manuscripts. Amongst these are several Division publications–Number 6 of the Engineering Geology Case Histories Series will be printed in August. Plans for subsequent numbers in this Series are being developed and already include an issue on Case Histories in Engineering Seismology. Volume 2 of Reviews in Engineering Geology is expected to be printed in September. To the authors and editors who contributed towards these forthcoming publications, the Division owes a debt which we can only partially repay by saying "Thank You" here.

You will all have received Circular 1 of the Program for this year's Annual Meeting which will be held in Mexico City on November 11, 12 and, 13. Tom Thompson and Dr. Leonardo Zeevaert are Co-Chairmen of the Division's activities and they are organizing a program that promises to contain much of interest to all of us. Included will be a symposium on settlement problems in Mexico City and a joint field trip with the Hydrogeology Division to visit projects of mutual interest in or near the City. Other informal tours are being considered and will be run if the demand warrants them.

Since 1946, when a small group gathered at the Annual Meeting in Chicago to launch what later (1950) became this Division, engineering geology has come of age within the Society. Our aims are to encourage and promote the development of knowledge and techniques in engineering geology, and one of its chief means of doing this is through the technical programs at the Annual Meetings. We have had many fine ones in the past and this year's program promises to equal past standards. With the location this year in Mexico, where interesting problems in engineering geology are numerous, I am sure that all of you will want to attend and help to make this our most successful meeting. I look forward to seeing you there.

Yours sincerely,

Don MacDonald

## MAN POWER REPLACES MOTOR POWER IN THE INACCESSIBLE TROPICS

JEFFERY W. WIEGAND
WOODWARD-CLYDE AND ASSOCIATES

*ABSTRACT* - A wash-boring system designed to cope with inaccessible areas of the tropics is described. The system utilizes man-power and a tripod-mounted line to drive casing and obtain penetration samples for bridge site foundation studies.

Access if often a problem in soils and foundation investigations for highways in the undeveloped tropics. Offsetting this disadvantage is the low cost of indigenous labor usual in such areas. In lowland Bolivia a system was recently devised to investigate bridge site foundations wherein the labor advantage was used to neutralize the accessibility problem. It could apply as well in other jungle areas.

The function of the bridge site investigations was to determine whether pile foundations could be used, or if not, what depth for a spread footing should be planned.

The method of exploration was to sample the overburden material to a minimum of 30 feet, or the top of rock by standard 2-inch penetration drive sampler using a 2-1/2-inch casing and a wash-and-drive boring system.

Fortunately, the two major stream crossings (of 1,140 feet and 2,050 feet length) were accessible to a skid-mounted drill rig. But for most of the dozens of remaining bridge sites the only access was by mule trails.

The first system used was motorized cathead hoist and portable aluminum derrick (tripod). The equipment was readily portable by mules or dugout canoes except for the pumping station (a small skid-mounted pump) which had to be dismantled into three separate components.

During the first boring where this system was used boulders were encountered. The small motor was unable to extract or "bump out" the casing which was firmly embedded in boulders to a depth of 33 feet. It was then discovered that seven men pulling down on the hoisting line could "bump out" the casing with relative ease. The motorized cathead was deleted and the rig was operated by man-power along. *(See Fig. 1)* This required only the aluminum tripod with a sheave and several feet of one-inch rope. With this system it was possible to drive casing with a 280-pound hammer, drive the penetration sampler with a 140-pound weight and wash out the casing with the pumping station attached to a chopping bit.

Later the relatively heavy pumping station was deleted and light-weight centrifugal or piston-type pumps were used which were more easily carried from site to site, yet were able to wash out the casing.

The system worked excellently and was well adapted for such an area. It involved less equipment, less gasoline, was less expensive and the extra men who comprised the power walked from site to site under their own power.

By experimentation it was found that the men could pull down most comfortably on a separate bight of the line for each

*Man Power Cont.*

man. Also, a piece of wood could be turned in the bight to make a handle. In particularly hard or bouldery zones two men would pull down on lines attached to the drive weight when driving casing.

The system worked so well that a second "rig" was organized. For this team the men simply cut trees at the site for the tripod and hung a sheave from it. The rest of the system comprised rope, 38 feet of 2-1/2-inch casing, 41 feet of "A" drill rod with a chopping bit, a standard 2-inch penetration split tube sampler, a small pumping station, a 140-pound drive hammer, a drive head and a guide.

