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The Engineering Geologist

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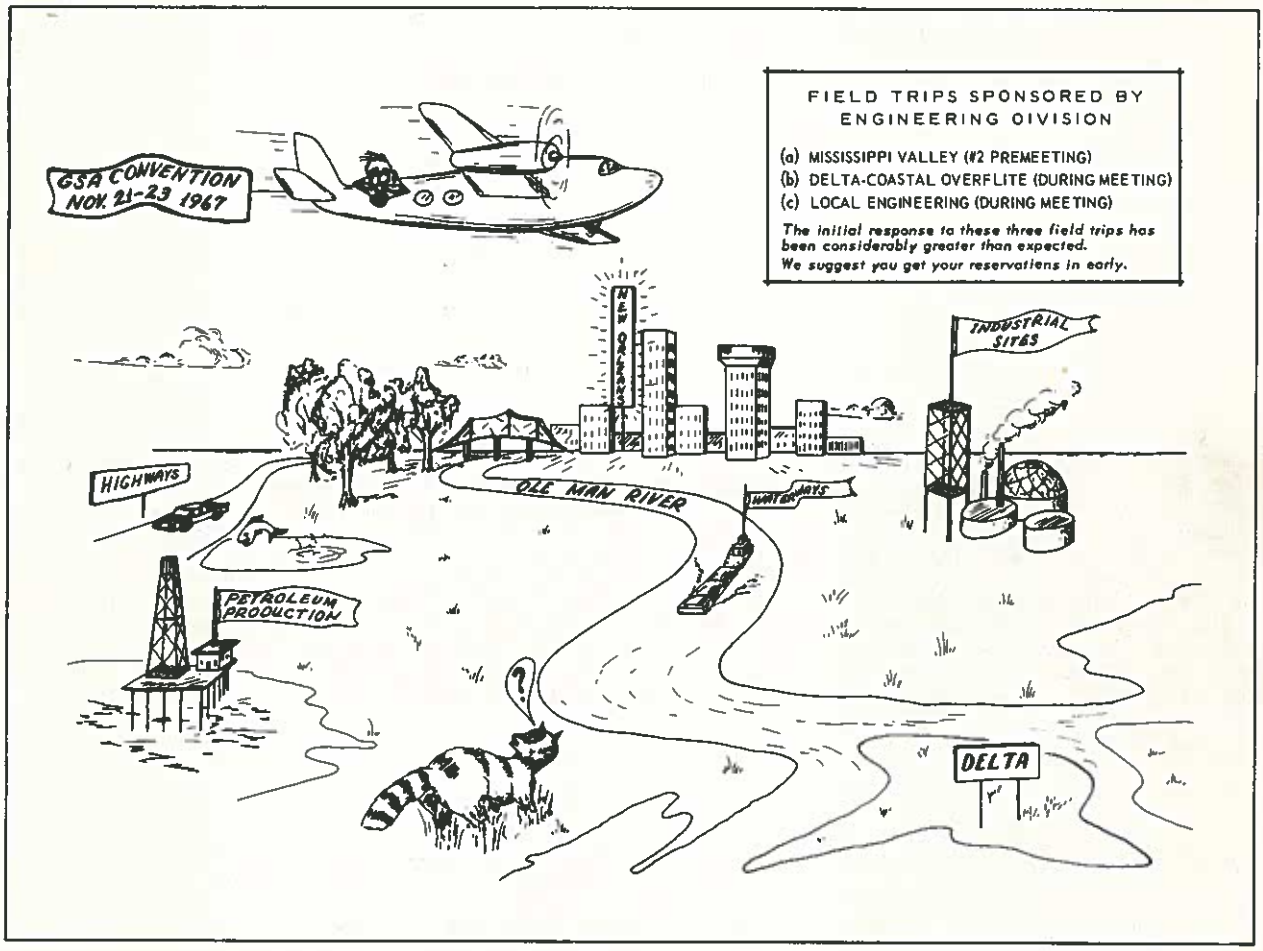

NEW ORLEANS CONVENTION - NOVEMBER 20-22

Charles R. Kolb

The EGD program for the New Orleans Convention is beginning to take shape. Field trips are being organized, symposia are planned, and the first of what appear to be a sizable number of interesting engineering geology abstracts are being received.

Dr. Hirschfeld of MIT is organizing one symposium of papers on "The significance of pore pressures in problems of engineering geology," as a joint ASCE-EGD offering. A closely related symposium of papers has been organized by Dr. Kolb, Chief of the Geology Branch, Waterways Experiment Station at Vicksburg, Miss., on "Engineering geology problems in alluvial and deltaic plain soils." Certainly, no more suitable locale for discussing problems associated with deltaic soils could be found than New Orleans, nor could an area be found where pore pressures are of more concern.

We report with sadness the untimely death of Mr. Elmer Marliave. See page 2 for short profile.

Authors and tentative titles of the alluvial-deltaic plain symposium are:

Robert F. Legget, "Soils and the engineering geologist." (Opening Remarks)

Charles R. Kolb, "Lower Mississippi alluvial and deltaic plain--the geologic setting."

Robert I. Kaufman and Roger T. Saucier, "Dewatering, foundation, levee safety, and river stabilization problems in the Yazoo Basin."

J. M. Coleman and Clara Go, "Consolidation and cementation in sediments of Southeast Louisiana."

Ellis L. Krinitzsky, "Sedimentary structures and postdepositional disturbances in alluvial and deltaic plain clays."

Colonel Thomas J. Bowen, "Navigation, flood control and hurricane protection along the lower Mississippi River."

Bres Eustis, "Foundations for high-rise buildings and other heavy structures in the New Orleans area."

Ali S. Kemahlioglu, "Building highways on the soils of south Louisiana."

Bramlette McClelland, "Foundations for drill rigs--coastal and offshore Louisiana."

