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Cover Picture

KIRKIDIUM BIOFACIES OF HENRYHOUSE FORMATION (SILURIAN) CENTRAL OKLAHOMA SUBSURFACE

This thin section is from a photomicrograph ($\times 12$) of a section of core cutting the Late Silurian *Kirkidium* biofacies of the Henryhouse Formation of the Hunton Group at a depth of 8,621 feet in the Tenneco 1-5 Biller, C SE $\frac{1}{4}$ sec. 5, T. 13 N., R. 6 W., Canadian County, Oklahoma. The rock texture, which is fairly typical for occurrences in central Oklahoma, is a result of disarticulated and moderately fragmented shelly debris set in a matrix composed of lime mud mixed with fine terrigenous detritus. The faunal assemblage is dominated by crinoid plates, a halysitid chain coral, and a *Kirkidium* brachiopod valve (cross section in lower part of picture). Average point counts of five thin sections from the *Kirkidium*-bearing strata in the 1-5 Biller show the following components (expressed as percentages of total rock volume): matrix, 34.5 percent; crinoid plates, 22.1 percent; ostracodes, 2.6 percent; trilobites, 0.7 percent; bryozoans, 1.7 percent; brachiopods, 11.4 percent; corals, 4.5 percent; calcareous algae, 4.0 percent; and unidentified fossils, 18.1 percent. Chemical analyses of 11 spot samples from the *Kirkidium* biofacies average: CaCO₃, 89.4 percent; MgCO₃, 4.4 percent; and acid insolubles, 6.5 percent.

—Thomas W. Amsden

(The photomicrograph on the cover of this issue is from figure 5, plate 10, of the Oklahoma Geological Survey's Bulletin 129, Hunton Group (Late Ordovician, Silurian, and Early Devonian) in the Arkoma Basin of Oklahoma, by Dr. Amsden. A description of this recently published Bulletin can be found on page 238 of this issue.—Ed.)

Editorial staff: William D. Rose, Elizabeth A. Ham, Connie Smith

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, \$1.00; 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. 1,800 copies have been prepared for distribution at a cost to the taxpayers of the State of Oklahoma of \$3,230.

OKLAHOMA GEOLOGICAL SURVEY

ANNUAL REPORT

July 1, 1979–June 30, 1980

Introduction

The leading industry in Oklahoma is mineral and energy exploration and production. The annual value of mineral and energy resources produced in the State exceeded \$4 billion in 1979 and is expected to exceed \$7 billion in 1980. Nor is the end of this phenomenal growth in sight. Although the rate of increase is expected to decline somewhat in the years ahead, a figure of more than \$10 billion will probably be achieved by 1983, and possibly as much as \$15 billion by 1990. Thus, mineral and energy production should continue, as it has for many years, to be the principal industry of the State.

About 95 percent of the value of the State's mineral production is derived from petroleum and natural gas. Coal contributes about \$150 million to the total, and all other mineral resources, about \$200 million. The deregulation of petroleum prices is the primary factor in the present growth in value of mineral production, and with the gradual deregulation of natural-gas prices, that growth will continue for the next several years. During this time, petroleum production is expected to remain essentially constant. Natural-gas production, which is now demand-limited, may increase to more than 2 trillion cubic feet per year if anticipated growth in demand occurs.

The Oklahoma Geological Survey's overall program reflects the importance of wise use of the State's natural resources. Information collection and research in fossil fuels, industrial minerals, water, land use, and natural hazards are major components of this program. A review of the past fiscal year's highlights of the Survey's program is presented in the following sections.

Energy-Resources Studies

Petroleum investigations are a major focus of the Survey's energy-resources studies. These investigations include regional subsurface mapping, case-history field analyses, source-rock geochemical evaluations, and petroleum-data collection and analysis. Publication of Bulletin 129, *Hunton*

Group (Late Ordovician, Silurian, and Early Devonian) in the Arkoma Basin of Oklahoma, by T. W. Amsden, completes a geological investigation of this important petroleum- and natural-gas-producing rock sequence. An earlier report (Bulletin 121) describes the geology of this rock group for the Anadarko Basin. Amsden currently is conducting an intensive investigation of Hunton facies in southwestern Oklahoma and an adjoining part of the Texas Panhandle from new core and sample data resulting from recent drilling in this area.

Compilation of reservoir information necessary for anticipated enhanced-oil-recovery projects has been completed for a selection of fields in the State. This project, under the supervision of W. E. Harrison, will be released in the near future as a Special Publication of the Survey. Additional field and reservoir studies are scheduled. One such investigation is an examination of the Cement Field in southwestern Oklahoma. Under the supervision of D. A. Preston, this study is concerned with an assessment of the volume and characterization of formation fluids for partial use in water-flooding and enhanced-oil-recovery projects. This project is supported in part by a contract with the U.S. Department of Energy.

An investigation of the Woodford Shale as a petroleum source rock is continuing under the supervision of W. E. Harrison. It involves an organic-geochemical characterization of this black-shale sequence, which is generally considered to be a major source of hydrocarbons. The results of this study are expected to be available in 1981 and should provide important geochemical information about this rock sequence.

An important, continuing function of the Survey is the annual compilation of statistical information on the State's petroleum activities. These reports, published in *Oklahoma Geology Notes*, provide important information and analyses of drilling, production, reserves, and other related statistics for petroleum and natural gas in Oklahoma. D. A. Preston currently is supervising the preparation of these reports.

An unusual event required a significant amount of staff time this past year. Explosive venting of a large quantity of natural gas in western Woods County gave Harrison and Preston, together with other staff members, a major challenge in determining the cause of this event. Using a combination of geological and geochemical information, these staff members were able to provide important assistance to those State agencies responsible for the solution to the problem. A report of their findings was published in the October 1980 issue of *Geotimes*. (American Geological Institute, v. 25, no. 10, p. 18-20).

A 3-year research project supported by the American Chemical Society has resulted in the development of a promising tool for oil exploration. The technique is a pyrolysis-gas-chromatograph method that involves quantification of residual hydrocarbons in samples of reservoir rock. W. E. Harrison developed the technique and will conduct additional analyses in 1981 to refine methodology and provide more case studies. In 1980, The University

of Oklahoma initiated patent proceedings, which are expected to be completed during 1981.

Numerous additional activities concerned with petroleum investigations were conducted during the past fiscal year. Consultation with exploration geologists, land owners, State and federal officials, and the general public continues to consume a major part of staff time. Because of the importance of these efforts, together with the need to complete research projects in a timely fashion, an increase in staff for the petroleum section has been planned for the coming fiscal year [three new staff members were added: Michael W. Lambert, M. Lynn Prater, and Raja P. Reddy]. In addition, Robert L. Eutsler was added to the section, following completion of the uranium-resources investigation.

Coal investigations continue to constitute an important research effort. The preparation of comprehensive coal-resources maps is continuing for each of the coal-containing counties in eastern Oklahoma. Present investigations in Craig, Nowata, Mayes, and Rogers Counties are being conducted by LeRoy Hemish. The first of these reports is expected to be published in 1981. Collection of information on all active mines and the preparation of an updated active-mine map are current projects of S. A. Friedman. A new active-mine map is anticipated in early 1981.

A small but important study concerns the estimation of methane resources found in selected coal beds in eastern Oklahoma and an evaluation of the potential use of these resources. This study, supported in part by a contract from the U.S. Department of Energy, is being conducted by S. A. Friedman. The focus of the investigation is the Hartshorne coal in the southern part of the Oklahoma Coal Field. The results, expected in early 1981, should provide useful information leading to the potential development of methane recovery projects.

Information and assistance requests continue to demand a substantial part of staff time in the coal section. These inquiries, handled primarily by S. A. Friedman, indicate the continuing interest in coal development and support the contention that coal production has an important future in the State.

An investigation of potential uranium resources in west-central and north-central Oklahoma was completed, and final reports were submitted to Bendix Field Engineering Corp., the general contractor for the U.S. Department of Energy's National Uranium Resource Evaluation (NURE) program. This investigation was conducted by Salman Bloch, with staff support from R. L. Eutsler and J. J. Myers. These reports will be released, after review, by the U.S. Department of Energy.

A geothermal-resources program will be initiated in the coming fiscal year. This project, supported in part by a contract with the U.S. Department of Energy, will utilize unsuccessful oil or gas tests in selected parts of the State by placing expendable thermistors in those wells prior to plugging. Information obtained from this study will provide more precise information

on heat flow throughout the State. These data, together with selected reservoir studies in areas of higher heat flow, will give useful information on the potential application of unsuccessful oil or gas tests for geothermal-space-heating applications.

Minerals Investigations

Although nonfuel minerals represent a small portion of the value of mineral production in the State, they nevertheless are important in Oklahoma's overall economy. For example, the production of limestone for construction aggregate is essential to the building industry of the State, as is the production of clay and shale for brick and tile manufacture. Thus, the small value of primary-resources production does not convey the true importance of that commodity nor its added value in the industrial sector.

Minerals investigations in the Survey are directed primarily toward the industrial-minerals sector, although some studies are concerned with metallic resources. Although most of these projects are related to commodity analyses on a regional basis, some site-specific studies also are being conducted.

An inventory of all past and present surface-mining operations, exclusive of coal, has been completed. This project, under the supervision of K. S. Johnson, was supported in part by a grant from the U.S. Geological Survey. Publication of the results is expected in late 1981.

A study of all active mines in the State is continuing under the supervision of K. S. Johnson, with staff support from A. J. Myers. This project, funded with a grant from the U.S. Bureau of Mines, is concerned with locating and describing each active mine in the State. The results will be incorporated into the computer data base known as the Mineral Industry Location System (MILS) of the U.S. Bureau of Mines.

A study of the Southwest Davis Zinc Field has been completed by R. O. Fay, with the report due to be released through publication in 1981. Another project by R. O. Fay concerns the geology of copper mineralization in Mesozoic strata of the Panhandle of Oklahoma and adjacent states. It will be reviewed for possible publication in 1981. Other investigations of copper anomalies in the State are continuing.

In addition, several site-specific studies of nonfuel minerals have been conducted for a variety of reasons. Many of these have supported proposed industrial development in various parts of the State. The growing need for such studies reflects the need for additional staff in this area. The addition of a staff member on a part-time basis has been planned in connection with the directorship of the Oklahoma Mining and Minerals Resources Research Institute. [That position has now been filled by R. H. Arndt, who is also a Geologist IV with the Oklahoma Geological Survey.]

Environmental and Engineering Studies

Identification, delineation, and recommendations for mitigation, or at least accommodation, of natural and man-induced earth hazards are impor-

tant responsibilities for the Survey. Such matters include earthquakes, landslides, surface subsidence, floodings, and land and water contamination from the disposal of hazardous and toxic substances. Although the Survey has no regulatory responsibilities in these matters, the obligation to provide scientific information and technical assistance to State and federal agencies having such responsibilities is clearly within the Survey's charter.

Expansion and improvement of recording capabilities of the Oklahoma Geophysical Observatory have been continued during the past year. These plans also include expansion of the Observatory building, to be initiated in the fall of 1980. [That expansion is now nearing completion with a 900-square-foot addition to the Observatory building.] A report of earthquake activity in Oklahoma for 1979 was published in *Oklahoma Geology Notes* (v. 40, p. 95-105). This report, together with the map and report published the previous year, provides complete information on all locatable, historic earthquakes in Oklahoma through 1979. A similar report for 1980 will be published in early 1981. Plans to establish a geomagnetic recording station at the Observatory are continuing, with equipment support from the U.S. Geological Survey. That facility is expected to be installed during 1981.

The study of seismicity and tectonic analysis of the Nemaha Ridge and related geologic environs is continuing under the supervision of K. V. Luza. The 5-year study, supported in part by a contract with the U.S. Nuclear Regulatory Commission (NRC), is producing a variety of information directed toward the analysis of the tectonic framework and seismicity of this part of the State. Results to date have included an earthquake-location map and catalog (GM-19), a series of regional subsurface structural maps on selected geologic horizons, and gravity- and magnetic-anomaly maps for the study area. Continued funding at a modest level is expected from the NRC to assist in supporting the statewide earthquake-detection and -location program. Some support for these efforts will possibly be obtained also from the U.S. Army Corps of Engineers.

With partial support from the U.S. Bureau of Mines, a new study is being initiated in the fall of 1980 to study environmental hazards associated with abandoned, underground lead and zinc mines in northeastern Oklahoma. This project, under the supervision of K. V. Luza, with support from D. A. Preston and others, is part of a three-state study of the Tri-State Mining District.

Publication of a study of State geologic formations with favorable characteristics for surface and subsurface disposal of industrial wastes has been scheduled for the fall of 1980 [now released as Circular 80]. This investigation, conducted by K. S. Johnson, K. V. Luza, and the late J. F. Roberts, was an attempt to make a general characterization of various geologic units with regard to their potential for safe containment of industrially generated wastes.

A myriad of other environmental issues were examined by Survey staff members during the past year. The Observatory, under the supervision of J.

E. Lawson, Jr., continued to respond to a multitude of requests for earthquake and other geophysical information for Oklahoma. Geological, geophysical, and geochemical information relating to environmental issues was reviewed by several staff members. These activities continue to make heavy demands on the Survey's overall public-service efforts.

Stratigraphy and Geologic Mapping

An essential component of any sound natural-resources program is the collection and analysis of information basic to the ultimate goals of that program. Such basic information as surface and subsurface geologic maps and related stratigraphic studies are vital components in any natural-resources appraisal or land-use analysis. Therefore, the Survey's geologic mapping and related stratigraphic studies provide the foundation for almost all of the other projects.

During the past year a geologic map and report on Noble County were released as Bulletin 128. This publication was prepared by J. W. Shelton, of Oklahoma State University, with the assistance of W. A. Jenkins on petroleum and R. H. Bingham, of the U.S. Geological Survey, on water resources.

Work has been completed by G. G. Huffman on the geology of Marshall County, with publication expected during 1981. This project will complete a series of county reports covering the Cretaceous strata of southeastern and south-central Oklahoma.

Work is continuing on several other counties, including Alfalfa and Washita Counties by K. S. Johnson. Pushmataha County is being investigated by W. D. Pitt, of Eastern New Mexico State University, with support from R. O. Fay and L. R. Wilson. This latter project has been supported in part by the Survey through the staff time of Fay and Survey vehicle use. It is anticipated that upon its completion, the Survey will review the map and manuscript for possible publication.

Work on statewide and regional stratigraphic-correlation charts is continuing. The principal effort is directed toward the Correlation of Stratigraphic Units of North America (COSUNA) project, which involves C. J. Mankin as a regional coordinator and R. O. Fay as a principal compiler, with contributions from several Survey staff members and faculty of The University of Oklahoma School of Geology and Geophysics. Contributions from the geological surveys of Arkansas and Texas are important to the successful completion of this project, as are the reviews of draft stratigraphic sections by representatives of the various geological societies in the region. Final draft copies of selected correlation charts will be presented for public inspection at the American Association of Petroleum Geologists (AAPG) annual meetings in San Francisco in the late spring of 1981. (The COSUNA project is being conducted under the auspices of AAPG, with funding by the U.S. Geological Survey.)

P. K. Sutherland's stratigraphic studies of Upper Mississippian and Lower Pennsylvanian strata in northeastern and south-central Oklahoma

are continuing, and several publications, including guidebooks, have been produced from these efforts.

Further geologic investigations in the Wichita Mountains of southwestern Oklahoma are being made under the supervision of M. C. Gilbert, of Virginia Polytechnic Institute and State University, with individual studies being done by several persons from The University of Texas at Arlington, Rice University, and the Survey. An early result of this comprehensive project will be a geologic map of the area, compiled by Gilbert. The eastern sheet of this map is anticipated by early 1981, with the western sheet approximately 1 year later. The Survey plans to publish this map set.

The Survey is continuing its support of partial field and other selected expenses of graduate students who are completing research for theses and dissertations on relevant geological topics in the State. In recent years such support has been granted to students from approximately a dozen universities on projects pertinent to the Survey's interests.

Cooperative Water-Resources Investigations

One of the more successful cooperative ventures of the Survey has been the water-resources program with the U.S. Geological Survey. During the past few years this program has assessed the availability and quality of the State's ground-water resources, identified selected aquifers for more comprehensive analyses, and initiated special studies related to other mineral- and energy-resources activities.

The regional ground-water assessment for Oklahoma has been completed, and the results are being published in a series of $1^{\circ} \times 2^{\circ}$ sheets as hydrologic atlases. Through this fiscal year, six of the nine atlases covering the State, exclusive of the Panhandle, have been published. The completion of the remaining publications in this series is expected in 1981.