*CONCLUSION* - The access problem required us to de-mechanize our procedures and equipment. From a motorized cathead and aluminum tripod we de-mechanized to a tripod of tree-poles with a sheave and seven men on a line. The latter was functional; it could get into the most inaccessible areas at less cost, and make wash borings through boulder layers that the light motorized equipment was incapable of penetrating.

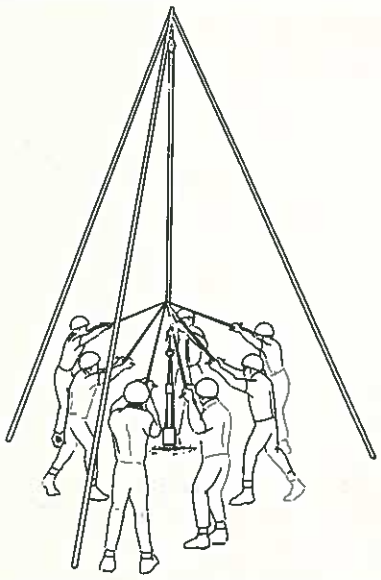

*Fig. 1 – Man-powered drill rig. Seven men pulling on a line prepare to extract or "bump-out" casing. Use of men instead of power equipment helped solve the access problem of highway foundations and materials investigations in the tropical jungle.*

## NEW PANAMA CANAL SLIDE

A new slide located immediately north of the Continental Divide on the Panama Canal is under investigation. The slide adjoins the notorious West Culebra Slide that developed during the original construction of the Canal and still continues to show activity. The new slide is interpreted to be an example of the long-time loss of strength of weak sedimentary materials. A consulting board has been appointed by the Panama Canal Company consisting of Mr. Wendell E. Johnson, Mr. Robert Peterson, Dr. Phillip Rutledge and Mr. T. F. Thompson to advise on study procedures leading to recommendations for corrective measures. Formations of concern to this failure are all of Tertiary age and include weak, slickensided shales, siltstones and sandstones, agglomerates and basalts.

## FOUNDATIONS FOR LARGE CANADIAN DAM NOW EXPOSED

The foundations for Mica Dam located on the Columbia River in British Columbia about 80 miles upstream from Revelstoke are now partially exposed. This dam will be the highest of its type in the world (800 feet). The shells of the huge embankment will be constructed of stream gravels with a steeply clay core, upstream inclined. The selection of gravel shells instead of conventional broken rock was governed by large diameter triaxial tests which indicated that the rock would break down under the loading of the dam. The foundation rock is interlayered granite gneiss and schist of Precambrain age. Work on the large underground powerhouse which will be located within the right abutment is scheduled for a subsequent contract. Current operations include abutment stripping and shaping, construction of haul roads and borrow areas, and foundation grouting. BC Hydro will own and operate the project with CASECO Consultants Ltd. of Vancouver responsible for its engineering aspects. A consulting board consisting of Dr. A. C. Casagrande, Dr. Ralph Peck, Dr. Frank Nickell, T. F. Thompson, R. W. Spencer and Dr. Hunter Rouse has been set up to advise CASECO on geology, soils and hydraulic features of the design and construction.

## *CHILEAN NATIONAL POWER AUTHORITY PROJECTS UNDER WAY*

Construction of the El Toro Project and investigations of the Antuco hydroelectric scheme are well under way in south-central Chile. This work, financed in part by the World Bank, will involve the construction of 5 dams and about 18 miles of large tunnels, mostly through volcanic sediments, flow rocks and granitic rocks of this portion of the Andes. Engineering for the work is by the Chilean National Power Authority "ENDESA". The combined projects will add over 1 million kws to Chile's rapidly growing demand for electricity. An interesting aspect of the scheme will be the underwater tap of Lake Laja, a lake that was created in relatively recent times, geologically speaking, as a result of the growth of a volcano across a river valley. The "tap" will be at a depth of 80 meters below the surface of the lake. The El Toro powerhouse will be underground with long rock anchors to provide roof stability.

Other projects in Chile of interest to the engineering geologist are the Colbun Project on the Maule River (deep alluvial deposits) which has a power potential of over 1 million kws, and the proposed future development of the Rio Bio Bio, the next major drainage south of the El Toro development where sites for two high dams have been located, with combined power potentials on the order of 4 million kws. Both projects visualize the use of underground power plants.