Speakers and subjects for the pore pressure symposium, comoderated by Ronald Hirschfeld and Laurence B. James, are:

R. C. Hirschfeld	Principle of Effective Stress
K. V. Taylor	Pore Pressures, Dams, and Foundations
D. U. Deere and F. D. Patton	Pore Pressures and Slope Stability
J. F. Poland	Subsidence
H. B. Seed	Liquefaction

Our field trips consist of one preconvention trip that begins at the Waterways Experiment Station Laboratory at Vicksburg, tackles the controversial problems associated with the loess of the area, meanders through the Mississippi Valley floodplain and the Tertiary geology of the area to ante-Bellum Natchez, and ends in New Orleans after examining some of the problems associated with the deltaic plain and the Mississippi alluvial terraces. During the meeting we are arranging for several plane flights over the Mississippi deltaic and coastal plain (see sketch). These are two-hour flights that permit the greatest exposure to the landforms and engineering problems of an otherwise almost inaccessible part of Louisiana. During the convention we are also offering bus trips within the local area to see a few of the interesting problems associated with high-rise buildings, levees, hurricane protection, flood control, subsidence, riverbank caving, and the French Quarter.

See y'all there.

MR. ELMER MARLIAVE

Elmer C. Marliave, age 57, died September 24, 1967, in Sacramento, California. A graduate of the University of California at Berkeley, Mr. Marliave started working as an engineering geologist with the State of California in 1933 and rose to the position of Chief Geologist, Department of Water Resources. In 1956 he left State service to become a noted geological consultant on ground water and civil engineering works. Elmer Marliave was a member of the committee of ten who founded the California Association of Engineering Geologists, predecessor to the Association of Engineering Geologists. He was also active with the Geological Society of America and was Chairman-elect of the Engineering Geology Division at the time of his death. He pioneered the engineering geology investigations for Oroville dam and other features of the California State Water Project and contributed substantially to the development of water resources in California. His efforts in promoting the stature of engineering geology and in helping and encouraging many young engineering geologists will be long remembered.

AN OPPORTUNITY FOR ENGINEERING GEOLOGISTS

The Board of Water Supply of the City of New York is looking for geologists. Contact Mr. Martin Hauptmann, Deputy Chief Engineer, 120 Wall Street, New York, N. Y. 10005.

CONFERENCES AND ACTIVITIES OF SOCIETIES

R. E. Goodman

UPCOMING MEETINGS

ANNUAL MEETING--GSA--New Orleans, November 20-22. See article, first page. Plan to attend.

ANNUAL MEETING--AEG--Dallas, Texas, October 24-28. Features engineering geology of clay shales and the moon. Field trips are planned to see NASA-Houston, a salt mine, Amistad dam, and to review geology of the Dallas area. Address inquiries to W. J. Samuelson, Box 17295, Fort Worth, Texas.

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REPORT ON FIFTH IDAHO SYMPOSIUM ON ENGINEERING GEOLOGY

John F. Cutler, Department of Geology, Idaho State University

About 150 geologists and engineers attended the Fifth Annual Symposium on Engineering-Geology and Soils Engineering, which met April 12-14, 1967, on the campus of Idaho State University in Pocatello.

The eighteen technical papers presented at the three-day conference included theoretical as well as case studies and covered a wide variety of topics--ground water problems, land subsidence, frost action in soils and effects on man-made structures, harbor design, slope stability, foundation engineering, soil creep, and many others. All of these papers will be published in a Proceedings volume that will be available by mid-October (available for $5.00 from Harold Loveless, Idaho Department of Highways, P.O. Box 7129, Boise, Idaho 83707).

The main banquet speaker, Henry J. Moore, Astrogeology Branch of the U. S. Geological Survey, presented a very interesting "Field Trip to the Moon". Dr. Moore explained in some detail the techniques being used to make geologic maps of the lunar surface and described studies made on simulating lunar craters.

Next year's symposium, to be hosted by the Idaho Department of Highways, will be held in Boise, Idaho, sometime in April.

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PROCEEDINGS OF ROCK MECHANICS MEETING, KYOTO UNIVERSITY, JAPAN, 1966.

At a recent meeting at Kyoto University, papers were presented on: 1) a new electrical method for determining the extent of rock fractured by blasting; 2) correlation of geological studies and tunnel performance in two tunnels of Kansai Power Co.; 3) the bearing capacity of foundations containing a weak layer; 4) the safety of dam foundations; 5) prediction of faults by seismic prospecting methods during tunnel driving (authors laid detectors over the tunnel line and recorded the blasts of driving the face forward); 6) strength estimation of mudstone from pulse velocity results; 7) an analysis of progressive foundation failure; and 8) in situ stress estimation. The editor has Japanese texts of the papers and short English summaries.

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Proceedings of the 3rd Pan Am Conference on Soil Mechanics and Foundation Engineering, (Caracas, July, 1967) are available. Please send your remittance ($30.00) payable to: "Comite Organizador III CPMSIF," c/o Apartodo No. 10760, Saban Grande, Caracas, Venezuela.

NEW ALLUVIAL GEOLOGY MAP

The U. S. Army Engineer Waterways Experiment Station has recently published a composite map "Alluvial geology of the Yazoo Basin, Lower Mississippi Valley." The 1:250,000-scale, slightly generalized, single-sheet, composite map of the basin is accompanied by a second map depicting the suballuvial geology and topography. The multicolor maps measure 24 by 50 inches.

The two maps, plus an explanatory, illustrated legend sheet are avaiable from the Director, U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, Mississippi 39180. Cost for the set is $2.00 (rolled and postpaid). Remittance should be made by certified check, money order, or postal note made payable to the Treasurer of the United States, Vicksburg, Mississippi.

Applied research and investigations in alluvial geology and geomorphology of the Lower Mississippi Valley are principal functions of the Waterways Experiment Station. Specific geologic site investigations for major Corps of Engineers projects as well as valley-wide surveys and systematic mapping programs are currently being carried out. Unfortunately, reports on these investigations have usually been published in only a very limited number of copies, mostly for internal distribution within the Corps. Some of the earlier works, such as the renowned 1944 report entitled "Geologic Investigation of the Alluvial Valley of the Lower Mississippi River," by the late Harold N. Fisk, are now almost collectors items.

Large-scale maps similar to those in the Yazoo Basin report are being prepared for areas elsewhere in the Alluvial Valley, and 1:250,000-scale composite maps will be compiled from other major physiographic subdivisions of the valley from time to time.

CALIFORNIA AQUEDUCT
PROGRESS REPORT ON TUNNELS

Arthur B. Arnold
Supervising Engineering Geologist
California Department of Water Resources

Progress on the tunnels in Southern California on the California Aqueduct is continuing.

The four Tehachapi crossing tunnels and the Angeles tunnel are under construction.

The adit for the two Tehachapi Underground Discharge Line tunnels has been completed. The adit permitted inspection and testing of the rock, and will provide additional headings for the excavation of the Discharge Line tunnels.

