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OKLAHOMA GEOLOGY NOTES

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Cover Picture

TEN ACRE ROCK, EASTERN ARBUCKLE MOUNTAINS

Ten Acre Rock, exposed at the Capitol quarry in the eastern Arbuckle Mountains of Oklahoma (C NE¼ sec. 3, T. 3 S., R. 5 E., Johnston County), is composed of the Tishomingo Granite of Precambrian age. It will be the subject of a field-trip stop on an excursion through the Arbuckles in conjunction with the annual meeting of The Geological Society of America in Dallas in November. Another pre-meeting trip will cover the Wichita Mountains and the economic geology of Permian rocks in southwestern Oklahoma. (See p. 197-198 of this issue for more details on both trips.)

The photograph on the cover was taken in 1916, when granite was being quarried as a source of dimension stone for use in construction of the Oklahoma State Capitol. The quarry appears much the same today, not having been actively worked in the intervening years, except that the original equipment has been removed.

According to Rodger E. Denison and William E. Ham, the Tishomingo Granite is the youngest massive igneous rock in the Tishomingo-Belton anticline. It is about 1,270 m.y. (47 b.y. half life) old, based on Rb/Sr whole-rock determinations. It intrudes the Troy Granite to the west and the Blue River gneiss to the east. In the Capitol quarry, the Tishomingo Granite is composed principally of about 33 percent microcline perthite, 26 percent plagioclase, 5 percent feldspar alterations after plagioclase, 30 percent quartz, 3 percent biotite, and 1 percent sphene.

Editorial staff: William D. Rose, Rosemary Croy, Elizabeth A. Ham

Oklahoma Geology Notes is published bimonthly by the Oklahoma Geological Survey. It contains short technical articles, mineral-industry and petroleum news and statistics, an annual bibliography of Oklahoma geology, reviews, and announcements of general pertinence to Oklahoma geology. Yearly subscription, $2.00. All subscription orders should be sent to the address on the front cover.

Short articles on aspects of Oklahoma geology are welcome from contributors. A set of guidelines will be forwarded on request.

OKLAHOMA GEOLOGICAL SURVEY

ANNUAL REPORT

July 1, 1972-June 30, 1973

INTRODUCTION

The Oklahoma Geological Survey designs its programs to meet its constitutional obligation to investigate the land, water, mineral, and energy resources of our State and to disseminate the information thus collected to foster the orderly and progressive development of Oklahoma's natural resources. What that boils down to, essentially, is that Survey activities center around basic geologic investigations, evaluations of water and mineral resources, examinations and recommendations for general land use, and provision of technical assistance to the general public and to other governmental agencies.

BASIC SURVEY TASKS

Geologic mapping on a scale of at least 1 inch to the mile is basic to all Survey activity; without the information obtained from first-rate geologic base maps the Survey's resources investigations would be impossible. For instance, during the past fiscal year the Survey has been involved in several programs concerned with land utilization. In one such program, the Survey cooperated with the Tulsa Geological Society in the preparation of a special issue of the Society's *Digest,* Volume 37, which focused on the environmental geology of Tulsa County. The Survey's cartographic section prepared four large color maps: an areal geologic map with Bouguer gravity contours, a general soil map, a construction map, and a map showing the locations of oil and gas wells and fields. (In addition, Survey staff members C. C. Branson and L. R. Wilson contributed paleontological articles on the Tulsa County area.)

Mapping programs are in various stages of completion in Alfalfa, Bryan, Choctaw, Custer, Muskogee, Noble, and Payne Counties. Yet in spite of many years of concerted effort, less than three-fourths of the State is mapped at the necessary scale.

The State of Oklahoma has long enjoyed a large financial bounty from the minerals and energy industry, which exceeded $1 billion for the 7th consecutive year in 1972. An important Survey objective is to assist in prolonging the economic productivity of this segment of our economy, consistent with equally important needs to preserve our environment. Therefore, compilation and publication of statistical information about Oklahoma mineral production is another basic Survey task.

Data released by the U.S. Bureau of Mines and material obtained from the annual survey of petroleum statistical information for the State, compiled by J. F. Roberts, are published by the Survey each year in *Oklahoma Geology Notes,* providing the basis for determining the status of this important aspect of Oklahoma's economic base.

One of the least understood aspects of scientific activity is how to bridge the gap between accumulation of scientific knowledge and the application of such knowledge to serious public needs. In the case of the Geological Survey, data obtained from basic geologic investigations, field and laboratory examinations, must be translated into a form fit to tackle a myriad of problems confronting our State government—like the current energy "crisis."

Shortages of natural gas, liquefied petroleum gas (primarily propane), gasoline, and diesel fuel were experienced during the past year, and experts predict that the full impact of the energy deficit has not been felt. Moderate-to-severe supply dislocation and the shortages mentioned are expected to continue on at least a short-term basis. The Oklahoma Geological Survey believes that its public-service responsibilities include strengthening public understanding of the causes for the shortage and outlining effective measures to correct the situation.

The Survey also has a responsibility to evaluate the State's potential for augmenting the nation's dwindling fossil-fuel supply. Two current projects, an investigation of factors controlling porosity and permeability of Hunton strata in the deep Anadarko basin, by T. W. Amsden, and an evaluation of coal resources in eastern Oklahoma, by S. A. Friedman, are specifically directed toward this vital objective.

The Hunton is an important gas producer in parts of the Anadarko basin. However, because of its depth throughout most of the basin and the complex nature of the overlying strata, exploration is extremely expensive. The Lone Star Producing Co. 1 Baden Unit (drilled in Beckham County), which holds the world depth record of 30,050 feet, is reported to have cost close to $6 million. The fact that the Hunton was nonproductive at this locality illustrates the importance of determining, if possible, what factors control the porosity of this rock sequence. Dr. Amsden's study—now nearing completion—is directed toward identifying these factors.

The investigation of coal resources in eastern Oklahoma is especially important because the strain on other energy supplies has greatly increased the demand for low-sulfur coal for electric-power generation in the Midcontinent. A moderately increased demand for metallurgical coal for coke and steel manufacture and the likelihood of commercial coal gasification in Oklahoma as an alternative to existing power sources combine to place top priority on the coal program. The initial objectives of the program, assessment of the State's coal resources in terms of quantity, quality, and economic minability, are near completion. The project was funded by the Ozarks Regional Commission for the first 2 years, but the Survey finds it of sufficient importance to plan continued funding from its own budget once outside funding is discontinued.

Studies such as those undertaken by Amsden and Friedman are never divorced from other Survey activities; ongoing and previously completed studies provide valuable information for new projects. Palynological investigations of coal beds by L. R. Wilson and mapping of surficial geology in eastern Oklahoma by M. C. Oakes and others have provided much background information necessary for the success of the coal-investigation program. Industrial contributions of logs from previous extensive drilling programs have also proved essential to the success of this investigation.

The energy crisis currently occupies a central position in public concern, but as serious as the energy crisis is, it will soon be joined by equally critical problems, because it is only one part of a larger problem—depletion of natural resources. Population growth and corresponding increases in commercial development are placing increasing pressure on available land and water supplies, and several programs initiated by the Survey are directed toward aiding in the search for solutions to resulting problems. The water-resources programs conducted in cooperation with the U.S. Geological Survey is one such activity.

In 1970 the Survey entered into a 10-year agreement with USGS to establish a comprehensive water-investigation program for the State. The first 4 years of this program were to involve preparation of a series of 9 hydrologic atlases on a scale of 1:250,000 depicting the quantity, quality, and usage of surface and subsurface waters in the State. The first two atlases (Fort Smith and Tulsa quadrangles) have been published as HA-1 and HA-2 and are available from the Survey. HA-3, the Ardmore-Sherman sheet, which includes the Arbuckle Mountains, will be released later this year. Field work has been completed on HA-4, the Oklahoma City sheet, and revisions in geology are being made on HA-5, the McAlester-Texarkana sheet. The remaining four sheets in the series are in various stages of field preparation.

