

# **PROCEEDINGS OF THE 43RD ANNUAL HIGHWAY GEOLOGY SYMPOSIUM**

**AUGUST 19-21, 1992  
Fayetteville, Arkansas**

## **CO-SPONSORED BY**

**Department of Civil Engineering, University of Arkansas  
Arkansas State Highway and Transportation Department**

**and**

**Arkansas Geological Commission**

## **CHAIRMAN OF LOCAL ARRANGEMENTS**

**Sam I. Thornton  
BELL 4190, University of Arkansas  
Fayetteville, AR 72701**



# 43RD HIGHWAY GEOLOGY SYMPOSIUM

AUGUST 19-21, 1992

FAYETTEVILLE, ARKANSAS

**Program: TUESDAY, 18 AUGUST**

5:00 to 6:30 PM Registration (Hilton)

**WEDNESDAY, 19 AUGUST**

8:00 to Noon Registration (Continuing Education 4th floor)

<b><u>TECHNICAL SESSION I</u></b> - Mr. Russell Glass, Moderator	Page
8:30 AM -- Welcome, Harry Moore HGS Steering Committee Chairman	
8:40 AM -- Opening Remarks, Sam Thornton 43rd Symposium Chairman	
8:50 AM -- Keynote Address "Geology of Arkansas", Norman F. Williams, Sr., State Geologist	1
10:00 AM -- Coffee Break Sponsored By <b>Preformed Line Products</b>	
10:30 to Noon	
•Critical State of Debris Flow - Lin and Lovell	8
•Influence of Post Depositional Effects on Properties of a Marine Clay - McManis & Nataraj	25
•Overview of the Highway Geology in West-Central Arkansas - Stone	37
•Evaluation of Coal Refuse for Access Road Construction - O'Hara & West	38
 <b><u>TECHNICAL SESSION II</u></b> - Dr. Terry West, Moderator	
1:30 to 3:00	
•Landslides on Crowley's Ridge - McFarland	64
•Slope Failures on Highway 71 Relocation Project - Sharum & Annable	79
•Slope Maintenance and Slide Restoration - Munoz	99
•Repairs to Rock Slopes in Stuberville, Ohio - Graham, Ingraham & Humphries	100
3:00 to 3:30 -- Break, Sponsored By <b>Contech Construction Products and Tensar</b>	
3:30 to 5:00	
•Cannon Creek Embankment Instrumentation - Thornton, McGuire & Thian	113
•Design Construction & Monitoring of a Geogrid Embankment - Lumbert & Thian	117
•Use of Geomembranes for Mitigation of Pyritic Rock - Moore	141
•Field Trip Preview	
 <b>THURSDAY, 20 AUGUST</b>	
8:00 AM - 5:00 PM - <b>FIELD TRIP</b> ; Field Trip Lunch Sponsored by <b>Brugg Cable Products</b>	
6:30 PM - Banquet-Hilton Ballroom; Mr. John David McFarland III, Speaker	164
 <b>FRIDAY, 21 AUGUST</b>	
<b><u>TECHNICAL SESSION III</u></b> - Mr. Willard McCasland, Moderator	
8:00 to 9:30	
•Steel Wire Rope Safety Net System in the US - Yarnell	198
•Value Engineering to Replace Slope with a Reinforced Wall - Macintosh	208
•In-situ Moisture Content of Arkansas Subgrades - Austin & Annable	219
•Investigations and Remediation of Undermined Highway - Henthorne & Rockers	236
9:30 - 10:00 -- Break, Sponsored By <b>Hilfiker Walls</b>	
10:30 - 11:30	
•Correlations for Piles in Cohesionless Soils - Darrag, Lovell & Karim	253
•F.E. Analysis of Pavements Using a Micro-computer - Selvam & Elliott	273
•Aggregate Stripping Evaluated for Asphalt Pavement Use - Thornton & Ford	280
•When Does the Work End? - Ruppen	291



# Highway Geology Symposium

## HISTORY ORGANIZATION AND FUNCTION \*

Established to foster a better understanding and closer cooperation between geologists and civil engineers in the highway industry, the Highway Geology Symposium (HGS) was organized and held its first meeting on February 16, 1950, in Richmond, Virginia. Since then 39 consecutive annual meetings have been held in 26 different states. Between 1950 and 1962, the meetings were held east of the Mississippi River, with Virginia, Ohio, West Virginia, Maryland, North Carolina, Pennsylvania, Georgia, Florida, and Tennessee serving as the host states.

