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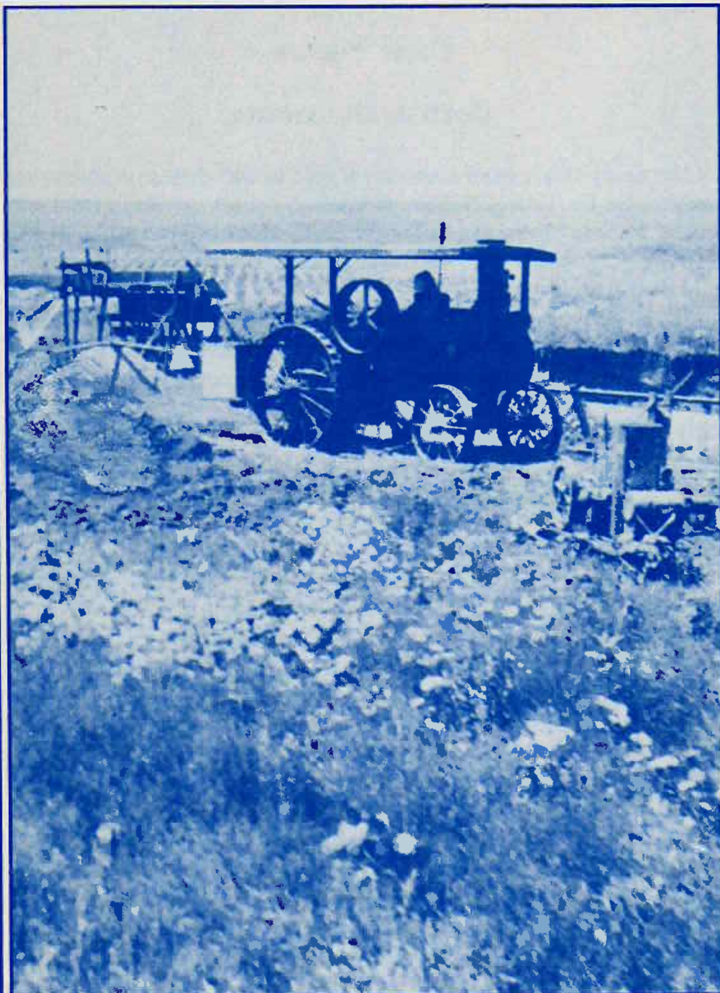

OKLAHOMA GEOLOGY NOTES

OKLAHOMA GEOLOGICAL SURVEY

Cover Picture

GOLD IN OKLAHOMA

Of the many stories and accounts of gold in Oklahoma, only one appears to be authentic. Dr. Edwin DeBarr published a short article in 1904, entitled "Report of Mineral Deposits in the Wichita Mountains" (published by the Department of Geology and Natural History, Territory of Oklahoma, Norman, as the *3d Biennial Report*).

Dr. DeBarr did the assay work at The University of Oklahoma and found one sample (No. 136) that contained gold. His notes (p. 36) are quoted here.

"No. 136, Placer washings made by myself south of Brushy Mt., Gold Hill, and Bald Mountain.

"All samples were assayed by fluxes and by the cyanide processes and heavy sulphides were assayed by the chlorination process, and all save No. 136 showed no trace of gold.

"No. 136 was obtained from washing placer material south of Brushy and Bald Mountains and Gold Hill, in the creeks and in Deep Red in which material there is a very small quantity of exceedingly fine gold in a limited area. The lack of water and the black iron in which it is found, together with the limited amount of gold therein, renders it unprofitable for working."

The area where the gold sample was collected is southeast of Snyder, Kiowa County, where some prospectors worked until 1935. For a more detailed account of gold stories, please refer to *Oklahoma Treasures and Treasure Tales* by Steve Wilson (published by The University of Oklahoma Press, Norman, in 1976).

The cover photograph (courtesy of the Western History Collections, University Libraries, The University of Oklahoma) shows a placer operation south of Snyder.

—Robert O. Fay

Editorial staff: William D. Rose, Rosemary L. 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. Single copies, seventy-five cents; yearly subscription, $4.00. 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.

This publication, printed by the Transcript Press, Norman, Oklahoma, is issued by the Oklahoma Geological Survey as authorized by Title 70, Oklahoma Statutes 1971, Section 3310, and Title 74, Oklahoma Statutes 1971, Sections 231-238. 1,500 copies have been prepared for distribution at a cost to the taxpayers of the State of Oklahoma of $2,775.20.

OKLAHOMA GEOLOGICAL SURVEY

ANNUAL REPORT

July 1, 1975-June 30, 1976

INTRODUCTION

Last year, fossil fuels produced the largest segment of Oklahoma's gross State income. Revenue was derived from 202.5 million barrels of liquid petroleum and natural-gas liquids, 1.7 trillion cubic feet of natural gas, and 2.4 million tons of coal. The estimated value of their production exceeded $2 billion in 1975, whereas all other components of the State's minerals industries produced natural resources valued at $100 million.

Because of the enormous importance of the fossil-fuel industry to the State and the nation, the Oklahoma Geological Survey has focused a lot of its attention on energy research. In fact, during the 1976 fiscal year, about one-half of the Survey's total effort was directed toward fossil fuels or related energy studies.

ENERGY PROGRAMS

One of the Survey's most satisfying accomplishments during the last year was completion of a study of the Hunton strata in the deep Anadarko basin. The results of this study, conducted by Survey geologist Thomas W. Amsden, were published as Bulletin 121, *Hunton Group (Late Ordovician, Silurian, and Early Devonian) in the Anadarko basin of Oklahoma*, a 214-page, soft-cover text that is accompanied by 10 color maps and a sheet containing 4 cross sections. The purpose of the study was to provide a stratigraphic and lithologic analysis of the Hunton as an aid in delineating further exploration targets in the Anadarko basin. After completion of this study, a similar investigation of Hunton strata in the Arkoma basin was initiated by Dr. Amsden. This study is scheduled for completion in the next fiscal year, and publication is projected for late 1977 or early 1978.

An investigation of heavy-oil occurrences in northeastern Oklahoma was initiated during the 1976 fiscal year (as part of a coordinated effort involving Oklahoma, Kansas, and Missouri in a 3-year study of occurrences of heavy oils in the contiguous 3-state area). This project, funded in part by a grant from the Energy Research and Development Administration (ERDA), concerns heavy oils in sandstones of Pennsylvanian age. Analysis of available electrical and sample logs from earlier exploration activities in the region has been initiated, with the objective of establishing a stratigraphic framework for the lenticular sandstone bodies in the region. A second phase of the study will involve drilling a series of cores at selected locations to obtain data on the degree of saturation and to provide better definition of the organic chemistry of these heavy-oil deposits. John Roberts, the Survey's chief petroleum geologist, is supervising the project, assisted by several graduate research assistants.

Heavy-oil deposits also occur in other parts of the State. Preliminary investigations of occurrences in Simpson strata in the Arbuckle Mountains suggest that a more comprehensive study of these deposits should be undertaken, and such a project will probably be initiated in the 1978 fiscal year.

Because of the increased work load resulting from special petroleum investigations in addition to the normal requirements of responding to requests for petroleum-related information, the Survey added an additional professional staff member to the petroleum-geology section. William E. Harrison joined the Survey in August. His prior experience includes 3 years with Shell Oil Company and 1 year with Atlantic Richfield Company. His professional experience includes both exploration and research. In addition to his contributions on current projects, Dr. Harrison is expected to initiate studies on the origin of petroleum and non-conventional methods of hydrocarbon detection.

Coal resources in Oklahoma represent a substantial and still largely untapped energy source; production has increased slowly from a low of 800,000 tons in 1967 to 2.4 million tons in 1975. For the past several years, all coal production has been from surface-mining operations. At present, 31 mines are operating, although several of them have not reached full production. When they do, the annual production should approach 5 million tons.

Following completion of the Survey's general report on the coal resources of the State, *Investigation of the Coal Reserves in the Ozarks Section of Oklahoma and Their Potential Uses*, by S. A. Friedman, the Survey has initiated several specific coal studies. A compilation of the location, operating name, and general-production information for each coal mine in the State was completed during the fiscal year, and the compilation was published in July 1976 as the Survey's *Map of Eastern Oklahoma Showing Active Coal Mines (January 1, 1976)*. Plans call for an annual revision and reprinting of this map in order to provide current information on the status of coal-mining activities in Oklahoma.

In addition, coal samples have been collected from each active mine in the State. Complete coal analyses, including a substantial amount of trace-element information, are being performed on each sample. This project is supported in part by the U.S. Geological Survey, and much of the coal analysis is being handled by the U.S. Bureau of Mines. Preliminary results on some of the samples are now available, and the remaining information should be available during the latter part of the 1977 fiscal year. Further sampling and analysis of coals from the currently developing mines will probably be initiated in the 1978 fiscal year.

The major thrust of the Survey's coal-investigation program, however, is the preparation of maps for each county showing the location of each coal bed. Specific information that will be completed on each map includes coal-bed thickness, structural attitude, location of structural contour at the maximum estimated stripping ratio for coal recovery by surface mining, information on roof-rock conditions for potential underground mining operations, and coal chemistry at selected point sources. These activities have been initiated (with partial support from the U.S. Bureau of Mines) for data on the Hartshorne coal in Haskell and Le Flore Counties. Additional work on the project is being accomplished through the Survey's partial support of several thesis projects at Oklahoma State University and The University of Oklahoma. It is expected that this program will be continued, with the possibility of some outside funding, until all counties in the coal fields have been completed.

BASIC SURVEY TASKS

Although energy studies are a significant portion of the Survey's program, basic geologic mapping, mineral-resource assessments, water-resources investigations, and environmental studies are all important Survey tasks.

The Survey published Bulletin 120, *Geology and Mineral Resources of Choctaw County, Oklahoma,* during fiscal year 1976. This study, authored by OU geology professor G. G. Huffman and several of his former students, provides information on the geology, industrial-mineral resources, and oil and gas development of this county. Mapping programs are in various stages of completion for Alfalfa, Bryan, Custer, Muskogee, Noble, Payne, and Washita Counties. At least one of these county reports will be published during the next fiscal year.

The Survey is currently in the second year of a 3-year study on the impact of surface mining in each of Oklahoma's 77 counties, excluding coal fields. This study, funded in part by a grant from the U.S. Geological Survey, involves locating each current or former surface-mining operation in the State and compiling information on the commodity extracted from each mine, the tonnage involved, and any reclamation practices that have been employed. The results will provide definitive base-line information for future mining and reclamation operations. The project is being conducted by Survey geologists K. S. Johnson and K. V. Luza, assisted by OU geology professor A. J. Myers and several graduate research assistants.

The Survey investigates problems related to mined-land reclamation practices in order to provide technical assistance to industry and to the State's regulatory agency, the Oklahoma Department of Mines. In that connection, the Survey assisted in developing proposed legislation pertaining to the reclamation of orphaned mined land in the Oklahoma coal fields. The data supporting the need for such legislation was provided in part by an earlier study of Oklahoma coal-mining operations conducted by Dr. Johnson.