A new water-resources investigation, a detailed study of the Cretaceous sandstone aquifer in southern and southeastern Oklahoma, will be undertaken this fall. The results of this study will provide regional information on the ground-water characteristics of this rock sequence and insure better preservation during further development of this important aquifer.

A more pressing problem at the moment, however, is the metals situation. Growing shortages of many metals and of other mineral resources within the United States is resulting in increasing importation of these materials. The Secretary of the Interior, in his Second Annual Report to the U.S. Congress (a report required by the Mining and Minerals Policy Act of 1970), projects a growing deficit in the minerals balance of trade, with a forecast that this deficit could approach an annual sum of $100 billion by the year 2000.

One way the Survey is addressing itself to this problem is by keeping an accurate inventory of all Oklahoma resources. One valuable bit of information is that while 40 percent of the nation's consumption of gypsum in 1972 was derived from foreign imports, gypsum reserves in western Oklahoma continue to be underdeveloped. Expansion of the gypsum industry in our State would broaden our economic base and would also reduce our reliance upon foreign imports for this commodity. In a similar manner, increased development of such commodities as salt, stone, clay and shale, and sand and gravel would have beneficial economic effects.

Currently, copper is the only metal being produced in Oklahoma in significant quantities, and production figures for this metal cannot be disclosed because only one company, Eagle-Picher Industries, is involved. An important point to remember is that a study released several years ago by the Survey, and directed by K. S. Johnson and the late W. E. Ham, precipitated the discovery of copper-bearing strata in Permian red-bed deposits in southwestern Oklahoma and led to the subsequent development of this copper-mining industry.

For many years, our State was an important producer of lead and

zinc from the Tri-State mining district. Production of these metals has declined in recent years because of the increased cost incurred by compliance with safety and environmental-control requirements for mining and the discovery of richer deposits in Missouri and elsewhere. Production of lead and zinc in Oklahoma is now dormant—and will probably remain so for several years—but growing shortages of these metals in the world market plus heavy United States reliance on foreign imports (25 percent for lead and 50 percent for zinc in 1972) may result in reactivation of this district and in exploration in other parts of Oklahoma. The Survey is currently conducting an inventory of metal occurrences in the State in anticipation of the future need for such information.

With the expected increase in surface mining for coal, copper, and the industrial minerals, the need for more effective land-reclamation practices will become even more readily apparent. Oklahoma has effective legislation in the Mining Lands Reclamation Acts of 1968 and 1971, but operators need technical assistance to accomplish the reclamation requirements more efficiently and effectively. In addition, Oklahoma has some 26,000 acres of "orphan" mined land—unreclaimed land strip-mined prior to the enactment of current reclamation regulations. The Survey, in cooperation with the Oklahoma Department of Mines, has just completed a program designed to locate and assess the status of such land. Kenneth S. Johnson, project director, reports that the study should be in print late this year. A long-range program of mined-land-reclamation practices has also been initiated, but the details of this project have not yet been worked out.

PUBLIC SERVICE

During the past year, the Oklahoma Geological Survey received hundreds of calls for assistance. Professional geologists called to request technical assistance, Oklahoma residents brought in earth-science materials to be analyzed and identified, and school children wrote in requesting information for term papers. Survey staff members delivered public lectures to approximately 20 scientific and civic groups and were interviewed from time to time by the news media. While these calls for assistance can be directly traced, other Survey services are harder to pin down. Survey publications have reached countless readers, within and far beyond State boundaries, through private purchase and library acquisitions, and it is impossible to determine what information collected today may prove invaluable to someone tomorrow. It is our hope that no Survey undertaking will fail to contribute, directly or indirectly, to the welfare of the citizens of Oklahoma.

Charles J. Mankin, *Director*
September 7, 1973

APPENDIX A

Survey Staff, 1972-73 Fiscal Year

Professional

Thomas W. Amsden

William H. Bellis

Carl C. Branson[1]

Rosemary (Kellner) Croy

Robert O. Fay

David A. Foster

S. A. Friedman

Kenneth S. Johnson

Charles J. Mankin

John F. Roberts

William D. Rose

T. L. Rowland

Leonard R. Wilson

Part-Time Professional

George C. Huffman
(The University of Oklahoma)

Malcolm C. Oakes

John W. Shelton
(Oklahoma State University)

James H. Stitt
(University of Missouri, Columbia)

Patrick K. Sutherland
(The University of Oklahoma)

Technical

Cartographic

Marion E. Clark[2]

Roy D. Davis

David M. Deering

John O. Langford III[3]

Sondra L. Underwood

Core and Sample Library

Billy D. Brown

Eldon R. Cox

Editorial

Elizabeth A. Ham

Geological Technician

Eugene R. Parris

Secretarial

Helen D. Brown

Margarett K. Civis

Lynda (Baker) Smith

Gwendolyn C. Williamson

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[1]Retired July 1972.
[2]Granted 1-year leave of absence, March 1973.
[3]Appointed March 1973.

APPENDIX B

List of Survey Publications Issued, 1972-73 Fiscal Year

Bulletin 117.—*Articulate Brachiopods of the Viola Formation (Ordovician) in the Arbuckle Mountains, Oklahoma,* by Leonard P. Alberstadt. 90 pages, 38 figures, 9 plates, 1 table. Issued February 1973.

Educational Publication 1.—*Geology and Earth Resources of Oklahoma–An Atlas of Maps and Cross Sections,* by Kenneth S. Johnson, Carl C. Branson, Neville M. Curtis, Jr., William E. Ham, Melvin V. Marcher, and John F. Roberts. 8 pages. Introductory text; 7 pages of maps and cross sections, scale 1:2,000,000. Issued July 1972.

Educational Publication 3.—*Guidebook for Geologic Field Trips in Oklahoma. Book 2: Northwest Oklahoma,* by Kenneth S. Johnson. 42 pages, 54 figures. Issued October 1972.

Guide Book XV (2d printing).—*Guide to Alabaster Cavern and Woodward County, Oklahoma,* by Arthur J. Myers, A. M. Gibson, Bryan P. Glass, and Carol R. Patrick. 38 pages, 41 figures. Issued September 1972.

Map GM-16.—*Vertical-Intensity Magnetic Map of McClain and Southern Cleveland Counties, Central Oklahoma,* by John A. E. Norden, John L. Bedwell, Arthur J. Blair II, Carl B. Kaupp III, John W. Marchetti, Jr., and J. M. Markas. 1 color sheet, scale 1:63,360. Issued August 1972.

Oklahoma Geology Notes.—Six bimonthly issues (August 1972-June 1973), containing 252 pages.

APPENDIX C

Publications by Survey Staff, 1972-73 Fiscal Year

THOMAS W. AMSDEN

Misener Sandstone (Middle-Upper Devonian), north-central Oklahoma: American Association of Petroleum Geologists Bulletin, v. 56, p. 2323-2334 (with Gilbert Klapper).

Porosity and permeability in Silurian carbonate rocks of Anadarko basin, Oklahoma [abstract]: American Association of Petroleum Geologists Bulletin, v. 57, p. 766-767 (reprinted in Petroleum Abstracts, v. 13, p. 762).

WILLIAM H. BELLIS

Clay products in Oklahoma: Oklahoma Geology Notes, v. 32, p. 157-168.

CARL C. BRANSON

Geology and earth resources of Oklahoma—An atlas of maps and cross sections: Oklahoma Geological Survey Educational Publica-

tion 1, 8 p. (with Kenneth S. Johnson, Neville M. Curtis, Jr., William E. Ham, Melvin V. Marcher, and John F. Roberts).
Invertebrate fossils of the Tulsa area, *in* Tulsa's physical environment: Tulsa Geological Society Digest, v. 37, p. 142.

ROSEMARY L. CROY
Northwest Oklahoma, *book 2 of* Guidebook for geologic field trips in Oklahoma: Oklahoma Geological Survey Educational Publication 3, 42 p. (ed.).
The undergraduate student in his natural habitat: The Sooner Geologist, v. 6, no. 1, p. 3-9.
The Sooner geologist: University of Oklahoma Foundation of Geology and Geophysics, v. 5, no. 2, 36 p.; v. 6, no. 1, 40 p. (ed., with Elizabeth A. Ham).
Oklahoma geology notes: Oklahoma Geological Survey, v. 32, nos. 4-6, v. 33, nos. 1-3, 252 p. (ed., with William D. Rose and Elizabeth A. Ham).