## *STATUS OF SEVERAL MEXICAN DAMS*

Studies are being advanced by Mexico's Comision Federal de Electricidad to select the most appropriate type of dam for the Angostura site located in a deep limestone gorge on the upper Grijalvo River upstream from the now completed Malpaso Dam and near the city of Tuxtla Guttierez. Rockfill and arch dams are competitive for this 500-foot development. Programs of field and laboratory rock mechanics testing are underway to assist in defining the properties of the rock as these will influence final selection of type of dam. Another site downstream from Angostura is within the spectacular limestone gorge known as the Sumidero, a feature comparable to Hells Canyon and the Grand Canyon of the western United States. This dam would be over 700 feet high, in Cretaceous limestone beds similar to those at the Angostura location. Underground powerhouses are being considered for both sites.

The LaVillita Dam on the lower Balsa River, 125 miles north of Acapulco, recently was topped out but work on the spillway and other features continues. A flood in excess of 100,000 cfs was successfully handled during construction with but minor damage to completed work. Design of this dam includes the use of what is probably the world's deepest ICOS wall (about 280 meters deep and 50 cms wide) to provide a cutoff through the alluvial deposits of the valley floor. Abutments for this dam are composed of partially metamorphosed Cretaceous sediments and andesites with a mass of granodior in thrust fault contact in the spillway area.

Some of the dams that are under study or in construction will be discussed in the GSA meeting to be held in Mexico City, November 11-13, as will the Mexico Basin gravity drainage scheme which is under supervision of the Federal District.

## FLATHEAD TUNNEL EXCAVATION COMPLETED

"Holing-through" ceremonies were held on 21 June 1968 for the Flathead Tunnel in northwestern Montana. This seven mile long railroad tunnel is being constructed as part of the U.S. Army Corps of Engineers' extensive Libby Reservoir Project. A 39 mile relocation of the Great Northern Railroad, including the Flathead Tunnel beneath Elk Mountain, is necessitated by the building of Libby Dam now under construction on the Kootenai River. The Flathead Tunnel is second only in length in the western hemisphere to the Great Northern's Cascade Tunnel in Washington and is the seventh longest railroad tunnel in the world.

## *81ST ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA MEXICO CITY, D. F., MEXICO*

The 1968 Annual Meeting of the Geological Society of America and its affiliated societies will be held at the Medical Center of the Mexican Institute of Social Security (Centro Medico) on Monday, Tuesday and Wednesday, 11, 12, 13 November 1968.

Thomas F. Thompson, Chairman of the Program Committee for the Division of Engineering Geology, assures us that the program including papers and field trips should be of great interest to all engineering geologists.

The "kickoff" phase of the program will be a symposium on the subsidence and settlement problems of Mexico City. Other papers on interesting features of engineering geology will also be presented. It is hoped that several papers on the use of long rock anchors for stabilization of rock slopes and underground openings will be presented at the meetings.

Arrangements are being formulated for a visit to the University of Mexico to view the large triaxial machine and large plane shear device that have been developed down there. Other possible visits to local areas of interest to engineering geologists are being planned, including the review of construction on the underground rapid transit scheme and the Mexico City drainage project, both of which are now under construction and can be reached in a short time.

One formal field trip in conjunction with the hydrogeologists is also scheduled for the day following the meetings.

It is hoped we will have a large turn-out for our sessions on engineering geology in Mexico City.

## *FROM THE COMMITTEE ON CONSTRUCTION MATERIALS*

A study of cracking and serious deterioration of a 40-year-old dam in Northern Ontario, by Dr. L. Dolar-Mantuani, Petrographer, Ontario Hydro Electric Power Commission, Toronto, Canada, led to the conclusion that alkali aggregate (alkali-silica) reaction was responsible. Petrographic examination and chemical tests on concrete and aggregate in cores taken from the dam indicated that the deleterious rock was a varved argillite which was a component of the coarse aggregate. The other components of the aggregate were local gravel and sand running the lithologic gamut of the local rock types in the area. Further detailed studies of the argillite suggests that the particular reactive material is finely-divided quartz.