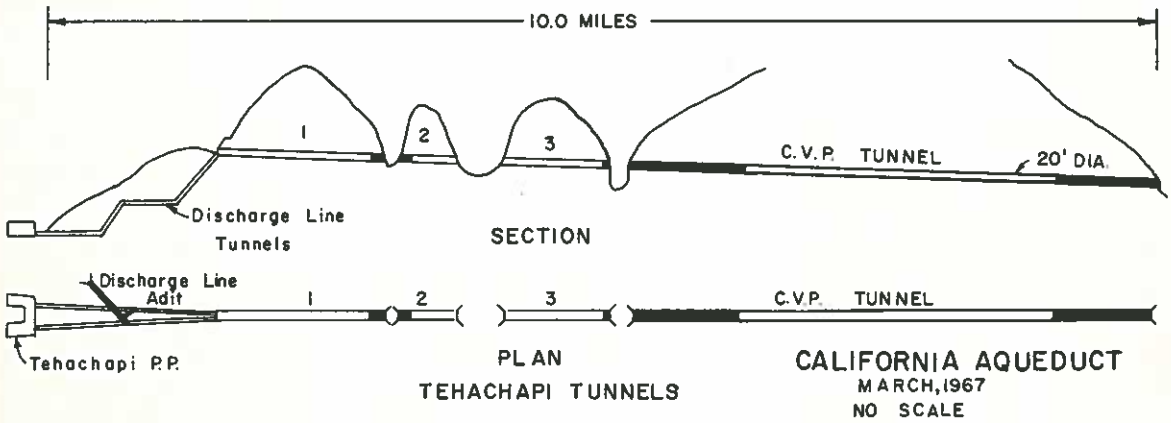
Tehachapi tunnel No. 1 is being driven from the south portal, and tunnel No. 2, from the north portal. Tunnel No. 1 has progressed in diorite gneiss 200 feet. Tunnel No. 2 has advanced in diorite gneiss 100 feet.

Support consists of 8M40 horseshoe ribs on 4-foot centers. Williams' expansion shell rock bolts, 1-inch in diameter, 10-feet long, have been used in areas of more competent rock. Overbreak has ranged from 1.0 to 3.5 per cent, and the powder factor has varied from 1.6 to 3.3 pounds per cubic yard of rock. The excavation for north portal of tunnel No. 3 is essentially complete.

The 4.8 mile, 20-foot diameter Carley V. Porter tunnel is being driven with a shield from two headings. The south heading has progressed 4,314 feet. The north heading has advanced 5,000 feet. Both headings are penetrating the Tejon Lookout Granite, which is the southern block of the Tehachapi Maountains. The Carley V. Porter tunnel is bordered by the Garlock fault to the north and the San Andreas to the south. The movement on these faults has severely compressed and fractured the granite, causing many fault slivers and gouge zones. Hydrothermal alteration and weathering have affected the rock to the degree that the material encountered at tunnel grade has the characteristics of a soil. The granite is so weak in some sections of the south heading that during tunneling operations, caving at the heading formed a sink hole on the surface in an area of 240 feet of cover. Very little water has been encountered (fortunately).

The circular support consists of 8M40 sets that weigh approximately 12,000 pounds. The liner plate sets (MEMCO rings) are installed under the protection of the shield. In some instances, 6-inch and 8-inch H beam jump sets are required where loads appear to deform the MEMCO rings. There has been some difficulty maintaining line and grade.

The contractor has been underground about a year on the Carley V. Porter tunnel.



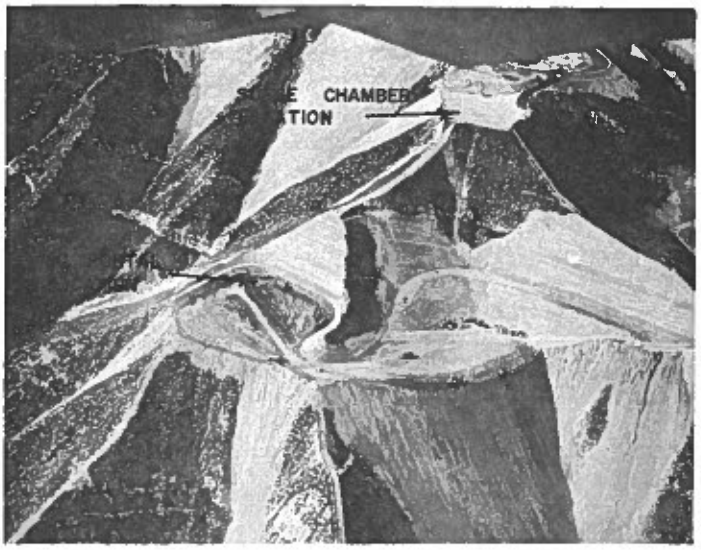
Angeles Tunnel

Angeles tunnel is entirely in sedimentary rock units of the Castaic formation of Miocene Age and the Ridge Basin group of Pliocene age. The sandstones, shales, and siltstones strike at nearly right angles to the tunnel and dip from 20 to 30 degrees northwest (toward the north portal).

The 30-foot diameter, 7 mile long Angeles tunnel is being driven from six headings. The three adits (1,185, 2,585, and 1,350 feet long) have intersected the main tunnel; the south heading has advanced 200 feet. The main tunnel is being mined by the top heading method. Supports consist of steel rebs, 10WF49, placed on double wall plates at 4-foot centers, with moderate timber lagging and blocking.

Aerial view of North Adit looking east, showing construction plant area, adit and the relocation contract work for Highway No. 99 above the North Adit.