ROBERT O. FAY
Geology, *in* Appraisal of the water and related land resources of Oklahoma—Region Ten, 1972: Oklahoma Water Resources Board Publication 40, p. 19-29.
Economic geology, *in* Appraisal of the water and related land resources of Oklahoma—Region Ten, 1972: Oklahoma Water Resources Board Publication 40, p. 123-126.
The Elk City blowout: Oklahoma Geology Notes, v. 33, p. 30.

S. A. FRIEDMAN
A new program of coal investigations in Oklahoma [abstract]: Oklahoma Geology Notes, v. 32, p. 127-128 (reprinted from Geological Society of America Abstracts with Programs, v. 4, p. 279-280).
A new coal-investigations program in Oklahoma: Shale Shaker, v. 22, p. 152-156.
Interstate Mining Compact Commission adopts bylaws: Oklahoma Geology Notes, v. 32, p. 191-193.
Oklahoma, *in* State-by-state reports on coal west of the Mississippi, including Canada: Coal Age, v. 78, no. 5, p. 142-145, 148-149.
Oklahoma, *in* Coal seams and fields: 1973 Keystone Coal Industry Manual, p. 516-519.

ELIZABETH A. HAM
National Petroleum Council issues final report in energy series: Oklahoma Geology Notes, v. 33, p. 13-14.
Bibliography and index of Oklahoma geology, 1972: Oklahoma Geology Notes, v. 33, p. 31-65 (with William D. Rose).
The Sooner geologist: University of Oklahoma Foundation of Geology and Geophysics, v. 5, no. 2, 36 p.; v. 6, no. 1, 40 p. (ed., with Rosemary L. Croy).
Oklahoma geology notes: Oklahoma Geological Survey, v. 32, nos. 4-6, v. 33, nos. 1-3, 252 p. (ed., with William D. Rose and Rosemary L. Croy).

KENNETH S. JOHNSON
Preparation of non-technical guidebooks for conducting geologic

field trips: International Geological Congress, 24th, Montreal, Section 17, Geological Education, p. 101-104. (Abstract in 24th Geological Congress Abstracts, p. 477.)

Geology and earth resources of Oklahoma—An atlas of maps and cross sections: Oklahoma Geological Survey Educational Publication 1, 8 p. (with Carl C. Branson, Neville M. Curtis, Jr., William E. Ham, Melvin V. Marcher, and John F. Roberts).

Deep-marine Ouachita sediments: Oklahoma Geology Notes, v. 32, p. 102.

OCGS sponsors field seminar: Oklahoma Geology Notes, v. 32, p. 111-113.

Northwest Oklahoma, *book 2 of* Guidebook for geologic field trips in Oklahoma: Oklahoma Geological Survey Educational Publication 3, 42 p.

Permian copper-shale deposits of southwestern Oklahoma [abstract]: Geological Society of America Abstracts with Programs, v. 4, p. 555 (with William E. Ham; reprinted in Oklahoma Geology Notes, v. 33, p. 22-23).

Gypsum and salt resources in Oklahoma: Industrial Minerals, no. 62, p. 33-39.

The mineral industry of Oklahoma, *in* Area reports: domestic, *v. 2 of* Minerals yearbook 1970: U.S. Bureau of Mines, p. 569-584 (with L. G. Southard and John F. Roberts).

Stereo and mosaic aerial photo study of part of the central Ouachita Mountain system in Oklahoma and Arkansas [abstract]: American Association of Petroleum Geologists Bulletin, v. 57, p. 422 (with F. A. Melton; reprinted in Oklahoma Geology Notes, v. 33, p. 82-83).

Kansas Survey opens new building and honors Raymond C. Moore: Oklahoma Geology Notes, v. 33, p. 65-66.

Environmental geology tome released by Tulsa Geological Society: Oklahoma Geology Notes, v. 33, p. 115.

CHARLES J. MANKIN

Science versus technology; a salute to the Alumni Advisory Council: The Sooner Geologist, v. 5, no. 2, p. 3-7.

Oklahoma Geological Survey annual report, July 1, 1971-June 30, 1972: Oklahoma Geology Notes, v. 32, p. 139-147.

Alteration of Tertiary volcanic ash, western Oklahoma [abstract]: Geological Society of America Abstracts with Programs, v. 4, p. 622-623 (with David M. Patrick; reprinted in Oklahoma Geology Notes, v. 33, p. 23).

JOHN F. ROBERTS

Geology and earth resources of Oklahoma—An atlas of maps and cross sections: Oklahoma Geological Survey Educational Publication 1, 8 p. (with Kenneth S. Johnson, Carl C. Branson, Neville M. Curtis, Jr., William E. Ham, and Melvin V. Marcher).

Statistics of Oklahoma's petroleum industry, 1971: Oklahoma Geology Notes, v. 32, p. 103-110.

Oil and gas, *in* Appraisal of the water and related land resources of Oklahoma—Region Ten, 1972: Oklahoma Water Resources Board Publication 40, p. 129.

The mineral industry of Oklahoma, *in* Area reports: domestic, *v. 2 of* Minerals yearbook 1970: U.S. Bureau of Mines, p. 569-584 (with L. G. Southard and Kenneth S. Johnson).

WILLIAM D. ROSE

The new AGI *Glossary of Geology*: Oklahoma Geology Notes, v. 33, p. 13.

Bibliography and index of Oklahoma geology, 1972: Oklahoma Geology Notes, v. 33, p. 31-65 (with Elizabeth A. Ham).

Oklahoma geology notes: Oklahoma Geological Survey, v. 32, nos. 4-6, v. 33, nos. 1-3, 252 p. (ed., with Rosemary L. Croy and Elizabeth A. Ham).

T. L. ROWLAND

Chemical and physical properties of selected Oklahoma crushed-stone products: Oklahoma Geology Notes, v. 32, p. 151-155

USGS traveling exhibit visits Langston University: Oklahoma Geology Notes, v. 33, p. 2.

Depositional facies in the Wapanucka Formation (Lower Pennsylvanian) in the Hartshorne-Wilburton area, Oklahoma [abstract]: Geological Society of America Abstracts with Programs, v. 5, p. 277-278 (reprinted in Oklahoma Geology Notes, v. 33, p. 127).

LEONARD R. WILSON

Palynological evidence for a Pennsylvanian age assignment of the Gearyan Series in Kansas and Oklahoma [abstract], *in* Barlow, J. A. (editor), Symposium abstracts and reference papers, I. C. White Memorial Symposium—The age of the Dunkard: West Virginia Geological Survey (with M. A. Rashid).

Three Sisters of Cimarron County, Oklahoma: Oklahoma Geology Notes, v. 32, p. 170.

Geomorphology of Tesesquite Creek valley, Cimarron County, Oklahoma: Oklahoma Geology Notes, v. 32, p. 195-208.

Palynological evidence for a Pennsylvanian age assignment of the Eskridge Shale [abstract]: Geological Society of America Abstracts with Programs, v. 5, no. 3, p. 288 (reprinted in Oklahoma Geology Notes, v. 33, p. 128-129).

Fossil plants of the Seminole Formation (Pennsylvanian) in Tulsa County, Oklahoma, *in* Tulsa's physical environment: Tulsa Geological Society Digest, v. 37. p. 151-161.