Detailed aquifer studies of the Vamoosa Formation in east-central Oklahoma, the Antlers Sandstone in southeastern Oklahoma, and a part of the Arbuckle Group in the vicinity of the Wichita Mountains have been completed. In addition, an investigation of the chemical quality of water in abandoned zinc mines in the Picher Mining Field, northeastern Oklahoma, was completed. Publication of these studies is anticipated by the Survey.

Work is under way on the water resources of the Ozark region of northeastern Oklahoma and on a base-line study of water quality in the Oklahoma Coal Field. Results of these investigations will be available during the next few years as publications of the Survey.

The cooperative nature of this program permits the Survey to contribute professional staff time and analytical services as a part of the overall effort and to receive in return the use of extensive hydrologic capability available through the U.S. Geological Survey. Thus, the respective missions of these two organizations are accomplished with no duplication or overlap of effort by either agency.

Public Information and Assistance

The charter of the Survey emphasizes the public-service responsibilities of the organization. The charge of dissemination of information to promote wise use of the State's natural resources, consistent with sound environmental practice, is accepted as our most challenging responsibility.

To fulfill this function, the Survey maintains an active program of publication under the supervision of W. D. Rose, editor and publications manager. This publication effort is supplemented with an open-file arrangement for information having a limited audience or limited time value.

Information files and other materials maintained by the Survey for public inspection include a microfilm log file of wells drilled in Oklahoma, a Core and Sample Library containing materials from some of the wells drilled in the State, an open-file system of site-specific information arranged by counties, and a variety of other data files on various aspects of Oklahoma geology.

Public requests for identification of rock and mineral specimens are the responsibility of the analytical-chemistry section under the supervision of S. J. Weber. Routine identifications are handled free of charge by the staff when samples are submitted by citizens of the State from their property.

The largest single public-service category is response to requests for information. These requests range from questions concerning the presence of petroleum under a specific tract of land to identifying the best place to collect fossils. Each request is handled as a legitimate inquiry, with an answer based upon the best available information. In this endeavor, the role of the Survey cannot be overstated.

Conclusion

The staff takes great pride in the many accomplishments of the Survey in fulfilling its charter. We recognize, however, that most of these accomplishments would not have been possible except for the close and cooperative relationships with other State and federal organizations. To all who have contributed, we offer our sincere and heartfelt appreciation. As we look ahead to 1983, when the Survey will celebrate its 75th anniversary, we approach this milestone with the same dedication and purpose that have been the hallmark of this organization throughout its history.

A handwritten signature in black ink, reading "Charles J. Mankin". The signature is fluid and cursive, with the first name "Charles" and last name "Mankin" clearly legible.

—CHARLES J. MANKIN, *Director*

APPENDIX A

Survey Staff, 1979–80 Fiscal Year

Professional

Thomas W. Amsden
Salman Bloch
Robert O. Fay
Paul H. Foster¹
S. A. Friedman
T. Wayne Furr²
Elizabeth A. Ham
William E. Harrison
LeRoy A. Hemish
Kenneth S. Johnson
James E. Lawson, Jr.
Kenneth V. Luza
Charles J. Mankin
Arthur J. Myers
Donald A. Preston³
William D. Rose
Emre A. Sancaktar⁴
Connie G. Smith⁵
Stephen J. Weber

Part-Time Professional

M. Charles Gilbert
(Virginia Polytechnic Institute
and State University)
George G. Huffman
(The University of Oklahoma)
Patrick K. Sutherland
(The University of Oklahoma)

Temporary Professional

Robert L. Eutsler
Raja P. Reddy⁶

Technical

Cartographic
Marion E. Clark
Roy D. Davis
Mary Ellen Kanak
Zack T. Morris⁷
Joseph M. Zovak

Core and Sample Library
Eldon R. Cox
Gary L. Wullich

Electronics Technician
Richard L. Watkins⁸

Geological Technician
David O. Pennington

Maintenance
Ron E. Evans

Print-Shop Operator
Paula A. Hewitt

Senior Laboratory Technician
Robert M. Powell

Secretarial
Betty D. Bellis
Helen D. Brown
Margarett K. Civis
Laveda F. Hensley
Shirley Jackson
Mitzi G. Moore
M. Sue Saunders⁹
I. Jean Smith
Gwen C. Williamson

¹Retired June 80.

²Appointed July 79.

³Appointed September 79

⁴Appointed May 80.

⁵Appointed April 80.

⁶Appointed June 80.

⁷Appointed September 79.

⁸Appointed April 80.

⁹Appointed November 79.

APPENDIX B

List of Survey Publications Issued, 1979–80 Fiscal Year

New Publications

Bulletin 127.—*Cranial Anatomy of Primitive Captorhinid Reptiles from the Late Pennsylvanian and Early Permian, Oklahoma and Texas*, by Malcolm J. Heaton. 84 pages, 34 figures, 2 tables. Issued July 1979.

Bulletin 128.—*Geology and Mineral Resources of Noble County, Oklahoma*, by John W. Shelton, Roy H. Bingham, and William A. Jenkins. 66 pages, 42 figures, 3 plates, 7 tables. Issued February 1980.

Special Publication 79-2.—*Catalog of Theses and Dissertations Granted by The University of Oklahoma in Geology, Geophysics, and Geological Engineering, 1904–1977*, compiled by Katherine L. Keener, Elizabeth A. Ham, and Claren M. Kidd. 129 pages. Issued September 1979.

Special Publication 79-3.—*Core Catalog 5*. 40 pages. Issued September 1979.

Oklahoma Geology Notes.—Six bimonthly issues (August 1979–June 1980), containing 272 pages.

Publications Reprinted

Guidebook 10.—*Common Minerals, Rocks, and Fossils of Oklahoma*, by William E. Ham and Neville M. Curtis, Jr. 28 pages, 28 figures, 2 tables. Issued November 1960; fourth printing, November 1979.

Guidebook 18.—*Upper Chesterian–Morrowan Stratigraphy and the Mississippian–Pennsylvanian Boundary in Northeastern Oklahoma and Northwestern Arkansas*, Patrick K. Sutherland and Walter L. Manger, editors. Guidebook for field trip no. 5, August 5–7, 1977, North American Paleontological Convention II. Road logs, stop descriptions, 17 papers, 185 pages, 79 figures, 21 plates, 14 tables. Issued July 1977; second printing, August 1979.

Mineral Report 7.—*A Selected Bibliography on the Theories of the Origin of Oil*, by Alan G. Skelton and Martha B. Skelton. 14 pages. Issued 1940; second printing, May 1980.

Mineral Report 23.—*Oil Possibilities Near Idabel, McCurtain County, Oklahoma*, by Leon V. Davis. 26 pages, 3 figures, 1 map, 2 tables. Issued March 1953; fourth printing, April 1980.

Special Publication 73-3.—*Regional Geology of the Arbuckle Mountains, Oklahoma*, by William E. Ham, compiled by T. L. Rowland, with contributions by Thomas W. Amsden, Rodger E. Denison, James R. Derby, Robert O. Fay, A. Allen Graffham, T. L. Rowland, Richard L. Squires, James H. Stitt, and Elliott W. Wiltse. Guidebook for AAPG field trip no. 1, AAPG 1978 annual meeting, and GSA field trip no. 5, GSA 1973 annual

meeting. 61 pages, 54 figures, 1 map. (Largely supersedes OGS Guidebook 17.) Published by Oklahoma Geological Survey, November 9, 1973; fifth printing, April 15, 1980.

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, William E. Harrison, Melvin V. Marcher, and John F. Roberts. 8 pages. Introductory text; 7 pages of maps and cross sections of Oklahoma at a scale of 1:2,000,000 (1 inch = 32 miles) showing topography, geomorphic provinces, geology, and mineral and water resources. Issued July 1972; second printing, October 1979.

Educational Publication 3.—*Northwest Oklahoma. Book II of Guidebook for Geologic Field Trips in Oklahoma*, by Kenneth S. Johnson. 42 pages, 54 figures, 26 field-trip sites. Issued September 1972; second printing, February 1980.

APPENDIX C

Publications by Survey Staff, 1979–80 Fiscal Year

THOMAS W. AMSDEN

Welling Formation, new name for upper Ordovician unit in eastern Oklahoma (formerly called "Fernvale"): American Association of Petroleum Geologists Bulletin, v. 63, p. 1135–1138. 1979.

SALMAN BLOCH

Application of WATEQF computer model (Runnells version) to interpretation of hydrogeochemical data from Clinton quadrangle, west-central Oklahoma: Oklahoma Geology Notes, v. 39, p. 221–228. 1979.

Distribution and alteration of Ogallala volcanic-ash deposits and their possible relation to uranium mineralization in western Oklahoma [abstract]: American Association of Petroleum Geologists Bulletin, v. 64, p. 677–678 (with K. S. Johnson). 1980.

Origin of radium-rich oil-field brines—a hypothesis: Oklahoma Geology Notes, v. 39, p. 177–182. 1979.

Some factors controlling the concentration of uranium in the world ocean: *Geochimica et Cosmochimica Acta*, v. 44, p. 373–377. 1980.

ROBERT L. EUTSLER

Soil map reflects a classic stratigraphic dichotomy in the Enid Quadrangle, Oklahoma: Oklahoma Geology Notes, v. 39, p. 189–195. 1979.

S. A. FRIEDMAN

- ICCP meets in Urbana, Illinois: Oklahoma Geology Notes, v. 39, p. 152-153. 1979.
- Surface mine in Stigler Coal, Haskell County, Oklahoma: Oklahoma Geology Notes, v. 39, p. 162 (cover-photo description). 1979.
- Stratigraphic relationship of Desmoinesian coals in Kiowa Syncline: Geological Society of America Abstracts with Programs, v. 12, p. 16 (with H. H. Rieke III and R. G. Galliers). 1980.

ELIZABETH A. HAM

- Bibliography and index of Oklahoma geology, 1978: Oklahoma Geology Notes, v. 39, p. 111-150.
- Catalog of theses and dissertations granted by The University of Oklahoma in geology, geophysics, and geological engineering, 1904-1977: Oklahoma Geological Survey Special Publication 79-2, 129 p. 1979.

WILLIAM E. HARRISON

- Leg 67: The Deep Sea Drilling Project Mid-America Trench transect off Guatemala: Geological Society of America Bulletin, pt. 1, v. 91, p. 421-432. 1980.
- Gas hydrates described from DSDP Leg 67: Oklahoma Geology Notes, v. 40, p. 17-18. 1980.
- Generalized oil and gas map of Oklahoma: Oklahoma Geological Survey Educational Publication 1, p. 7 (with John F. Roberts). 1979 edition.
- Geochemical prospecting for stratigraphic traps [abstract]: American Association of Petroleum Geologists Bulletin, v. 63, p. 2117. 1979. (Reprinted in Oklahoma Geology Notes, v. 40, p. 40, 1980.)
- Investigation of Desmoinesian rocks in northeastern Oklahoma for heavy-oil potential, *in* Hyne, N. J., editor, Pennsylvanian sandstones of the Mid-Continent: Tulsa Geological Society Special Publication 1, p. 337-347 (with Joseph A. Curiale and John F. Roberts). 1979.
- Initial reports of the Deep Sea Drilling Project: National Science Foundation, U.S. Government Printing Office, v. 47, 1182 p. (with Leg 48 scientists). 1979.
- Premiers résultats des forages profonds dans le Pacifique au niveau de la fosse du Guatemala: C. R. Academy of Science, Paris, t. 289, serie D., p. 1215-1220. 1979.
- Shipboard organic geochemistry: initial reports of the Deep Sea Drilling Project, v. 48, p. 959-964 (with J. L. LaPorte). 1979.

Subsidence and thermal history of southern Oklahoma aulacogen [abstract]: American Association of Petroleum Geologists Bulletin, v. 64, p. 705 (with Shimon Feinstein and Thomas L. Thompson). 1980.

Tar sands and heavy oil in Oklahoma: Proceedings, 15th Intersociety Energy Conversion Engineering Conference, p. 45-59. 1980.

LEROY A. HEMISH

Observations and interpretations concerning Quaternary geomorphic history of northeastern Oklahoma: Oklahoma Geology Notes, v. 40, p. 79-94. 1980.

KENNETH S. JOHNSON

Distribution and alteration of Ogallala volcanic-ash deposits and their possible relation to uranium mineralization in western Oklahoma [abstract]: American Association of Petroleum Geologists Bulletin, v. 64, p. 677-678 (with Salman Bloch). 1980.

Investigations of geologic media for the subsurface disposal of radioactive wastes [abstract]: Rockstore 80, an International Symposium on Use of Subsurface Space, Volume of Abstracts, p. S191-S192. 1980.

Precambrian granite in the Arbuckle Mountains: Oklahoma Geology Notes, v. 40, p. 78 (cover-photo description). 1980.

Ward Padgett leaves Department of Mines: Oklahoma Geology Notes, v. 40, p. 110. 1980.

JAMES E. LAWSON, JR.

Oklahoma Earthquakes, 1979: Oklahoma Geology Notes, v. 40, p. 95-105. 1980.

Seismicity and tectonic relationships of the Nemaha Uplift in Oklahoma, part III: U.S. Nuclear Regulatory Commission, NUREG/CR-0875, 70 p. (with Kenneth V. Luza). 1980.

Seismicity in Oklahoma [abstract]: American Geophysical Union, 1979 Midwest meeting, program with abstracts, p. 9 (with K. V. Luza). 1979. (Reprinted in Oklahoma Geology Notes, v. 39, p. 243-244, 1979.)

KENNETH V. LUZA

Hydraulic mining near Mill Creek, Oklahoma: Oklahoma Geology Notes, v. 39, p. 110 (cover-photo description). 1979.

Iodine processing plant near Woodward, Oklahoma: Oklahoma Geology Notes, v. 39, p. 202 (cover-photo description). 1979.

- Oklahoma earthquakes, 1979: Oklahoma Geology Notes, v. 40, p. 95–105 (with James E. Lawson). 1980.
- Seismicity and tectonic relationships of the Nemaha Uplift in Oklahoma, part III: U.S. Nuclear Regulatory Commission, NUREG/CR-0875, 70 p. (with James E. Lawson). 1980.
- Seismicity in Oklahoma [abstract]: American Geophysical Union, 1979 Midwest meeting, program with abstracts, p. 9 (with James E. Lawson). 1979. (Reprinted in Oklahoma Geology Notes, v. 39, p. 243–244, 1979.)
- Tectonics of the Oklahoma City Uplift: Geological Society of America Abstracts with Programs, v. 12, p. 5 (with T. L. Thompson and L. R. Koff). 1980.

CHARLES J. MANKIN

- Oklahoma Geological Survey annual report, July 1, 1978–June 30, 1979: Oklahoma Geology Notes, v. 39, p. 203–209. 1979.

DONALD A. PRESTON

- Bursting natural-gas bubble, Woods County, Oklahoma: Oklahoma Geology Notes, v. 40, p. 2 (cover-photo description). 1980.
- Geologists and field trips—hats off to a long tradition: Oklahoma Geology Notes, v. 40, p. 46 (cover-photo description). 1980.
- Statistics in Oklahoma's Petroleum Industry: Oklahoma Geology Notes, v. 39, p. 163–173. 1979.