J. Lyons 1/4/67

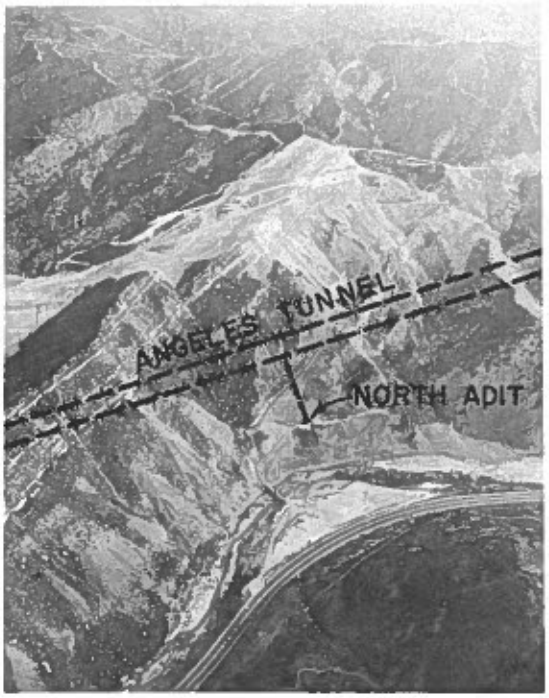


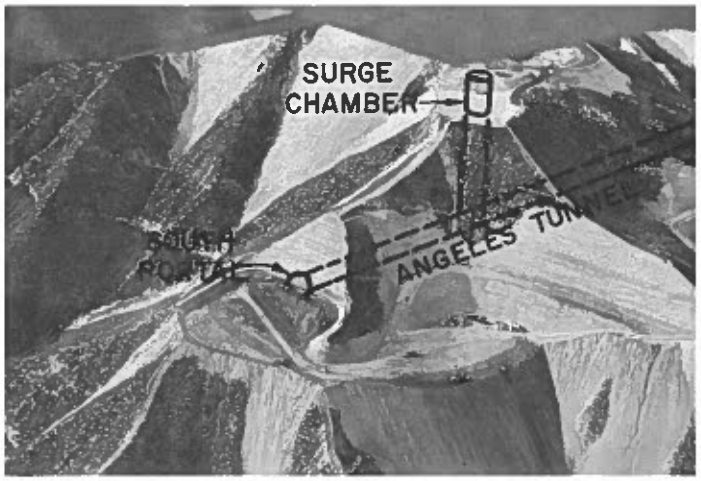
View looking west at South Portal excavation.

J. Lyons 1/19/67

Aerial view of South Portal looking northeast from surge chamber area showing South Portal excavation. Dashed line indicates probable alignment of future penstocks to Castaic Power Plant.

J. Lyons 1/19/67



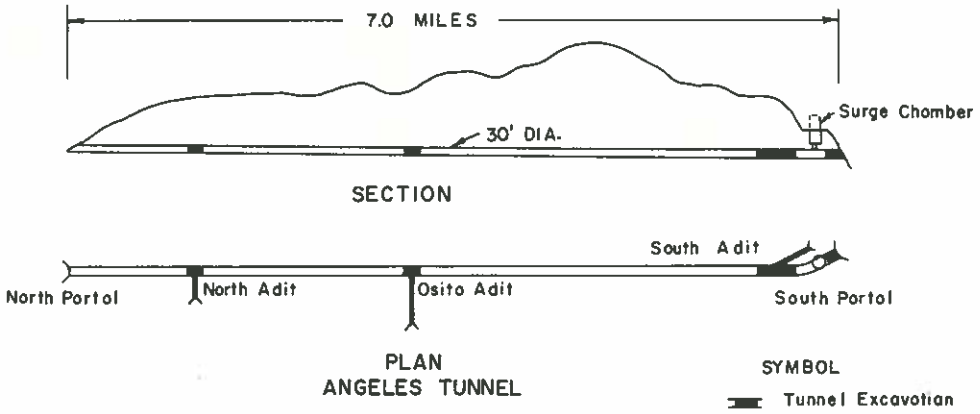


Exploration showed the presence of methane gas in several drill holes, and the possibility of encountering gas during tunneling was indicated to the contractor.

The contractor has placed an automatic alarm for detection of gas in the air return line. The alarm is triggered if the gas concentration is in excess of 1 per cent. The alarm has been triggered during tunneling on the Osito adit. Examination of the face showed concentrations of 0.5 per cent methane; remnants of blast holes registered 4.0 per cent. The area cleared of gas in a few minutes.

The shooting pattern for the top heading of the main bore consists of 80 to 90 holes 4 to 5 feet deep. The round is pulled with about 230 pounds of 30 per cent dynamite on 11 delays. The powder factor varies from 2.9 to 4.5 pounds per cubic yard.

The surge chamber at the south end of the Angeles tunnel will be 235 feet deep and 120 feet in diameter. A large diameter hole is to be drilled in the chamber that will permit the excavated material to be dumped down the hole into the tunnel and out of the south portal. Grouting perimeter holes to improve the rock conditions in the surge chamber is in progress.



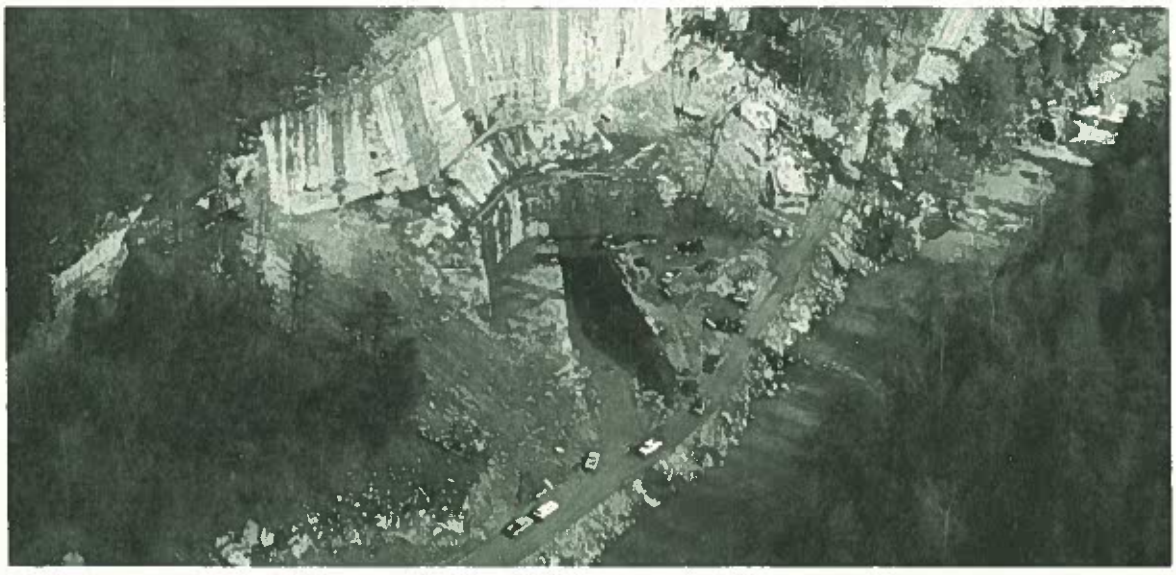
LAUREL RIVER TUNNEL

Marvin Simmons
Geologist, Nashville District
Corps of Engineers

General

The Nashville District of the Corps of Engineers is in the process of constructing a 19-foot ID tunnel, 1,310 feet in length, at a site on the Laurel River, Laurel County, Kentucky. The tunnel, which is now completed except for lining, will be used to divert the river while a 275-foot rockfill dam is being constructed. A 150-foot vertical shaft has been constructed to intersect the tunnel about midlength, and the combination shaft and tunnel will be utilized as a power penstock, with the upstream portion of the tunnel plugged at the completion of the dam.