APPENDIX D

Papers Presented by Survey Staff at Professional Meetings, 1972-73 Fiscal Year

24th International Geological Congress
Montreal, Canada, August 29, 1972

KENNETH S. JOHNSON

Preparation of non-technical guidebooks for conducting geologic field trips

Oklahoma City Geological Society, Monthly Meeting
Oklahoma City, Oklahoma, September 14, 1972

KENNETH S. JOHNSON

Nonpetroleum mineral resources of Oklahoma

I. C. White Memorial Symposium—The Age of The Dunkard
Morgantown, West Virginia, September 25-29, 1972

LEONARD R. WILSON
Palynological evidence for a Pennsylvanian age assignment of the Gearyan Series in Kansas and Oklahoma

Interstate Mining Compact Commission, Fall Meeting
Tulsa, Oklahoma, October 11-13, 1972

SAMUEL A. FRIEDMAN
Coal resources and mining in Oklahoma

KENNETH S. JOHNSON
Oklahoma's mineral resources and mining activities

CHARLES J. MANKIN
Introductory remarks on the Oklahoma Geological Survey's relations with the mining industry

Gamma (OU) Chapter of Sigma Gamma Epsilon, Monthly Meeting
Norman, Oklahoma, November 1, 1972

SAMUEL A. FRIEDMAN
Bituminous coal distribution in Oklahoma

Geological Society of America, Annual Meetings
Minneapolis, Minnesota, November 13-15, 1972

KENNETH S. JOHNSON
Permian copper-shale deposits of southwestern Oklahoma (with William E. Ham)

CHARLES J. MANKIN
Alteration of Tertiary volcanic ash, western Oklahoma (with David M. Patrick)

Ardmore Geological Society Monthly Meeting
Ardmore, Oklahoma, February 15, 1973

KENNETH S. JOHNSON
Nonpetroleum mineral resources of Oklahoma

American Institute of Mining, Metallurgical, and Petroleum Engineers, Annual Meeting
Chicago, Illinois, March 1, 1973

KENNETH S. JOHNSON
Gypsum and salt resources in Oklahoma portion of Permian basin

American Association of Petroleum Geologists Southwest Section-Society of Exploration Geophysicists Joint Meeting
Fort Worth, Texas, March 14-16, 1973

KENNETH S. JOHNSON
Stereo and mosaic aerial photo study of the central Ouachita Mountain system in Oklahoma and Arkansas (with F. A. Melton)

Geological Society of America, South-Central Section Annual Meeting
Little Rock, Arkansas, April 5-7, 1973

T. L. ROWLAND
Depositional facies in the Wapanucka Formation (Lower Pennsylvanian) in the Hartshorne-Wilburton area, Oklahoma

LEONARD R. WILSON
Palynological evidence for a Pennsylvanian age assignment of the Eskridge Shale

American Institute of Professional Geologists, Oklahoma Section Monthly Meeting
Oklahoma City, Oklahoma, April 10, 1973
KENNETH S. JOHNSON
Coal mining and land reclamation in eastern Oklahoma

Shreveport Geological Society Annual Field-Trip Orientation
Lake Murray Lodge, Oklahoma, April 12, 1973
ROBERT O. FAY
Introduction to a study of Paleozoic rocks in Arbuckle and western Ouachita Mountains of southern Oklahoma

Ardmore Geological Society, Monthly Meeting
Ardmore, Oklahoma, April 19, 1973
KENNETH S. JOHNSON
Stereo and mosaic aerial photo study of the central Ouachita Mountain system in Oklahoma and Arkansas (with F. A. Melton)

American Association of Petroleum Geologists-Society of Economic Paleontologists and Mineralogists, Annual Meetings
Anaheim, California, May 14-16, 1973
THOMAS W. AMSDEN
Porosity and permeability in Silurian carbonate rocks of Anadarko basin, Oklahoma

Claren Kidd Takes Over As OU's Geology Librarian

Claren Kidd has been named to the important post of librarian for The University of Oklahoma Geology and Geophysics Library, a position entailing the care of a growing collection of 85,000 volumes plus a large and constantly increasing assemblage of maps, well logs, and well-completion cards. Mrs. Kidd replaces Katherine Keener, who has left OU to join the staff of the U.S. Geological Survey library in Washington, D.C.

A native of Geary, Oklahoma, Claren has transferred from OU's Bizzell Library, where she served as assistant information services librarian with the duties of interloan librarian. She holds B.A. and M.A. degrees in geography from OU and the M.L.S. degree from the University of Pittsburgh. She is a member of the Oklahoma Library Association and the American Li-

brary Association, and she has taught geography and earth science on the secondary level in the Norman public schools and in Illinois.

Claren is married to Robert Lee Kidd III, formerly of Poteau, Oklahoma, where his father is publisher of the *Poteau News*. Bob is serving as supervisor of music for Norman public schools and has bachelor's and master's degrees in music education, lacking only completion of his dissertation for a doctorate in that field from the University of Illinois.

We are happy to welcome Claren to the School and to the Survey, and we wish her every success.

Report on Sandstone Models Published by OGS

At the end of September the Oklahoma Geological Survey issued a comprehensive study by John W. Shelton, professor of geology at Oklahoma State University, entitled *Models of Sand and Sandstone Deposits: A Methodology for Determining Sand Genesis and Trend.* The 122-page report, released as Bulletin 118, is in 2 parts and contains some 140 illustrations including a beautifully detailed drawing of crossbedded sandstone by Survey artist-cartographer John O. Langford III.

The first part of the report contains a discussion of the general concepts of sandstone deposition, criteria for recognizing various depositional environments, and a system for classifying sandstone deposits according to genesis. An important part of the work is a large table, folded in a back pocket, utilizing this sandstone-classification system.

The second part of the report consists of a detailed compilation of 24 separate sandstone bodies as they occur in the geologic record of various parts of North America. Oklahoma is represented by the Bluejacket (Bartlesville) Sandstone. The models range in age from Cambrian to Quaternary and include the Appalachian Mountains, Eastern Interior, Great Lakes, Midcontinent, Western Interior-Rockies, Gulf Coast, and Pacific Coast provinces.

Author Shelton states that the compilation is intended to represent a wide range of geologic conditions, and he feels that the individual sandstone models "may be used for comparative purposes in the study of many sandstone deposits with a reasonable level of confidence."

The value of such a study is underscored, of course, because the general public is increasingly aware of the need to solve the present energy gap. The report is expected to be an important aid to the explorationist in locating additional energy reserves in sandstone bodies in the Midcontinent region and in other provinces throughout North America.

Bulletin 118 can be ordered from the Oklahoma Geological Survey for $3.00 paperbound and $4.00 clothbound.

Occurrence of *Acanthodes* in the Lower Permian of Oklahoma

Larry C. Simpson[1]

Abstract—Only four occurrences of *Acanthodes* have been reported previously from the Lower Permian of the Western Hemisphere. Recent collections from the East Manitou site in southwest Oklahoma have yielded numerous remains of this fish genus and have extended its range. The zones from which acanthodian remains were collected are upper Leonardian in age, making this the youngest occurrence of *Acanthodes* of record in this hemisphere.

Many acanthodian scales, spines, and scapulae were collected at the East Manitou site in Tillman County, southwestern Oklahoma, in 1972. Because Acanthodii of Permian age are rare in the Western Hemisphere, these fish remains warrant a published account.

The East Manitou site (Olson, 1967, p. 24-25) is a roadcut 4.6 miles east of U.S. Highway 183 on a secondary road that goes through the center of Manitou (fig. 1). Most of the specimens collected were from or near the south side of the roadcut in the NW¼ sec. 5, T. 1 S., R. 16 W., although some material was obtained across the road, to the north.

The stratigraphic succession in this area consists of a basal red shale overlain by gray to tan shale and siltstone, the latter containing thick lenses of coarse sandstone and conglomerate. Olson (1967) described these beds as being nearshore marine deposits. However, a paleoenvironmental study that I am conducting shows them to be of fresh-water, fluvial origin.

According to R. O. Fay of the Oklahoma Geological Survey (oral communication, 1973), these beds form the basal part of the Purcell Sandstone, at the very base of the Hennessey Group. They are, therefore, upper Leonardian in age (fig. 2), and the fauna here is another element in the Garber-Hennessey transition zone, which has proved to be a relatively fossiliferous sequence across Oklahoma (Olson, 1967, p. 13).