APPENDIX D

Papers and Talks Given by Survey Staff at Public Meetings

1979-80 Fiscal Year

Lecture for English Language Service Language Center at The University of Oklahoma: Norman, Oklahoma, July 23, 1979

LEROY A. HEMISH: "Coal geology of Oklahoma"

J. M. Munsil, Willshire Co. of Texas lecture tour: Leonard, Oklahoma, August 1, 1979

JAMES E. LAWSON: A lecture tour of Oklahoma Geophysical Observatory

Oklahoma Center for Continuing Education, class: Norman, Oklahoma, August 13, 1979

CHARLES J. MANKIN: "Energy alternatives and trends"

Fifteenth Intersociety Energy Conversion Engineering Conference: Seattle, Washington, August 18, 1980

WILLIAM E. HARRISON: "Tar sands and heavy oil in Oklahoma"

Eastern Oklahoma State College, evening seminar and discussion group: Wilburton, Oklahoma, September 6, 1979

S. A. FRIEDMAN: "Coal—past, present and future"

American Geophysical Union, Midwestern Sectional Meeting: Columbus, Ohio, September 13, 1979

KENNETH V. LUZA: "Seismicity in Oklahoma"

Retired Officers Association: Norman, Oklahoma, September 13, 1979

CHARLES J. MANKIN: "National energy future"

Energy Information Association of U. S. Department of Energy, special meeting: Washington, D.C., September 18, 1979

S. A. FRIEDMAN: "Coal resources and reserves exemplified by coal deposits of Oklahoma"

Astronomy Club of Tulsa, lecture tour: Leonard, Oklahoma, September 21, 1979

JAMES E. LAWSON: A lecture tour of Oklahoma Geophysical Observatory

American Association of Petroleum Geologists, Mid-Continent Meeting: Tulsa, Oklahoma, October 9, 1979

WILLIAM E. HARRISON: "Geochemical prospecting for stratigraphic traps and investigation of Desmoinesian rocks in northeast Oklahoma for heavy oil potential"

The University of Oklahoma, Sixth Annual Short Course on Coal Geology Fundamentals: Norman, Oklahoma, October 15–18, 1979

S. A. FRIEDMAN: "Definitions of coal terms," "Sulfur in coal," "Stratigraphy of coal," "Remaining coal resources," "Interior province," and "Coal economics"

Association of Earth Science Editors, Annual Meeting: Tulsa, Oklahoma, October 16, 1979

KENNETH S. JOHNSON: "Assisting the geoscientist in the search for geoscience information"

Hope Unitarian Church, "Liberated Religious Youth" lecture tour: Leonard, Oklahoma, October 28, 1979

JAMES E. LAWSON: A lecture tour of Oklahoma Geophysical Observatory

National Waste Terminal Storage Program, Annual Meeting: Columbus, Ohio, October 31, 1979

KENNETH S. JOHNSON: "Preliminary assessment of argillaceous deposits"

Filming of Candid Campus: Stillwater, Oklahoma, November 1, 1979

CHARLES J. MANKIN: "The Energy Resources Center at The University of Oklahoma"

Oklahoma Academy of Science, Annual Meeting: Edmond, Oklahoma, November 9, 1979

KENNETH S. JOHNSON: "Potential for disposal of industrial waste in Oklahoma"

KENNETH V. LUZA: "Earthquakes in Oklahoma"

Phillips University, geology students lecture tour: Leonard, Oklahoma, December 2, 1979

JAMES E. LAWSON: A lecture tour of Oklahoma Geophysical Observatory

Brooklyn College, Geological Society, illustrated lecture: Brooklyn, New York, December 3, 1979

S. A. FRIEDMAN: "Coal geology and the role of coal in the energy imbalance"

Daughters of the American Revolution: Norman, Oklahoma, January 5, 1980

CHARLES J. MANKIN: "The energy situation—what it means to you"

Oklahoma Mineral and Gem Society monthly meeting: Oklahoma City, Oklahoma, January 17, 1979

KENNETH S. JOHNSON: "A guide to field trips and related guidebooks for Oklahoma"

Rocky Mountain Association of Geologists, luncheon talk: Denver, Colorado, January 18, 1980

WILLIAM E. HARRISON: "Geochemical prospecting for stratigraphic traps"

Downtown Rotary Club: Oklahoma City, Oklahoma, January 22, 1980

CHARLES J. MANKIN: "Oklahoma's energy resources—outlook for the future"

Columbia University, Mineral Policy Colloquium Series: New York, New York, February 12, 1980

CHARLES J. MANKIN: "National energy issues"

Moody Christian Academy, student lecture tour: Leonard, Oklahoma, February 20, 1980

JAMES E. LAWSON: "A lecture tour of the Oklahoma Geophysical Observatory"

Fourth Forum of Coal Geologists of Western Interior Coal Basin: Rolla, Missouri, February 21, 1980

S. A. FRIEDMAN: "Oklahoma Geological Survey coal investigations"

LEROY A. HEMISH: "Coal stratigraphy of northeastern Oklahoma"

International Alfred Wegener Symposium, Berlin, Germany, February 25–29, 1980

WILLIAM E. HARRISON: Presentation of poster session on deep-sea drilling results from the Pacific Middle America Margin off Guatemala

American Nuclear Society, topical meeting: Los Angeles, California, February 27–29, 1980

CHARLES J. MANKIN: "Nuclear resources and reserves"

Downtown Kiwanis Club: Oklahoma City, Oklahoma, March 3, 1980

CHARLES J. MANKIN: "Oklahoma's energy resources—outlook for the future"

Geological Society of America, South-Central Section Meeting: Wichita, Kansas, March 4, 1980

KENNETH V. LUZA: "Tectonic and earthquake studies in central Oklahoma"

Lecture for English Language Service Language Center at The University of Oklahoma: Norman, Oklahoma, March 6, 1980

LEROY A. HEMISH: "Coal geology of Oklahoma"

Civic Improvement Council: Norman, Oklahoma, March 24, 1980

CHARLES J. MANKIN: "The future is not what it used to be"

Sigma Gamma Epsilon: Norman, Oklahoma, March 31, 1980

CHARLES J. MANKIN: panelist for "Energy issues" discussion

Oklahoma State University, Extension Program: Muskogee, Oklahoma, April 7, 1980

S. A. FRIEDMAN: "How Oklahoma Geological Survey can help solve problems facing landowners in the central part of Oklahoma coal field"

Duncan Rotary Club: Duncan, Oklahoma, April 9, 1980

WILLIAM E. HARRISON: "Current programs at The University of Oklahoma Energy Resources Center"

Boy Scouts of America meeting, Troop 177: Oklahoma City, Oklahoma, April 21, 1980

S. A. FRIEDMAN: "Minerals, rocks, and mining in Oklahoma"

Tulsa Geological Society meeting: Tulsa, Oklahoma, April 22, 1980

KENNETH V. LUZA: "Tectonic and earthquake studies in central Oklahoma"

American Institute of Professional Geologists, Oklahoma Section: Oklahoma City, Oklahoma, May 10, 1980

CHARLES J. MANKIN: "Washington, D.C.'s national mineral and energy issues"

Boy Scouts of America meeting, Troop 177: Oklahoma City, Oklahoma, May 9, 1980

S. A. FRIEDMAN: "There is more to mining than meets the eye"

American Association of Petroleum Geologists, Annual Meeting: Denver, Colorado, June 7-12, 1980

SALMAN BLOCH and KENNETH S. JOHNSON: "Distribution and alteration of Ogallala volcanic-ash deposits and their possible relation to uranium mineralization in western Oklahoma"

Rockstore 80, an International Symposium on Use of Subsurface Space: Stockholm, Sweden, June 23, 1980

KENNETH S. JOHNSON: "Investigations of geologic media for the disposal of wastes"

Northeastern Oklahoma State University, Summer Research Apprentice Program lecture tour: Leonard, Oklahoma, June 18, 1980

JAMES E. LAWSON: A lecture tour of Oklahoma Geophysical Observatory



Three New Publications Issued by Survey

A bulletin, a circular, and a hydrologic atlas are among the most recent publications of the Oklahoma Geological Survey.

Bulletin 129, *Hunton Group (Late Ordovician, Silurian, and Early Devonian) in the Arkoma Basin of Oklahoma*, covers an area extending from the eastern edge of the Arbuckle Mountains eastward to the Bonanza Gas Field of western Arkansas and northward to the Sylvan-Hunton-Woodford outcrops of northeastern Oklahoma.

The 136-page illustrated volume was prepared by Survey geologist Thomas W. Amsden, who is internationally recognized for his investigations of the rocks of the Silurian and Devonian Systems.

Amsden's report presents a stratigraphic and sedimentary model for the mid-Paleozoic sediments of the Arkoma Basin. His primary approach is a biostratigraphic-lithostratigraphic and biofacies-lithofacies analysis of the Hunton for the purpose of determining the relationships of the strata.

He stresses biostratigraphy in order to provide a time framework for these facies relationships. Subsurface data used in the study were obtained from 11 cores and samples from 90 wells and approximately 800 thin sections.

The publication contains a 36-page appendix and four large map panels folded in an attached pocket.

Circular 80, *Disposal of Industrial Wastes in Oklahoma*, is also now in print. This study presents the results of a project begun in 1977 to evaluate the surface and subsurface geology of Oklahoma in order to identify zones that are capable of receiving and containing low-level industrial wastes by keeping them isolated from fresh-water zones and the biosphere for as long a time as the material may be potentially hazardous. Disposal of radioactive wastes is not considered in the report.

The circular was authored by Kenneth S. Johnson, associate director of the Survey; Kenneth V. Luza, OGS engineering and environmental geologist; and John F. Roberts, now deceased, long-time petroleum geologist with the Survey.

The report was prepared in cooperation with the Oklahoma Department of Economic and Community Affairs and the Economic Development Administration of the U.S. Department of Commerce.

Because criteria are basically different for safe repositories in the surface and subsurface, the two classifications are covered separately in Part II and Part III of the circular. Part I is an introduction prepared by Johnson, Luza, and Roberts.

Surface disposal requires impermeable bedrock, at least 50 feet thick, in which pits can be excavated and from which migration or other loss cannot occur. Shales and clays are good examples, since clay minerals are capable of absorbing metal ions and retarding fluid migration. Least favorable are limestone, gypsum, permeable sandstone, alluvium, terrace deposits, and igneous and metamorphic rocks.

Subsurface disposal, in contrast, calls for units having high porosity and permeability for the acceptance of injected liquid wastes such as organic solvents, spent acids, caustic solutions, salt water, ammonia, and rinse waters. Sandstone, limestone, and dolomite, and possibly fractured shale or mined caverns in shale and salt, are acceptable for this type of disposal. But such zones must be isolated and sealed by overlying and underlying impervious rocks.

The surface study for this report has involved evaluation of the geologic setting, thickness, physical properties, and mineralogy for each of the major geologic formations that crop out in the State. Investigations also included analysis of hydrologic, climatological, engineering, and demographic data, which is presented in numerous figures and tables.

Although, as the authors emphasize, this is a reconnaissance evaluation, the information offered should be of considerable value in providing guidelines to control one of Oklahoma's environmental problems and should prove to be valuable in regional planning.

Hydrologic Atlas 7 has been released by the Survey as a set of four large, colorful map sheets showing the water resources, water quality, and geology of an 11-county area in north-central Oklahoma. Counties included are Kay, Noble, Osage, Pawnee, and parts of Creek, Garfield, Grant, Kingfisher, Logan, Payne, and Tulsa Counties.

This atlas, *Reconnaissance of the Water Resources of the Enid Quadrangle, North-Central Oklahoma*, by Roy H. Bingham and DeRoy L. Bergman, both of the U.S. Geological Survey (USGS) Water Resources Division in Oklahoma City, represents a step toward completion of a long-term cooperative project between the OGS and the USGS to provide hydrologic information for all of Oklahoma except the Panhandle.

The program was instituted in 1967, and first publication came in 1969 with the issuing of HA-1, *Reconnaissance of the Water Resources of the Fort Smith Quadrangle, East-Central Oklahoma*, by Melvin V. Marcher. Subsequent atlases have covered the Tulsa, Ardmore-Sherman, Oklahoma City, Clinton, and Lawton Quadrangles. Separate publications prepared by the USGS cover Cimarron, Texas, and Beaver Counties of the Panhandle.

The HA series offers data on the availability of both surface and ground waters and on the chemical quality of the water. An updated geologic map is included as sheet 1 of each set, since the mineral content, porosity, and permeability of the rocks determine to a large extent the quality and, to some extent, the quantity of recoverable water in an area.

Measurements and analyses from hundreds of sampling stations, wells, and gaging stations were used by Bingham and Bergman in the preparation of this report, and data obtained are included. Updating of the geologic map was done by Robert O. Fay, OGS geologist. Mary Ellen Kanak, of the OGS cartographic staff, prepared the map sheets for publication.

These three new publications can be obtained from the Oklahoma Geological Survey by writing to the address on the front cover. The prices are: Bulletin 129, *Hunton Group (Late Ordovician, Silurian, and Early*

Devonian in the Arkoma Basin of Oklahoma, \$15 hardcover, \$11 paperbound; Circular 80, *Disposal of Industrial Wastes in Oklahoma*, \$9 hardcover, \$5 paperbound; HA-7, *Reconnaissance of the Water Resources of the Enid Quadrangle, North-Central Oklahoma*, \$5.

Funds Allocated for Geothermal-Energy Project

The dry holes drilled by those looking for supplies of Oklahoma's oil and gas may soon prove useful to the State as a possible source of alternate energy.

The U.S. Department of Energy has given Oklahoma Geological Survey geologist William E. Harrison \$118,000 to determine which areas of the State might use exploratory dry holes to reach hot water trapped 5,000 to 10,000 feet below the earth's surface.

Harrison believes that some of these holes can be adapted for bringing geothermal energy to the surface, perhaps turning an unsuccessful drilling venture into a profitable undertaking.

"The trick," Harrison said, "is to install the right plumbing in the hole."

During the first stages of the study, a map showing geothermal gradients in the State is planned. The map will show increases in temperature for every 100 feet of vertical depth below the surface and will indicate areas that may have geothermal potential. The heated water is commonly trapped both in rocks and in subsurface pores and fractures, much like petroleum.

The more promising areas will be tested further. Sensitive thermometers and other instruments will be used to confirm whether each site's geothermal resources can be developed economically.

The project should last 18 months to 2 years, after which the development of the areas will be left to other State agencies and private interests.

Geothermal resources have been used to meet a Salt Lake City, Utah, office building's heating and cooling needs, said Harrison, citing an example of its use.

In Oklahoma, Harrison believes there may be some potential for geothermal-resource development in the southeastern section of the State.

The region is not heavily populated but historically has had a relatively high unemployment rate. The availability of inexpensive geothermal energy and a work force might make the region more desirable to industries seeking new plant sites, he said.

Harrison also wants to know if readings of the Arkoma Basin subsurface temperatures might be able to help explain the lack of oil in the area. Large supplies of natural gas are known to exist, and it is possible that temperatures have increased over the past few million years, converting any oil that may have accumulated there into gas.

"We really don't know why the Arkoma Basin is basically a gas province," he said. "This study will help answer that question."

STATISTICS IN OKLAHOMA'S PETROLEUM INDUSTRY, 1979

M. Lynn Prater¹

Drilling Activity

Drilling activity in 1979 continued an upward trend in Oklahoma (table 1; fig. 1). Exploratory-test completions numbered 484 (down 4 percent), and development-well completions 5,863 (up 9 percent). The completion success ratio for both categories increased: 37 percent for exploratory and 73 percent for development wells. The average development well in Oklahoma reached 4,811 feet (down 153 feet from 1978), whereas the average exploratory test was more than 1,000 feet deeper (7,370) than in 1978.

Grady County, with 10 gas and two oil discoveries, had the best exploration record in the State. Roger Mills County, with nine gas and two oil, and Woods County, with eight gas and three oil discoveries, tied for second in exploratory success.

Canadian County had the highest exploratory-success ratio, 88 percent; the county also exceeded all other counties in footage drilled, closing the

TABLE 1.—DRILLING ACTIVITY IN OKLAHOMA, 1979

(Source: OU Energy Resources Center and *World Oil*, v. 190, no. 3, February 15, 1980)

	1979			Total	1978
	Oil	Gas	Dry		Total
All wells					
Number of wells	2,712	1,768	1,867	6,347	5,822
Total footage				31,771,376	29,860,456
Average footage				5,006	5,129
Exploratory wells					
Number of completions	85	107	295	484	502
Percentage of completions				37	30
Total footage				3,567,157	3,453,125
Average footage				7,370	6,301
Development wells					
Number of completions	2,627	1,664	1,572	5,863	5,320
Percentage of completions				73	72
Total footage				28,204,219	26,407,331
Average footage				4,811	4,964

¹Geologist, Oklahoma Geological Survey.