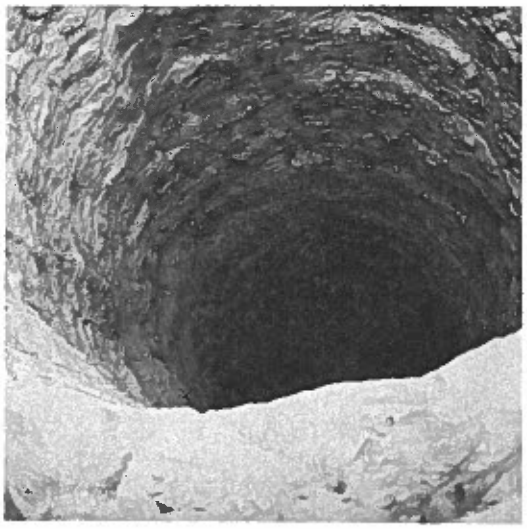
Construction of the dam is scheduled to commence in the fall of 1967, and the entire project to be completed in 1972. The tunnel is being constructed by Fenix and Scission of Tulsa, Oklahoma.



DOWNSTREAM PORTAL, LAUREL TUNNEL (Showing 90' sandstone cut 4 on 1, shale cut 1 on 1)

Geology

The Laurel River traverses a region of flat-lying Pennsylvanian sandstones and shales. The sandstones are fairly hard, mostly massive, white or creamy colored, and fine grained; but in a few zones, conglomeratic. The shales are gray to black "cemented shale" and in some cases, silt shale with minor coal interbeds. The tunnel is driven through the Rockcastle Member of the Lee Formation, which at the site is a massive, fine-grained sandstone with conglomeratic zones. The compressive strength of this sandstone ranges from 6,000 to 13,000 psi and there is only a minor amount of jointing present. The shaft enters 7 feet below the upper contact of a massive sandstone member some 90 feet in thickness. Below the sandstone it passes through a two-foot coal bed, 14 feet of shale, and then into the Rockcastle Member, where it intersects the tunnel some 52 feet below the lower contact of the shale.

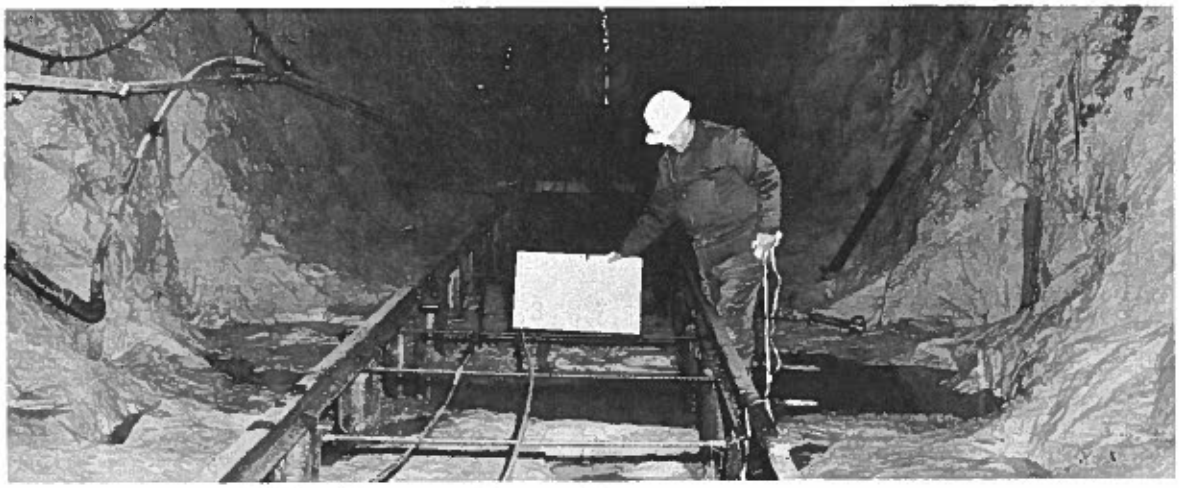


VIEW OF SHAFT (Rock shown is 90' sandstone member)

Construction

Before tunnel construction could begin, a vertical section of some 175-feet of sandstone and shale had to be removed in order to develop the portals. All final faces were presplit, with the exception of the faces in the immediate area of the tunnel openings. These faces were developed by utilizing buffer zone blasting techniques. This consists of removing all rock to within 8 or 10 feet of the final face, recessing perforated sleeve mortared type rock anchors through the buffer zone into the rock behind the final face, and then removing the buffer zones in 10- to 12-foot lifts.

Tunnel construction was begun at the upstream end, with a 12-foot pilot bore driven one 8-foot pull ahead of the full opening for a distance of 310 feet. This was 180 feet beyond the design requirements and was performed at the discretion of the contractor. Perforated sleeve mortared type rock anchors were recessed from the design pilot tunnel into the rock surrounding the final tunnel for support. The only variation from the above procedure on the downstream end of the tunnel was that the pilot bore was driven its full length of 70 feet before enlarging the tunnel to its full diameter. Ring beams on 3-foot centers were erected the first 30 feet of either end. Beyond the limits of the pilot bores, the tunnel was driven full face from the upstream end to the pilot tunnel section of the downstream end, at which point the operation was completed working from the downstream portal.



TUNNEL WALLS (Tracks are for placing steel lining)

The rounds were drilled with jackleg drills working from a three-deck truck-mounted jumbo. The smoothwall blasting technique was utilized, with the only problem resulting from poor hole alignment. The perimeter holes were 1 5/8" ID on 24 to 30 inch centers, loaded .25 lb/ft with DuPont Trimtex and fired with "0" delay caps. The burden on these holes was approximately 1 1/2 times their spacing. A burn cut round was employed which pulled approximately 8 feet. The tunnel generally advanced 32 feet in three 8-hour shifts. Mucking was accomplished with an up-and-over mucking machine loading into back-dump trucks. A systematic program of installing groutable-type rock anchors was utilized throughout the tunnel above the springline.