Mr. Haraldur Asgeirsson of the Building Research Institute, Reykjavik, Iceland, in correspondence with the Highway Research Board, has reported an apparently puzzling situation which exists there regarding high alkali cement and potentially reactive aggregates. Mr. Asgeirsson reports that for ten years they have been using a cement with total alkalies up to 1.3% (about .7 greater than that recommended to avoid alkali-silica reaction) and often potentially reactive aggregates, but they have yet to observe damage in the field due to alkali aggregate reaction. Mr. Asgeirsson expects that this may be due to short age and low temperature. In the absence of more detailed information, it is difficult to judge the mitigating effect of low temperature. Alkali silica reaction damage has, in the past, occurred in regions of low temperatures. Perhaps considerations relating to "pessimum" proportion are also important. In any case, on the face of it, the situation is interesting and the Highway Research Board (especially MC-B2) is looking forward to developing an effective interchange of information with Mr. Asgeirsson on the problem.

Michael A. Ozol
Highway Materials Research Analyst
Virginia Highway Research Council

## COMING EVENTS OF INTEREST TO THE ENGINEERING GEOLOGIST

Sept. 3-12 Third International Symposium on Recent Crustal Movements, Moscow; Mascherikov, President, Commission on Recent Crustal Movements, Intern. Ass'n of Geodesy, Molodezhnaya 3, Moscow B-296, USSR

Sept. 18-20 Society of Mining Engineers Annual Fall Meeting (AIME), at Minneapolis, Minn.; Mr. J. Fox, 345 E. 47th St., N.Y., N.Y. 10017

Sept. 29 International Meeting of the Society for Exploration Geophysicists, Denver, Colo.; H. Breck, Box 1067, Tulsa, Okla. 74101

Oct. 1-4 ASCE Annual Meeting - Sessions on Special Foundations on Rock and Foundations Over Mined Areas, at Pittsburgh, Pa. (ASCE Hq.)

Oct. 22-25 International Symposium on Rock Mechanics, Madrid, Spain; Sociedad Espanolal de Mecanica de las Rocas, Paseo Bajo de la Virgen del Puerto, 3, Madrid 5, Spain (Cosponsored by Intern. Society for Rock Mechanics).

Oct. 22-26 Association of Engineering Geologists Annual Meeting - Symposium on Reservoir Leakage and Groundwater Control, at Seattle, Wash.; Dick Calster, 18233 13th Ave., N.W., Seattle, Wash. 98177

Oct. 28-29 Symposium of Research and Development in Rapid Excavation, School of Engineering, Sacramento State College, Sacramento, California

Oct. 27-31 Tenth Annual Colloquium on Rock Mechanics, International Bureau For Rock Mechanics, Leipzig, German Democratic Republic; Dr. G. Bilkenroth, Intern. Bureau For Rock Mechanics, Inselstrasse 12, DDR-102 Berlin, Germany

Nov. 11-13 Geological Society of America Annual Meeting - Papers on Engineering Geology, at Mexico City; GSA Hq., P.O. Box 1719, Boulder, Colo. 80302

Dec. 2-4 American Geophysical Union Western National Meeting, in San Francisco; AGU, 2100 Pennsylvania Ave., N.W., Washington, D.C. 20037

Dec. 5-7 Fifth Canadian Symposium on Rock Mechanics; at Education Centre, 155 College St., Toronto, Ontario; c/o Dept. of Mining Engineering, University of Toronto, Toronto 5, Ontario, Canada

## EDWIN B. ECKEL NAMED AS EDITOR FOR SOCIETY

The Geological Society of America has appointed Edwin B. Eckel, nationally recognized leader in the application of engineering geology, to the position of Editor.

Eckel, 62, of Denver, was formerly Research Geologist, Special Projects branch of the United States Geological Survey. In 1965 he received the Department of the Interior's Distinguished Service Award and in 1960 the University of Arizona Medallion of Merit. He was founder and first Chief of the Engineering Geology Branch of the USGS and is a member of the National Academy of Science's Committee on the Alaska Earthquake and of UNESCO's Emergency Missions' roster of scientists.

EDWIN B. ECKEL

Eckel began his career as a teaching Fellow at the University of Arizona in 1928 and began his USGS career in 1930. He was in charge of examination of dam sites in Arizona, Nevada, Utah, Colorado, and Idaho prior to World War II, when he headed investigation of quicksilver deposits in the United States and Mexico.

In 1944, Eckel was assigned to the European and Mediterranean Theatres as Technical Representative to Engineering Intelligence. He was appointed Chief of the Engineering Geology Branch in 1945 and in 1952 was Technical Advisor, Foreign Geology Branch, responsible for investigation of geological and mineral resources of Paraguay. In 1962 he was named Chief, Special Projects Branch, responsible for advising the Department of Defense and the Atomic Energy Commission regarding earth science information related to nuclear explosions.