The acanthodian spines are scattered throughout the coarse clastic lenses, with the highest concentration occurring in a thin bone bed, a highly fossiliferous lens exposed by quarrying, in the southwest part of the roadcut. All of the scales and scapulae collected were found in this bone bed. The acanthodian remains are mixed with fragments and, more rarely, with articulated specimens of platysomoid and palaeoniscoid fish. Four scapulae, 55 spines, and innumerable patches of scales have been recovered from this deposit.

The scales shown in figure 3 are the minute (1/6-1 mm) rhombic scales typical of *Acanthodes* (Gregory, 1951, p. 23). The more complete spines range in size from 57 to 130 mm in length (fig. 4). The scapulae

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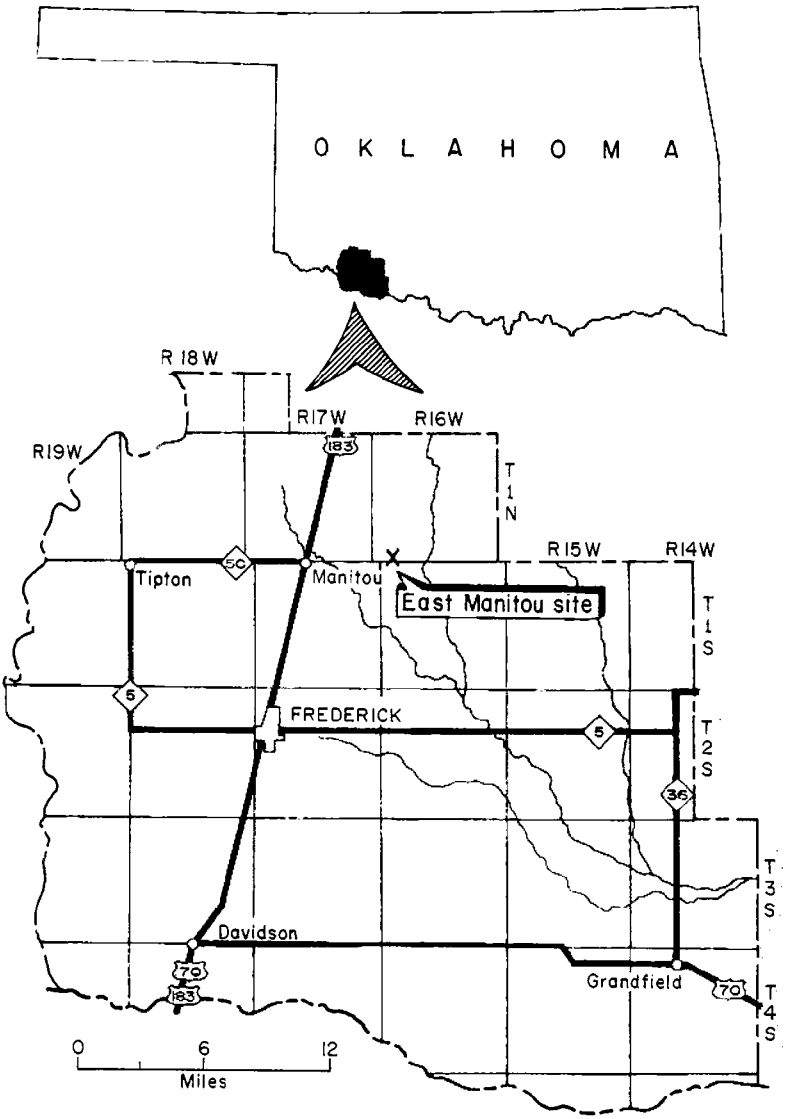

Figure 1. Index map of Oklahoma showing Tillman County and East Manitou site.

represent the only portion of the pectoral girdle preserved, and the two best preserved specimens were found associated with *Acanthodes* spines and scales and appear to have come from the same organism (fig. 4).

Acanthodes is the only genus of the Acanthodii group that is known

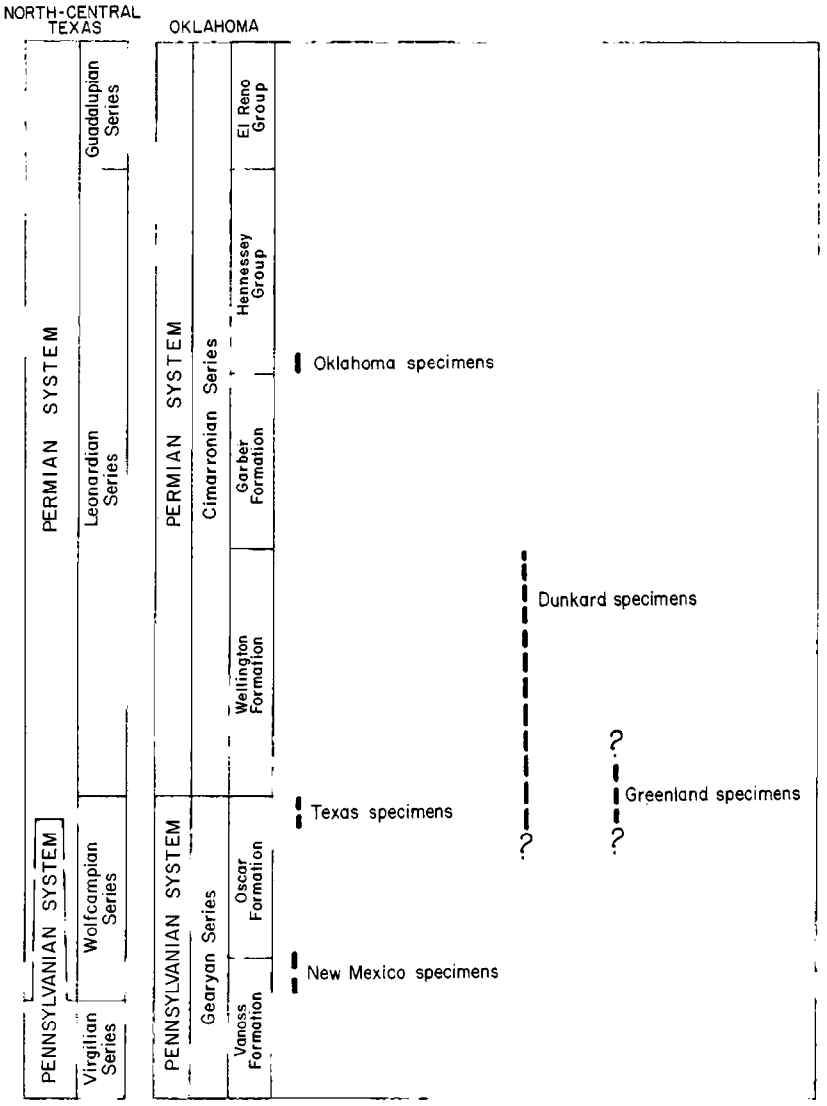

Figure 2. Positions of *Acanthodes* finds relative to Texas and Oklahoma stratigraphic columns.

to occur in the Lower Permian. The genus is common in Europe in the Permian of Germany and Czechoslovakia (Romer, 1966, p. 36, 352), but in the Western Hemisphere it is almost nonexistent above the Pennsylvanian (Dunkle and Mamay, 1956, p. 308). Only four Lower Permian occurrences have been described from this hemisphere.

Nielsen (1932, p. 7-8) described detached spines from the Permo-Carboniferous of east Greenland as either *Acanthodes* or *Acanthodopsis*. *Acanthodopsis* is known only from the Upper Pennsylvanian (Miles, 1966, p. 172), which suggests that Nielsen considered the remains Pennsylvanian rather than Permian in age. Unfortunately, his sketchy description of the locality makes it impossible to verify the stratigraphic position of the finds.