During shaft construction an unsuccessful effort by the contractor was made to pre-drill the shaft shot holes their entire length utilizing "long hole" drilling techniques. As much as 12 feet of misalignment resulted in the 150-foot vertical holes, and lifts of 8 feet were resorted to after a full length pilot shaft had been constructed. No water problems were encountered during shaft or tunnel construction.

GEOLOGY IN UNDERGROUND WORKINGS

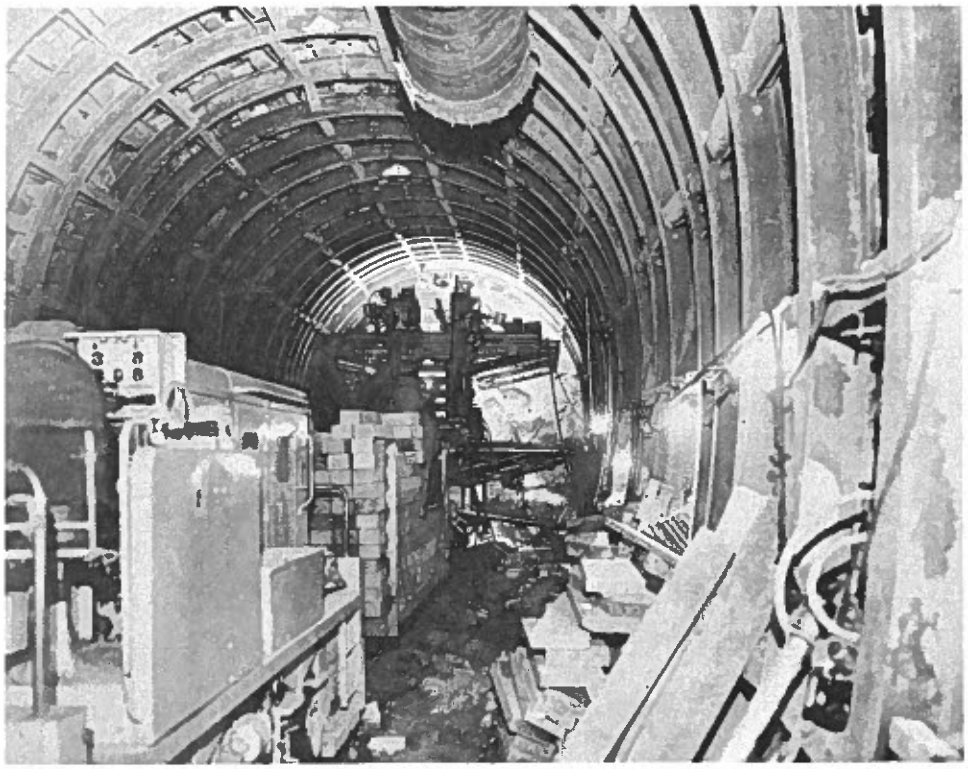
Lloyd Underwood

BERKELEY HILLS TUNNEL HOLES THROUGH

Charles Content
Manager of Engineering
Geology, Bechtel Corporation

The three and one-tenth mile long twin bore Berkeley Hills Tunnel was holed through in March 1967. This is the major tunnel in the San Francisco Bay Area Rapid Transit District's 75-mile transit system and the fourth longest vehicular tunnel in the United States. Preconstruction exploration included geologic mapping, 32 NX core drill holes totalling about 5,000 feet, and two 5 x 7-foot exploration adits--a 1,000-foot adit at the east portal and a 1,412-foot adit at the west portal. In situ rock tests in these adits and laboratory tests on selected cores were performed as part of the exploration program.

The tunnel was driven by conventional methods from four headings, working simultaneously. Average rate of progress for the four headings was about 19 feet per day per heading. The maximum advance in a 24-hour period was 48 feet in one heading and 120 feet in all four headings. The tunnels were supported throughout using 8-inch, wide flange continuous rib, 40-pound steel. The maximum spacing between the steel sets was 4 feet. The quantity of support steel, including the invert struts, estimated before bidding was 26,500,000 pounds. Actual weight used during construction was 27,021,000 pounds.



Setting steel for close rounds in Berkeley Hills Rapid Transit Tunnel.

Geology

The bearing of the Berkeley Hills Tunnel is such that it intercepts the strike of the major geologic units at approximately 45 degrees. Several lithologic units were penetrated, as was the Hayward Fault. The rock types include sandstone, shale, siltstone, conglomerate, chert, basalt, tuff, flow breccia, ryolite, diabase and limestone.

The active Hayward Fault was encountered a few hundred feet from the west portal and consisted of about 700 feet of gouge and crushed rock, chiefly serpentine. This badly sheared material was supported by steel sets on 2-foot centers, with invert struts.

Ground water presented no problem in driving the tunnel. A combined maximum inflow was estimated to be 650 gallons a minute at the portals. Maximum inflow at any one face occurred in basalt and was estimated to be 300 gallons per minute. In general the inflow decreased as the heading advanced.

Engineering geologists of the Bechtel Corporation were responsible for collecting the required preconstruction geologic data and recording geologic features intercepted during construction.

NEW BOOKS AND LITERATURE IN ENGINEERING GEOLOGY

Raymond E. Whitla

Presplitting, a Controlled Blasting Technique for Rock Cuts. Bureau of Public Roads Publication, 36 pp., 1967. Price $0.30. Available from Superintendent of Documents, Washington, D. C. 20402.

As reviewed in Public Roads for April, 1967, this report presents the findings of a staff study by the Bureau of Public Roads on rock presplitting, particularly as they apply to highway construction. The report reviews the different field practices used to improve rock blasting operations and emphasizes the use of presplitting as a method of producing smooth wall surfaces that require less maintenance and provide more safety during highway construction. It should be of interest to all who are engaged in rock excavation activities.

Rock Excavation and Specification Trials for the Lancashire-Yorkshire Motorway, Yorkshire (West Riding) Section: Williams, Harold; and Stothard, John Northedge. The Institution of Civil Engineers (London) Proceedings, Vol. 36, Session 1966-67, pp. 607-631, March 1967.