This study was published in 1974 as GM-17, *Maps and Description of Disturbed and Reclaimed Surface-Mined Coal Land in Eastern Oklahoma.*

The Survey is continuing its cooperative water-resources investigations with the U.S. Geological Survey. This program is designed to provide (1) a regional assessment of the State's water resources, and (2) detailed information on the State's most important ground-water aquifers. The first phase of this program is nearing completion. Most of the field mapping has been completed, and the cartographic preparation of the information is advancing steadily. The Survey has already published 5 of the 9 proposed hydrologic atlases (the Fort Smith, Tulsa, Ardmore-Sherman, Oklahoma City, and Clinton quadrangles). It is anticipated that 2 additional atlases (covering the Lawton and the Enid quadrangles) will be published in the next fiscal year.

The second phase of the water-investigations program, detailed aquifer studies, has been initiated with analysis of the Vamoosa Formation and the Antlers (Trinity) sandstone. The studies should be completed in the next fiscal year and published during fiscal year 1978.

A special study of the water resources in the abandoned zinc mines of the Miami-Picher mining district was initiated this year. The study, designed to be completed in fiscal year 1978, will provide information on the quantity and quality of the water contained in the mines. Should the water quality prove satisfactory, it is anticipated that the quantity involved would be suitable for industrial purposes. This project is being funded under the joint sponsorship of the Northeast Counties of Oklahoma Development Association, the U.S. Geological Survey, and the Oklahoma Geological Survey.

Water-investigation programs may prove to be some of the Survey's most important projects as future demands impose an increasing burden on the State's water resources. Information collected today will be essential in arriving at rational decisions in future years concerning the most effective use of this invaluable natural resource.

Another continuing Survey program, trace-metal analysis, was concentrated this last year on occurrences of zinc in the Arbuckle Mountains and copper, lead, and zinc in the Ouachita Mountains. Dr. R. O. Fay is collecting information on trace-metal occurrences in an effort to understand the geologic factors controlling them. From such information it is anticipated that criteria can be established to aid in the search for economic concentrations of these metals.

A new project, concerned with assessing the seismicity and tectonic framework of the State, was developed at the end of the 1976 fiscal year. This study, funded in part by a grant from the Nuclear Regulatory Commission, is part of a multi-state effort to provide information on earthquakes in the Midcontinent. The study is designed to provide information on the location and frequency of earthquakes—with particular attention devoted to the Nemaha Ridge in Oklahoma, Kansas, and Nebraska. It is expected to be completed in 5 years, and interim annual reports will be prepared. The results of the study should provide information to aid in developing effective building codes for the metropolitan areas of the State and to assist the NRC in assessing potential sites for nuclear power plants.

PUBLIC SERVICE

The Oklahoma Geological Survey is the State's basic research and development agency concerned with natural resources. In order to discharge our constitutionally-mandated responsibilities, the Survey must maintain a close working relationship with all State and federal agencies, the business and industrial sector, and most importantly with the public. For several years The University of Oklahoma Geology and Geophysics library has served as the official repository for Oklahoma Corporation Commission drillers' logs. Increased demand for these files and lack of funding to maintain the files such that they could be readily accessible spurred the Survey to join with the Corporation Commission in establishing an agreement with Petro-Well Libraries to microfilm the material. That project has now been completed, and a microfilm library of the Corporation Commission drillers' logs is available for public inspection at the Survey. This file will be continually updated under the terms of the agreement.

Finding new ways to assist the public and more efficient ways to meet our continuing obligations to the people of the State is the Survey's most important task and the objective to which the entire staff is dedicated.

Charles J. Mankin, *Director*

APPENDIX A

Survey Staff, 1975-76 Fiscal Year

Professional

Thomas W. Amsden

Rosemary L. Croy

Robert O. Fay

David A. Foster

S. A. Friedman

William E. Harrison[1]

Kenneth S. Johnson

Kenneth V. Luza[2]

Charles J. Mankin

John F. Roberts

William D. Rose

Leonard R. Wilson

Part-Time Professional

George C. Huffman
(The University of Oklahoma)

Frederick H. Manley
(Georgia State University)

A. J. Myers
(The University of Oklahoma)

James H. Stitt
(University of Missouri, Columbia)

John B. Thuren[3]
(The University of Oklahoma)

Technical

Cartographic

Marion E. Clark
Roy D. Davis
David M. Deering
Christine G. Pflegl[4]
Sondra L. Underwood[5]

Core and Sample Library

Billy D. Brown[6]
Eldon R. Cox
Kenneth N. Miller[7]

Editorial

Elizabeth A. Ham

Electron Microscope Technician

William F. Chissoe III

Geological Technician

Robert D. Wingate

Laboratory Technician

Robert M. Powell[8]

Secretarial

Betty J. Bellis
Helen D. Brown
Margarett K. Civis
Cynthia (Trettevik) Sarem-Aslani
Gwen C. Williamson

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[1]Appointed August 1975.
[2]Appointed July 1975.
[3]Resigned December 1975.
[4]Resigned June 1976.
[5]Resigned June 1976.
[6]Resigned September 1975.
[7]Appointed October 1975.
[8]Appointed September 1975.

APPENDIX B

List of Survey Publications Issued, 1975-76 Fiscal Year

New Publications

Annals No. 5, Oklahoma Academy of Science.—*Oklahoma Reservoir Resources*. Proceedings of a symposium held November 1974 at Southeastern Oklahoma State University, Durant. 151 pages, 33 figures, 52 tables. Issued March 1976.

Bulletin 120.—*Geology and Mineral Resources of Choctaw County, Oklahoma*, by G. G. Huffman, P. P. Alfonsi, R. C. Dalton, Andres Duarte-Vivas, and E. L. Jeffries. 39 pages, 18 figures, 5 tables, 1 color plate (geologic map; scale 1:63,360). Issued October 1975.

Bulletin 121.—*Hunton Group (Late Ordovician, Silurian, and Early Devonian) in the Anadarko Basin of Oklahoma*, by Thomas W. Amsden. 214 pages, 41 figures, 15 plates, 11 color map panels. Issued May 1976.

Geologic Map, GM-18.—*Stereoscopic and Mosaic Aerial-Photograph Study of the Structure of the Central Ouachita Mountains in Oklahoma and Arkansas*, by Frank A. Melton. One 4-color map sheet, with 3 maps at scales of 1:250,000, 1:125,000, and 1:62,500, showing principal structures visible from aerial photographs. Issued April 1976.

Guidebook for GSA South-Central Section Meeting.—*Plutonic Igneous Geology of the Wichita Magmatic Province, Oklahoma*, by Benjamin N. Powell and Joseph F. Fischer, with contributions by David W. Phelps and Martin A. Pruatt. 10th annual meeting, guidebook for field trip no. 2. 35 pages, 52 figures, 7 tables. Issued February 1976.

Oklahoma Geology Notes.—Six bimonthly issues (August 1975-June 1976) containing 244 pages.

Publications Reprinted

Circular 23.—*Barite in Oklahoma*, by William E. Ham and Clifford A. Merritt. 42 pages, 4 plates, 2 figures. Issued 1944; reprinted February 1976.

Circular 27.—*Cellular Products from Oklahoma Volcanic Ash*, by A. L. Burwell (with a section on geology and petrology, by William E. Ham). 89 pages, 10 plates, 7 figures, 13 tables. Issued 1949; reprinted September 1975.

Circular 36.—*Spores of the McAlester-Stigler Coal of Oklahoma*, by J. L. Morgan. 54 pages, 3 plates, 3 figures. Issued 1955; reprinted November 1955.

Coal report.—*An Investigation of the Coal Reserves in the Ozarks Section of Oklahoma and Their Potential Uses*, by S. A. Friedman. Final Report to the Ozarks Regional Commission. 117 pages, 24 figures, 77 tables. Issued July 1974; reprinted November 1975.

Educational Publication 2.—*Introduction, Guidelines, and Geologic History of Oklahoma*, Book 1 of *Guidebook for Geologic Field Trips in Oklahoma*, by Kenneth S. Johnson. 15 pages, 16 figures, 7 photographs, 1 table. Issued 1971; reprinted March 1976.

Guide Book 10.—*Common Minerals, Rocks, and Fossils of Oklahoma*, by William E. Ham and Neville M. Curtis, Jr. 28 pages, 25 figures. Issued 1960; reprinted May 1976.

Guide Book 14.—*The Composite Interpretive Method of Logging Drill Cuttings*, second edition, by John C. Maher. 48 pages, 14 figures, 1 plate. Issued 1964; reprinted February 1976.

Guide Book 15.—*Guide to Alabaster Cavern and Woodward County, Oklahoma*, by A. J. Myers, A. M. Gibson, B. P. Glass, and C. R. Patrick. 38 pages, 41 figures. Issued 1969; third printing, July 1975.

Guidebook for 1973 annual meeting of The Geological Society of America.—*Igneous Geology of the Wichita Mountains and Economic Geology of Permian Rocks in Southwest Oklahoma*, by Kenneth S. Johnson and Rodger E. Denison, with contributions by Douglas C. Brockie, Hugh E. Hunter, and Nancy L. Scofield. Guidebook for Field Trip No. 6. 33 pages, 35 figures, 9 tables. Issued November 1973; third printing, November 1975.

Guidebook for 1974 annual meeting of The Geological Society of America, South-Central Section.—*Guidebook to the Depositional Environments of Selected Pennsylvanian Sandstones and Carbonates of Oklahoma*, by John W. Shelton and T. L. Rowland. 8th annual meeting, guidebook for field trip no. 3. 75 pages, 33 figures, 15 plates. Issued 1974; reprinted November 1975.

Mineral Report 6.—*Dolomite and Magnesium Limestone*, compiled by J. O. Beach and S. G. English. 20 pages. Issued 1940; reprinted September 1975.

Mineral Report 15.—*Carbonizing Properties of McAlester Bed Coal from Dow No. 10 Mine, Dow, Pittsburg County, Okla.* (Preliminary Report), by J. D. Davis and D. A. Reynolds. 12 pages plus tables. Issued 1942; reprinted August 1975.

Mineral Report 26.—*Occurrence of Radioactive Material in Sandstone Lenses of Southwestern Oklahoma*, by G. C. Chase. 7 pages, 1 map. Issued 1954; reprinted November 1975.

Mineral Report 30.—*Asphaltite in the Ouachita Mountains of Southeastern Oklahoma*, by W. E. Ham. 12 pages. Issued 1956; reprinted July 1975.

Symposium Proceedings.—*Proceedings of the 22nd Annual Highway Geology Symposium*, Rosemary Kellner (Croy) and William D. Rose, editors. 12 papers, 123 plates, 74 figures, 14 tables. Issued 1972; reprinted December 1975.