Romer (1952, p. 49) described several spines resembling *Acanthodes* cf. *A. marshi* from the Dunkard Group of the southwestern Pennsylvania-northern West Virginia region. The Dunkard was once widely considered to be Permian in age, but in recent years there has been controversy as to where the Pennsylvanian-Permian boundary should be drawn in relation to the Dunkard. Palynological studies by Clendening (1970) showed the Dunkard to be Pennsylvanian; on the other hand, Olson (1970, p. 2), Tasch (1972, p. 31), and Durden (1972, p. 33) present evidence for a Permian age assignment for the Dunkard, correlating it with the Wellington Formation of Oklahoma. Thus, even the most recent studies leave a question as to whether the Dunkard

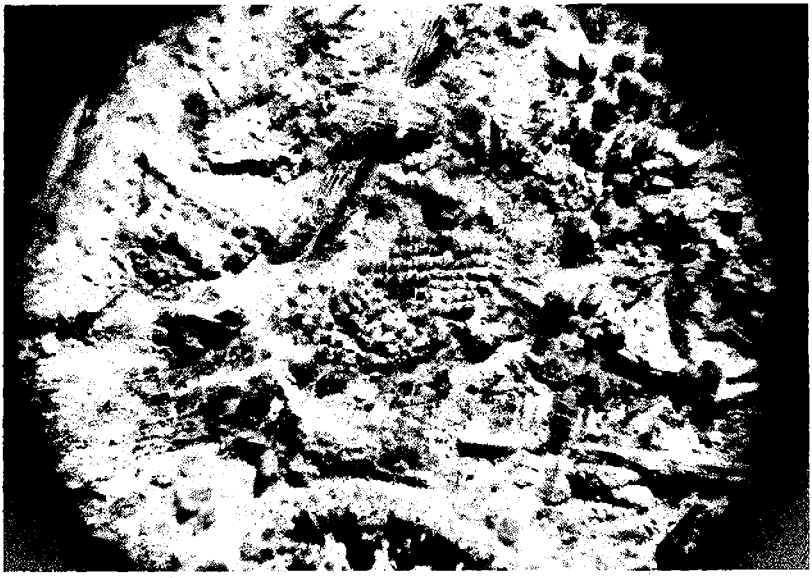

Figure 3. Two sizes of *Acanthodes* and palaeoniscoid scales from East Manitou site, ×5½.

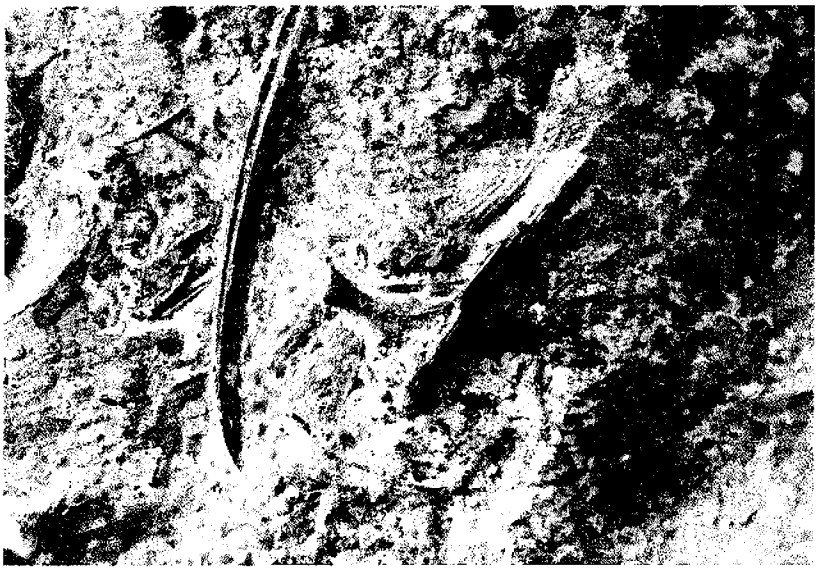

Figure 4. Scapula and spines of *Acanthodes* associated with palaeoniscoid scales from East Manitou site, ×2.

specimens should be regarded as Permian or Pennsylvanian in age.

Vaughn (1969) has a large collection from south-central New Mexico of *Acanthodes* material from the Laborcita and Abo Formations, which, through the fossil zones, are Wolfcampian in age. A discrepancy exists in the placement of the Pennsylvanian-Permian boundary in the Midcontinent region and also in the eastern United States. In Oklahoma and Kansas some of the stratigraphy has been reevaluated. Wolfcampian beds have been placed in the Gearyan Series (Fay, 1972, p. 26; O'Connor and others, 1968, p. 43), which in Oklahoma is now considered to be Upper Pennsylvanian rather than Lower Permian (Wilson and Rashid, 1972, p. 21).

Dunkle and Mamay (1956) have described an imprint of a complete acanthodian from a Permian locality in Baylor County, Texas. The unit in which the fossil was found is believed to represent the middle of the Belle Plains Formation of Texas, which would place the occurrence very near the top of the Wichita Group, a Wolfcampian equivalent (Olson, 1967, p. 88). (Zidek, 1973, comments in greater detail on this occurrence—see p. 201 of this issue.)

It appears from the above accounts that the Oklahoma occurrence of *Acanthodes* is the youngest, stratigraphically, documented in the Western Hemisphere. Furthermore, the Permian *Acanthodes* material from the East Manitou site constitutes one of the largest and best preserved collections yet found. Continued collecting will undoubtedly increase the amount of acanthodian material from this locality.

I am deeply grateful to Dr. Jiri Zidek of The University of Okla-

homa School of Geology and Geophysics for help in identifying the specimens and for agreeing to review the manuscript. I also wish to express gratitude to Dr. R. O. Fay of the Oklahoma Geological Survey for supplying much of the stratigraphic information.

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GSA Annual Meeting to Feature Pre-Convention Field Trips in Oklahoma

The Geological Society of America will hold its 86th annual meeting in Dallas, Texas, November 12-14. Seven societies associated with GSA will hold their annual meetings concurrently: the Paleontological Society of America, Mineralogical Society of America, Society of Economic Geologists, Society of Vertebrate Paleontology, Geochemical Society, National Association of Geology Teachers, and Geoscience Information Society.

Oklahoma geology and geologists will be represented on 2 of the 8 pre-convention field trips and in several papers to be offered at the meetings.

Geologists giving papers include, from the Oklahoma Geological Survey and The University of Oklahoma School of Geology and Geophysics, Samuel A. Friedman, "Selection of a Coal Gasification Plant Site in Oklahoma"; Kenneth S. Johnson, "Inventory of Strip-Mined Lands in Oklahoma Coal Field"; and Patrick K. Sutherland and Thomas W. Henry, "Definition of a Time-Stratigraphic Unit Based on a System (Set) Open at One End." Also at the meeting, the Survey and the School will have a joint exhibit highlighting current research and public-service activities. And on November 12, the School will host an alumni reception from 5:00 to 7:00 p.m.

Immediately prior to the GSA meeting, two related meetings are scheduled on the geological calendar. On November 7-9, a gas-exploration symposium will be held in Midland, Texas, by the West Texas Geological Society. On November 11-12 in Dallas, the Society of Economic Geologists will sponsor a symposium on stable isotopes as applied to problems of ore deposits. Other pre-meeting and post-meeting excursions will deal with the geology, hydrology, land use, and mineral resources of Texas. Information about the two Oklahoma field trips is given in the following sections.

WICHITA MOUNTAINS AND PERMIAN ROCKS IN SOUTHWESTERN OKLAHOMA

A 3-day trip leaving Dallas November 9 and returning to Dallas November 11 will cover the Cambrian igneous rocks of the Wichita Mountains and the mineral resources in surrounding Permian rocks of the area. Field-trip leaders will be Kenneth S. Johnson of the Oklahoma Geological Survey and Rodger E. Denison of Mobil Oil Corporation in Dallas.

The first night will be spent in Lawton, and the first trip stop will be made the next day at an overlook on Mount Scott to introduce participants to the general geologic features of the region and the relationships of the granites, rhyolites, diorites, and gabbros.

Later observations will be more specific, and the remainder of the day's stops will encompass the homoclinal sequence of 3,600 feet of Carlton Rhyolite disconformably overlain by the Reagan Sandstone at Bally Mountain, followed by a stop at Roosevelt, where Nancy Lou Scofield will discuss the layered sequence of the Raggedy Mountain Gabbro—the subject of her M.S.

thesis at The University of Oklahoma. The next stop will afford an opportunity to examine the plutonic granites of Quartz Mountain State Park, in the western half of the mountains. Horizontal grooves cut by waves of the Permian sea can be seen here, setting the stage for Permian observations on the final day of the trip.