The article describes test excavations and test fills that were made in connection with the preparation of specifications for construction of the Yorkshire (West Riding) Section of the Lancashire-Yorkshire Motorway. This section of highway crosses the Pennines and will involve cuts up to 150 feet deep and embankments up to 215 feet high. One of the high embankments also will act as a dam to impound water for a reservoir. The test excavations were made in irregularly bedded sandstone and were performed by ripping and by using various blasting techniques. The test fills were made from material from the test excavations and were placed on a "fairly firm" clay foundation after removing between 2 and 4 feet of peat and between 2 and 6 feet of soft clay. The main aspects of the studies were the rock excavation methods, the suitability of the material for placement in fill, and the placement and compaction of the material in the fills. The article would be improved by the addition of information on such characteristics of the sandstone as the thicknesses and the attitudes of the beds and the kind and the degree of cementation, characteristics that relate to excavation, handling, and compaction behavior.

The Geometry of Discontinuities and Slope Failures in Siwalik Clay: Fookes, Peter G., and Wilson, D. Dene. Geotechnique, Vol. 16, No. 4, pp. 305-320, December 1966.

This paper is concerned primarily with the geometry of structural discontinuities in the foundation rock for the Mangla Dam project and their relationship to slope failures. Mangla Dam project is being constructed in northern Pakistan approximately 100 miles north of Lahore, and the foundation rocks are clay and sandstone beds of the Siwalik System of Pliocene age. The rocks were subjected to uplift and folding following deposition, and such structural features as shear zones, faults, and joints were formed in response to the stresses that caused the folding. The structural discontinuities discussed in the paper are grouped under four classifications, fissures, thrust shear joints, faults, and shear zones. The paper describes the four classes of structural discontinuities, describes briefly the three types of slope failure involved, and presents four case histories of slope failures on the project.

Mechanics of Landslides with Non-Circular Slip Surfaces with Special Reference to the Vaiont Slide: Mencl, V. Geotechnique, Vol. 16, No. 4, pp. 329-337, December 1966.

Previous writers have described the disastrous landslide that occurred at Vaiont Dam in Italy on October 9, 1963, and have made analyses and presented hypotheses to explain its cause. The author of this paper, however believes that the previous analyses have overlooked some features that deserve consideration. He gives a short review of data from previous reports and then presents an analysis of the mechanism of the landslide in the course of plastic flow in which he supposes a gap or cavity to have developed along the curved section of the slip surface. The assumption of the cavity helps to explain the sudden, unexpected collapse of the slope.

Rock Mechanics in 1966: Ahrenholz, H. William. Mining Engineering, Vol. 19, No. 2, pp. 99-104, February 1967.

Rock Mechanics in 1966 is a review article on rock mechanics, in which the author covers recent developments in fundamental rock mechanics research, techniques for field testing, and some of the more notable applications of rock mechanics in mining operations. The review is written primarily from the viewpoint of mining but should be of interest to all who wish to keep current on what is going on in rock mechanics. No references are given, however, to indicate the author's sources of information.

High-Head Hydro Readied Despite Slides, Squeezing Rock, Explosions. Engineering News-Record, Vol. 177, No. 25, pp. 32-34, December 22, 1966.

This article describes some of the problems related to geology that were encountered in constructing a 5-mile tunnel and a 3-mile penstock in connection with construction of El Colegio Hydroelectric Project in Colombia, South America. This project is about 30 miles west of Bogota and diverts water from Bogota River to a riverside, above-ground powerhouse. Although the article should be of considerable interest to engineering geologists, its interest would have been greater if a description of the geologic setting of the project had been included.

Interpreting Local Geology from Radar Imagery: Rydstrom, Hubert O. Geological Society of America Bulletin, Vol. 78, No. 3, pp. 429-433, March 1967.

The report is a revision of a paper presented at the Fourth Symposium on Remote Sensing of Environment held at Ann Arbor, Michigan, on April 13, 1966. Its purpose is to show that both diffuse and specular radar energy reflections can be used to advantage in local geologic interpretation and that they emphasize certain geologic features that may be poorly defined on aerial photographs. The paper discusses radar imaging principles and describes geologic interpretations that can be obtained from application of these principles. The author concludes that high resolution, side-looking radar in the existing state of the art can be useful in local geologic interpretation and that, with increasing knowledge of the complex radar parameters that enter into image formation and by study and development of approaches such as multifrequency radar, radar will be an increasingly useful tool.

Blaster's Handbook (15th edition): E. I. du Pont de Nemours & Co., Inc., Explosives Department, Willmington, Delaware 19898, 526 pp., 1966. Price $6.00.

Most persons who have had any connection with blasting operations are familiar with the Blaster's Handbook published by the Explosives Department, E. I. du Pont de Nemours & Co. This book describes the various blasting materials and methods of handling them and the latest blasting techniques and practices as applied to mining, quarrying, construction work, seismic explorations, agricultural uses, and underwater blasting. New features contained in this latest edition include sections on ammonium nitrate explosives and their handling and use, chapters on controlled blasting techniques, and on noise and vibrations from blasting. The book is abundantly illustrated with photographs and diagrams.

Rock Mechanics and the Design of Structures in Rock: Obert, Leonard; and Duvall, Wilbur I. John Wiley & Sons, Inc., 605 Third Ave, New York, N. Y. 10016, 650 pp., 1967. Price $21.95.

The volume is intended to be a general exposition and reference on rock mechanics for the engineering profession. The authors have attempted to bring together the general fundamentals and pertinent information necessary for an understanding of rock mechanics and the design of structures in rock. The book contains (1) a brief mathematical treatment of stress, strain, elasticity, and inelastic effects to provide the reader with the necessary theoretical background for analyzing stresses, strains, and deformation in structures; (2) a discussion of the methods and procedures for measuring the mechanical properties of rock and a consideration of the mechanisms of failure; (3) a description of the instruments and procedures for measuring stress, strain, deformation, and other related qualities together with results from laboratory and field investigations; and (4) a discussion of procedures based on both theoretical and empirical results for designing, analyzing, and evaluating the stability of underground structures. At the end of each chapter is a short list of references that either are cited in the chapter or are considered to be of sufficient interest to be recommended for supplemental reading.

Introduction to Soil Behavior: Yong, Raymond N.; and Warkentin, Benno P. The Macmillan Company, 866 Third Avenue, New York, N. Y. 10022, 451 pp., 1966. Price $12.95.