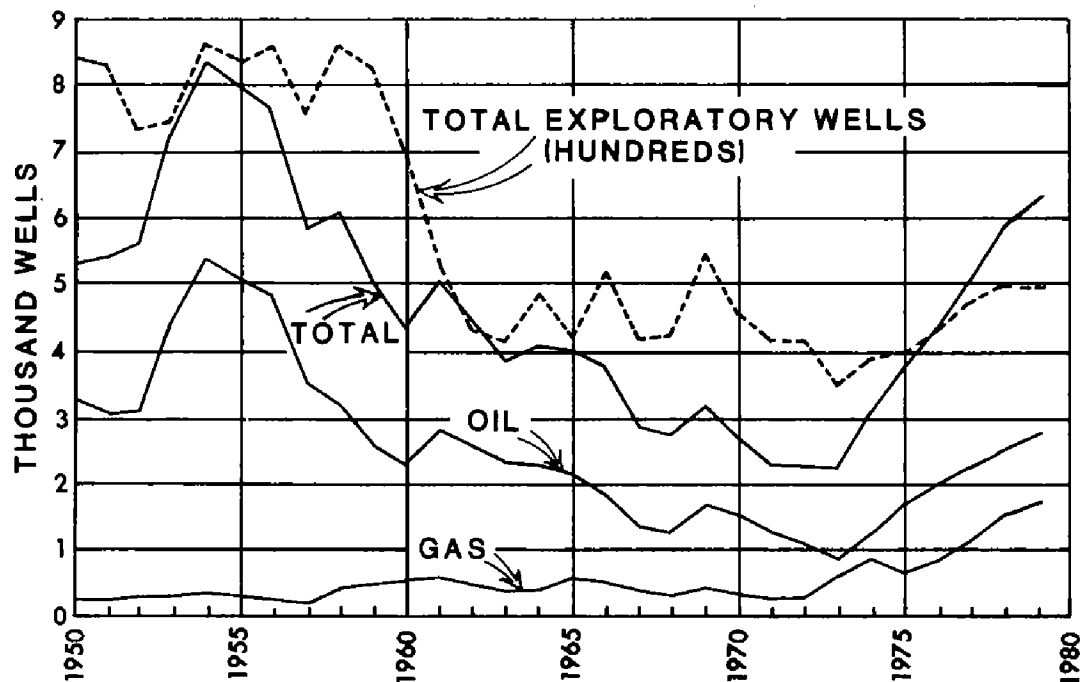


Figure 1. Graph showing total wells drilled, oil wells completed, and gas wells completed in Oklahoma, 1950–79. (Source: OU Energy Resources Center.)

year with a total of 2,368,340 feet (a decrease of 11,495 feet from 1978). Garfield County was second with 1,748,756 feet (an increase of 180,530 feet). Seven other counties attained totals greater than 1 million feet. As seen in table 2, eight tests were drilled deeper than 20,000 feet. More than half of the tests (55 percent) were drilled less than 5,000 feet, and 90 percent penetrated to less than 10,000 feet.

Figure 2 depicts the maximum 1979 drilling depths, by county, for either development or exploratory tests in Oklahoma. The deepest drilling occurred in the west-central and south-central parts of Oklahoma. The shallowest drilling occurred mostly in the northeastern part of the State.

Figure 3 indicates the amount of oil produced in each county of Oklahoma. The south-central part of the State produced the greatest amount. Stephens and Carter Counties produced more than 16,000,000 barrels of oil each in 1979.

Figure 4 shows by county the distribution of natural-gas production for the State. The Panhandle and the west-central part of Oklahoma produced the most natural gas during 1979. Texas County led the State, having produced more than 150 million cubic feet of natural gas.

World Oil (v. 190, no. 3, Feb. 15, 1980) attributed 94.6 percent of Oklahoma's 1979 wells to independent operators, as compared to 87.1 percent nationwide. Once again, Oklahoma was third highest in 1979 in independent-operator activity in states averaging more than 2,000 wells.

Figure 5 illustrates the historical behavior of exploratory drilling and hydrocarbon wellhead prices in Oklahoma from 1955 through 1979. The

TABLE 2.—COMPLETION DATA AND DEPTH INFORMATION FOR WELLS
 DRILLED IN OKLAHOMA DURING 1979
 (Source: OU Energy Resources Center)

County	Total number of wells drilled	Completions		Percent completions (Oil and Gas)	Number of wells drilled in following total-depth ranges (in feet) ¹				
		Oil	Gas		0- 5,000	5,000- 10,000	10,000- 15,000	15,000- 20,000	>20,000
Alfalfa	57	25	20	79	3	54	—	—	—
Atoka	8	0	1	13	4	2	1	—	—
Beaver	192	27	107	70	26	160	—	—	—
Beckham	29	1	22	79	6	1	3	18	1
Blaine	76	10	41	67	—	29	47	—	—
Bryan	3	1	2	100	1	2	—	—	—
Caddo	58	14	23	64	6	2	41	5	3
Canadian	245	152	75	93	1	160	81	—	—
Carter	98	75	1	78	41	44	7	1	1
Cherokee	1	0	0	0	1	—	—	—	—
Cimarron	41	4	18	54	28	12	—	—	—
Cleveland	43	20	0	47	—	41	1	—	—
Coal	38	4	14	47	22	16	—	—	—
Comanche	31	14	2	52	27	4	—	—	—
Cotton	15	6	1	47	15	—	—	—	—
Craig	27	7	8	56	27	—	—	—	—
Creek	226	163	11	77	221	—	—	—	—
Custer	70	11	32	61	—	1	56	13	—
Dewey	61	21	23	72	1	31	28	1	—
Ellis	57	9	28	65	1	31	25	—	—
Garfield	269	199	45	91	25	242	—	—	—
Garvin	101	44	8	51	50	44	3	—	—
Grady	107	21	62	78	18	4	67	13	—
Grant	58	10	18	48	31	25	—	—	—
Greer	33	1	10	33	33	—	—	—	—
Harmon	3	0	0	0	2	1	—	—	—
Harper	117	14	50	55	3	113	—	1	—
Haskell	73	0	40	55	11	58	4	—	—
Hughes	154	37	65	66	143	8	—	—	—
Jackson	7	2	0	29	7	—	—	—	—
Jefferson	10	4	0	40	6	4	—	—	—
Johnston	3	0	0	0	2	—	—	—	—
Kay	243	40	146	77	238	3	—	—	—
Kingfisher	166	116	39	93	1	161	1	—	—
Kiowa	29	18	0	62	27	1	1	—	—
Latimer	20	0	9	45	—	5	14	—	—
Le Flore	42	0	20	48	1	37	4	—	—
Lincoln	134	46	29	56	114	19	—	—	—
Logan	187	115	27	76	23	159	—	—	—
Love	33	25	1	79	17	10	3	—	—
McClain	32	15	2	53	4	18	9	—	—

¹List does not include re-entry wells that have been drilled deeper.

TABLE 2.—Continued

County	Total number of wells drilled	Completions		Percent completions (Oil and Gas)	Number of wells drilled in following total-depth ranges (in feet) ¹				
		Oil	Gas		0- 5,000	5,000- 10,000	10,000- 15,000	15,000- 20,000	> 20,000
McCurtain	1	0	0	0	1	—	—	—	—
McIntosh	53	2	28	57	52	1	—	—	—
Major	174	112	52	94	1	145	24	—	—
Marshall	35	24	5	83	15	18	—	1	1
Mayes	9	4	0	44	9	—	—	—	—
Murray	18	5	0	28	9	7	1	—	—
Muskogee	81	27	14	51	81	—	—	—	—
Noble	119	50	24	62	69	49	—	—	—
Nowata	248	93	143	95	247	—	—	—	—
Okfuskee	97	30	35	67	96	—	—	—	—
Oklahoma	42	10	9	45	5	37	—	—	—
Okmulgee	292	119	94	73	292	—	—	—	—
Osage	598	372	34	68	594	—	—	—	—
Pawnee	55	36	0	65	54	—	—	—	—
Payne	110	80	7	79	95	13	—	—	—
Pittsburg	72	3	40	60	31	31	10	—	—
Pontotoc	98	60	5	66	97	—	—	—	—
Pottawatomie	104	41	5	44	72	30	—	—	—
Roger Mills	71	5	39	62	2	6	19	43	—
Rogers	54	31	18	91	54	—	—	—	—
Seminole	79	46	6	66	76	2	—	—	—
Sequoyah	14	0	4	29	4	9	—	—	—
Stephens	129	85	5	70	94	26	4	3	—
Texas	140	27	73	71	49	95	—	—	—
Tillman	17	14	0	82	1	16	—	—	—
Tulsa	67	52	5	85	67	—	—	—	—
Wagoner	24	7	1	33	23	—	—	—	—
Washington	113	84	17	89	112	—	—	—	1
Washita	12	2	7	75	—	1	5	5	1
Woods	117	15	62	57	3	112	—	—	—
Woodward	107	15	36	48	3	90	11	—	—
Totals	6,347	2,712	1,768	60	3,491	2,190	470	104	9
				(avg.)	(55%)	(35%)	(7%)	(2%)	(<0.1%)

¹List does not include re-entry wells that have been drilled deeper.

drilling and discovery data are expressed as 5-year moving averages. Well-head prices have been converted to 1967 dollars.

Drilling and oil discoveries have shown an upward trend since 1975. The 1979 wellhead price of oil and gas continued the sharp increase that was first experienced in 1974. As in 1978, the trends of exploratory drilling, discoveries, and prices have all been upward.

Production and Reserves

Figures 6 and 7 express the continuing decrease in reserves of all hydrocarbons produced in Oklahoma. Once again, production has surpassed the addition of new reserves in all categories.

Figure 6 continues the downward trend from 1978 with a net reserve loss of 0.3 trillion cubic feet of gas. The production-to-reserves ratio decreased from 6.97 in 1978 to 6.74 in 1979.

Figure 7 illustrates the downward trend of total liquid hydrocarbons produced in Oklahoma. Yearly production declined slightly from 177 to 174 million barrels, while net reserves declined from 1,340 to 1,281 million barrels by the year's end.

The historical listing of Oklahoma's annual production and marketing value of hydrocarbons from 1955 to 1979 is given in table 3. The format of

TABLE 3.—CUMULATIVE (THROUGH 1955) AND YEARLY (1956–78) MARKETING PRODUCTION AND VALUE OF PETROLEUM, NATURAL GAS, AND LIQUEFIED NATURAL GAS IN OKLAHOMA¹

Year Through	Petroleum		Natural gas		Liquefied natural gas	
	Volume (1,000 bbls)	Value (\$1,000)	(Volume MMcf)	Value (\$1,000)	Volume (1,000 bbls)	Value (\$1,000)
1955	7,230,010	11,443,269	12,977,332	1,378,370	430,806	1,010,826
1956	215,862	600,096	678,603	54,288	25,454	49,970
1957	214,661	650,423	719,794	59,743	24,947	47,153
1958	200,699	594,069	696,504	70,347	26,141	51,851
1959	198,090	578,423	811,508	81,151	26,767	56,513
1960	192,913	563,306	824,266	98,088	30,816	65,483
1961	193,081	561,866	892,697	108,016	31,865	63,499
1962	202,732	591,977	1,060,717	135,772	33,136	60,987
1963	201,962	587,709	1,233,883	160,405	32,532	64,112
1964	202,524	587,320	1,323,390	166,747	34,163	62,066
1965	203,441	587,944	1,320,995	182,297	34,876	66,769
1966	224,839	654,281	1,351,225	189,172	36,771	80,046
1967	230,749	676,095	1,412,952	202,052	37,489	85,122
1968	223,623	668,202	1,390,884	197,506	39,402	78,349
1969	224,729	701,155	1,523,715	223,128	41,925	73,334
1970	223,574	712,419	1,594,943	248,811	42,842	92,908
1971	213,312	725,610	1,684,260	273,945	41,727	97,588
1972	207,633	709,033	1,806,887	294,523	41,707	99,810
1973	191,204	723,273	1,770,980	334,110	43,718	144,334
1974	177,785	1,277,076	1,638,492	458,904	43,812	251,099
1975	163,123	1,389,164	1,605,410	513,731	40,025	203,535
1976	161,426	1,484,297	1,726,513	866,710	42,514	254,018
1977	151,390	1,504,817	1,824,710	1,452,683	42,350	317,625
1978	150,456	1,640,595	1,773,582	1,599,771	44,369	488,059(e)
1979	143,641	2,158,526	1,845,389	2,062,868	50,752	762,662(e)
Totals	11,943,459	32,370,945	45,489,631	11,413,138	1,320,906	4,627,768

¹Preliminary figures for 1979 (from U.S. Department of Energy).

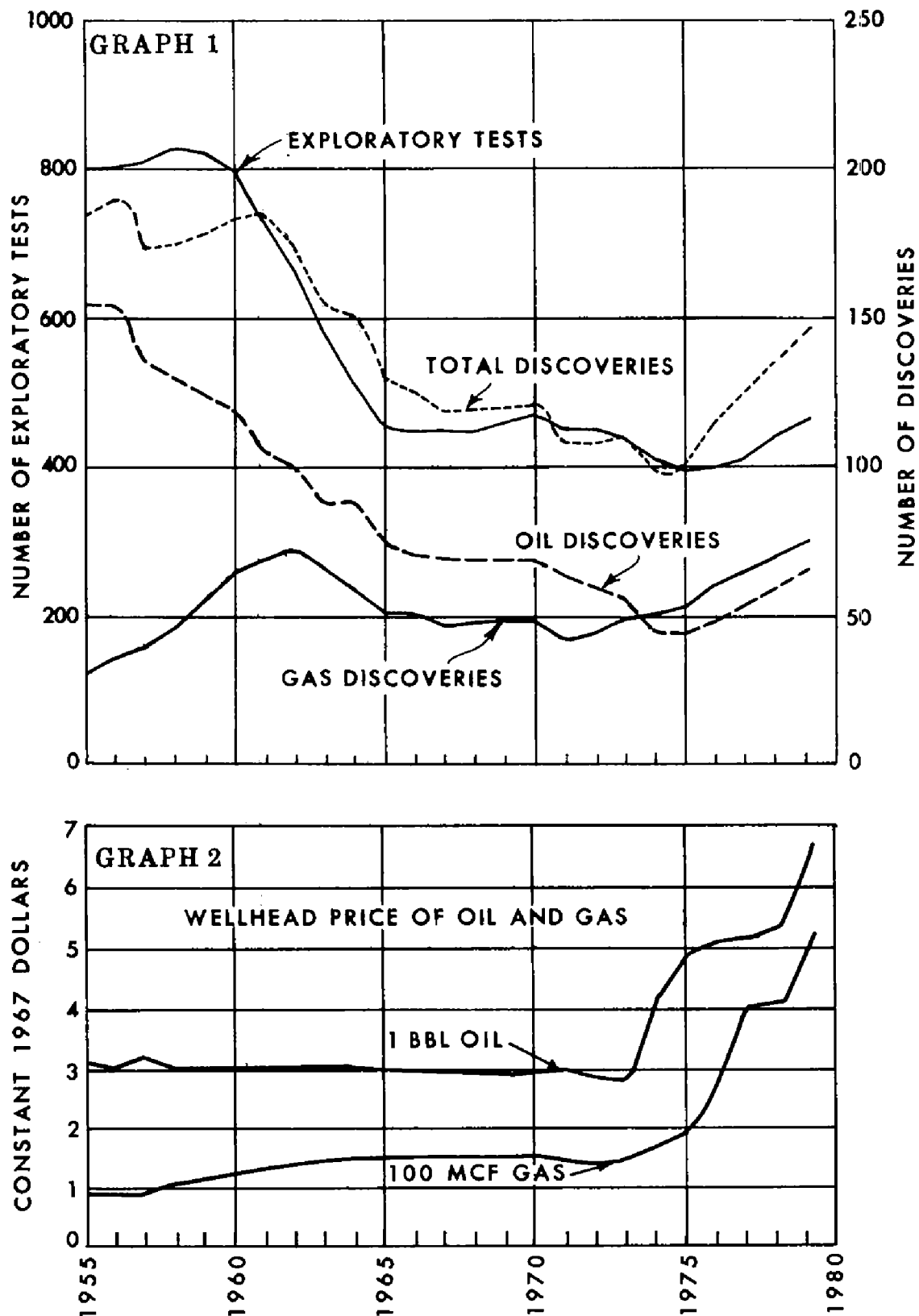


Figure 5. Graphs of exploratory activities and hydrocarbon prices in Oklahoma, 1955-79. Curves in graph 1 are 5-year moving-average trend lines; exploration curve related to scale on left; discovery curves related to scale on right.