Eckel received his B.S. in Chemical Engineering from Lafayette College, Easton, Pennsylvania, his M.S. in Geology from the University of Arizona; he furthered his studies in Geology at the Colorado School of Mines. He has published 78 technical reports.

He has been a member of the Council for the Geological Society and has served as Chairman of many of its committees. He is a Fellow in the Mineralogical Society of America, is a member of the Society of Economic Geologists, New Mexico Geological Society, Colorado Engineering Council, Geological Society of Washington, and American Institute of Professional Geologists, past President of both the Colorado Scientific Society and Association of Engineering Geologists.

## NEW BOOKS AND LITERATURE IN ENGINEERING GEOLOGY

*by Raymond E. Whitla*

ENGINEERING GEOLOGY OF THE NORTHEAST CORRIDOR,WASHINGTON, D.C., TO BOSTON, MASSACHUSETTS, U.S. Geological Survey Miscellaneous Geologic Investigations Map I-514, 1967. Available from Distribution Section, U.S. Geological Survey, Arlington, Virginia 22202. Price $6.00 for the set of 3 parts or $2.50 each for parts A and B and $1.00 for part C. This is a three-part report prepared by the U.S. Geological Survey at the request of the Office of High Speed Ground Transportation, U.S. Department of Transportation, to summarize the geologic conditions of part of the Northeast Corridor, the highly urbanized area between Washington, D.C., and Boston, Massachusetts, as they would affect construction of a proposed high-speed ground transportation facility between major cities along this Corridor. The data contained in the report was compiled from existing data and is presented on maps and accompanying cross sections and tables. Outcrop maps are on a scale of 1:250,000, and other maps are on a scale of 1:500,000. Part one of the report, Map I-514A, BEDROCK GEOLOGY, contains a set of five maps showing outcrops of the various bedrock lithologic types in the Northeast Corridor area accompanied by a sheet on which is tabulated detailed descriptions of the lithologic types and their engineering properties. A seventh sheet lists the sources of published data for the bedrock geology. Part two of the report, Map I-514B, COASTAL PLAIN AND SURFICIAL DEPOSITS, is a set of eight sheets made up of five maps on which are shown outcrops of Coastal Plain and of surficial deposits in the Corridor area, one sheet of selected subsurface cross sections through surficial deposits, one sheet containing a table of detailed descriptions of the mapped units and of their engineering and hydrologic characteristics, and one sheet showing sources of published data for the surficial geology. The third part of the report, Map I-514C, EARTHQUAKE EPICENTERS, GEOTHERMAL GRADIENTS, AND EXCAVATIONS AND BORINGS, is composed of maps showing the data listed in its title and listing the sources of the engineering data.

In addition to its use by planners for the high-speed transportation facility, the report can be useful in planning other engineering projects and can have broad educational use.

Sabins, Floyd F., Jr., INFRARED IMAGERY AND GEOLOGIC ASPECTS: Photogrammetric Engineering, vol. 23, no. 7, p. 743-750, July 1967. This is a report of a study having as an objective the correlation of nighttime infrared scanner imagery with the geologic features of the Indio Hills, Riverside County, California. Geologic maps, serial photographs, and field observations were used in the interpretation. The author describes the geologic features and their appearance on the infrared imagery strips. He concludes that nighttime infrared imagery in the Indio Hills can furnish stratigraphic and structural information and suggests this as a potentially useful technique for locating faults that are covered by alluvium. He also suggests its possible use in detecting areas of shallow ground water in arid land areas.

Wise, Donald U., RADAR GEOLOGY AND PSEUDOGEOLOGY ON AN APPALACHIAN PIEDMONT CROSS SECTION: Photogrammetric Engineering, vol. 23, no. 7, p. 752-761, July 1967. In this article, the author analyses the imagery from a K-band, multipolarized, side-scan radar obtained during a flight along Susquehanna River from near Harrisburg, Pennsylvania, to Chesapeake Bay. He concludes that the imagery of the Susquehanna region shows vegetational and cultural patterns much more clearly than the geology. Geologic information can be gleaned from the images insofar as slope and vegetational pattern depend on the geology, but these interpretations require a strong backlog of ground truth to draw upon. He points out also that pseudogeologic linears are abundant, particularly in the form of tree lines at acute angles to the flight path and with bare trunks exposed to the view of the aircraft. The author suggests that geologic utility of the images could be improved by a lower slant angle of illumination, selection of flight direction parallel with the geologic grain of the country rather than across it, and selection of some wavelength that decreases the effect of camouflaging agricultural pattern.