In 1962, the Symposium moved west for the first time to Phoenix, Arizona. Since then, it has rotated, for the most part, back and forth from east to west. Following meetings in Texas and Missouri in 1963 and 1964, the Annual Symposium moved to different locations as follows:

<u>Year</u>	<u>HGS Location</u>	<u>Year</u>	<u>HGS Location</u>
1965	Lexington, KY	1966	Ames, IA
1967	Lafayette, IN	1968	Morgantown, WV
1969	Urbana, IL	1970	Lawrence, KS
1971	Norman, OK	1972	Old Point Comfort, VA
1973	Sheridan, WY	1974	Raleigh, NC
1975	Coeur d'Alene, ID	1976	Orlando, FL
1977	Rapid City, SD	1978	Annapolis, MD
1979	Portland, OR	1980	Austin, TX
1981	Gatlinburg, TN	1982	Vail, CO
1983	Stone Mountain, GA	1984	San Jose, CA
1985	Clarksville, IN	1986	Helena, MT
1987	Pittsburgh, PA	1988	Park City, UT
1989	Montgomery, AL	1990	Albuquerque, NM
1991	Albany, NY	1992	Fayetteville, AR

Unlike most groups and organizations that meet on a regular basis, the Highway Geology Symposium has no central headquarters, no annual dues, and no formal membership requirements. The governing body of the Symposium is a steering committee composed of approximately 20 engineering geologists and geotechnical engineers from state and federal agencies, colleges and universities, as well as private service companies and consulting firms throughout the country. Steering committee members are elected for three-year terms, with their elections and re-elections being determined principally by their interests and participation in and contribution to the symposium. The officers include a chairman, vice chairman, secretary, and treasurer, all of whom are elected for a two-year term. Officers except for the treasurer may only succeed themselves for one additional term.

A number of three-member standing committees conduct the affairs of the organization. The lack of rigid requirements, routing, and the relatively relaxed overall functioning of the organization is what attracts many of the participants.

Meeting sites are chosen two or four years in advance and are selected by the Steering Committee following presentations made by representatives of potential host states. These presentations are usually made at the steering committee meeting which is held during the Annual Symposium. Upon selection, the state representative becomes the state chairman and a member protem of the Steering Committee.

The symposia are generally for two and one-half days, with a day-and-a-half for technical papers and a full-day for the field trip. The symposium usually begins on Wednesday morning. The field trip is usually Thursday, followed by the annual banquet that evening. The final technical session generally ends by noon on Friday.

The field trip is the focus of the meeting. In most cases, the trips cover approximately from 150 to 200 miles, provide for six to eight scheduled stops, and require about eight hours. Occasionally, cultural stops are scheduled around geological and geotechnical points of interest. To cite a few examples, in Wyoming, the group viewed landslides in the Big Horn Mountains; Florida's trip included a tour of Cape Canaveral and the NASA space installation; the Idaho and South Dakota trips dealt with principally with mining activities; North Carolina provided stops at a quarry site, a dam construction site, and a nuclear generating site; in Maryland, the group visited the Chesapeake Bay hydraulic model and the Goddard Space Center; the Oregon trip included visits to the Columbia River Gorge and Mount Hood; the Central Mineral Region was visited in Texas; and the Tennessee trip provided stops at several repaired landslides in Appalachia. The Colorado field trip consisted of stops at geological and geotechnical problem areas along Interstate 70 in Vail Pass and Glenwood Canyon, while the Georgia trip in 1983 concentrated on highway design and construction problems in the Atlanta urban environment. The 1984 field trip had stops in the San Francisco Bay area which illustrated the planning, construction and maintenance of transportation systems. In 1985, the one day trip illustrated new highway construction procedures in the greater Louisville area. The 1986 field trip was through the Rockies of recent interstate construction in the Boulder Batholith. The trip highlight was a stop at the Berkeley Pit in Butte, Montana, an open pit copper mine.