Following an overnight stay at Quartz Mountain Lodge, the group will travel to the Western Salt Company plant, 25 miles west-northwest of Mangum, where natural springs provide saturated NaCl brine which yields, by means of solar evaporation, salt at a rate of 1,000 tons per acre per year.

Beds 10 to 18 feet thick of high-purity (97-98 percent) gypsum of the Blaine Formation are mined at Duke by the Republic Gypsum Company for production of wallboard; the Texas Gypsum Company is quarrying 60 feet of Cloud Chief Gypsum of equal purity at Fletcher. Both sites will be visited and discussed.

The Creta copper district, 15 miles southwest of Altus, where a 6- to 10-inch copper-bearing shale of the Flowerpot Formation is being surface mined by Eagle-Picher Industries, Inc., will be the subject of another stop. Douglas C. Brockie will explain the company's operations.

ARBUCKLE MOUNTAINS

A 2-day field trip covering the regional geology of the Arbuckle Mountains will leave Dallas November 10 and return to Dallas November 11. Leaders will be T. L. Rowland, Robert O. Fay, and Thomas W. Amsden, Oklahoma Geological Survey, and Rodger E. Denison, Mobil Oil Corporation. Oklahoma Geological Survey Guide Book XVII, *Regional Geology of the Arbuckle Mountains, Oklahoma,* by William E. Ham, will provide the basis for the trip.

Upon reaching the anticlinal core of the Arbuckles, the group will walk for 3 miles along the shoulder of Interstate Highway 35, where new roadcuts provide excellent exposures of the entire Cambrian-Mississippian sequence. The next stop, at Turner Falls overlook, will afford a break for lunch and discussion by Fay and Rowland of the general geology of the Arbuckle Mountains. The third stop, a fine exposure of rocks of the Hunton Group along U.S. Highway 77, will offer discussion and explanation of regional relationships by Amsden.

The 2,000 feet of Collings Ranch Conglomerate of Pennsylvanian age, the first and thickest orogenic unit deposited during the Arbuckle uplift and subsequently preserved in a graben, will be seen at the last stop before dinner and an overnight stay at Lake Murray State Lodge, south of Ardmore.

The next day's stops will begin with the Blue River gneiss, and new ideas on the Precambrian history of the area will be presented by Denison. The Capitol quarry in Precambrian porphyritic granite at Ten Acre Rock; the Pennsylvania Glass Sand Company's hydraulic mining of the high-purity Oil Creek quartzose sands of Ordovician age at Mill Creek; the Buckhorn asphalt pit, where middle Desmoinesian mollusks are preserved with their original shell material; and the famous asphalt district, with abandoned quarry pits in the Oil Creek Formation, will all be examined before the return to Dallas.

Oklahoma Academy of Science Geology Program Announced

The Oklahoma Academy of Science will hold its annual meeting at Oklahoma City University on Friday, November 16, 1973. Talks scheduled for the Geology Section of the meeting cover a wide range of geologic, environmental, and resource problems that are currently being faced in Oklahoma. Chairman of the Geology Section this year is Kenneth S. Johnson, geologist with the Oklahoma Geological Survey.

The Geology Section will meet during the morning session only, from 9:00 to 11:30, and will break up in time for the Academy luncheon, which will feature a talk by Robert L. DuBois, professor of geophysics at The University of Oklahoma, on "Short-Term Variations of the Earth's Magnetic Field and Development of an Archaeomagnetic Chronology." Other section meetings held concurrently in the morning and during the afternoon session will cover the biological, physical, social, and engineering sciences, as well as geography, conservation, microbiology, and science education.

Titles and speakers for the Geology Section are:

1. "Energy Needs and Resources in Oklahoma: Present and Future": Alex P. Aven, consulting geologist, Resource Analysis and Management Group; vice-chairman, Oklahoma Energy Advisory Council.
2. "Geologic and Energy Implications of Geothermal-Gradient Map of Oklahoma": John W. Shelton, professor, Department of Geology, Oklahoma State University.
3. "Earthquakes and Earthquake Risk in Oklahoma and the Midcontinent Region": Leon Reiter, assistant professor, School of Geology and Geophysics, The University of Oklahoma.
4. "Effects of Ground-Water Development in the Oklahoma Panhandle": Donald L. Hart, Jr., hydrologist, U.S. Geological Survey.
5. "Reclamation of Strip-Mined Coal Lands in Eastern Oklahoma": Kenneth S. Johnson, geologist, Oklahoma Geological Survey.

The timeliness of these topics should prompt a large attendance of scientists, engineers, and concerned citizens. Registration begins at OCU at 8:30 a.m. November 16, and registration fees are as follows: nonstudent, $5.00; student, $1.00; luncheon (student and nonstudent), $3.00.

CRIB—It's Not Just a Place for Baby to Sleep

The Computerized Resources Information Bank (CRIB), a national mineral-resources data bank established in mid-1972 by the U.S. Geological Survey, already contains over 15,000 sets of records on mineral deposits and commodities in the United States and elsewhere.

The purpose of the data bank, as described by James A. Calkins, geologist with the USGS in Washington, D.C., is "to keep our store of mineral information up-to-date, centralized, and easily accessible to aid the decision-making process." The importance of such a source of information grows with the growing possibility of mineral shortages accompanying

the already existing energy shortage. It cuts down on time, space, and effort, and it provides a central source and storage point for basic data on all minerals in all localities.

CRIB–The Mineral Resources Data Bank of the U.S. Geological Survey, a descriptive report prepared by James A. Calkins, Olaf Kays, and Eleanor K. Keefer, is issued as USGS Circular 681 and may be obtained free on request from the Director, U.S. Geological Survey, Washington, D.C. 20244.

USGS Traveling Exhibit Routed Toward OU, Bacone College

The U.S. Geological Survey's traveling exhibit, an integral part of a program encouraging minority participation in the earth sciences, is scheduled to pay a visit to The University of Oklahoma campus on November 5 and 6, where it will be on display outside Gould Hall, home of the School of Geology and Geophysics and the Oklahoma Geological Survey. An account of the exhibit's stop at Langston University, in north-central Oklahoma, is given in the February 1973 issue of *Oklahoma Geology Notes* (v. 33, p. 2).

After the OU visit, the exhibit will travel to Bacone College, northeast of Muskogee, eastern Oklahoma, where it will be displayed November 8 and 9. Named after Baptist missionary Almon C. Bacone, the junior college was established at its present location in 1885 as a school for American Indians.

Next, the exhibit will go to Dallas for the annual meeting of The Geological Society of America.

The program on minority participation in the earth sciences is supported jointly by USGS, GSA, and the American Geological Institute as well as by various industry groups and academic institutions.

OURI Becomes ORA

The administrative staff of The University of Oklahoma Research Institute (OURI) has officially joined the University as the Office of Research Administration (ORA) with Raymond D. Daniels as executive director. Effective July 1, 1973, ORA assumed the responsibility of managing all sponsored research programs formerly administered by OURI.

Jack L. Morrison is director of Information Systems Programs and will continue to be responsible for the General Information Processing System (GIPSY).

A program to completely revise existing GIPSY documentation to produce a document that can serve as a standard reference guide for all levels of GIPSY users is under way. Guidelines have been established, and a GIPSY users conference was held in September in Washington, D.C. The goal of the conference was better communication of ideas among those who use the system, better information concerning the system, and the dissemination of ideas on the future use of the system.

Remarks on an Acanthodian Specimen from Texas

Jiri Zidek[1]

L. C. Simpson (1973, p. 191 of this issue), in reporting on the occurrence of acanthodian remains in beds of the lower Hennessey Group of Tillman County, southwestern Oklahoma, discusses other finds recorded previously from the Lower Permian of the Western Hemisphere. In all cases but one (Dunkle and Mamay, 1956), he regards the age placement of these specimens as questionable. A few remarks are in order here to clarify the placement of the specimen described by Dunkle and Mamay (1956) from the middle part of the Belle Plains Formation in Baylor County, Texas, south of the Tillman County area.