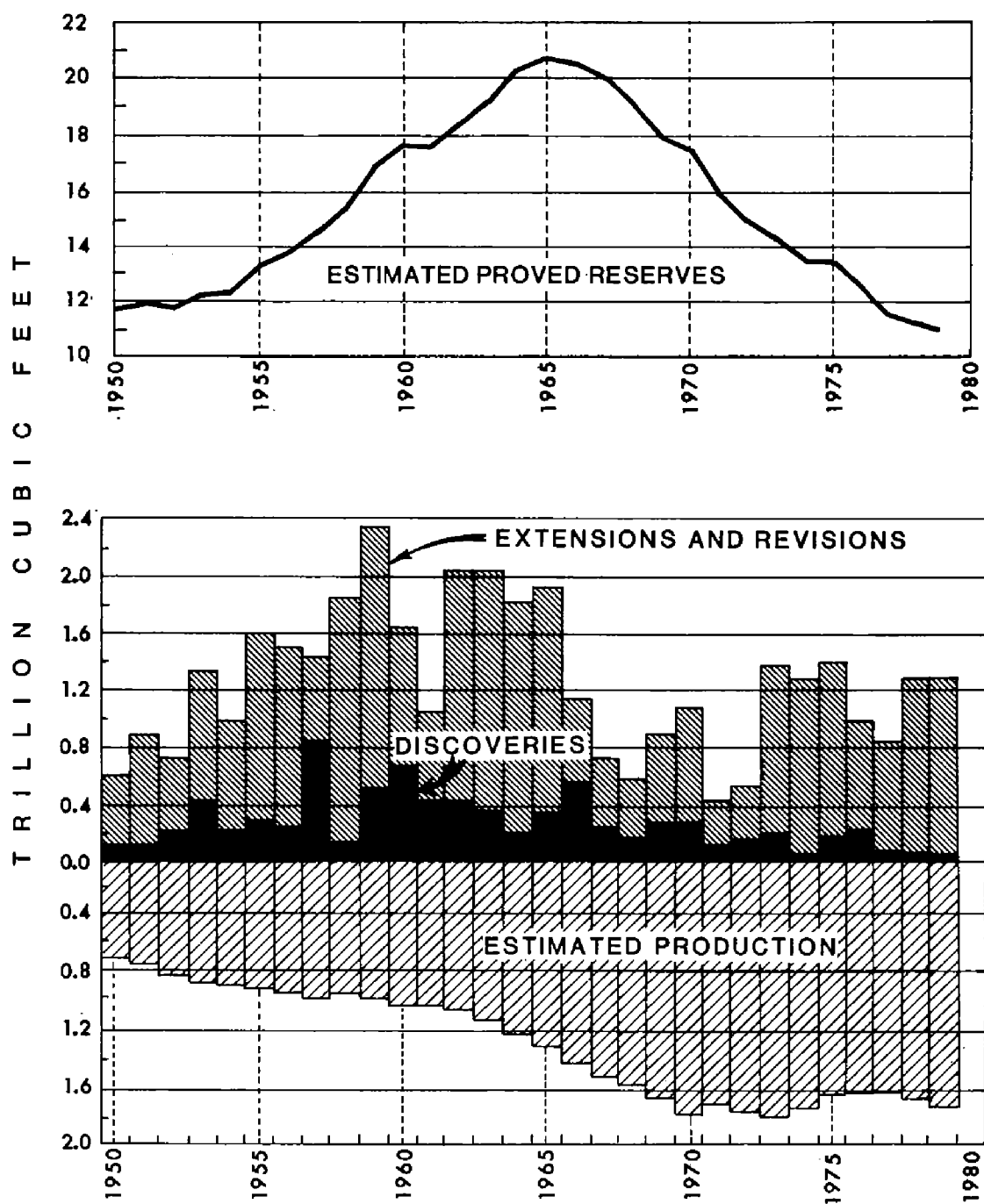


Figure 6. Graph showing statistics for estimated proved natural-gas reserves in Oklahoma, 1950-79. (Source: American Gas Association, annual reports.)

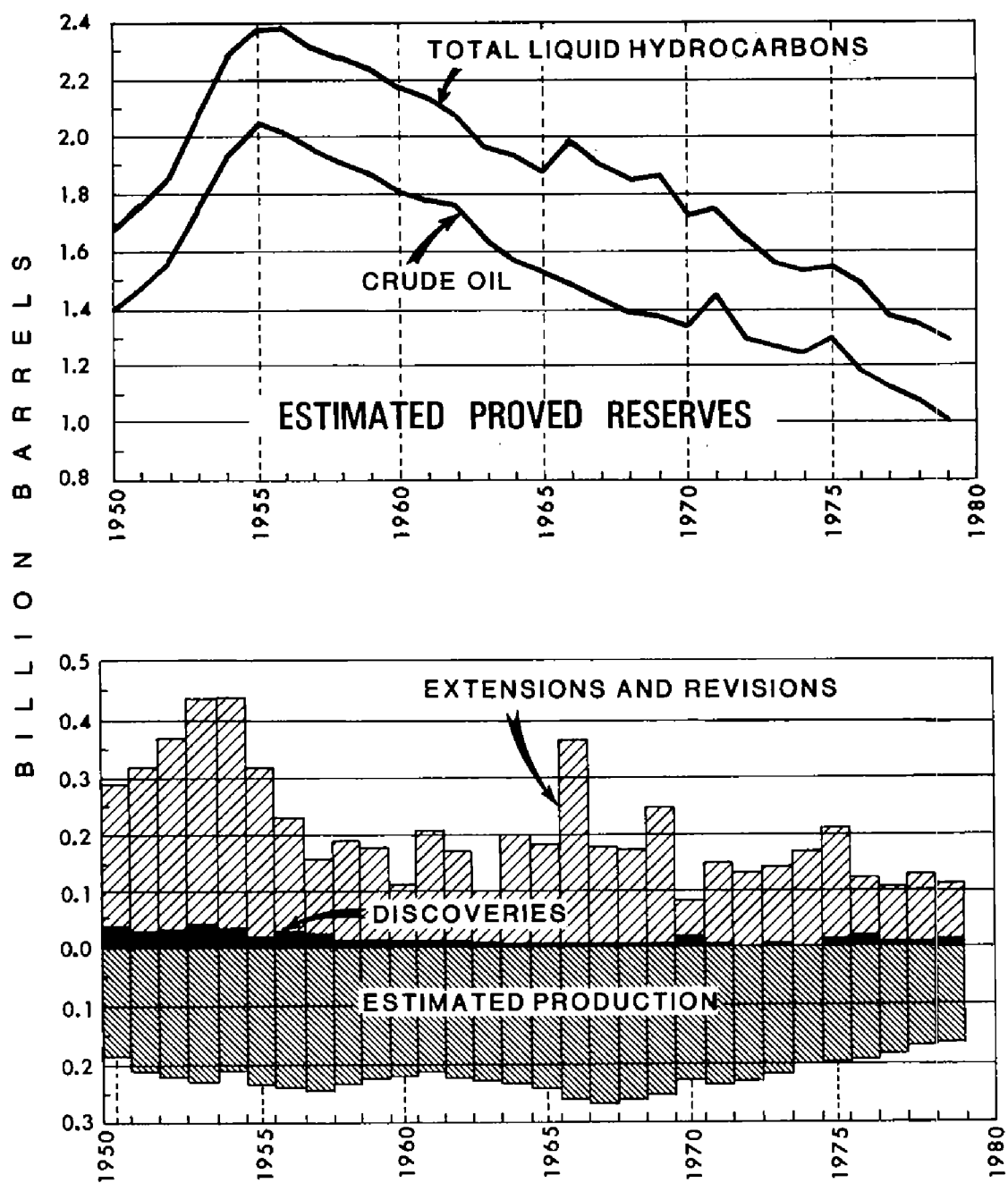


Figure 7. Graph showing statistics for estimated proved total liquid-hydrocarbon reserves in Oklahoma, 1950-79. (Source: American Petroleum Institute, annual reports.)

this listing conforms to data categories provided by the U.S. Department of Energy.

Table 4 explains in some detail the State's 1979 production and marketing activities. Again, the production of total hydrocarbons decreased, but the marketed value of products showed a net increase. Crude-oil prices for the year averaged \$15.03 (up from \$10.90 per barrel in 1978). In 1979, 1,635 producing wells were added, although the average daily production per well dropped from 5.5 to 5.2 barrels.

Table 5 lists 10 of the giant fields in Oklahoma (a giant field is one that has more than 100 million barrels of estimated recoverable oil or equivalent natural gas). Total oil production for 1979 was 47,504,000 barrels from these giant fields. This was a 19-percent decrease from the 58,891,000 barrels of oil produced in 1978.

In 1979, Oklahoma once again ranked third in natural-gas and fifth in crude-oil production.

TABLE 4.—HYDROCARBON PRODUCTION IN OKLAHOMA

	1978	1979
Crude oil and lease condensate		
Total annual production (1,000 bbls) ¹	150,456	144,623
Value (\$1,000) ²	1,640,596	2,158,526
Cumulative production 1891-1979 (1,000 bbls)	11,799,818	11,943,459
Daily production (bbls) ¹	412,208	396,220
Total number of producing wells ¹	74,870	76,505
Daily average per well (bbls) ¹	5.5	5.2
Oil wells on artificial lift (estimated) ¹	70,623	72,160
Natural Gas		
Total annual marketed production (MMcf) ²	1,773,582	1,845,389
Value (\$1,000) ²	1,599,771	2,062,868
Total number of gas and gas-condensate wells ¹	11,512	14,062
Natural-gas liquids		
Total annual marketed production (1,000 bbls) ¹	44,369	50,752
Value (\$1,000) ¹	488,059(e)	762,662(e)

¹*World Oil*, v. 190, no. 3, February 15, 1980.

²Oklahoma Tax Commission.

(e)=estimated.

TABLE 5.—GIANT OIL FIELDS OF OKLAHOMA, 1979
(SOURCE: OIL AND GAS JOURNAL, V. 78, NO. 4, JAN. 28, 1980)

Field	1979 production (1,000 bbls)	Cumulative production (1,000 bbls)	Estimated reserves ¹ (1,000 bbls)	Number of wells
Burbank	2,218	516,349	24,578	1,035
Eola-Robberson	1,664	120,769	19,206	530
Fitts	3,097	164,019	24,212	630
Golden Trend	3,809	419,019	35,713	1,060
Healdton	2,458	322,094	27,824	1,396
Hewitt	3,186	247,982	38,238	1,260
Oklahoma City	1,041	735,734	11,937	216
Postle	2,598	90,031	29,802	331
Sho-Vel-Tum	21,259	1,143,129	186,871	8,430
Sooner Trend	6,174	228,618	48,924	3,690
Totals	47,504	3,994,723	447,105	18,578

¹Percentage of remaining reserves (est.): 10.07.

New Theses Added to OU Geology Library

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

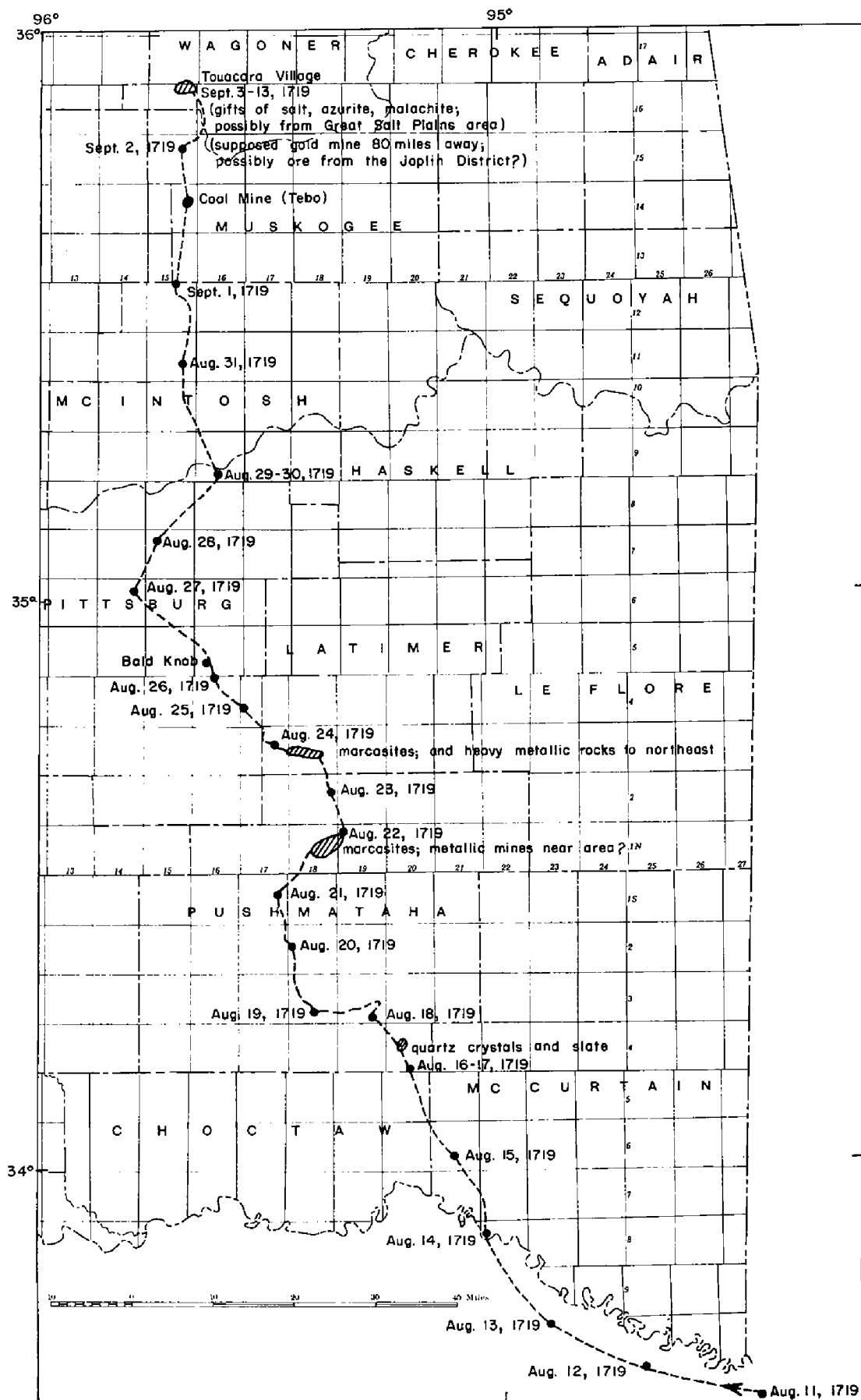
A Gravity and Magnetic Study of the Kingfisher Anomaly, North-Central Oklahoma, by Christopher M. Barrett. 45 p., 10 figs., 2 plates, 1980.

A Compressional and Shear-Wave Seismic Refraction Study for Near-Surface Earth Layers in Northwestern Oklahoma, by David W. Ballard. 139 p., 16 figs., 1980.

Analysis of Opaque Minerals in the Vanoss Group (Pennsylvanian), Oklahoma, by Gary Scott Steffens. 106 p., 4 figs., 10 plates, 1980.

The Stratigraphy of the Wapanucka Formation (Lower Pennsylvanian) Along the Frontal Margin of the Ouachita Mountains, Oklahoma, by Robert C. Grayson. 319 p., 30 figs., 4 tables, 9 plates, 1980 (Ph.D. dissertation).

An Application of the Compressional and Shear-Wave Synergism to the Detection of Changes in Rock Properties in Kingfisher County, Oklahoma, by Phil Dean Anno. 113 p., 33 figs., 1980.



Possible route of La Harpe Expedition in Oklahoma, August 14–September 13, 1719. Evening campsites are dated.

Geologic and Historic Notes on the La Harpe Expedition into Oklahoma in 1719

Robert O. Fay¹

One of the earliest recorded French expeditions to Oklahoma is that of Jean-Baptiste Bénard, Sieur de La Harpe, who recorded the occurrence of salt, coal, slate, quartz crystals, marcasite, mines, ultramarine blue (azurite), and verdigris (malachite) in the State.

La Harpe was born in St. Malo, France, in 1683. His surname was Bénard and his titled name was La Harpe, a name inherited from his father, a famous sea-captain. La Harpe came to the Louisiana Province on June 25, 1718, under John Law's Company of the West. He was instructed to establish a fort on the Red River and to explore, exploit, and settle the area for France. In return, La Harpe was given the trading, trapping, and mining rights to the area between the Red River and the Arkansas River.

On April 25, 1719, La Harpe established his Nassonite Post on the Red River, northwest of Texarkana, completing the 110- by 20-foot fort in July 1719. Up to the present time, according to Wedel (1978, pp. 15-16) and Miroir and others (1973), physical evidence of the post has not been discovered. After reading Lewis (1924), Smith (1958-59), Margry (1888), and other reports, such as Sibley's papers (1805, p. 693), I believe that the Nassonite Post was about 11 miles east-southeast of the southeast corner of Oklahoma, between Smith Hill and Spanish Bluff, Bowie County, Texas, where it could have been destroyed by the Red River. This area is covered on the U.S. Geological Survey Redbank Quadrangle topographic map (1950). On April 17, 1719, La Harpe was at the Nassonite village near Clear Lake, about 10 miles northwest of Texarkana (Ogden Sheet, 1950, 1970, 1975), and he stated, as reported by Smith (1958, p. 253-256):

I got into a pirogue with M. Du Rivage in order to search for, in going up the river, a suitable place for forming my habitation. We advanced ten leagues to the place where was formerly the village of the Nadsoos. This place appeared to me very fine, as there was a fine hillock jutting out into the river suited to establishing a fort there, below which the soil is excellent for producing wheat and all kinds of grain. . . . That made me resolve to locate my establishment above the chief of the Nassonites, on the left of the river, at a musket shot distance. In regard to the Cadodaquious, they are two leagues below the Nassonites and the Nadsoos, and the Natchitoches three leagues above, all on the right of the river. These nations are scattered

¹Geologist, Oklahoma Geological Survey.

into different isolated spots. . . . [p. 254] The terrain of the Nassonites is a little elevated, the soil is sandy, but at half a quarter of a league from the river, the country is fine, the earth black, and the prairies most beautiful and most fertile. Near the place that I have chosen for my establishment, there is an expanse two leagues long covered with ducks, swans, and bustards. Although the land there may be sandy. . . . [p. 255] My design being to establish myself at the deserted place of the chief of the Nassonites, I proposed to him, at this Calumet, to cede me his ground with its cabin and his *antichon*. . . . At the same time the chiefs of these nations offered thirty of their men to me to bring cypress wood to me for the construction of the house that I wished to construct. . . . [p. 256] . . . [T]he savages commenced to bring much cypress timber to me. I employed my men similarly at this work, and we laid the foundations for a house of a hundred ten feet long by twenty wide, which has been finished only in the end of the month of July.