At the technical sessions, case histories and state-of-the-art papers are most common with highly theoretical papers the exception. The papers presented at the technical sessions are published in the annual proceedings. Some of the more recent proceedings may be obtained from the Treasurer of the Symposium.

\* Revised from the 41st Highway Geology Symposium Proceedings.



# Highway Geology Symposium

## STEERING COMMITTEE OFFICERS

Mr. Harry Moore - Chairman Geological Engineering Supervisor I Tennessee Department of Transportation Geotechnical Section, PO Box 58 Knoxville, TN 37901 (615) 594-6219 or (615) 933-6776	1994
Mr. Charles T. Janick - Vice Chairman Soils Engineer Pennsylvania Department of Transportation 1118 State Street Harrisburg, PA 17120 (707) 787-5404	1994
Mr. Earl Wright - Secretary Geotechnical Branch Kentucky Department of Highways Frankfort, KY 40622 (502) 564-2374	1993
Mr. Russell Glass, Treasurer N.C. DOT, Geotechnical Section Box 3279 Ashville, NC 27702 (704) 298-8599	1993



# Highway Geology Symposium

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STEERING COMMITTEE MEMBERSHIP LIST

Name	Term Expires
Mr. David Bingham 3713 Lancelot Court Raleigh, N.C. 27604 Ph. (919)876-0416	1993
Mr. Vernon Bump Division of Engineering Dept. of Transportation Pierre, South Dakota 57501 Ph. (605)773-3401	1993
Mr. Richard Cross New York State Thruway Authority 200 Southern Blvd. P.O. Box 189 Albany, N.Y. 12201-0189 Ph. (518)471-4277	1994
Mr. John B. Gilmore Colorado Hwy. Dept. 4340 East Louisiana Denver, Colorado 80222 Ph. (303)757-9275	1992
Mr. Russell Glass N.C. D.O.T. P.O. Box 3279 Geotechnical Section Asheville, N.C. 27702 Ph. (704)298-7599	1993
Mr. Joseph A. Gutierrez Vulcan Materials Company P.O. Box 4195 Winston-Salem, N.C. 27105 Ph. (919)767-4600	1994
Mr. Richard Humphries Golder & Associates 3730 Chamblee Tucker Rd. Atlanta, Georgia 30341 Ph. (404)496-1893	1994

Mr. Jeffery Hynes Colorado Geological Survey 1313 Sherman St., Rm. 715 Denver, Colorado 80203 Ph. (303)866-3520	1991
Mr. Charles T. Janick PA. Dept. of Transportation 1118 State Street Harrisburg, Pennsylvania 17120 Ph. (707)787-5404	1994
Mr. Harry Ludowise 6308 NE 12th Avenue Vancouver, Washington 98665 Ph. (206)693-1617	1992
Mr. Henry Mathis Manager, Geotechnical Branch Kentucky Dept. of Highways Frankfort, Kentucky 40622 Ph. (502)564-2374	1992
Mr. Willard McCasland Oklahoma D.O.T. 200 N.E. 21st Street Oklahoma City, Oklahoma 73105 Ph. (405)521-2677	1994
Mr. Marvin McCauley CA. Dept. of Transportation 5900 Folsom Boulevard Sacramento, California 95819 Ph. (916)739-2480	1994
Mr. Verne McGuffey New York D.O.T. Bldg. 7 State Campus 1220 Washington Avenue Albany, New York 12232 Ph. (518)457-4710	1992
Mr. Harry Moore Tennessee D.O.T. P.O. Box 58 Knoxville, Tennessee 37901 Ph. (615)594-6219	1994
Mr. Gary Riedl Wyoming, Hwy. Dept. P.O. Box 1708 Cheyenne, Wyoming 82002-9019 Ph. (307)777-7450	1992

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## ARKANSAS

Arkansas Geological Commission, Vardelle Parham Geology Center, 3815 West  
Roosevelt Road, Little Rock, AR 72204. Phone 501-371-1488 or 663-9714.