This book is written primarily as an introductory text on soil behavior for advanced undergraduate and for graduate students taking soil mechanics courses, for research workers in soils, and for practicing engineers who require a more detailed knowledge of soil properties. It presents information on the basic behavior of soil from the related disciplines of soil mechanics, agricultural soil science, colloid chemistry, and geology. The first part of the book describes the origins and methods of formation of soil types and their physical and chemical properties. The remaining chapters deal with soil rheology, soil structure, problems of soil water, volume changes and consolidation behavior, strengths of soils, and soil freezing. The book is recommended to anyone interested in soil behavior.

Engineering Geology of Norwegian Normally-Consolidated Marine Clays as Related to Settlements of Buildings: Bjerrum, Laurits. Geotechnique, Vol. 17, No. 2, pp. 83-117, June 1967.

In 1961, the British Geotechnical Society inaugurated an annual lecture, known as the Rankine Lecture, to be given by a distinguished soil mechanics engineer. This paper is the 7th Rankine Lecture of that society. It was given on 15 February 1967 at the meeting of the Institution of Civil Engineers. The paper reviews the various geological processes that can take place with time in the normally consolidated Norwegian marine clay and that will lead to changes in the geotechnical properties of the material. The effects of the various processes discussed are illustrated by a collection of records of settlement of buildings in Drammen, a town of 47,000 inhabitants, 40 kilometers southwest from Oslo. The processes considered are leaching, delayed consolidation, and chemical bonding. The general validity of the concepts is demonstrated by the settlements of four buildings constructed on a layer of plastic clay.

Joint ASCE-USCOLD Committee on Current United States Practice in the Design and Construction of: Arch Dams, Embankment Dams, Concrete Gravity Dams. American Society of Civil Engineers, 131 pp., 1967. Price $4.00. Available from United States Committee on Large Dams, c/o Engineers Joint Council, 345 East 47th Street, New York 10017.

In 1962-63, the American Society of Civil Engineers and the United States Committee on Large Dams organized a Joint Committee on Design Criteria for Dams. This book is the work of that committee. It summarizes the current design and construction practices of the major engineering organizations in the United States for the three types of dams listed in the title and, thus, provides a convenient reference to those practices. It gives considerable space to foundation exploration practices and treatment. No attempt is made, though, to set up recommended design criteria as standards for adoption and universal use. The committee is hopeful that the book will stimulate interest in improving practices and in suggesting areas where additional knowledge and improvement are needed and can be achieved. The book will be as useful to engineering geologists as to engineers.

Stone for Architects: Winkler, Erhard M. Geotimes, Vol. 12, No. 4, pp. 14-16, April 1967.

The author of this article mentions some modern uses of stone for building and decorative purposes and discusses some of the considerations in selecting stone for those uses. The article is relatively short but should be of interest to any who may have occasion at some time to work with architects in selecting stone for use in buildings and in memorials.

Geology from a Deep-Diving Submersible: Schlee, John. Geotimes, Vol. 12, No. 4, pp. 10-13, April 1967.

Anyone wish to explore the ocean floor? The deep submersible "Alvin" is a new oceanographic research vessel constructed for just that purpose by Litton Industries for the Office of Naval Research and is operated by Woods Hole Oceanographic Institute. By use of this vessel, direct geologic observations can be made of the ocean floor. This article describes the Alvin and the author's impressions from two dives he made in it at the Tongue of the Ocean, British West Indies.

Geologic Effects of the March 1964 Earthquake and Associated Seismic Sea Waves on Kodiak and Nearby Islands, Alaska: Plafker, George; and Kachadoorian, Reuben. U. S. Geological Survey Professional Paper 543-D, 46 pp., 1966. Price $0.60. Available from the Superintendent of Documents, Washington, D.C. 20402.

This report is another of the series of some 40 or more reports being published by the U. S. Geological Survey on the March 27, 1964, Alaska earthquake, which was the most severe ever felt on Kodiak Island and its nearby islands in modern times. The authors discuss the topographic and the geologic setting of the islands in the introduction, then discuss in turn the eathquake and its after shocks, surficial subsidence and ground cracks, landslides, effects on ground and surface water, vertical tectonic deformation, seismic sea waves, and damages and casualties. The report is well illustrated with 10 maps and 21 photographs, 4 in color, showing effects of the earthquake and of the subsequent seismic sea waves including damages resulting from them.

The Falls Whispered: Dyment, Robert. Compressed Air, Vol. 72, No. 5, pp. 20-22, May 1967.

"TheFalls Whispered" describes current studies being made by the U. S. Army Corps of Engineers at Niagara Falls, New York, to determine what means if any could be taken to preserve and to enhance the beauty of the American Falls and the feasibility of those measures. The studies so far are of a preliminary survey nature. Local people have become much concerned with the recession of the crestline of the American Falls and the accumulation of debris at its foot from falls of rock from the crest. The article contains minor errors in technical descriptions apparently as a result of the author's unfamiliarity with certain equipment and procedures; nevertheless, the article should be interesting to engineering geologists because it deals with a problem somewhat different from those with which they usually come in contact.

Failure and Breakage of Rock; Eighth Symposium on Rock Mechanics: Fairhurst, Charles, ed. American Institute of Mining, Metallurgical, and Petroleum Engineers (A.I.M.E.), 345 East 47th St., New York 10017, 600 pp., May 1967. Price $20.00.

I have not had the opportunity to review this book, but it contains 23 papers that were given at the Eighth Symposium on Rock Mechanics, September 15-17, 1966, at the University of Minnesota. These papers present an analysis of current knowledge and thinking in the following five branches of rock mechanics: Rock Failure, Underground Design and Excavation, Surface Design and Construction, Drilling, and Blasting.

Electrical Methods in Geophysical Prospecting: Keller, George V.; and Frischknecht, Frank C. Pergamon Press, Inc., 44-01 21st Street, Long Island City, New York 11101, 519 pp., 1966. Price $18.50.

Clays and Clay Minerals: Proceedings of the Fourteenth National Conference: Bailey, S. W., ed. Pergamon Press, Inc., 44-01 21st Street, Long Island City, New York 11101, 447 pp., 1966. Price $20.00.

Review of Research on Laterites: Maignien, R. (Natural Resources Research IV), UNESCO Publications Center, 319 East 34th Street, New York, N. Y. 10016, 148 pp., 1966. Price $5.00.

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