This Nassonite Post may have been built on one of several points that project northward near Whaley and Applewhite Cut-off Lakes, on the south side of the river, in Bowie County, Texas, such as the area in secs. 17–18, T. 14 S., R. 31 W., using Arkansas coordinates. I used this area as the starting point for La Harpe's expedition, using 1 French league, which is equal to 2.6 miles, and allowing 8° east magnetic declination. (One Indian day, to which La Harpe refers, equals 5 French leagues, or about 13 miles.)

On June 4, 1719, before leaving on his main expedition, La Harpe sent M. Du Rivage up the Red River, 70 leagues west-northwest, to a Quidehais village, probably Spanish Fort which is about 15 miles south of Ringling, Jefferson County, Oklahoma. Miroir and others (1973) have suggested that the village might have been near the Womack site, northwest of Paris, Texas, although the distance to this location is probably too short to fit the description. Du Rivage returned June 29, 1719. Smith (1959, p. 377) translates La Harpe:

[T]he Cancy composed a very populous village on the banks of the Red River at sixty leagues from the place where M. Du Rivage was; that the Spaniards were established at the village of the Cancy; that they were working at taking a very heavy material from the earth, that one could go up the Red River in high waters to within three days journey of these nations. . . . [p. 379] That ought to make known of what importance it is to maintain the posts established on the Red River, particularly this one of the Nassonites, which is situated by land from the Cancy nation, at whose abode the Spaniards mine for gold, only 120 leagues of very fine country.

This village may have been on the North Fork of the Red River in Kiowa County, perhaps near Devils Canyon, in sec. 12, T. 4 N., R. 20 W., in the Wichita Mountains. The site was occupied in 1823, but earlier dates may be questionable. Father Juan de Salas established a mission near the Wichitas in 1629, and Don Diego del Castillo prospected for gold and silver for 6 months in 1650, according to Thoburn (1916, p. 20–21).

On August 11, 1719, La Harpe began his journey with six soldiers and three Indian guides. They traveled west-northwest on the Texas side for the first four days and probably camped on Mud Creek, north of Woodstock, on August 11, 1719.

The following dates and probable campsites outline the possible route of the La Harpe expedition:

August 12—Camp made at Mill Creek, west of Beaverdam, in Bowie County.

August 13—Camped at Pecan Bayou, east of Reeds Settlement, Red River County.

August 14—Camped on the north side of the Red River in McCurtain County, Oklahoma, just north of Albion, Texas.

August 15—Camped northwest of Valliant, in the NE $\frac{1}{4}$ sec. 28, T. 6 S., R. 21 E., McCurtain County.

August 16–17—Camped on Turkey Creek, 2 miles east-southeast of Sobol, in the SW $\frac{1}{4}$ sec. 34, T. 4 S., R. 20 E., Pushmataha County.

August 18—Smith (1959, p. 381) translates La Harpe: "The 18th, we advanced along several hillocks and through pretty prairies; we came upon quarries of slate and several pieces of crystal rock; we made this day four leagues to the north-northwest."

Quartz crystals occur in shales in the Stanley Group (Mississippian). Woodson (1964, p. 15) mentions finding a quartz vein in the Tenmile Creek Formation of the Stanley in section 16, T. 4 S., R. 20 E., Pushmataha County, and this is the westernmost known occurrence of quartz veins in the Ouachita Mountains. La Harpe was probably in sections 16–17, T. 4 S., R. 20 E., Pushmataha County.

August 19—Followed the Webb Trail westward, camping on Fish Creek in the SW $\frac{1}{4}$ sec. 27, T. 3 S., R. 18 E., Pushmataha County.

August 20—Moved northward and probably camped in the NW $\frac{1}{4}$ sec. 18, T. 2 S., R. 18 E., about 3 miles west-southwest of Snow, Pushmataha County.

August 21—Camped near the center of sec. 14, T. 1 S., R. 17 E., on a high hill in Pushmataha County.

August 22—Followed the ridge northeastward through the Pushmataha County State Game Refuge, dropping down to the Kiamichi River at 4 o'clock, probably camping on the north side of the Kiamichi, southeast of Clayton, in the SE $\frac{1}{4}$ sec. 6, T. 1 N., R. 19 E., Pushmataha County.

Upon approaching the Clayton area, Smith (1959, p. 382) quotes La Harpe's report on the latter part of the day: "We entered afterwards into a beautiful prairie, confined by mountains, which passes through the land of the Illinois; they may have in this place thirty leagues width from north to south, and, according to all appearances, there are metallic mines, judging from the different colors of the ground, the marcasites that are found there, and the assurances that the savages have given. The route for this day has been northeast, a quarter north, five leagues."

Shales of the Stanley Group occur in the valley, but the marcasites may have weathered down from higher geologic units. Metallic mines are unknown in the area, and possibly La Harpe meant "min-

erals" instead of "mines," although the words by Margry (1888, p. 283) are "des mines métalliques."

August 23—The group moved northward, probably making camp in the W½ sec. 13, T. 2 N., R. 18 E., Pushmataha County, just below the intersection of Jackfork and Anderson Creeks.

August 24—As Smith (1959, pp. 382–383) translates La Harpe: "The 24th, we continued to advance into the plain to a very thick forest near a stream which it was necessary to cross; in the afternoon (p. 383) we entered into mountains very difficult to pass, because of the denseness of the forest and of the overthrown rocks that are found there, in addition to the fact that this dale goes always upward; there perished two of our horses. At five o'clock in the evening we camped in this dale near a stream at the foot of several mountains. I had had the precaution to carry a big hammer for breaking open rocks in which it would be possible to find some metal; I found in this place several blackish marcasites, speckled inside with some grains verging toward gold, and spotted with white metal. I collected some and I do not doubt at all that, even though there would not prove to be any metal in these rocks, they do not fail to indicate mineral sources. We made this day five leagues toward the northwest."

They probably made camp, on the 24th, close to the center of sec. 14, T. 3 N., R. 17 E., Latimer County, on the West Fork of Anderson Creek. The marcasites would have come from the Lynn Mountain Formation (=lower Atoka).

August 25—The group proceeded northwestward, to a gap in the Wapanucka Limestone, about 1 mile southeast of Hartshorne Lake, probably making camp in the SE¼ sec. 19, T. 4 N., R. 17 E., Pittsburg County.

August 26—They marched northwestward, probably making camp on Peaceable Creek in the NE¼ sec. 4, T. 4 N., R. 16 E., Pittsburg County.

August 27—The group traveled again northwestward, passing Bald Knob in the NW¼ sec. 29, T. 5 N., R. 16 E., probably making camp on Coal Creek in the SE¼ sec. 11, T. 6 N., R. 14 E., Pittsburg County.

August 28—They marched northeastward, and may have camped on Rock Creek in sec. 8, T. 7 N., R. 15 E., Pittsburg County.

August 29—They moved northeastward again to the mouth of Gaines Creek on the Canadian River, probably making camp in sec. 34, T. 9 N., R. 16 E., Pittsburg County. Here they found a Naouydiche party already in camp at the site. Smith (1959, p. 385) translates La Harpe: "I showed them the marcasites that I had collected in the mountains; they assured me that in the same range to the northeast of where I had passed they had had knowledge of several very weighty metallic rocks."

August 30—They remained in camp, and the following day the two parties journeyed northward together.

August 31—They probably made camp in the SW¼ sec. 23, T. 11 N., R. 15 E., on the south side of the North Canadian River.

September 1—They probably made camp on the edge of Council Hill, in the NW¼ sec. 4, T. 12 N., R. 15 E., McIntosh County.

September 2—They proceeded northward, probably passing a local mine in the Tebo coal in the SW¼ sec. 13, T. 14 N., R. 15 E., south of Cane Creek, Muskogee County. They may have camped that night on Ash Creek in the SW¼ sec. 11, T. 15 N., R. 15 E., Muskogee County.

September 3—They marched eastward to where Coal Creek and Concharty Creek probably once met, but this junction has since been destroyed by the Arkansas River, and it is probable that at this time the Arkansas was 2 to 3 miles farther east on the east cutbank. They marched about 3 leagues north-northeast, probably to secs. 1–3, T. 16 N., R. 15 E., and S½ sec. 35, T. 17 N., R. 15 E., about 2 to 5 miles east-northeast of Stone Bluff, Wagoner County, where they met 6,000 to 7,000 Indians of many nations under a Touacara chief.

La Harpe remained for 10 days with the Indians on the bank of the Arkansas River, learning much about the Spanish and the region to the west, and making an alliance with the Indian nations. Smith (1959, p. 531) translates La Harpe:

They confirmed to me that at the headwaters of their river at some days journey, one found salt in the rock, verdigris and ultramarine blue, but that there was risk for them to go there, because of the Cancy who passed by these places to go to war against the Padoucas. One of the chiefs assured me that there was a hill at six days journey from the village, where there was gold, which the Spaniards esteemed highly. He gave me one of the stones, which he had in his cabin by chance [p. 534]. From the Nassonites to the Touacaras it is 110 leagues by road . . . southeast and northwest.

La Harpe returned by his same route, arriving at the Nassonite Post on October 13, 1719. He returned to Mobile and began rewriting his notes in 1720, evidently discarding his original field notes, according to Wedel (1978, p. 2). The only extant manuscript of La Harpe's 1718–1720 journal is a copy in the Bibliothèque Nationale (no. 8989, fols. 1–36) in Paris, France. The copy, however, is not in La Harpe's handwriting. Margry (1888, p. 239–306) published the manuscript copy in French, but made alterations, deletions, and additions. Lewis (1924) and Smith (1958–59) translated the Margry account into English. The original manuscript copy has not been published, nor has a translation of this copy; therefore, I have had to rely on Lewis, Smith, and Margry in preparing this account of La Harpe's journey.

After several other expeditions in Texas and Arkansas, La Harpe returned to France on February 12, 1723, and, according to Wedel (1971, p. 59), died on September 26, 1765, at age 82, at St. Malo.

References Cited

- Bénard de La Harpe, Jean-Baptiste**, 1718–20, *Journal Du Voyage De la Louisianne fait Par Le Sr Bernard De La Harpe Et Des DeCouvertes Qu'il a fait Dans la Party De l'ouest De Cette Colonie*: Bibliothèque Nationale, MSS copie Francais 8989, fols. 1–36, Paris.
- Lewis, Anna**, 1924, La Harpe's first expedition in Oklahoma, 1718–19: *Chronicles of Oklahoma*, v. 2, no. 4, p. 331–349, 1 map.
- Margry, Pierre**, 1888, Bénard de La Harpe, envoyé pour établir le poste des Cadodaguiens, cherche à reconnaître la source de la Rivière Rouge et celle de l'Arkansas. Il contracte alliance avec plusieurs nations voisines du Nouveau Mexique. Sa réception chez les Youacaras; *in* *Découvertes et établissements des Français dans l'Ouest et dans le sud de l'Amérique septentrionale (1614–1754)*, Mémoires et documents originaux, vol. 6, Exploration des affluents du Mississippi et découverts des Montagnes Rocheuses (1679–1754), Chapter 7, p. 239–306, Maisonneuve et Ch. Leclerc, editors, Paris.
- Miroir, M. P., Harris, R. K., Blaine, J. C., McVay, Janson, and others**, 1973, Bénard de la Harpe and the Nassonite Post: Southern Methodist University, Dallas, Texas, *Texas Archeological Society Bulletin* 44, p. 113–167, 10 figs., 6 tables.
- Sibley, John**, 1805, Documents to show that the settlement of Bayou Pierre, on the Red River, at which a principal aggression took place, was originally made by France, while possessing Louisiana, and came to the possession of Spain only by the general delivery of Louisiana to her, and as a part of it: United States Congress, *American State Papers, Class I, Foreign Relations*, v. 2, No. 191, p. 692–694, edited by Walter Lowrie and Matthew St. Clair Clarke, published in 1832, Washington, D.C.
- (Page 693, "Francois Grappe, of Campti . . . , aged 57 . . . saith, . . . he was born near the ancient Caddo village, on Red river, which, by the course of the river, he believes to be upwards of five hundred miles above Natchitoches, where his parents then lived, and had lived, he believes, a number of years before he was born, and where they continued to live until he was sixteen or seventeen years of age. As long as he can remember, he recollects a Mr. Francois Harvey, a French gentleman, living there, and who, he understood, was the first white man that settled there; and that his father settled there about two years after. But he always understood there had been a company of French traders settled, for a number of years, about forty miles higher up the river, and that Mr. Harvey was one of them, but they were broken up before he was born; it was always called *the Company*: And that, during the whole time he lived at the ancient Caddo village, there were three settled families, besides a number of single persons, and a detachment of soldiers; and that the number of soldiers assigned by the French Government for that post was always fifteen, but he never knew the number complete; and that his father was commandant of the place for many years, and was succeeded by a Mr. Closo, who continued to be commandant until it was abandoned, after the cession of Louisiana to Spain; and that his father, by order of the then Governor of Louisiana, built a small fort there, in which were two small pieces of cannon, and in which was a flag-staff, on which the French flag was occasionally hoisted; he believes that the whole time that this place was occupied by the French as a military post and a settlement of families was about thirty years . . . there was a pair of excellent European mill-stones and mill-irons there, but were not in use in his time; the stones he himself brought down

- in the year 1778, and they were carried to *Opelousas*; he understood they had been carried to the Caddo country by the Company, as it was called.”)
- (Page 692, “Julien Besson, an inhabitant of Campti . . . aged 57 . . . well recollects being carried from Natchitoches, by his father, to the ancient Caddo village, commonly called, by the course of the river, about one hundred and seventy leagues above Natchitoches on Red river; and that, at that time, there were there living several French families and some soldiers: the number of soldiers he does not remember, but only that it was a sergeant’s command, (which sergeant was then his father); and that his father by order of the then French Governor General of Louisiana, built a small fort at said place, erected a flag-staff, on which the French flag occasionally used to be hoisted; the name of the fort was called *St. Louis de Carloretto*; and that, from the appearance of the place, and everything he heard and understood about it, the establishment had been made for a considerable number of years before he went there, which is more than fifty years ago; and that he lived there fourteen or fifteen years during all which time there was continued a detachment of French soldiers there, with a number of French families, who continued to cultivate corn, tobacco, and garden vegetables, and that he recollects two small pieces of cannon being there, and one of them bursting by firing; and he believes the other slipped into the river, by an excavation of its bank, as it lay near the edge of the bank; and that he recollects there being some mill-stones there, but has no remembrance of seeing them in use . . . and that the settlement at the old Caddo village was abandoned about thirty-eight years ago, and he believes the cause of their removal was . . . the families were desirous their children should have the benefit of a better society.”)
- These and other depositions show that there were two forts northwest of Texarkana, and that La Harpe’s Nassonite Post was about 40 miles upstream from *Fort St. Louis de Carloretto*.
- Other reports by Sibley (1805, American State Papers, class 2, Indian Affairs, v. 5, p. 721, 725, 729) and Thomas Freeman and Peter Custus (1806), in a report to the U.S. War Office on their explorations of the Red River in Louisiana, locate *Fort St. Louis de Carloretto* between Clear Lake and the Old Sag, about 15 miles northwest of Texarkana, on the south side of the river.
- Smith, Ralph A.**, translator and annotator, 1958-59, Account of the journey of Bénard de la Harpe; discovery made by him of several nations situated in the west: Southwestern Historical Quarterly, v. 62, no. 1, p. 75-86, July 1958; no. 2, p. 246-259, October 1958; no. 3, p. 371-385, January 1959; no. 4, p. 525-541, map, April 1959.
- Thoburn, Joseph B.**, 1916, A standard history of Oklahoma: American Historical Society, Chicago and New York, (5 volumes, 2192 p.) v. 1, p. 20-21.
- U. S. Geological Survey**, 1950 [photorevised 1970 and 1975], Redbanks quadrangle, Texas-Arkansas, 7.5-minute series topographic map, scale 1:24,000.
- 1950 [photorevised 1970 and 1975], Ogden quadrangle, Arkansas-Texas, 7.5-minute series topographic map, scale 1:24,000.
- Wedel, Mildred Mott**, 1971, J.-B. Bénard, Sieur de la Harpe: visitor to the Wichitas in 1719: Great Plains Journal, v. 10, no. 2, Spring 1971, p. 37-70, 1 map. (Published by the Institute of the Great Plains, Museum of the Great Plains, Elmer Thomas Lake, Lawton, Oklahoma.)
- 1978, La Harpe’s 1719 post on Red River and nearby Caddo settlements: Texas Memorial Museum, University of Texas at Austin, Bulletin 30, 20 p., 5 figs.
- Woodson, John P.**, 1964, Areal geology of the southwest Pickens area, Pushmataha County, Oklahoma: University of Oklahoma, unpublished M.S. thesis, 81 p.