### HISTORICAL SEQUENCE OF ORGANIZATIONAL NAME:

First Survey (Owen's Survey), 1857-60  
Second Survey (Reconstruction Survey), 1871-75  
Branner Survey, 1887-93  
Geological Survey of Arkansas, 1923-45  
Division of Geology, Arkansas Resources and Development Commission, 1945-55  
Arkansas Geological and Conservation Commission, 1955-63  
Arkansas Geological Commission, 1963-present

### NAMES AND TITLES OF ORGANIZATIONAL DIRECTORS AND DATES SERVED:

David Dale Owen, State Geologist, 1857-60  
W. F. Roberts, Sr., State Geologist, 1871-73  
George Haddock, State Geologist, 1873-74  
William Hazeldine, State Geologist, January-June 1874  
Arnold Syberg, State Geologist, June 1874-January 1875  
John C. Branner, State Geologist, 1887-93  
George C. Branner, State Geologist, 1923-42  
Richard J. Anderson, Acting State Geologist, 1942-43  
Joe W. Kimzey, State Geologist, 1943-45  
Harold B. Foxhall, Director and State Geologist, 1945-51  
Norman F. Williams, Director and State Geologist, 1951-55; Director and  
State Geologist, 1955-63; Director and State Geologist, 1963-present

Note: From 1907-23 The Professor of Geology, University of Arkansas, acted *ex officio* as part-time State Geologist. Office holders were A. H. Purdue, N. H. Drake, and G. H. Cady.

### ARKANSAS GEOLOGICAL SURVEY

#### HISTORY

The beginning of a state geological survey in Arkansas was in 1857 and was known as the "First Survey" or "Owen's Survey." In 1857-58, the first geological survey of Arkansas was conducted by Dr. David Dale Owen. Two reports were published as a result of his work, the *First Geological Reconnaissance of Arkansas* and the *Second Geological Reconnaissance of Arkansas*. The first report was published in 1858 and then in 1859 the

Legislature made an appropriation to continue the work. Dr. Owen died in 1860 and his brother, Richard Owen, and his assistant, Edward T. Cox, edited the second report and had it published in 1861. These two volumes remain as the foundation to the present day State Geological Survey of Arkansas. It should also be noted that this work was done at a cost to the state of \$16,800.

For the next 10 years no geological surveys were conducted because of the Civil War and the period of reconstruction following the war. Activity resumed in 1871 when the State legislature enacted legislation to form a geological survey. W. F. Roberts was

appointed as State Geologist, and Dr. George Haddock was hired as his assistant. At this time they started a geological reconnaissance survey in western Arkansas. From 1873 through 1874 Dr. George Haddock, William C. Hazeldine, and Arnold Syberg held the office of State Geologist. During the 4 years (1871-74), no official reports were published, only a 63-page pamphlet by George Haddock in 1873. This period is known as the "Second Survey" or "Reconstruction Survey." Dr. John C. Branner was quoted in an Arkansas Gazette article in 1919 about the surveys of Owen's time and the period in the early 1870's.

It is to be noted regarding these surveys that they cover a period of seven years, that they cost the state \$51,428, but that, with the exception of Dr. Owen's reports, the work was of no value.

It was not until 1887 that the State had another state geological survey. At that time Dr. John Casper Branner was appointed State Geologist and remained in that position until 1893. He was an outstanding geologist of his time and was highly regarded by his colleagues. It was the excitement of the possibility of gold and silver in Garland and Montgomery Counties that sparked interest in establishing a new geological survey. The fight was led by Colonel Elias W. Rector of Hot Springs, a member of the Lower House. Over this 7-year period, Dr. Branner's survey produced some monumental economic geology reports which led to a much better understanding of the overall geologic relationships within the state. As a result of his work, nineteen volumes of his reports were published. During this period, one of Dr. Branner's assistants was Herbert Hoover, who later became President of the United States. Since the main reason for the reestablishment of the survey was to ascertain the potential for gold and silver in western Arkansas, it was essential that this be one of the

investigations conducted. Dr. Branner's staff made an evaluation of the gold and silver prospects open at that time and showed that at least in the case of the mines then open, there was no validity in claims being made about the gold possibilities. This so irritated some people in the State that funding for the geological survey was withdrawn, not to be reestablished until 1923.