Hilton, I. C., GROUT SELECTION: A NEW CLASSIFICATION SYSTEM: Civil Engineering and Public Works Review (London, England), vol. 62, no. 734, p. 993-995, September 1967. The author of this article proposes a classification system for grouts based on the flow characteristics of the fluid grout and on the properties of the grouts after they have set. His aim is to provide a means for selecting suitable grouts for a job on the basis of general knowledge of the permeability of the soil or rock to be treated, the strength that will be required, and whether or not the soil or rock needs to be made impermeable without the necessity for prior knowledge of the physical and the chemical nature of the grouting materials.

Niini, Heikki, ON ENGINEERING-GEOLOGICAL STUDIES CONCERNING THE SELECTION OF THE COURSE OF THE WATER TUNNEL HAUSJÄRVI-HELSINKI: Engineering Geology (Elsevier Publishing Co., Amsterdam, Holland), vol. 2, no. 1, p. 39-45, April 1967. This article describes the geological studies that were performed by the National Board of Public Roads and Waterways of Finland in selecting the alignment for a tunnel through bedrock to be part of an aquaduct system to convey water from Lake Päijänne in inner Finland to the Helsinki area. The tunnel will be constructed through a migmatitic part of the Svecofennian schist belt in Precambrian bedrock and will have a length of 60 kilometers and a cross-sectional area of 10 square meters. The studies were carried out in three stages: (1) preliminary map and airphoto studies for selection of possible routes for closer examination; (2) field studies, which included

detailed geological mapping of alternate tunnel routes and seismic soundings at the most critical places; and (3) economic comparison between alternate routes as related to geological considerations.

Cannon, D. E., RECORD TUNNEL EXCAVATION WITH BORING MACHINES: Civil Engineering, vol. 37, no. 8, p. 45-48, August 1967. This article describes tunnel excavation progress through use of boring machines in two tunnels, Azotea Tunnel and Blanco Tunnel, that are part of the Bureau of Reclamation's San Juan-Chama Project in southern Colorado and northern New Mexico. The project will divert 110,000 acre-feet of water annually from tributaries of San Juan River on Colorado's western slope to Rio Chama River in the Rio Grande Basin of northern New Mexico. Azotea Tunnel is 12.7 miles long and is being excavated to a diameter of 12 feet 8 inches through shale sandstone of the Mancos, the Mesa Verde, and the Lewis formations. Blanco Tunnel is about 8.6 miles long and is being excavated to a diameter of 10 feet through shale of the Lewis formation. Cutting rate in shale in Azotea Tunnel has averaged 12.1 feet per hour of operation. That in sandstone is less. Advance in Blanco Tunnel has averaged 3,432 feet per month.

## ANNOUNCEMENT OF THE 11TH ANNUAL NATIONAL MEETING OF THE ASSOCIATION OF ENGINEERING GEOLOGISTS

"Reservoir Leakage and Ground Water Control" is the theme for the 11th Annual National Meeting of the Association of Engineering Geologists, to be held at the Olympic Hotel in Seattle, Washington, October 22 through October 26, 1968.

This theme has been selected because of its far reaching influence on nearly all phases of engineering geology and related fields. Reservoir leakage implies direct concern with dam design, construction, water storage and ground-water geology. These general subjects together with applied hydrology, soil and rock mechanics, engineering seismology and construction practices are all intimately related to the theme of the Meeting and to the basic objective of AEG; minimizing the risk of geologic hazards in planning, design, construction, operation, and maintenance of engineering works.

The scope of the technical sessions will be broad and of general interest to those concerned with engineering geology. The response to the call for papers has been very gratifying, and we can expect a technical session that will feature outstanding authors presenting papers on research projects, case histories, and other topics related to engineering geology.

The symposium, working on the convention theme, will be held the last afternoon of the technical sessions, and will be moderated by W. Harold Stuart, Division Geologist, North Pacific Division of the Corps of Engineers. On the symposium panel and their specialities are H.R. Cedergren, Consulting Engineer; Berlen C. Moneymaker, Chief, Geolocial Branch, Tennessee Valley Authority, Limestone Areas; C.J. Monahan, Chief of Foundation and Materials Branch, Walla Walla District, Corps of Engineers, Volcanic areas; Dr. Howard A. Coombs, Chairman of Geology Department, University of Washington, Glaciated Areas, and William I. Gardner, Chief Geologist, Bureau of Reclamation. Reservoirs in Pleistocene and Eolian Deposits.