Oklahoma Editors Attend AESE Meeting in Halifax



The Lighthouse at Peggy's Cove, Nova Scotia. (Ink drawing by Roy D. Davis.)

Three members of the Oklahoma Geological Survey editorial staff and one faculty member from the OU School of Geology and Geophysics attended the 14th Annual Meeting of the Association of Earth Science Editors (AESE) in Halifax, Nova Scotia, during October.

OGS Geologist-Editor William D. Rose, Associate Editors Elizabeth A. Ham and Connie G. Smith, and OU Associate Professor Jiri Zidek participated in the various sessions and workshop. Zidek is editor of the *Journal of Vertebrate Paleontology*, a new journal which is scheduled to begin publication early in 1981.

Other Oklahoma delegates to the meeting included: Grace Hower, AAPG, Tulsa; Ron Hart, AAPG, Tulsa; Jerry Henry, *Geophysics* (SEG), Tulsa; AESE President Gary D. Howell, Erico, Tulsa; and workshop leader Thomas Warren, director of the technical writing program at OSU.

A wide range of topics related to the preparation of geologic manuscripts for publication was covered in the sessions, with papers presented ranging from such subjects as Orrin Pilkey's "The Volunteer Editor and the Associate Editor Review System: Hatcheting Your Best Friend's Paper" to "Geology as Journalism," by Wendell Cochran of *Geotimes*.

The Canadian hosts of the meeting arranged a boat tour of the harbor and a reception given by the Government of Nova Scotia at the historic Province House, Canada's oldest seat of government.

An afternoon field trip down the "Lighthouse Route" included a stop at Peggy's Cove, where the editors were warned not to stray too near the water's edge, and to avoid the slippery granite where sightseers have been

swept out to sea by particularly high waves. The group stopped at the Shore Club at Hubbard's Beach for a dinner that included your choice of lobster (2 per person!) or steak.

Those staying on after the conference were given the opportunity to tour the well-known Bedford Institute of Oceanography, which is located in Dartmouth, across the harbor from Halifax.

The meeting was both productive and enjoyable, and the earth sciences in Oklahoma were well represented.

Survey Employees Receive Promotions



Gwen Williamson



Helen Brown

Dr. Charles J. Mankin, director of the Oklahoma Geological Survey, recently announced that Helen Brown, of the Survey staff, has accepted a new position as assistant to the director. Gwen Williamson, another Survey staff member, has been promoted to the position of office manager, the title formerly held by Helen.

As assistant to the director, Helen will provide overall management of the budget affairs of the organization as well as carry out the routine operations of the Director's office. In addition, she has been assigned the responsibility for overall coordination of classified staff positions. She has been with the Survey since 1963, when she left the University Alumni office.

In assuming the position of office manager, Gwen will be responsible for delegating duties to the office staff, as well as taking care of paperwork for the grants and contracts awarded to the Survey. Formerly an employee of the OU Press, she has been with the Survey since 1966.

Congratulations are in order to both Gwen and Helen. Their efforts to implement programs, solve problems and untangle paperwork are always appreciated by the Survey staff.

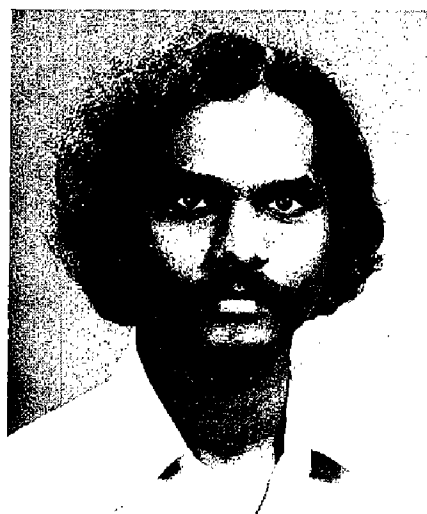


Michael W. Lambert



Mahota Lynn Prater

Three Geologists Join OGS Staff



Raja P. Reddy

Michael W. Lambert, Mahota Lynn Prater, and Raja Palpunuri Reddy are recent additions to the professional staff of the Oklahoma Geological Survey.

Mike Lambert, a native of Manhattan, Kansas, earned a B.S. in geology from Kansas State University at Manhattan and an M.A., also in geology, from Indiana University in Bloomington. He was awarded the Arthur B. Sperry scholarship in geology at KSU, and at Indiana University he served as a teaching assistant in earth materials and processes, metalliferous minerals, geochemistry, and geochemical exploration.

He has logged cores for the Kansas Geological Survey while working during the summer as a research assistant, and was again employed by the Kansas survey while preparing his master's thesis, *Copper Sulfides in the Permian Redbeds of Kansas*, for publication. This report is now in press and will be issued by KGS as a two-part bulletin: Part I, *Stratigraphy and Host*

Rock Lithology, was co-authored with Pieter Berendsen; and Part II, *Ore Mineralogy*, was written with Berendsen and E. M. Ripley. Another report, "Mineralogy and Paragenesis of Red-Bed Copper Mineralization in the Lower Permian of South Central Kansas," also prepared in cooperation with Ripley and Berendsen, was published in *Economic Geology*, v. 75, p. 722-729.

Since coming to the Oklahoma Geological Survey, Mike has been conducting investigations in vitrinite reflectance of the Devonian-age Woodford Shale in the western half of the State. He will also be identifying the various constituents of eastern Oklahoma coal samples by means of reflected light.

Mike is a member of The American Association of Petroleum Geologists and Sigma Gamma Epsilon.

Lynn Prater received her B.S. degree in education and natural sciences from Panhandle State College at Goodwell, Oklahoma, and earned an M.S. in earth science from East Texas State University, Commerce. She has taken additional courses in earth science and computer science while at East Texas State. She served as assistant instructor and interim instructor of geology at East Texas State and as teaching assistant and part-time instructor at Tarrant County Junior College, Fort Worth. She came to OGS from an East Texas State instructorship that involved teaching an introductory course in computer science and Fortran in the Computer Science Department and serving as director of the Learning Center for the Earth Science Department.

Lynn's hobbies are horseback riding, camping, and swimming. At Tarrant County Junior College she helped organize and instruct backpacking-geology mini-courses for trips into the Grand Canyon, Big Bend, and Grand Teton areas.

Raja is from Hyderabad, India. He has both B.S. and M.S. degrees in geology from Osmania University in Hyderabad, where he concentrated on petroleum geology. In August of this year he received a second M.S., this time in petroleum engineering, from The University of Oklahoma, with emphasis on petroleum evaluation and management, drilling engineering, and reservoir engineering. At OU, he served as a teaching assistant and as a research specialist in the Energy Resources Center's Information Systems Programs, where he helped to develop the oil- and gas-field data file and to analyze statistics on production and reserves. He received the Outstanding Graduate Student Award in petroleum engineering and the Outstanding International Student Award at OU as president of the Indian Student Association.

In India, Raja worked as a technical geologist for the Indian government's Council of Scientific and Industrial Research at New Delhi, evaluating petroleum prospects and analyzing well logs and cores. He studied geophysical-prospecting methods at the Geophysical Research Institute at Hyderabad and geochemical-prospecting methods at the Geological Survey of India.

He is a member of the Society of Petroleum Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers and of the Indian Geological Society.

Lynn and Raja have been working on an evaluation of data on surface and subsurface water resources in and near Oklahoma oil fields, part of a hydrologic study that will provide information essential to the development of enhanced oil-recovery operations. The pilot project selected for investigation is the Cement Field in Caddo and Grady Counties, in the Anadarko Basin, which has yielded production from 1,400 wells in a 30-square-mile area, with reservoirs ranging in depth from 2,000 to 6,000 feet into rocks of Permian through mid-Mississippian age. Data for this evaluation are being recovered from many sources, including published works, data files, completion records, log files, and industry records.

It is very good to have Mike, Lynn, and Raja with us, and we welcome them to the Oklahoma Geological Survey and to the community.

OU College of Geosciences to Open for Fall Semester

The University of Oklahoma, home of the world's first school of petroleum geology, is gearing up to meet the needs of the future with a new College of Geosciences that is scheduled to be in operation by the fall semester of 1981.

The new college will include geology, geophysics, geochemistry, meteorology, geography, and other academic programs related to these areas. Although exact curriculum plans are not final, spokesmen for OU suggested that a new mineral-economics program may also be added to the college.

By grouping the departments into a single college, the University hopes to foster greater cooperation among the programs while making them more effective and more visible.

OU President William S. Banowsky said that although OU's School of Petroleum and Geological Engineering will remain in the College of Engineering, it will be closely related to the new college.

President Banowsky has talked of a "renaissance" in energy education and called on the new academic unit to "train future leaders of the energy industry in all phases of energy production."

"I believe, through a combination of private and public support, we can design and construct a center that will focus our efforts in training future leaders for the energy industry. This is an idea that is so important to the University, State, and nation that it should fire the imagination of all our alumni and friends," he said.

"Oklahoma needs and deserves a top-rate Energy Center and it needs it now," Banowsky said, citing statistics that show how Oklahoma benefits

from the energy industry. Last year, Oklahoma ranked second only to Texas in drilling activity, with almost 6,500 wells drilled in the State.

The University currently plans to house the new college in an Energy Center that will be built just south of Gould Hall, the current home of the Oklahoma Geological Survey and the School of Geology and Geophysics. The new structure possibly will be patterned after OU's Dale Hall classroom and office buildings.

The finished building complex, which will include Gould Hall, will provide classrooms and office space for the Oklahoma Geological Survey; the Energy Resources Center; the Oklahoma Mining and Minerals Resources Research Institute; the Schools of Geology and Geophysics, Meteorology, Geography, and Petroleum and Geological Engineering; a computer facility; the Survey's core and sample library; and the geology library.

Of the \$30 million needed to build the center, the University plans to solicit \$20 million from private sources and \$10 million from State and federal funds.

The plan has been well received and has garnered strong support from many groups. The Oklahoma State Regents for Higher Education have encouraged the University to proceed as rapidly as possible with the project.

"The next 20-25 years will be a difficult time for the nation in facing the energy situation," Regent Jack Patten, of Norman, said. "It is the obligation of higher education to do what it can to seek solutions."

INDEX¹

Volume 40, 1980

abstracts	
AAPG Mid-Continent Section meeting	40, 176
AAPG-SEPM-EMD annual meeting	201
GSA annual meeting	117
GSA North-Central Section meeting	72
GSA Southeastern Section meeting	71
IXICC (Ninth International Carboniferous Congress)	31
Oklahoma State University	42
Society for American Archaeology annual meeting	213
University of Oklahoma, The	118
Adler, Frank J., <i>see</i> Rascoe, Bailey, Jr., and Adler, Frank J.	
Al-Shaieb, Zuhair, <i>see</i> Cox, Roy, and Al-Shaieb, Zuhair	
American Association of Petroleum Geologists, The	
annual meeting	67, 201, 210

¹Reference is to first page of article containing indexed item.

<i>Currents in Submarine Canyons and Other Seavalleys</i>	63
Mid-Continent Section meetings	40, 176
new officers	200
<i>Paleoclimate, Paleomagnetism, and Continental Drift</i>	63
<i>Problems of Petroleum Migration</i>	175
publications	63, 175, 193
<i>Stratigraphic Traps in Carbonate Rocks</i>	175
American Geological Institute	
GeoRef	71, 190
<i>Glossary of Geology</i> revised	172
<i>Mineral and Energy Resources of the USSR: A Selected Bibliography of Sources in English</i>	70
publications	70, 172
Amsden, Thomas W., author of <i>Hunton Group (Late Ordovician, Silurian, and Early Devonian) in the Arkoma Basin of Oklahoma</i>	219, 238
Anadarko Basin, tectonics	117
annual report, Oklahoma Geological Survey	217
Arbenz, J. Kaspar—Fresh Look at Some Ouachita Problems [abs.]	201
Arbuckle Mountains	
Mississippian–Pennsylvanian boundary	36
Tishomingo Granite	78
zinc deposits, mineralization	72
Ardmore Basin, Mississippian–Pennsylvanian boundary	36
Ardmore Geological Society, new officers	197
Arkoma Basin, Hunton Group	219, 238
Arndt, Robert H., new director of OMMRRI and OGS geologist	219
Association of Earth Science Editors, annual meeting	262
Avis, Loren E., and Booth, D. R.—Promising Morrow Sandstone Discoveries in Southeastern Colorado [abs.]	202
Axtmann, Tyrrell Charles—Structural Mechanisms and Oil Accumulation Along the Wayne Fault, South Central Oklahoma [abs.]	210
Bailey, J. Bowman, and Sandberg, Phillip A.—Preserved Mineralogy and Ultrastructure in Two New Pennsylvanian Bivalves [abs.]	31
Barker, Colin, <i>see</i> Lipstreuer, Kenneth A., and Barker, Colin	
Bartley, John W.—Phenetic Analysis of <i>Fistulipora</i> (Bryozoa) from the Henryhouse Formation (Silurian) of Southcentral Oklahoma [abs.]	73
Bennison, Allan P.—Mobile Basin–Shelf Border Area in Northeast Oklahoma During Desmoinesian Sedimentation [abs.]	31
Bergman, DeRoy L., co-author of OGS Hydrologic Atlas 7	238
Bernard, Bernie B., <i>see</i> Silver, Burr A., Bernard, Bernie B., and Drexler, Timothy	
bibliographies	
Oklahoma geology, 1979	123
theses and dissertations, Appalachian Basin geology	215
theses in science	76
Bingham, Roy H., co-author of OGS Hydrologic Atlas 7	238
Bloch, Salman—Ogallala Ash Outcrop in Ellis County [cover-photo description]	122
Bloch, Salman, and Johnson, Kenneth S.—Distribution and Alteration of Ogallala Volcanic-Ash Deposits and Their Possible Relation to Uranium Mineralization in Western Oklahoma [abs.]	203
Booth, D. R., <i>see</i> Avis, Loren E., and Booth, D. R.	
Bradley, Reta, <i>see</i> Stout, John, and Bradley, Reta	
Bridges, Kenneth F.—The Areal Geology and Cretaceous Stratigraphy	

of Southern Marshall County, Oklahoma [abs.]	118
Brown, Helen D., assumes position of assistant to director of OGS	263
Cambrian	
Butterly Formation	72
Royer Dolomite	72
Chadwick, A. V.—An Efficient Device for Heavy-Liquid Separation	64
coal	
Chelsea Quadrangle	42
coalbed gas, Hartshorne coals	32, 34
Desmoinesian coal cycles	31
mining problems, Hartshorne Formation	209
Oklahoma Geological Survey programs	219
plant fossils in coals	37, 38
sphalerite in coals	73
underground coal mine, Le Flore County	66
zinc and cadmium in coals	33
Cobb, James C.—Geology of Sphalerite in Coal [abs.]	73
Coney, Peter J., <i>see</i> Kluth, Charles F., and Coney, Peter J.	
Conservation Education Association convention	114
copper, Permian red beds	191
Coquel, Robert, <i>see</i> Owens, Bernard, Loboziak, Stanislas, and Coquel, Robert	
counties	
all counties	
earthquakes	95
petroleum and natural gas	241
Alfalfa	
Aline-Lambert Fields	207, 211
Great Salt Plains, lacustrine delta	40
Bryan	
Woodbine Formation	3
Canadian	
petroleum and natural gas	241
epicenter of earthquakes, 1979	95
Carter	
petroleum	241
Cherokee	
Pitkin Limestone and Fayetteville Shale	119
Choctaw	
Woodbine Formation	3
Cleveland	
pollution management, Sutton Wilderness Area	213
Craig	
Quaternary geomorphology	79
Ellis	
Ogallala ash outcrop	122
Garfield	
petroleum and natural gas	241
Grady	
petroleum and natural gas	241
Grant	
Aline-Lambert Fields	207, 211
copper deposit	191
Haskell	
gas, Hartshorne Formation	34