APPENDIX C

Publications by Survey Staff, 1975-76 Fiscal Year

THOMAS W. AMSDEN

Early Late Silurian biofacies in south-central Oklahoma as determined by point counting [abstract]: Geological Society of America Abstracts with Programs, v. 7, p. 974-975 (reprinted in Oklahoma Geology Notes, v. 36, p. 29).

Hunton Group (Late Ordovician, Silurian, and Early Devonian) in the Anadarko basin of Oklahoma: Oklahoma Geological Survey Bulletin 121, 214 p.

ROSEMARY L. CROY

Oklahoma Geology Notes: Oklahoma Geological Survey, v. 35, nos. 4-6; v. 36, nos. 1-3, 244 p. (ed., with William D. Rose and Elizabeth A. Ham).

ROBERT O. FAY

A possible origin for copper in Oklahoma: Oklahoma Geology Notes, v. 35, p. 151-153.

S. A. FRIEDMAN

Coal geology of parts of Craig, Nowata, and Rogers Counties, Oklahoma, *in* Coal and oil potential of the Tri-State area: Tulsa Geological Society Field Trip Guidebook, p. 41-47.

Giant coal-slurry pipeline planned for Midcontinent: Oklahoma Geology Notes, v. 35, p. 158-159.

New coal-preparation plant opens in Le Flore County: Oklahoma Geology Notes, v. 35, p. 133-134 (cover photo and description).

Oklahoma, *in* 1975 Keystone Coal Industry Manual: New York, McGraw Hill, Inc., p. 599-603.

ELIZABETH A. HAM

Bibliography and index of Oklahoma geology, 1975: Oklahoma Geology Notes, v. 36, p. 79-116 (compiler, with William D. Rose).

Dedication to Carl Colton Branson, *in* Coal and oil potential of the Tri-State area: Tulsa Geological Society Field Trip Guidebook, p. 2-3.

Oklahoma Geology Notes: Oklahoma Geological Survey, v. 35, nos. 4-6; v. 36, nos. 1-3, 244 p. (ed., with William D. Rose and Rosemary L. Croy).

WILLIAM E. HARRISON

Graphitization of sedimentary organic matter: a potentially useful method for assessing paleotemperatures [abstract]: Geological Society of America Abstracts with Programs, v. 8, p. 191-192.

Laboratory graphitization of a modern estuarine kerogen: Geochimica et Cosmochimica Acta, v. 40, p. 247-248.

Thermally induced diagenesis of aliphatic fatty acids in Holocene sediment: American Association of Petroleum Geologists Bulletin, v. 60, p. 452-455.

KENNETH S. JOHNSON

Geology of the Permian Blaine Formation and associated strata in southwest Oklahoma [abstract]: American Association of Petroleum Geologists, Mid-Continent Regional Meeting Program, p. 8 (reprinted in American Association of Petroleum Geologists Bulletin, v. 60, p. 320 and in Oklahoma Geology Notes, v. 36, p. 24).

Islands in the sea: Geology of the Wichitas: Great Plains Journal, v. 14, no. 1, p. 33-55.

The mineral industry of Oklahoma, *in* Area reports: domestic, *v. 2 of* Minerals yearbook, 1973: U.S. Bureau of Mines, p. 541-555 (with L. G. Southard and J. F. Roberts).

OGS exhibit at International Petroleum Exposition: Oklahoma Geology Notes, v. 36, p. 77-78 (cover photo and description).

Ridges and valleys of the Ouachita Mountains: Oklahoma Geology Notes, p. 45-46 (cover photo and description).

CHARLES J. MANKIN

Oklahoma, *in* Summary of state activities: The State Geologists Journal (Association of American State Geologists), v. 28, p. 45-46.

Oklahoma Geological Survey annual report, July 1, 1974-June 30, 1975: Oklahoma Geology Notes, v. 35, p. 203-215.

JOHN F. ROBERTS

The mineral industry of Oklahoma, *in* Area reports: domestic, *v. 2 of* Minerals yearbook, 1973: U.S. Bureau of Mines, p. 541-555 (with L. G. Southard and K. S. Johnson).

Statistics of Oklahoma's petroleum industry, 1974: Oklahoma Geology Notes, v. 35, p. 226-234.

WILLIAM D. ROSE

Bibliography and index of Oklahoma geology, 1975: Oklahoma Geology Notes, v. 36, p. 79-116 (with Elizabeth A. Ham).

Oklahoma Geology Notes: Oklahoma Geological Survey, v. 35, nos. 4-6; v. 36, nos. 1-3, 244 p. (ed., with Rosemary L. Croy and Elizabeth A. Ham).

LEONARD R. WILSON

Carl Colton Branson, 1906-1975: Oklahoma Geology Notes, v. 35, p. 224-226.

Desmoinesian coal seams of northeastern Oklahoma and their palynological content, *in* Coal and oil potential of the Tri-State area: Tulsa Geological Society Field Trip Guidebook, p. 19-32.

Field studies of Carl Colton Branson: Oklahoma Geology Notes, v. 35, p. 201-202 (cover photo and description).

Palynological evidence for a Pennsylvanian age assignment of the Gearyan Series in Kansas and Oklahoma [abstract and discussion], *in* Barlow, J. A. (editor), The age of the Dunkard: I. C. White Memorial Symposium, 1st, Morgantown, West Virginia, 1972, p. 183-193 (with M. A. Rashid).

Palynological evidence for the origin of the Atoka Formation (Pennsylvanian) rocks in the type area [abstract]: Geological Society of America Abstracts with Programs, v. 8, p. 72-78 (reprinted in Oklahoma Geology Notes, v. 36, p. 72-73.)

Appendix D

Papers Presented by Survey Staff at Professional Meetings, 1975-76 Fiscal Year

Oklahoma City Geological Society, Monthly Meeting
Oklahoma City, Oklahoma, September 9, 1975
THOMAS W. AMSDEN
Hunton lithostratigraphy

State Geological Surveys of the Midcontinent Region and Geological Division of the U.S. Geological Survey, Annual Conference
Estes Park, Colorado, September 22-24, 1975
CHARLES J. MANKIN
Oklahoma Geological Survey's research program

American Association of Petroleum Geologists, Mid-Continent Section Biannual Meeting
Wichita, Kansas, October 2, 1975
ROBERT O. FAY (paper prepared by Kenneth S. Johnson)
Geology of the Permian Blaine Formation and associated strata in southwest Oklahoma
KENNETH S. JOHNSON
Geology of the Permian Blaine Formation and associated strata in southwest Oklahoma (paper presented by Robert O. Fay)

Oklahoma Petroleum Council, Annual Meeting
Tulsa, Oklahoma, October 7, 1975
CHARLES J. MANKIN
Future prospects for petroleum in Oklahoma

Bureau de Recherches et Minieres, Special Conference
Orleans, France, October 10, 1975
KENNETH S. JOHNSON
Uranium mineralization in the Uravan district of the Colorado plateau

Bureau de Recherches et Minieres, Special Conference
Orleans, France, October 13, 1975
KENNETH S. JOHNSON
Permian copper shales of southeastern United States

Paleontological Society of America, Annual Meeting
Salt Lake City, Utah, October 22, 1975
THOMAS W. AMSDEN
Early Late Silurian biofacies in south-central Oklahoma as determined by point counting.

Institute of Electrical and Electronic Engineers, Oklahoma Section Monthly Meeting
Oklahoma City, Oklahoma, October 28, 1975
CHARLES J. MANKIN
Oklahoma's mineral and energy resources

U.S. Geological Survey, Kansas Geological Survey, and Kansas Water Resources Board, Special Conference on "Discharge of Saline Water from Permian Rocks to Streams in Central Kansas"
Lawrence, Kansas, November 18, 1975
KENNETH S. JOHNSON
Geologic framework of the Permian basin and its relation to discharge of saline water

Society of Physics Students, Regional Annual Meeting
Southwestern State University, Weatherford, Oklahoma, November 21, 1975
CHARLES J. MANKIN
Oklahoma's mineral and energy resources

Interstate Oil Compact Commission, Annual Meeting
Birmingham, Alabama, December 8, 1975
CHARLES J. MANKIN
Energy research and development

Oklahoma Gem and Mineral Society, Monthly Meeting
Oklahoma City, Oklahoma, January 15, 1976
KENNETH V. LUZA
A geological trek through the Black Hills

Bartlesville, Oklahoma, Chapter of Society of the Sigma Xi, Monthly Meeting
Bartlesville, Oklahoma, January 29, 1976
KENNETH S. JOHNSON
Coal mining and land-reclamation activities in eastern Oklahoma

Geological Society of America, South-Central Section Annual Meeting
Houston, Texas, February 26-27, 1976
LEONARD R. WILSON
Palynological evidence for the origin of the Atoka Formation (Pennsylvanian) rocks in the type area

Shallow Exploration Drillers, Annual Clinic
Oklahoma City, Oklahoma, March 3, 1976
KENNETH S. JOHNSON
Geology of Oklahoma

American Institute of Chemical Engineers, Oklahoma Section Annual Meeting
Tulsa, Oklahoma, March 6, 1976
S. A. FRIEDMAN
Recoverable coal reserves in Oklahoma

Geological Society of America, Penrose Conference
Houston, Texas, March 15-20, 1976
CHARLES J. MANKIN
The role of a state geological survey in energy research and development

Geological Society of America, Northeastern and Southeastern Sections Annual Meeting
Arlington, Virginia, March 25-27, 1976
William E. Harrison
Graphitization of sedimentary organic matter: a potentially useful method for assessing paleotemperatures

Oklahoma State Department of Energy, Special Seminar
Norman, Oklahoma, March 26, 1976
Charles J. Mankin
The University's conservation plan

Oklahoma Heritage Foundation, Monthly Meeting
Oklahoma City, Oklahoma, March 29, 1976
Charles J. Mankin
Oklahoma's mineral and energy resources

Society of Research Administrators, Regional meeting
New Orleans, Louisiana, April 2, 1976
Charles J. Mankin
Organizing for energy research

Ardmore Geological Society, Monthly Meeting
Ardmore, Oklahoma, April 8, 1976
Kenneth S. Johnson
Strip mining and land reclamation in the eastern Oklahoma coal field

U.S. Army Corps of Engineers, Special Conference
Tulsa, Oklahoma, April 28, 1976
Kenneth S. Johnson
Geology of Permian salt deposits and the salt plains of western Oklahoma

Tulsa Geological Society, Annual Field Trip
Tulsa, Oklahoma, April 30, 1976
S. A. Friedman
Coal stratigraphy and resources at Peabody's No. 1 and No. 2 strip mines, Rogers and Craig Counties, Oklahoma
L. R. Wilson
Desmoinesian coal seams of northeastern Oklahoma and their palynological content

Association of Professional Geological Scientists, Oklahoma Section Monthly Meeting
Oklahoma City, Oklahoma, May 11, 1976
Kenneth S. Johnson
Geological programs of Oklahoma State agencies

Enid Gem and Mineral Society, 6th Biennial Gem and Mineral Show
Enid, Oklahoma, May 22, 1976
Kenneth V. Luza
Geology and minerals of South Dakota

American Association of Petroleum Geologists, Annual Meeting
New Orleans, Louisiana, May 26, 1976
S. A. FRIEDMAN
Coal geology in Oklahoma

Association of American State Geologists, Annual Meeting
Vail, Colorado, June 20-25, 1976
CHARLES J. MANKIN
Presidential address

SOME MISSOURIAN TRILOBITES FROM NORTHEASTERN OKLAHOMA

ROGER K. PABIAN[1] and HARRELL L. STRIMPLE[2]

INTRODUCTION

Trilobites of Missourian age, unlike occurrences of Desmoinesian age, are not common in Oklahoma. Girty (1911) and Branson (1965) have recorded occurrences of *Ditomopyge parvula* (Girty) from the Wewoka and Lenapah Formations respectively. In each case, trilobites and trilobite parts are important constituents of the faunas.