Field trips will feature visits to the sites of several dams, including existing and proposed structures, together with projects under various stages of construction or modification and a classical partial reservoir failure. The field trips will also include a review and discussion of the glacial geology of the Puget Sound Region.

A bulletin on regional geology, site geology for all field trips and other interesting projects is being prepared and will be distributed to all individuals who register for the Meeting.

One trip, to the Central Cascades, will include visits to the Tolt Dam, a recently completed earth fill dam in a perched bedrock gorge adjacent to a deeply filled glacial valley; the Cedar Dam, a classic partial reservoir failure in a delta morainal embankment that left the dam intact; and the North Fork Snoqualmie site, a proposed dam site that is currently under study in a deeply filled glacial valley.

Another trip to the South Central Cascades will visit the Mud Mountain Dam, a flood control project for the Puyallup Valley with two seepage paths through a glacial embankment that marks the sites of two interglacial river channels; the Howard Hanson Dam, a flood control project on the Green River and the Cedar Dam mentioned above.

A fly-in trip to the North Central Washington area will feature visits to the Chief Joseph Dam, a major hydroelectric project on the Columbia River with the right abutment founded on pervious gravel, and Grand Coulee, the largest project in the Columbia River Development. Excavation of one abutment and a section of the dam will be under way in connection with construction of the Third Powerhouse. Irrigation projects of the Columbia Basin Project will be observed and discussed on this trip also.

An interesting trip by bus, inclined railway and boat to Gorge Diablo, and Ross Dams in the Skagit Project in the Northern Cascades will feature some of the most breathtaking scenery to be found in the United States. Some times called the "Alps of North America", this area must be seen by everyone visiting the Northwest, and it is especially for the ladies. A visit to the River Dam Powerhouse, which was destroyed by a landslide recently, will be included on this trip.

Some of the interesting local trips will include a visit to the Boeing Company Scientific Research Center and a display of the Stevens Pass Tunnel project, where a strain (laser) seismograph is installed in an abandoned railroad tunnel in the heart of the Cascade Range, and is measuring deformation of the earth's crust.

A number of special events are planned including a Northwest Indian-style salmon barbecue on an island in Puget Sound, a luncheon, exhibitors' hospitality hours, and the annual banquet featuring as guest speaker Dr. Tom Hornbein, member of the American Mount Everest Expedition. Dr. Hornbein will deliver an illustrated talk on the expedition which made the first successful ascent of Mount Everest via the West Ridge.

## ELEVENTH SYMPOSIUM ON ROCK MECHANICS

*Monday through Wednesday, June 16-18, 1969*

The Intersociety Committee on Rock Mechanics in cooperation with the University of California, Berkeley, is sponsoring a three-day symposium on rock mechanics. This is the one national annual meeting in which experts from the ten sponsoring scientific and professional societies (including GSA) meet to share the latest knowledge in this field of growing importance. Papers will be presented in the following subject fields: simulation of rock behavior, role of fluids in rock mechanics, and geological factors in rock mechanics. A general session will also provide coverage of the most recent developments in rock mechanics.

The Committee invites those who plan to present papers to submit extended abstracts by January 15, 1969. Abstracts should be sent to: Rock Mechanics Symposium Committee, University of California, 328 Hearst Mining Building, Berkeley, California 94720.

Enrollment fee: $30.00 (includes Proceedings)

For further information please write to the Committee or to Continuing Education in Engineering, University of California Extension 2223 Fulton Street, Berkeley, California 94720; or telephone (415) 642-4151.

# Engineering Geology Case Histories

# Number 6

GEORGE A. KIERSCH
Editor


Prepared for the Division on Engineering Geology
of
The Geological Society of America

1968

This is the sixth volume in the Case History series of the Division on Engineering Geology of the Geological Society of America, initiated in 1957. Each succeeding volume has enjoyed increasing acceptance as an aid to the practicing geologist and engineer, student, and teacher, alike. This volume is a collection of general case histories on dams, tunnels, highways, and underground construction. Indeed, the Baldwin Hills reservoir failure is another in a long list of cases which demonstrate why the geologic environment, features, and circumstances are of major concern to engineering works.

**THE ENGINEERING GEOLOGIST**
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