The occurrence reported by Dunkle and Mamay consists of a single specimen of a small acanthodian identified as *Acanthodes* sp. by the authors. I have had an opportunity to examine this specimen (U.S. National Museum cat. no. 21318) and have found it to be an enigmatic fossil showing little detail. The skull, the branchial apparatus, and the pectoral girdle are in such a poor state of preservation that their structure cannot be determined. No squamation is present, and the only evidence for its identification consists of the body outline and the fin-spines; these are preserved only as impressions. Most representatives of the order Acanthodiformes maintain rather uniform proportions, and the body outline alone should not, therefore, be taken as an indication for placement in a genus or, for that matter, even in a family.

In discussing the spines, Dunkle and Mamay (1956) stated that the pectoral one is noticeably more robust and presumably longer than the pelvic. There is no pelvic spine in the specimen, however; the only spines (impressions) present are the dorsal, the anal, and the right pectoral. The impressions of the pectoral and anal spines preserve very nearly the entire length of both and show them to be identical in diameter and length. The impression of the dorsal spine appears to lack its most proximal portion, and the mutual positions of this spine and the anal one cannot, therefore, be established with certainty.

In spite of being practically complete lengthwise, the specimen is only 37 mm long, i.e., smaller than even the immature individuals of acanthodians known to me. The total lack of scales might possibly be thought of as resulting from postmortem transport during which the squamation was stripped off, but in a specimen as delicate as the one in question, transport would most likely have caused disarticulation. Since the specimen is not broken up, we can justifiably assume that we are dealing with a juvenile individual in which squamation had not yet developed. To my knowledge, unquestionably juvenile specimens are known from only two acanthodian genera: *Acanthodes* and *Traquairichthys* (=*Traquairia* Fritsch, nom. praeocc.; cf. Whitley, 1933). Although no study of growth

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has so far been done on these specimens, a preliminary observation indicates that, however immature they are, the pectoral spines are invariably longer and more robust than the anal spines in *Acanthodes,* whereas in *Traquairichthys* the pectoral and anal spines are of approximately equal size in all the known growth stages. For this reason, and because of the apparent absence of the pelvic spines, it appears to me that the Texas specimen should not be identified as *Acanthodes* but rather as *Traquairichthys.*

Traquairichthys has been described only from the Upper Carboniferous, Westphalian D, of Bohemia (Fritsch, 1893, p. 50; *Traquairia pygmaea),* and the specimen in question would be the first hitherto reported of this genus outside that area and stratigraphic level. During my tenure in Prague I was aware of a large comparative collection in the National Museum of Czechoslovakia from the coal fields of central Bohemia that included a number of as yet unpublished *Traquairichthys* specimens from the Kounov Strata, Stephanian in age. However, the Texas specimen comes from the Belle Plains Formation, regarded as Early Permian (Leonardian) in age by most students. So far, *Acanthodes* has been the only acanthodian genus known to cross the Pennsylvanian-Permian boundary. The question now arises as to whether *Traquairichthys* also persisted into the Early Permian or whether the Belle Plains may be of Gearyan (Late Pennsylvanian) age rather than Leonardian.

I would like to express sincere gratitude to Robert W. Purdy of the U.S. National Museum for his help during my visit. Financial assistance received through the short-term visitors program of the Smithsonian Institution and through the Foundation of Geology and Geophysics of The University of Oklahoma is gratefully acknowledged.

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New Theses Added to OU Geology Library

The following M.S. theses were recently added to The University of Oklahoma Geology and Geophysics Library:

The Feasibility of Detecting Lithologic Variations Using a Modified Magnetotelluric Method, by Gary Alan Crews.

Subsurface Stratigraphic Analysis, Late Ordovician to Early Mississippian, Southwest Oakdale-Campbell Trend, Woods, Major, and Woodward Counties, Oklahoma, by John William Isom.

U.S. Board on Geographic Names Honors Former USGS Director, Publishes Recent Oklahoma Decisions

A hitherto unnamed 6,000-foot ridge in the Bearpaw Mountains of north-central Montana has been named Pecora Ridge in honor of the late William T. Pecora, who began his geologic field work there in 1937 and returned to the area frequently throughout his life. The ridge is in Hill and Chouteau Counties and extends southwest about 2 miles from the 6,916-foot top of Baldy Mountain, forming a divide between Eagle Creek and the headwaters of Birch and Little Birch Creeks.

A career scientist with the U.S. Geological Survey, Dr. Pecora was the Survey's 8th director, serving in that capacity from 1965 until he became undersecretary of the Department of the Interior in 1971. Under Dr. Pecora's direction, the USGS assumed leadership of the Interior Department's EROS (Earth Resources Observation Systems) program. He also led the way in establishing the Survey's National Center for Earthquake Research at Menlo Park, California. More recently, Dr. Pecora coordinated preparation of the massive environmental impact statement on the proposed trans-Alaska pipeline.

In addition to approving Pecora Ridge for use on all federal maps and publications, the U.S. Board on Geographic Names has approved a number of designations for geographic features in Oklahoma. Listed below are the ones contained in the most recent issue of *Decisions on Geographic Names in the United States* (Decision List 7301, January through March 1973, p. 10).

Elm Creek (variant: Grief Creek) has been adopted by the U.S. Board on Geographic Names to identify a 7-mile-long stream in Hughes County, Oklahoma. It heads at 35° 04′ 51″ N., 96° 19′ 33″ W. and flows northeast to Graves Creek 4 miles east southeast of Yeager (sec. 29, T. 8 N., R. 10 E., Indian Meridian; 35° 08′ 36″ N., 96° 16′ 09″ W.).

Little Saline Creek (variant: Little Salina Creek) has been adopted to identify an 11-mile-long stream that heads at 35° 12′ 40″ N., 94° 57′ 20″ W. and flows northwest to Saline Creek 3.5 miles east of Salina in Delaware and Mayes Counties, Oklahoma (sec. 20, T. 21 N., R. 21 E., Indian Meridian; 36° 17′ 07″ N., 95° 05′ 25″ W.).

Saline Creek (variant: Salina Creek) has been adopted for a 25-mile-long stream that heads at 35° 12′ 14″ N., 94° 56′ 37″ W. and flows northeast and west in Delaware and Mayes Counties to Lake Hudson 3.3 miles southeast of Salina, Oklahoma (sec. 30, T. 21 N., R. 21 E., Indian Meridian; 36° 16′ 10″ N., 95° 06′ 04″ W.). This revises an 1899 decision.

Wickliffe Creek (variant: Wicklittle Creek) has been adopted as the name for an 8-mile-long stream that heads at 36° 20′ 40″ N., 95° 02′ 12″ W. and flows southwest to Lake Hudson 3.3 miles southeast of Salina, Mayes County, Oklahoma (sec. 30, T. 21 N., R. 21 E., Indian Meridian; 36° 16′ 11″ N., 95° 06′ 05″ W.).

Wolf (variants: Dewright, Snomac) has been adopted to identify a community 10 miles south of Seminole, Seminole County, Oklahoma (35° 05′ 15″ N., 96° 39′ 30″ W.).

State Hydrologic Maps To Be Released in 1973

Under production by the U.S. Water Resources Council, in cooperation with the U.S. Geological Survey, is a set of "Basic Hydrologic Unit Maps" that will be of value in supporting national, regional, state, and local planning projects. These nationally consistent state maps will be scaled at 1:500,000 and will show drainage, culture, and unit hydrologic boundaries. The maps are projected to cover the 1,530 cataloging units used by the USGS in the 1972 edition of the *Catalog on Water Data.*

The maps have been scheduled for nationwide review by individuals and agencies; suggested changes resulting from this field review will be evaluated by the USGS, and modifications approved by the Water Resources Council will be incorporated into the maps prior to their printing late in 1973.

Guidelines for review can be obtained from USGS district and regional offices. Office locations are available from Arden O. Weiss, chief of the council's National Programs and Assessment Division (phone 202—254-5684).

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