While making collections of Missourian crinoids for a biostratigraphic study of the Midcontinent Missourian, several trilobites were collected in northeastern Oklahoma.

MATERIAL

Three pygidia and a single, complete, damaged specimen of *Ditomopyge scitula* (Meek and Worthen) were collected from the Wann Formation, Ochelata Group, exposed at the Bartlesville Mound, west of Bartlesville, Oklahoma.

A large, complete but crushed specimen of *Ameura missouriensis* (Shumard), collected by W. D. White, and a pygidium of *D. scitula* were collected from a sandy, oolitic, calcareous zone of the Wann exposed at the hairpin-turn section in the E½ sec. 15, T. 25 N., R. 12 E., northwest of Ochelata, in Osage County. The *Ameura* specimen is estimated to be about 65 mm long.

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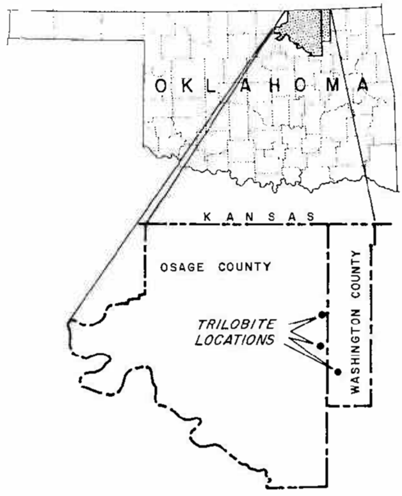

Index map showing locations where trilobites of Missourian age have been collected in Oklahoma.

A complete specimen and a pygidium of *D. scitula* were found in the upper shale zone in the Avant Limestone Member exposed about 2 miles west of Ramona in the S½ sec. 25, T. 25 N., R. 12 E., Osage County.

ASSOCIATED FAUNAS

Some similarities between Missourian trilobite occurrences in Oklahoma and Nebraska have been observed. In both areas, trilobites occur with large, diverse, invertebrate faunas.

Fagerstrom (1964) and Fagerstrom and Boellstorff (1964) indicated that *Ameura sangamonensis* (Meek and Worthen) [=*A. missouriensis* (Shumard)] occurred with at least 16 other species of marine invertebrates in the Bonner Springs Shale of Nebraska. Pabian and Fagerstrom (1972) indicated that *Ditomopyge scitula* from the basal Ervine Creek Limestone (Virgilian) was found with at least 57 other marine invertebrate species.

The fauna in the Wann Shale exposed at the Bartlesville Mound appears to contain at least 3 bryozoan, 3 brachiopod, 1 bivalve, 1 gastropod, 2 echinoid, and 25 crinoid species.

At the hairpin turn, the fauna is equally diverse though not identical in generic make up. Collections show that there are at least 2 bryozoan, 8 brachiopod, 5 gastropod, 1 echinoid, and 14 crinoid species. At the hairpin turn, *Ameura* and *Ditomopyge* are found together, which is unusual. Pabian and Fagerstrom (1968) indicated that the trilobites *Ameura* and *Ditomopyge* do not normally occur together. Pabian (1970) found that in Nebraska these two genera were for the main part incompatible. Only one sample of 70, that from the basal Stoner Limestone, contained appreciable numbers of both *Ameura* and *Ditomopyge*.

The fauna collected from the Avant exposure near Ramona contains at least 1 sponge, 4 bryozoan, 6 brachiopod, 6 gastropod, 4 bivalve, 2 nautiloid, 1 echinoid, and 10 crinoid species.

Trilobites form a small part of the total Missourian fauna of Oklahoma. However, trilobites may eventually aid in refining correlations of Missourian units in Oklahoma with similar units in neighboring states, because trilobites frequently occur in essentially intact fossil communities.

ACKNOWLEDGMENTS

The manuscript was reviewed by Terence Frest of The University of Iowa. Thanks are also due Doris Peabody and Nancy Christensen of the Conservation and Survey Division, University of Nebraska, the former for typing the manuscript and the latter for preparing the index map.

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Energy Index Available

Doctoral dissertations that deal with energy research and development have been identified and indexed by University Microfilm International of Ann Arbor, Michigan. The firm has published the index, which contains 6,000 titles and 25,000 citations, and copies are available. The price is $65.00.

Wyoming Geological Survey Dedicates New Building

In September, the Wyoming Geological Survey dedicated its new headquarters—a 22,400-square-foot stone and metal structure that cost $930,000. The two-story building is located in Laramie on the University of Wyoming campus. It includes a complete basement for storage and laboratory facilities. The ground floor is devoted to public services and contains drafting, publications, sales, and mailing facilities. The second floor has offices for the staff geologists and houses the Survey's extensive files on oil and gas, coal, mineral, and environmental information. The second floor also houses the Laramie office of the U.S. Geological Survey.

While most of the construction was paid for by a 1975 appropriation of the state legislature, nearly 100 Wyoming firms, organizations, and individuals contributed $100 each toward the building's cost as a result of a 1974 fund drive launched to show the geology profession's support for the project.

Dr. Charles J. Mankin, director of the Oklahoma Geological Survey, addressed the dedication ceremony, and a number of regional dignitaries were in attendance.

The Wyoming Survey has grown from a 1-man operation when it was founded in 1933 to the point that it now employs 12 people full time and a number of part-time employees.

View of the new Wyoming Geological Survey headquarters.

Stream-Sediment Studies for Central U.S.A.

A program initiated by the U.S. Energy Research and Development Administration (ERDA) to provide hydrogeochemical and stream-sediment data for 12 central states is described in a series of quarterly reports prepared by ERDA's Oak Ridge Gaseous Diffusion Plant (ORGDP). The study, entitled *Hydrogeochemical and Stream Sediment Survey in Central United States,* is part of ERDA's National Uranium Resource Evaluation Program (NURE) and will provide information that can be used to determine the distribution of uranium in surface and underground waters and stream sediments and will serve as indicators of areas favorable for the discovery of uranium.

The five reports issued to date describe the administration and managerial set-up of the program and give detailed information on sampling, testing and analysis of samples by various methods, processing of data obtained, and storage of samples. They are as follows: GJBX-29(76) [K-TL-524], Part 1, April 1, 1975 through June 30, 1975; GJBX-30(76) [K-TL-524], Part 2, July 1, 1975 through September 30, 1975; GJBX-31(76) [K-TL-524], Part 3, October 1, 1975 through December 31, 1975; GJBX-32(76), [K-TL-524, Part 4], January through March 1976; and GJBX-52(76) [K-TL-524, Part 5], April through June 1976.

The reports have been placed on open-file by ERDA's Grand Junction, Colorado, office, and the Oklahoma Geological Survey has copies available for inspection. Microfiche copies can be ordered for $2.25 prepaid from Bendix Field Engineering Corporation, Technical Library, P.O. Box 1569, Grand Junction, Colorado 81501. Printed copies will be made at the requestor's expense by Colorado Copy Center, Suite T-8, Valley Federal Plaza, Grand Junction, Colorado 81501; Qhahada Engineering, 307 South 12th Street, Grand Junction, Colorado 81501; or Sir Speedy Instant Printing Center, Engineering Center, 912 North Avenue, Grand Junction, Colorado 81501. As they become available, reports can be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Uranium Evaluated in Michigan and Wisconsin

Uranium and Thorium Occurrences in Precambrian Rocks, Upper Peninsula of Michigan and Northern Wisconsin, with Thoughts on Other Possible Settings, issued as GJBX-48(76), has been placed on open file by ERDA's Grand Junction, Colorado, office. This 5-part, 294-page report was prepared by J. Kalliokoski and Carol Johnson of the Department of Geology and Geological Engineering, Michigan Technological University, Houghton, Michigan, for ERDA's NURE program. It evaluates the uranium and thorium potential of the area and gives the geologic background and mode of occurrence of these metals in the Precambrian. It also discusses relationships of uranium in glaciated terrain. Occurrence maps and an end-moraine map are included.

The report can be ordered as above and is also available for inspection at the Oklahoma Geological Survey.

ERDA Funds OSU Study

Oklahoma State University has received a $50,000 grant from ERDA to carry on the NURE program in southwestern Oklahoma. The contract for this project was negotiated with Bendix Field Engineering Corporation, the prime contractor for ERDA's Grand Junction office. Investigations will involve detailed study of Permo-Pennsylvanian alluvial-fan deposits associated with the Wichita and Arbuckle uplifts, Lower Permian channel sands deposited on gentle local features associated with major structures, and the crystalline basement rocks of the Wichita and Arbuckle uplifts.

Statistics of Oklahoma's Petroleum Industry, 1975

John F. Roberts[1]

In spite of loss of the depletion allowance and the possibility of price controls, higher prices for both oil and gas resulted in 3,646 wells being drilled in 1975 in search of oil and gas—the most drilled during one year since 1966 (table 1, fig. 1). This was 589 more wells than were drilled in the previous year, an increase of 19 percent. There were 2 less exploratory wells drilled than during 1974, even though there were 591 more development wells, which indicates a reluctance to invest in high-risk ventures due to economic uncertainties. The success ratio for exploratory wells was the same as last year, 28 percent. Osage, with a total of 456 wells, was the most actively drilled county, and 19 of its wells were exploratory (fig. 2). Grant County had 15 wildcat wells, followed by Garvin, Kay, and Lincoln Counties with 14 each. These discoveries were from formations ranging from the Hoxbar (Middle Pennsylvanian) down to the Arbuckle (Ordovician). The

[1]Geologist, Oklahoma Geological Survey.

TABLE 1.—DRILLING ACTIVITY IN OKLAHOMA, 1975[1]

	1975[2]				1974
	CRUDE	GAS	DRY	TOTAL	TOTAL
All wells					
Number of completions	1,743	638	1,265	3,646	3,057
Footage				18,253,324	17,046,378[3]
Average footage				5,003	5,345
Exploration wells					
Number of completions	59	52	283	394	396
Percentage of completions				28	28
Footage				2,608,013	2,674,764[3]
Average footage				6,619	6,754
Development wells					
Number of completions	1,684	586	982	3,252	2,661
Percentage of completions				70	67
Footage				14,371,614	14,371,614[3]
Average footage				4,810	5,146

[1]Source: *Oil and Gas Journal*, v. 74, no. 24, June 14, 1976.
[2]Footages and totals do not include 150 service wells, average of 2,522 feet per well.
[3]Footages include service wells.