From 1907 until 1923, the Legislature appropriated a small amount of money for the Department of Geology at the University of Arkansas to conduct geologic surveys. The geological work was to be conducted under the direction of a commission composed of the Governor, the President of the University, and the Commissioner of Mines, Manufactures, and Agriculture. The professor of geology at the University was to designate a small portion of his time to survey work. The work at this time was done by Professor A. H. Purdue, Professor A. A. Steel, and Dr. N. F. Drake. The most notable contributions published during this period were on the slates of Arkansas and the coal fields in the Arkansas Valley.

In 1923 the Geological Survey of Arkansas was once again established and has continued to the present. George C. Branner, son of John Branner, was appointed State Geologist and held that position until 1942. George Branner was not a geologist by training, and the amount of new work performed in the 18 years he headed the survey was only a fraction of what his father had accomplished in less than a third of the time. George Branner served as State Geologist until the beginning of World War II, when he served as a Colonel in the Army. During this period very little was added to the knowledge of the geology of the State. Richard J. Anderson served as Acting State Geologist in 1942-43 and Joe W. Kimzey was State Geologist from 1943 to 1945.

The end of the war brought about a reorganization of State government and placed the Geological Survey in the Arkansas Resources and Development Commission as its Division of Geology. This reorganization took place in 1945 and Harold B. Foxhall served as the Director and State Geologist until 1951. During this period, the Division of Geology experienced some growth. In 1947, a young geologist from Oklahoma came to work for the survey, his name was Norman F. (Bill) Williams.

In 1951, N. F. Williams was appointed Director and State Geologist of Arkansas and holds that position today. Since the reorganization after World War II, the survey has experienced several name changes and reorganizations. In 1955, under a reorganization, the geological survey was called the Arkansas Geological and Conservation Commission. In 1963, this Commission was designated as the Arkansas Geological Commission. In 1977, State government was reorganized into twelve major departments. The Arkansas Geological Commission was placed in the Department of Commerce. In 1983, the Legislature abolished the Department of Commerce and again the Arkansas Geological Commission became a separate entity in state government.

In the early years, the Survey was housed in the State Capitol Building. It was not until 1966 that it moved out of the Capitol to temporary quarters west of the Capitol while plans were being made for a dedicated building. In 1970, the Survey moved into its current building and named it the Vardelle Parham Geology Center in honor of Vardelle Parham, a long-time Chairman of the Arkansas Geological Commission.

In 1977, the State Land Survey Division was added to the Arkansas Geological Commission. Thus today, the Arkansas Geological Commission is made up of the Geology Division and

the Land Survey Division. The number of employees has grown to 32, including 11 full-time geologists.

## ORGANIZATION

The Arkansas Geological Commission has a staff of 32 and consists of the Geology and Land Survey Divisions. The agency has a Board of Commissioners consisting of seven members with contiguous terms of 7 years. They are appointed by the Governor with the advice and consent of the Senate, and each staggered district must be represented by membership on the Commission.

The Land Survey Division, created in 1973 as part of the Office of the State Land Commissioner, was transferred to the Arkansas Geological Commission in 1977. The State Surveyor serves under the authority, direction, and approval of the State Geologist. The Land Survey Division has an Advisory Board composed of seven members who assist the State Surveyor in developing policies and regulations to establish uniform standards for professional surveying and mapping methods in the state.

### Geology Division

The primary purpose of the Arkansas Geological Commission is to increase the knowledge of the geology of the State and to stimulate the orderly development and utilization of the State's mineral resources. The Geology Division is organized into three sections: Administrative Services, Information Services, and Technical Services, all of which are under the direct supervision of the State Geologist.

The Administrative Services section consists of administrative, accounting, and secretarial services, and provides all administrative support of the agency. Specific activities include preparing budgets and operation plans, monitoring and processing expenditures, typing and reproducing letters and reports, maintaining an agency