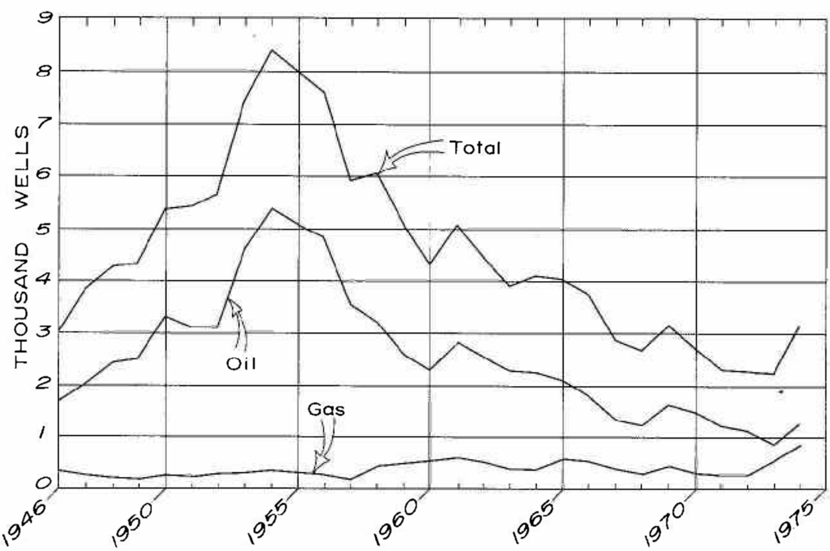

Figure 1. Graph showing total wells drilled, oil wells completed, and gas wells completed in Oklahoma, 1946-75. Source: *Oil and Gas Journal.*

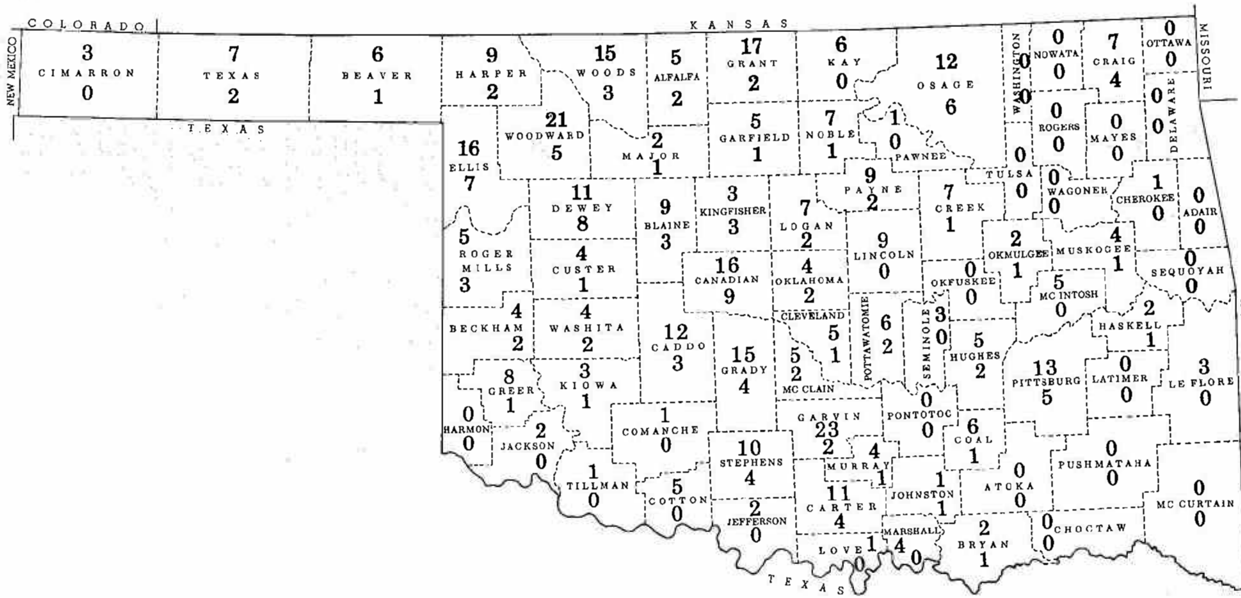

Figure 2. Exploratory drilling by counties during 1975. Upper figures give number of exploratory wells drilled; lower figures give number of successful completions. Source: American Petroleum Institute in cooperation with U.S. Bureau of Mines.

major contributors to new reserves and production were the Hunton and the Morrow-Springer sands along the northern rim of the Anadarko basin in middle and western parts of the State.

Table 1 summarizes drilling activity during 1975 and compares it with that of the previous year. The average total depth of all wells decreased from 5,345 feet the previous year to 5,003 feet. This decrease reflects the fact that few wells drilled below 20,000 feet were active during the year and also registers the large increase in the number of relatively shallow wells in and around the Osage platform.

TABLE 2.—GIANT OIL FIELDS OF OKLAHOMA, 1975

FIELD	1975 PRODUCTION (1000 BBLS)	CUMULATIVE PRODUCTION (1000 BBLS)	ESTIMATED RESERVES (1000 BBLS)	NUMBER OF WELLS
Allen	2,245	129,166	10,834	1,495
Avant	355	106,957	2,043	650
Bowlegs	1,245	159,737	1,563	160
Burbank	3,380	507,419	33,581	1,050
Cement	2,490	142,726	12,274	1,430
Cushing	2,670	465,852	19,148	1,665
Earlsboro	490	216,914	3,086	205
Edmond, West	530	155,677	4,323	435
Eola-Robberson	3,150	111,127	28,873	480
Fitts	2,650	153,523	19,477	635
Glenn Pool	1,775	311,196	18,804	1,055
Golden Trend	6,190	408,201	91,799	1,115
Healdton	6,720	300,960	52,040	1,440
Hewitt	5,500	224,486	45,514	1,155
Little River	300	160,201	4,799	165
Oklahoma City	1,915	735,811	16,104	250
Postle	5,100	75,660	55,002	285
Seminole, Greater	880	200,336	9,664	255
Sho-Vel-Tum	32,600	1,035,056	264,944	8,060
Sooner Trend	9,140	208,554	55,446	3,075
St. Louis	970	217,115	7,885	585
Tonkawa	270	135,482	1,518	205
Totals	90,565	10,352,156	758,721	25,850

Source: *Oil and Gas Journal*, v. 74, no. 4, January 26, 1976.

TABLE 3.—CUMULATIVE (THROUGH 1955) AND YEARLY (1956-1975) MARKETED PRODUCTION AND VALUE OF PETROLEUM, NATURAL GAS, NATURAL GASOLINE, AND LIQUEFIED PETROLEUM GAS IN OKLAHOMA[1]

YEAR	CRUDE PETROLEUM		NATURAL GAS		NATURAL GASOLINE AND CYCLE PRODUCTS		LIQUEFIED PETROLEUM GAS	
	VOLUME (1,000 BBLS)	VALUE ($1,000)	VOLUME (MMCF)	VALUE ($1,000)	VOLUME (1,000 GALS)	VALUE ($1,000)	VOLUME (1,000 GALS)	VALUE ($1,000)
Through 1955	7,230,010	11,443,269	12,977,332	1,378,370	14,420,482	890,729	3,673,364	120,097
1956	215,862	600,096	678,603	54,288	489,963	26,543	579,101	23,427
1957	214,661	650,423	719,794	59,743	460,644	25,329	587,140	21,824
1958	200,699	594,069	696,504	70,347	440,798	26,029	657,114	25,822
1959	198,090	578,423	811,508	81,151	448,353	29,443	675,869	27,070
1960	192,913	563,306	824,266	98,088	531,995	33,074	762,258	32,409
1961	193,081	561,866	892,697	108,016	521,237	33,358	817,082	30,141
1962	202,732	591,977	1,060,717	135,772	552,795	35,764	838,903	25,223
1963	201,962	587,709	1,233,883	160,405	555,467	35,131	810,894	28,981
1964	202,524	587,320	1,323,390	166,747	554,053	34,011	880,804	28,055
1965	203,441	587,944	1,320,995	182,297	570,129	34,561	894,665	32,208
1966	224,839	654,281	1,351,225	189,172	576,124	35,715	968,254	44,381
1967	230,749	676,095	1,412,952	202,052	568,905	35,846	1,005,633	49,276
1968	223,623	668,202	1,390,884	197,506	584,010	38,829	1,070,874	39,520
1969	224,729	701,155	1,523,715	223,128	614,082	38,931	1,146,768	34,403
1970	223,574	712,419	1,594,943	248,811	622,146	39,933	1,177,218	52,975
1971	213,312	725,610	1,684,260	273,945	595,854	40,856	1,156,680	56,732
1972	207,633	709,033	1,806,887	294,523	611,478	42,709	1,140,216	57,101
1973	191,204	723,273	1,770,980	334,110	616,308	49,070	1,219,848	95,264
1974	177,785	1,277,076	1,638,492	458,904	528,402	84,638	1,311,702	166,461
1975	161,394	1,367,007	1,735,934	531,196	467,082	85,010	1,250,026	196,250
Total	11,334,817	25,560,553	38,449,961	5,448,571	25,330,307	1,695,509	22,624,413	1,187,620

Figures from: *Minerals Yearbook* of the U.S. Bureau of Mines. Totals for crude petroleum differ from those compiled by the U.S. Bureau of Mines and the American Petroleum Institute principally because of the exclusion from USBM and API compilations of an estimated production of 26,355,000 barrels for the years 1905-1906.

[1]Preliminary figures for 1975.

The 22 giant fields of Oklahoma are listed in table 2. (A giant field is one that has an estimated ultimate recovery of more than 100 million barrels of oil.) The giant fields produced 45 percent of the year's total liquid hydrocarbons from 36 percent of the State's producing wells.

Table 3 lists cumulative and yearly production and the value of all petroleum products to January 1, 1976. Table 4 compares petroleum production for the last 2 years. Crude-oil production declined, even though the number of wells completed during the year increased, because the maturity of numerous wells resulted in their abandonment. Natural-gas production increased slightly, even though fewer gas wells were completed during the previous year.

TABLE 4.—HYDROCARBON PRODUCTION IN OKLAHOMA

	1974	1975
Crude oil and lease condensate		
Total annual production (1,000 bbls)[1]	177,785	161,394
Value ($1,000)[1]	1,277,076	1,367,007
Cumulative production 1891-year (1,000 bbls)	11,179,024	11,334,817
Daily production (bbls)	487,000	442,000
Total number of producing wells[2]	71,848	71,657
Daily average per well (bbls)	6.8	6.2
Oil wells on artificial lift (estimated)[2]	67,969	67,568
Natural gas		
Total annual marketed production (MMCF)[1]	1,638,942	1,735,934
Value ($1,000)[1]	458,904	531,196
Total number of gas and gas-condensate wells[2]	9,367	9,707
Natural-gas liquids		
Total annual marketed production (1,000 bbls)[1]	43,812	41,074
Value ($1,000)[1]	251,099	281,260

[1]Item for 1974 is U.S. Bureau of Mines final figure. Item for 1975 is U.S. Bureau of Mines preliminary figure.

[2]*World Oil*, annual forecast and review issue, v. 180, no. 3, February 15, 1976.

Figure 3 shows a decrease in natural-gas reserves from 13.4 trillion cubic feet to 13.1 trillion cubic feet, because more natural gas was produced than was added by discoveries and revisions. The ratio of reserves to production was 7.8, down 0.1 from the previous year.

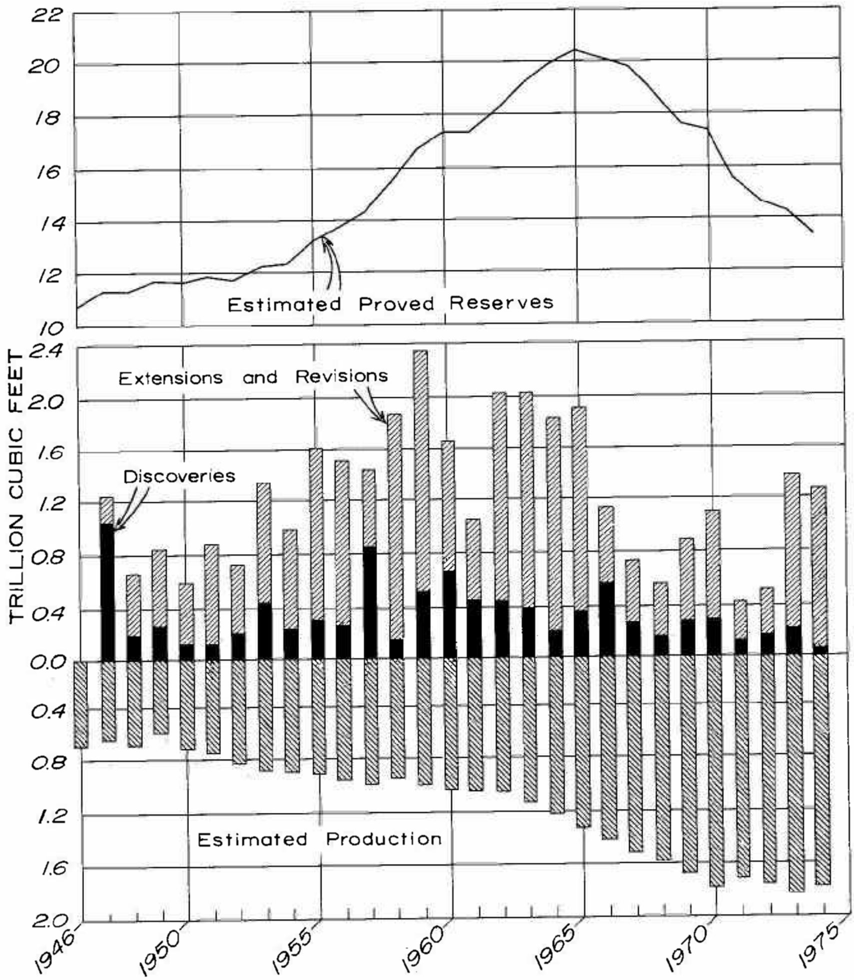

Figure 3. Graph showing statistics on estimated proved reserves of natural gas in Oklahoma, 1946-75. Source: American Gas Association, annual reports.

Figure 4 displays an increase in discoveries and extensions of total liquid hydrocarbons. The decrease in production from 207 million barrels in 1974 to 195 million barrels in 1975 accounts for a slight increase of remaining reserves to 1,539 million barrels, a reserve-production ratio of 7.9.

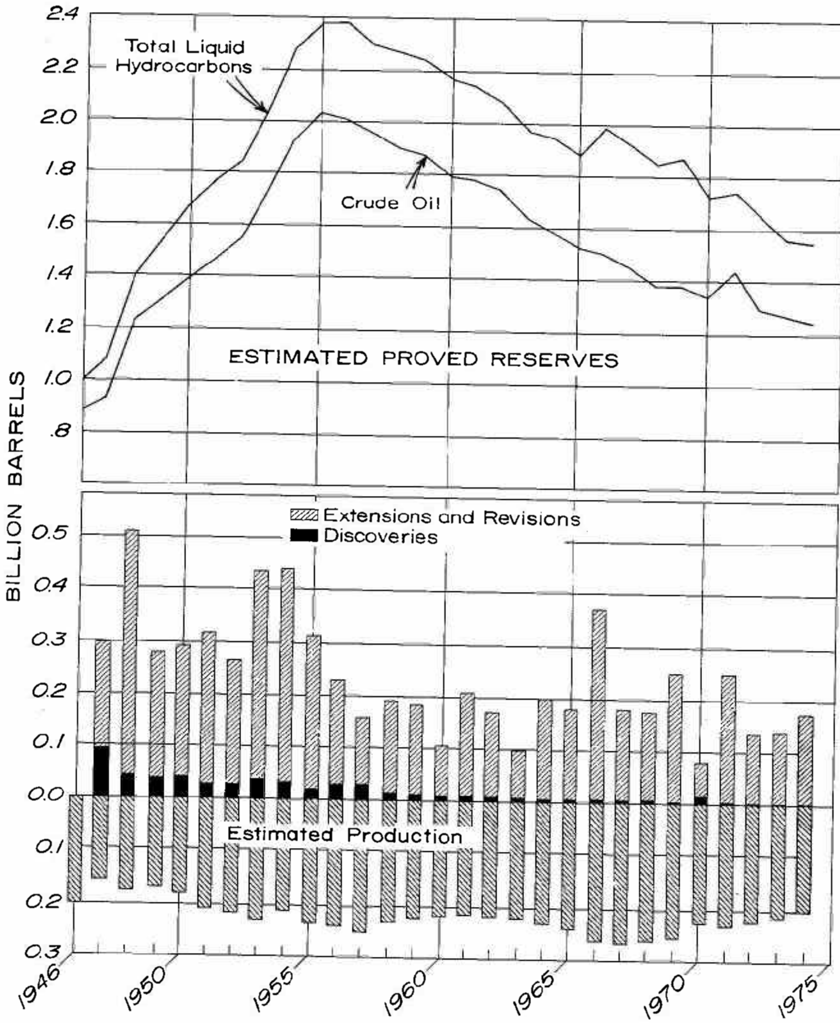

Figure 4. Graph showing statistics on estimated proved reserves of total liquid hydrocarbons in Oklahoma, 1946-75. Source: American Petroleum Institute, annual reports.

National Stripper Well Survey, January 1, 1976, a joint project of the Interstate Oil Compact Commission and the National Stripper Well Association, indicates that at the close of 1975, Oklahoma had 58,736 stripper wells, a 1.8 percent decrease over the 1974 figure and 82 percent of the total number of producing oil wells. A stripper well, for the purpose of this survey, is a well producing 10 barrels of oil per day, or less, during the year under consideration. In Oklahoma, stripper wells produced 72,730,579 barrels of oil—45 percent of the State's crude-oil production. This is an increase in the percentage of the State total in 1974, due to the fact that there was a greater decrease in the State total than there was in stripper-well production. There were 1,739 stripper wells abandoned during 1975—130 less than were abandoned in 1974. The increasing importance of stripper wells and their increasing share of the total State production reflects the impact of increases in the price of oil. Higher prices permit wells to be produced to lower levels of daily production before the economic limit is reached. Lower production levels also produce additional quantities of oil that otherwise would not be recovered before abandonment.

Oklahoma continues to rank third in the nation in natural-gas production (with 8.5 percent of the total U.S. production) and fourth in liquid-hydrocarbon production (5.4 percent of the total). The State ranks fourth in the nation in natural-gas reserves and fifth in oil reserves.

OWRT Seeks Research Scholar

The Office of Water Research and Technology (OWRT) of the Department of the Interior is seeking the services of an "in-house scholar" for a 1-year period, starting this summer. OWRT can work with the applicant's home institution to arrange either full salary or a supplement for a partial salary such as might be needed during sabbatical leave. The task of the research scholar, in a general sense, is to be supportive of the mission of OWRT. The agency hopes to attract a senior scholar in the water-resources field who is willing to devote a year to a creative activity that will enhance water-resources research; the specific assignment will be tailored to the individual desires and talents of the scholar.

Persons interested in occupying this post from the summer of 1977 to the summer of 1978 (with specific starting and finishing dates to be arranged individually) should write to: Dr. William S. Butcher, Director, Office of Water Research and Technology, U.S. Department of the Interior, Washington, D.C. 20240. Applicants should provide an outline of the kind of contribution they feel they could make to OWRT through their field of specialization. They must notify OWRT of their interest by February 1, 1977; selection will be announced before April 1, 1977.

OKLAHOMA ABSTRACTS

GSA Annual Meetings, Denver, Colorado November 8-11, 1976

The following abstracts are reprinted from the *Abstracts with Programs* of The Geological Society of America, v. 8, no. 6. Page numbers are given in brackets below each abstract. Permission of the authors and of Mrs. Jo Fogelberg, managing editor of GSA, to reproduce these abstracts is gratefully acknowledged.

Communicating with the Congress; the Geological Scientist Must Provide Greater Input

ALLEN F. AGNEW, Congressional Research Service, Library of Congress, Washington, D.C.

More geological scientists must get involved in the legislative process at the national level. In recent years the complexity of environmental problems has become increasingly evident to most thinking members of society. A majority of geological scientists, because of their broad background and experience in the interrelations among the natural sciences and in the applications of their knowledge to the wise use and development of our natural resources, are in a particularly favorable position to provide such authoritative and useful information in helping solve environmental problems such as those dealing with soil and water. National policies affecting environmental issues are formulated by the Congress and implemented by the Executive Branch—the latter maintaining large numbers of geological scientists to help it design and carry out the programs. On the other hand, because the Congress has only a meager staff of geological scientists, it must depend on other sources for most of this badly needed scientific input. Geological scientists therefore have an opportunity (and a responsibility) to communicate more with the Congress, so that better-informed environmental decisions will be reached.

However, we geological scientists have been derelict, and we (and society) are paying the consequences. It is time that we reverse this course,

1. by running for congressional office;
2. by serving on the staff of a member or a committee or as a staff member of a congressional advisory agency;

OKLAHOMA ABSTRACTS is intended to present abstracts of recent unpublished papers relating to the geology of Oklahoma and adjacent areas of interest. The editors are therefore interested in obtaining abstracts of formally presented or approved documents, such as dissertations, theses, and papers presented at professional meetings, that have not yet been published.

3. as a staff or resource person of an executive agency, of a lobby, or of a professional or scientific society; or
4. by providing advice as an individual professional.

Such involvement brings both positive and negative rewards; as responsible professional scientists we owe it to ourselves and to society to take these risks. [p. 750]

Geochemistry of Wichita Mountain Igneous Rocks as Related to Copper and Uranium Mineralizations in Southwestern Oklahoma

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The distribution of copper, uranium, and other trace elements was studied in Raggedy Mountain Gabbro, Carlton Rhyolite, and Wichita Granite, the three major igneous rock groups in the Wichita Mountain Province. The distributions of copper in both the rhyolites and the granites were similar with an average value of 11.0 ppm. Few anomalies (more than 50 ppm) were detected in the granitic rocks. Copper distribution in the Raggedy Mountain Gabbro Group could be divided into two distinct populations, a gabbroic population and an anorthositic population, with average values of 140 ppm and 20 ppm respectively. The uranium content of the rhyolites is very consistent, showing an average value of 4.0 ppm, while the granites show a range of concentration between 2 and 7 ppm, which is proportional to the degree of alteration. Riebeckite-bearing pegmatite dikes in the granite are relatively rich in uranium with values ranging between 40 and 90 ppm. The Raggedy Mountain Gabbros have the lowest uranium content with concentrations of less than .5 ppm.

The Permian sedimentary copper deposits and uranium mineralization in arkosic rocks in southwestern Oklahoma probably are related to enormous volumes of granitic and gabbroic material eroded from the Wichita Mountain Province following Late Pennsylvanian uplift. "Granite wash" locally is more than 5,000 feet thick. The gabbroic materials, however, underwent nearly complete decomposition and only a few assemblages of zeolite and opal, and some grains of highly weathered anorthosite, have been found. Simple calculations demonstrate that enough copper probably was released from gabbroic material and enough uranium probably was leached from granitic and rhyolitic materials to account for known mineralizations in southwestern Oklahoma and to suggest possible future discoveries in the area. [p. 752]

Late Canadian-Whiterockian Strata in Eastern North America: New Data on Distribution and Biostratigraphy

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The prominent unconformity separating Early and Middle Ordovician rocks over the North American interior is less pronounced, if developed at all, in marginal areas such as the Great Basin, Oklahoma, and Texas. Based on sections in central Nevada, the Whiterockian Stage was proposed for earliest Middle Ordovician deposits (Cooper, 1956) and such strata have been thought to be restricted in the U.S. to the areas just mentioned. However, in the last few years, Whiterockian-type fossils have been found in the Appalachians in Shelby Co., Alabama and Polk Co., Georgia where strata mapped as Lenoir Limestone have yielded Whiterockian conodonts. The lower Lenoir of the easternmost thrust belts in Tennessee apparently includes Whiterockian strata, but the stratigraphic position of the base of the stage remains unknown there. Whiterockian-type conodonts are known also from the upper Beekmantown in Virginia (Suter & Tillman, 1973; Tillman, 1976), and an excellent Whiterockian succession is present in West Virginia-Maryland (Boger & Bergström, 1976) where the base of the stage is some 900 feet below the top of the Beekmantown. Preliminary studies have proved the presence of *Multiostodus* and other conodonts suggesting a Whiterockian age in the Bridport Dolomite, the youngest formation of the Beekmantown in its reference section at Shoreham, Vermont, which has previously yielded no diagnostic fossils. Accordingly, rather than being absent in eastern U.S., as was generally assumed in the past, Whiterockian strata appear to be rather widely distributed but developed largely in a biofacies lacking the typical Whiterockian megafossils. The lithology of these strata suggests deposition in very shallow water, and it seems likely that this environment was too extreme for the development of a benthic fauna of the type characteristic of Whiterockian strata in the Great Basin and Oklahoma. [p. 775-776]

Degradation of Water Quality by Salt Water Infiltration in East-Central Oklahoma

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The specific conductance of surface and ground water in east-central Oklahoma, in most localities, ranges from 200 to 600 micromhos per centimetre. In some areas, however, the conductance ranges from 2,000 to 50,000 micromhos per centimetre because of an increase in salinity of the water.

Water use in the area is primarily for domestic and city water supplies, and these high-salinity levels could represent a hazard for certain uses.

The increase in salinity of surface water and ground water is the result of brine infiltration in areas of salt water injection. Evidence for surface-water contamination is based upon several hundred specific conductance measurements made in all major basins at periods of low flow. Additional evidence is provided by field observations of brine being discharged into streams and of vegetation kills in some oil fields under secondary recovery.

Evidence for ground water degradation is based on approximately 150 chemical analyses and analysis of approximately 300 geophysical logs. Because bromide is abundant in Oklahoma brines (from 500 to 6,500 milligrams per litre) and almost nonexistent in fresh ground water, it is used as a tracer and, where present, indicates salt-water infiltration. Cross sections based on geophysical logs show that in some areas the base of fresh water has risen since the onset of brine injection. However, due to the complexity of the stream-aquifer system, the extent of surface and subsurface movement of salt water is not accurately known. [p. 837-838]

Effect on Recoverable Coal Reserves by Surface Mining Under Adverse Geological and Engineering Conditions

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The revised 1974 estimate by the Oklahoma Geological Survey of Oklahoma's identified remaining bituminous coal resources is 7,200,000,000 short tons, of which only 2,300,000,000 tons was classified as net (economically) recoverable reserves, primarily because of steep dips, faults, excessive depth, or thin coal. Resources and reserves were determined within the measured, indicated, and inferred reliability categories. The inferred areas were restricted to no more than 2 miles from coal data points to avoid overestimating resources that might be limited by the complex structural geology in the 7,700 feet of Middle Pennsylvanian coal-bearing strata (mostly shales and sandstones) of the Arkoma basin.

Profitable surface mining has progressed to a depth of 120 feet in the 4-6-foot-thick, low- to high-volatile bituminous Hartshorne coking coals that dip 20°-56° on the flanks of west-southwestward plunging, faulted anticlines and broad synclines. One surface mine, 90-120 feet deep, produces from the 13-24-inch thick, coking medium-volatile bituminous Stigler coal that dips only 3° westward. Thus, steeply dipping thick coal is mined by surface methods to the same depth as gently dipping thin coal, indicating that adverse geological and mining conditions have been overcome by operators responding to a demand for high-priced coking coal in Oklahoma. This type of mining suggests that as demand and prices increase for bituminous coking coal, some coal that has been considered nonrecoverable because of steep dips, faults, or excessive depth might become strippable, net-recoverable reserves, not only in Oklahoma, but in additional coal regions of North America. [p. 876]

Character of Copper Ore in Prewitt Shale (Permian) at Creta Mine, Southwestern Oklahoma

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The Creta Mine copper deposit in southwestern Oklahoma is a Kupferschiefer-type deposit that is confined to a narrow stratigraphic horizon (Prewitt Shale, Permian) and is widely distributed. The primary copper ore consists of chalcocite and digenite. The other copper sulfides, which are covellite, rare bornite, and chalcopyrite, were deposited as replacements of pyrite, spores, and other material. Pyrite occurs in a variety of forms and is less replaced in the upper portion of the Creta ore body. Melnicovite pyrite in the form of spheroidal bodies ranging in size from 50mμ to less is the most abundant form of iron sulfide. Much of the digenite and chalcocite is pseudomorphic after melnicovite pyrite. The more crystalline layers of the melnicovite pyrite spheroids commonly remain as replacement remnants within the grains of copper sulfide in the form of atolls. Octahedral, cubic, and pyritohedral pyrite crystals, which are less common than the melnicovite pyrite, are commonly replaced by copper sulfides but are much more resistant to replacement. Spores of *Triletes* are totally replaced by copper sulfide and show all stages of replacement beneath the ore zone. Small amounts of native silver replace copper sulfide. Lesser amounts of copper sulfide are present as chalcocite crystals, veinlets, and pore fillings in silty lamellae. The Creta copper ore is not of syngenetic origin. It was epigeneticly introduced after the host Prewitt Shale was deposited and after the melnicovite and crystalline pyrites were diagenetically developed at an early stage. [p. 899]

Recognition and Paleoenvironmental Significance of Low Velocity Current Deposits in Ancient Submarine Canyon and Fan Channel Sequences

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Discrete units of ripples, dunes, and small bars similar to those encountered in modern fluvial sediments are observed in ancient submarine canyon and fan deposits. These units, which are interbedded with Bouma sequences and other common canyon and fan deposits, are probably the result of constant low velocity (20-50 cm/sec) currents traveling down canyon into fan distributaries. Such currents could be generated by continuous shelf processes such as delta distributary progradation or longshore current deflection. Catastrophic turbidity current processes dominate canyon and fan deposition prior to, and at cessation of, such low velocity current activity.

Two ancient examples illustrate the relative importance of such low velocity current deposits in different submarine canyon and fan systems. In the Cambrian St-Roch Formation of southern Quebec a few dune cross-bedded coarse sandstone units of 1.0 m maximum thickness are interbedded with thick resedimented conglomerates and graded sandstone beds in a submarine fan channel. These thin units represent a brief interlude of constant low velocity current deposition in a turbidity current dominated system. In an Upper Pennsylvanian marine pelitic section in the Anadarko basin of western Oklahoma a ripple and dune cross-bedded sand body of 26.5 m maximum thickness was deposited in a low velocity current dominated submarine canyon-fan complex. This sand, which is underlain by a thin crinoidal pebbly mudstone and overlain by thin incomplete Bouma sequences, prograded southwestward from three low gradient submarine canyons to form several overlapping fans. These canyons were fed by westward accreting delta distributaries. [p. 955]

Facies and Communities of an Ordovician Aulacogen Deposit: The Bromide Formation of Southern Oklahoma

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The Bromide Formation was deposited in a shallow storm-dominated equatorial sea in the Southern Oklahoma Aulacogen. A low-lying desert bordered the aulacogen on the north but provided little sediment. Because subsidence initially exceeded the rate of deposition, the interbedded terrigenous and carbonate rocks of the lower Bromide were deposited during a transgression. Depositional environments ranged from tidal flat (laminated sandstone) to shoreface (thick sandstone beds), transition zone (shale and biosparite), and open shelf (shale and biomicrite). Eventually the sea flooded the desert and cut off the supply of terrigenous material. Subsidence slowed, and the remains of carbonate-producing organisms began filling the basin. The offlapping micrites and biomicrites of the upper Bromide were deposited in environments ranging from open shelf through transition zone and shoreface to supratidal mudflat. Similar transgressive-regressive cycles, apparently produced by sporadic subsidence in the aulacogen, occur in other formations of the Simpson Group and may also be present in other aulacogens.

Community diversity in both the mixed terrigenous-carbonate facies and pure carbonate facies of the Bromide increased in an offshore direction. Tidal flat communities in both were dominated by algal mats and ostracods. The terrigenous shoreface communities were dominated by active burrowers and other infauna, whereas the carbonate shoreface community was dominated by the epifaunal coral *Tetradium*. Transition zone communities in both were characterized by vagrant epifaunal deposit and suspension feeders such as trilobites and cystoids. Open shelf communities were diverse and dominated by sessile epifaunal suspension feeders, especially brachiopods, bryozoans, and pelmatozoan echinoderms. [p. 985]

***Ditomopyge* and *Ameura*, Trilobites in the Permian Wreford Megacyclothem of Kansas, Nebraska, and Oklahoma**

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Extending from southernmost Nebraska across Kansas and into northern Oklahoma, the Wreford Megacyclothem (Lower Permian) has been investigated for its paleoenvironments, bryozoans, and brachiopods. Its rocks also yield trilobites, of scientific interest because they represent some of the later surviving relicts of this formerly thriving major invertebrate group.

Ameura missouriensis (Shumard, 1858) is very rare in the Wreford Megacyclothem, occurring only in lower Havensville brachiopod-molluscan limestone in central Kansas.

Ditomopyge scitula (Meek & Worthen, 1865) is rather common in the Wreford, especially as pygidia and isolated free cheeks with genal spines, but occasionally also as enrolled complete carapaces. Two pygidia bear possible fossilized color markings, a row of small dark round spots (one per segment) on each lateral flank of the axial lobe. Bivariate plots of measured dimensions indicate rectilinear ontogenetic growth in this trilobite population. Neither qualitative nor quantitative characters show any microevolutionary (stratigraphic), clinal (geographic), or ecotypic (lithologic) variations within Wreford *Ditomopyge scitula*. Found all across Kansas, and from uppermost Speiser up through middle Schroyer horizons, *Ditomopyge scitula* is concentrated in calcareous shale, cherty limestone, and brachiopod-molluscan limestone, and thus clearly preferred off-shore, deeper-water (but still rather shallow), normal-marine paleoenvironments within the Early Permian Mid-Continent shelf sea. However, these Wreford trilobites exhibit nothing obviously premonitory of the impending extinction which later overtook their entire class. [p. 989]

Plate Margins Cross-Sections

JOHN C. MAXWELL, Reporter, Plate Margins Group, U.S. Geodynamics Committee

Cross-sections have been prepared for the western continental margin of the United States, including Alaska, and for the Ouachita-Wichita-Marathon orogenic system by participants in the Plate Margins Group of the U.S. Geodynamics Committee. The sections are designed to demonstrate the actual state of mapping and available geophysical work in the area of the section. One or more interpretative sections will also be provided to accompany each actualistic section. The objective is to demonstrate the state of present knowledge, to indicate problems of interpretation resulting from gaps in the data or inconclusiveness of existing data, and to point out problem areas requiring additional work. It is hoped that the cross-sections will provide a basis for correlation of geological and geophysical phenomena bearing on crustal adjustment processes which have occurred within ancient and modern converging plate boundaries.

Participants and Area of Cross-Section:

1. R. E. Von Huene, J. Casey Moore, George W. Moore: Alaska Peninsula-Kodiak Island-Aleutian Trench.
2. Peter Misch, R. J. Stewart, J. A. Vance: Olympic Peninsula-San Juan Islands-Northern Cascade Mountains.
3. M. Clark Blake: Southwestern Oregon-Medford 2° sheet and extensions.
4. Gregory A. Davis: Central Klamath Mountains approximately through Cecilville, California.
5. W. Porter Irwin: Southern Klamath Mountains and extensions.
6. Paul R. Gucwa, Michael A. Jordan, John R. Kleist, David H. Lehman, Jay A. Raney, Deborah M. Fritz, J. C. Maxwell: Northern California Coast Range and Sacramento Valley-Cape Vizcaino Quadrangle, north of Fort Bragg to Elk Creek and northeastward across the Sacramento Valley.
7. John Suppe, Eli A. Silver and Robert McLaughlin: Northern California Coast Range-Continental Margin-Fort Ross-northeastward to vicinity of Willows.
8. Benjamin M. Page, Eli A. Silver, Holly C. Wagner, David McCulloch, John Spotts: From edge of continental shelf northeastward, passing near San Luis Obispo and Avenal to point near mouth of King's River on east side of San Joaquin Valley.
9. John C. Crowell, Larry Beyer, Shawn Biehler, Perry Ehlig, George Feister, Ed Hall, Jack Vedder: Transverse Ranges region and adjacent continental borderland, Southern California.
10. Eldridge M. Moores: Northern Sierra-Sonoma-Antlers orogenic belt.

11. Eldridge M. Moores and colleagues: Longitudinal section in the western Sierra Nevada.
12. Paul C. Bateman and Donald Ross: Point Sur to 37N, 120W, then eastward across the Sierra Nevada.
13. B. C. Burchfiel, Bennie W. Troxel, and Lauren Wright: Southern Sierra Nevada across Death Valley area and thrust belt of southern Nevada.
14. George W. Viele: Eastern Ouachita Mountains-Batesville, Arkansas-Arkedelphia, and southward to Sabine uplift.
15. Jay M. Zimmerman, Dietrich Roeder, Robert C. Morris and David P. Evansin: Section through Ouachita Mountains of western Arkansas, from a point north of Fort Smith through the Crystal Mountains to Caddo Gap, and thence south to Cretaceous overlap.
16. John Wickham, Paul Lyons and Robert C. Morris: Ouachita Mountains of Oklahoma, Arkansas Basin, Potato Hills, Broken Bow uplift, and south to the Sabine uplift.
17. William R. Muehlberger: Section through the Marathon Mountains and hinterland.
18. Dr. Rodger E. Denison: Section through N. Texas, Muenster Arch near Bonita, NE across Marietta Basin, Wichita-Criner axis, Ardmore Basin, Arbuckle uplift, to vicinity of Sulphur, Oklahoma.

[p. 1002-1003]

Sedimentology of the Braided-to-Meandering Transition Zone of the Red River in Texas and Oklahoma

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The Red River system was studied between Burkburnett, Texas and Terral, Oklahoma. The river changes from a braided to a meandering pattern within a fluctuating transition zone that is dependent upon variations in discharge and sediment input.

Medium sand and gravel dominate the upper and middle reach, with fine-to-medium sand dominating the lower reach. Clast b-axis length for the largest clasts ranged from 2 to 13.5 cm. Clasts consist of rock fragments, quartz, and armored and unarmored mud balls. Channel bed forms are predominantly transverse-to-linguoid bars. Lateral, braid, and longitudinal bars occur in straight channel segments and large radius meander bends. Channel bar slip faces rarely exceed 1 m. in height and wave lengths vary between 10 and 200 m., generally increasing downstream. Point bar frequency remains constant throughout the reach while height increases downstream.

Stratification in the transition reach is variable. Channel deposits of the upper and middle reach are characterized by graded large- and small-scale trough and foreset cross-stratification and basal clast lag. Channel deposits of the lower reach have a small proportion of large-scale trough, with increased tabular cross-stratification. Lower point bars of the transition reach have large-scale trough and tabular cross-stratification, with upper point bars dominated by small-scale trough and tabular cross-stratification. Small-scale trough cross- and climbing ripple stratification characterize the overbank deposits. Horizontal stratification is present with variable frequency throughout the reach.

Similar downstream trends of grain size and sedimentary structures can be seen in Pleistocene terraces which flank the present flood plain. [p. 1092]

The Cambrian-Ordovician Boundary in North America

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No international agreement exists on the position of the Cambrian-Ordovician boundary. Detailed faunal information on trilobites, conodonts and brachiopods gathered in the past decade from 18 measured sections in Texas, Oklahoma, the Great Basin, Montana and Alberta has resulted in agreement on the definition of the boundary in North America at the *Saukia-Missisquoia* Zone boundary. In none of these areas does this faunal boundary coincide with formational boundaries.

Near the top of the *Saukiella serotina* Subzone, many diverse taxa of Trempealeauan trilobites and conodonts become extinct. The thin overlying *Corbinia apopsis* Subzone (top of *Saukia* Zone) is characterized by *Corbinia, Apatokephaloides, Leiobienvillia, Nanorthis* and new lineages of conodonts (*Cordylodus, Hirsutodontus* and usually *Oneotodus*). The top of the *C. apopsis* Subzone marks the ultimate extinction of the major families of Trempealeauan trilobites. Conodont and brachiopod species cross this boundary unaffected. Species of *Missisquoia, Ptychopleurites* and *Plethopeltis* mark the base of the *Missisquoia* Zone (basal Ordovician), followed shortly by *Fryxellodontus, Apheoorthis, Syntrophina, Apoplanias* and later *Symphysurina*. Trilobite and conodont families then diversify rapidly in the earliest Ordovician.

International correlations using conodonts indicate that the Australian and North American systemic boundaries may be closer to the base of the Tremadocian than previously believed. We suggest for international standardization of the boundary that the lowest occurrence of the widespread conodont genus *Cordylodus* (= base of *C. apopsis* Subzone) provides a correlative horizon that is distinctive and recognizable on several continents. [p. 1123]

New Theses Added to OU Geology Library

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

Depositional Environment of the Basal Atoka Formation in Northeastern Oklahoma, Based on Biogenic Structure and Faunal Evidence, by James Hugh Trexler, Jr.

The Palynology of the Eocene Wilcox Group Associated with Arkansas Bauxite, by Suchit Suthirachartkul Hart.

AAPG Reprints Papers on Deltas

The American Association of Petroleum Geologists has reissued a number of papers on deltas. No. 18 in AAPG's Reprint Series, *Modern Deltas,* contains 8 papers; no. 19, *Ancient Deltas,* has 12 papers, grouped as "Local Oil Field and Outcrop Studies" (4 articles), "Deltaic Facies of Entire Basins" (7 articles), and "Pennsylvanian Deltas of Oklahoma" (1 article). Both numbers were compiled by Rufus J. Le Blanc.

Two contributions from no. 19 should be of special interest to Oklahoma geologists: "Genetic Units in Delta Prospecting," by Daniel A. Busch, and "Pennsylvanian Delta Patterns and Petroleum Occurrences in Eastern Oklahoma," by G. S. Visher, Sandro Saitta B., and R. S. Phares.

These publications can be ordered from The American Association of Petroleum Geologists, P.O. Box 979, Tulsa, Oklahoma 74101. The price is $5.00 each to AAPG or SEPM members and $6.00 each to nonmembers.

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U.S. Board on Geographic Names Decision

The following Oklahoma place name was approved by the U.S. Board on Geographic Names and was published in the July through September 1976 issue of *Decisions on Geographic Names in the United States* (Decision List 7603).

Heyburn Reservoir (variant: Lake Heyburn—former decision) is a statutory adoption for a reservoir formed by damming Polecat Creek 4 kilometres (2.5 miles) north of Heyburn, Creek County, Oklahoma, sec. 13, T. 17 N., R. 9 E., and sec. 18, T. 17 N., R. 10 E., Indian Meridian (35°56′55″ N., 96°17′40″ W., at dam). Named by Congressional action, Public Law 80-290, 1946, this decision revises a 1950 geographic names decision.

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