Jefferson	
La Harpe expedition	255
Johnston	
Tishomingo Granite	78
Kiowa	
gastropod	19
La Harpe expedition	255
Latimer	
La Harpe expedition	255
Le Flore	
gas	34
underground coal mine	66
McCurtain	
Devonian–Mississippian boundary	211
La Harpe expedition	255
Woodbine Formation	3
McIntosh	
La Harpe expedition	255
Marshall	
geology and Cretaceous stratigraphy	118
Woodbine Formation	3
Murray	
White Mound, photo	45
Muskogee	
La Harpe expedition	255
Pitkin Limestone and Fayetteville Shale	119
Noble	
<i>Geology and Mineral Resources of Noble County, Oklahoma,</i>	
Oklahoma Geological Survey Bulletin 128	43, 238
Nowata	
Quaternary geomorphology	79
Okmulgee	
Henryetta coal, plant fossils	37
Osage	
fossil fish	185
Pittsburg	
La Harpe expedition	255
Pontotoc	
fossil bivalves	31
Pushmataha	
La Harpe expedition	255
Roger Mills	
petroleum and natural gas	241
Rogers	
Plumb Creek Valley	79
Quaternary geomorphology	79
Stephens	
petroleum	241
Texas	
natural gas	241
Tulsa	
plant fossils in coals	38
Wagoner	
Pitkin Limestone and Fayetteville Shale	119
crinoid	107

Woods	
natural-gas bubbles	1, 2
petroleum and natural gas	241
Cox, Roy, and Al-Shaieb, Zuhair—Stratabound Copper in Lower Permian Red Beds, North-Central Oklahoma	191
Cretaceous	
Antlers Formation	47
Dakota Sandstone	47
Marshall County	118
Tokio Formation	47
Woodbine Formation, southern Oklahoma	3
Cuffey, Roger J., <i>see</i> Hall, William B., and Cuffey, Roger J.	
Davis, Roy D., honored at awards ceremony	115
Deep Sea Drilling Project (DSDP)	17
Deul, Maurice—Coalbed Derived Natural Gas in Conventional Gasfields [abs.]	32
Devonian	
Arkansas Novaculite	47, 209, 211
Devonian–Mississippian boundary	211
Hunton Group, Arkoma Basin	238
Woodford chert	209
Drexler, Timothy—The Diagenesis and Environments of Deposition of the Oswego Limestone, Aline–Lambert Field, Alfalfa and Grant Counties, Oklahoma [abs.]	211
Drexler, Timothy, <i>see</i> Silver, Burr A., Bernard, Bernie B., and Drexler, Timothy	
Dutton, Shirley P., <i>see</i> Handford, C. Robertson, Presley, Mark W., and Dutton, Shirley P.	
earthquakes	
catalog, 1979	95
correlation of epicenters with Landsat lineaments	212
general, 1979	95
Mount St. Helens	179
Oklahoma Geophysical Observatory recordings	95, 179
English, Otis, named new chief mine inspector	110
environmental geology	
<i>Disposal of Industrial Wastes in Oklahoma</i> , OGS Circular 80	238
mining problems, Hartshorne Formation	209
natural-gas eruption, Woods County	1, 2
oil-well-pollution management, Cleveland County	213
Oklahoma Geological Survey programs	219
Fay, Robert O.—Geologic and Historic Notes on the La Harpe Expedition into Oklahoma in 1719	255
Feinstein, Shimon, Harrison, William E., and Thompson, Thomas L.—Subsidence and Thermal History of Southern Oklahoma Aulacogen—Implication for Petroleum Exploration [abs.]	203
gas hydrates	17
geochemistry	
helium analysis, use of, in prospecting	207
lacustrine delta, Great Salt Plains	40
prospecting for stratigraphic petroleum traps	40
geological societies, new officers	196
Geological Society of America, The	
annual meeting	117
<i>Geology in the Siting of Nuclear Power Plants</i>	62

publications	62
section meetings	71, 72
geomorphology, Quaternary, northeastern Oklahoma	79
Geophysical Society of Oklahoma City, new officers	197
Geophysical Society of Tulsa, new officers	197
GeoRef	71, 190
geothermal-resources investigation in Oklahoma	219, 238
<i>Glossary of Geology</i> , revised edition	172
Great Salt Plains, lacustrine delta	40
Hall, Stephen A.—Pollen Evidence for Late Holocene Environments in the Southern Plains [abs.]	213
Hall, William B., and Cuffey, Roger J.—Species-Level Bryozoan Assemblages in the Wreford Megacyclothem (Lower Permian) of Kansas, Oklahoma, and Nebraska [abs.]	33
Ham, Elizabeth A.—Bibliography and Index of Oklahoma Geology, 1979 AGI Issues New Glossary	123 172
Handford, C. Robertson, Presley, Mark W., and Dutton, Shirley P.— Depositional and Tectonic Evolution of a Basement-Bounded, Intracratonic Basin, Palo Duro Basin, Texas [abs.]	204
Hansen, Michael C.—New Occurrences of the Petalodontiform Chondrichthyan <i>Megactenopetalus</i> in the Pennsylvanian of Oklahoma and Kansas	185
Harrison, William E., attends USGS resource-appraisal meeting recipient of DOE geothermal-energy project grant	169 240
Harrison, William E.—Gas Hydrates Described from DSDP leg 67 Geochemical Prospecting for Stratigraphic Traps [abs.]	17 40
Harrison, William E., <i>see</i> Feinstein, Shimon, Harrison, William E., and Thompson, Thomas L.	
Hatch, Joseph R.—Distribution of Zinc and Cadmium in Coals from the Eastern and Western Regions, Interior Coal Province [abs.]	33
Haun, John D.—Petroleum Geology in 1980's [abs.]	204
heavy-liquid-separation technique	64
Heckel, Philip H.—Paleogeography of Eustatic Model for Deposition of Mid-Continent Upper Pennsylvanian Cyclothem [abs.]	206
helium analysis in energy prospecting	207
Hemish, LeRoy A.—Observations and Interpretations Concerning Quaternary Geomorphic History of Northeastern Oklahoma	79
Highway Geology Symposium, 31st	109
Hinkle, M. E., <i>see</i> Reimer, G. M., Roberts, A. A., and Hinkle, M. E.	
history	
Cushing–Drumright petroleum area, monument	30
Gould, Charles Newton	46
La Harpe expedition into Oklahoma	255
Miser, Hugh Dinsmore	45, 46
Monnett, Victor Elvert	69
Houseknecht, David W., and Iannacchione, Anthony T.—Anticipating Coal Mining Problems in Hartshorne Formation, East-Central Oklahoma, Using Sedimentary Facies Analysis [abs.]	209
Huffman, George G.—Stratigraphy of the Woodbine Formation (Upper Cretaceous), Southern Oklahoma	3
Iannacchione, Anthony T., and Puglio, Donald G.—Geologic Association of Coalbed Gas and Natural Gas from the Hartshorne Formation in Haskell and Le Flore Counties, Oklahoma [abs.]	34
Iannacchione, Anthony T., <i>see</i> Houseknecht, David W., and Iannacchione, Anthony T.	

indexes	
geology theses and dissertations, Appalachian Basin	215
Oklahoma geology, 1979	123
water-data acquisitions	196
Johnson, Kenneth S.—Precambrian Granite in the Arbuckle Mountains [cover-photo description]	78
Ward Padgett Leaves Department of Mines	110
Johnson, Kenneth S., co-author of OGS Circular 80, <i>Disposal of Industrial Wastes in Oklahoma</i>	219, 238
receives distinguished achievement award	174
Johnson, Kenneth S., <i>see</i> Bloch, Salman, and Johnson, Kenneth S.	
Jurassic	
Exeter Sandstone	47
Morrison Formation	47
Keasler, Walter Robin—Coal Geology of the Chelsea Quadrangle in Parts of Craig, Mayes, Nowata, and Rogers Counties, Oklahoma [abs.]	42
Kluth, Charles F., and Coney, Peter J.—Plate Tectonics of the Ancestral Rocky Mountains [abs.]	117
La Harpe expedition	255
Lambert, Michael W., joins OGS staff	264
Lane, H. Richard, and Nemirovskaya, Tamara I.—Correlation of Early Pennsylvanian Conodont Sequences between Europe and North America [abs.]	38
Lawson, Jim—Geophysical Observatory Establishes Continuous Time Synchronization	214
Oklahoma Observations of May 18, 1980, Eruption of Mount St. Helens	179
Lawson, James E., Jr., and Luza, Kenneth V.—Oklahoma Earthquakes, 1979	95
lineament map, north-central Oklahoma	212
Lipstreuer, Kenneth A., and Baker, Colin—Geochemistry of Small Lacustrine Delta, Great Salt Plains, Alfalfa County, Oklahoma [abs.]	40
<i>Lithostratigraphic Analysis of Sedimentary Basins</i>	196
Loboziak, Stanislas, <i>see</i> Owens, Bernard, Loboziak, Stanislas, and Coquel, Robert	
Luza, Kenneth V., co-author of OGS Circular 80, <i>Disposal of Industrial Wastes in Oklahoma</i>	219, 238
Luza, Kenneth V., <i>see</i> Lawson, James E., Jr., and Luza, Kenneth V.	
McAlester Quadrangle, DOE report	75
McHargue, T. R.—A Reconstruction of the Unusual Apparatus of <i>Histiodellla</i> [abs.]	74
<i>Man and the Biosphere</i>	175
Manger, Walter L., and Sutherland, Patrick K.—The Mississippian– Pennsylvanian Boundary in the Southern Midcontinent, United States [abs.]	34
Manger, Walter L., and Thompson, Thomas L.—Lower Mississippian Carbonate Shelf, Southern Missouri, Eastern Oklahoma and Northern Arkansas [abs.]	35
Manger, Walter L., <i>see</i> Sutherland, Patrick K., and Manger, Walter L.	
Mankin, Charles J.—Oklahoma Geological Survey Annual Report, July 1, . 1979–June 30, 1980	219
Mankin, Charles J., named chairman of Board on Mineral and Energy Resources	111
signs agreement with Technical University of West Berlin	174

<i>Master's theses in the Pure and Applied Sciences, v. 23</i>	76
mineral resources	
coal, <i>see</i> coal	
copper mineralization, Grant County	191
Oklahoma Geological Survey programs	219
OSM mining regulation grant	169
petroleum and natural gas, <i>see</i> petroleum and natural gas	
zinc mineralization, Arbuckle Mountains	72
Mississippian	
Arkansas Novaculite	47, 209
Boone Formation	47
carbonate shelf, Lower Mississippian	34
Devonian–Mississippian boundary	211
Fayetteville Shale	119
miospores	36
Mississippian–Pennsylvanian boundary	35, 36, 37
Pitkin Limestone	119
Stanley Formation	47, 211
USGS Professional Paper 1010, tectonics	71
USGS Professional Paper 1110—M-DD	193
Woodford chert	209
Morris, Robert C., and Sutherland, Patrick K.—The Mississippian–Pennsylvanian Boundary in the Ouachita Mountains and Ardmore Basin, Oklahoma and Arkansas [abs.]	36
Morrison, Lawrence S.—Oil Production from Fractured Cherts of Woodford and Arkansas Novaculite Formations, Oklahoma [abs.]	209
Mount St. Helens, Oklahoma recordings of earthquake	179
Munro, I., <i>see</i> von Bitter, P. H., and Munro, I.	
Murgatroyd, Carolyn D.—Significance of Silicified Carbonate Rocks near the Devonian–Mississippian Boundary, Ouachita Mountains, Oklahoma [abs.]	211
National Petroleum Council, <i>Materials and Manpower Requirements for U.S. Oil and Gas Exploration and Production—1979–1990</i>	62
National Uranium Resource Evaluation (NURE) project (DOE), open-file reports	66, 114
Nemirovskaya, Tamara I., <i>see</i> Lane, H. Richard, and Nemirovskaya, Tamara I.	
Oklahoma Academy of Science, annual meeting	215
Oklahoma City Geological Society, new officers	197
Oklahoma Department of Mines, new chief mine inspector	110
Oklahoma Geological Survey	
annual report, July 1, 1979–June 30, 1980	219
coal investigations	219
COSUNA project	219
geothermal-resources program	219, 240
industrial-waste-disposal investigation	219
mapping programs	219
mining inventories	219
Oklahoma Geophysical Observatory	95, 179, 214, 219
petroleum investigations and inventory	219
publications	43, 219, 238
public service	219
seismic programs	219
staff	115, 116, 173, 219, 263, 264
uranium investigations	219
water-resources investigations	219

Oklahoma Geophysical Observatory	
Mount St. Helens earthquake recordings	179
Oklahoma earthquake recordings	95
programs	219
time synchronization system	214
Oklahoma Mining and Minerals Resources Research Institute (OMMRRI),	
new director	219
Oklahoma State University, abstract	42
Oklahoma Water Resources Board, Publication 94-S, <i>Synopsis of the</i>	
<i>Oklahoma Comprehensive Water Plan</i>	75
Ordovician	
Butterly Formation	72
Cool Creek Formation, paleontology	19
Hunton Group, Arkoma Basin	238
Joins Formation, conodont	74
Kindblade Formation, gastropod	19
Oread Megacyclothem	39
Orgren, April H.—Lithostratigraphy and Depositional Environments of	
the Pitkin Limestone and Fayetteville Shale (Chesterian) in	
Portions of Wagoner, Cherokee and Muskogee Counties,	
Oklahoma [abs.]	119
Ouachita Mountains	
Devonian–Mississippian boundary	211
Mississippian–Pennsylvanian boundary	36
petroleum	209
tectonics	117, 201
Owens, Bernard, Loboziak, Stanislas, and Coquel, Robert—Late	
Mississippian–Early Pennsylvanian Miospore Assemblages from	
Northern Arkansas [abs.]	36
Padgett, Ward, resigns as chief mine inspector	110
paleobotany (<i>see also</i> palynology), Pennsylvanian coals	37, 38
paleozoology	
conodonts	38, 39, 74
crinoidal bioherms, Lower Mississippian	34
crinoids	107
Mississippian–Pennsylvanian boundary	35, 36, 37
Mississippian–Pennsylvanian miospores	36
Ordovician gastropod	19
Pennsylvanian fish	34, 185
Permian bryozoans	33
Silurian bryozoan	73
Palo Duro Basin, Texas	204
palynology	
Holocene pollens, northeastern Oklahoma	213
miospores	36
Pennsylvanian coals	37, 38
Parker, R. G., <i>see</i> Simon, D. E., and Parker, R. G.	
Pennsylvanian	
Atoka Formation	47
coals	31, 32, 33, 34, 37, 38, 42, 209
conodonts, correlation with Europe	38
crinoid	107
Desmoinesian, coal cycles	31
Desmoinesian, sedimentation	31

Desmoinesian-Missourian boundary	38
Hartshorne Formation	32, 34, 209
helium analysis in prospecting	207
Henryetta coal, plant fossils	37
Jackfork Sandstone	47
McAlester Formation	47
miospores	36
Mississippian-Pennsylvanian boundary	35, 36, 37
molluscs	31
Morrowan reservoirs, well stimulation	41
Morrow sandstones, petroleum	41, 202
oil and gas traps	41
Oread Megacyclothem, conodont biofacies	39
Oswego Limestone, Aline-Lambert Fields	207, 211
Pitkin Formation	35
Red Eagle Limestone, fossil fish	185
Sausbee Formation, Braggs Member	35, 107
Upper Pennsylvanian cyclothems	206
zinc and cadmium in coals	33
Permian	
Blaine gypsum	47
Cloud Chief Formation	47
Dog Creek Shale	47
Duncan Sandstone	47
Flowerpot Shale	47
Garber Sandstone	47
Hennessey Shale	47
Marlow Formation	47
Pontotoc Group	47
Rush Springs Sandstone	47
Wellington Formation	47, 191
Wreford Megacyclothem, bryozoans	33
petroleum and natural gas	
Aline-Lambert Fields, Oswego Limestone	207, 211
coalbed gas, Hartshorne Formation	32, 34
Cushing-Drumright petroleum area, monument	30
geochemical prospecting	40, 207
giant oil fields	241
helium analysis in exploration	207
industry in 1980's	204
Marshall County	118
<i>Materials and Manpower Requirements for U.S. Oil and Gas</i>	
<i>Exploration and Production—1979-1990</i>	62
Morrow sandstone reservoirs	41, 202
natural-gas eruption, Woods County	1, 2
natural gas in Hartshorne Formation	34
Oklahoma Geological Survey programs	219
Pennsylvanian traps	41
petroleum-province folios	208
<i>Problems in Petroleum Migration</i>	175
<i>Salt Domes: Gulf Region, United States and Mexico</i>	106
statistics, 1979	241
<i>Stratigraphic Traps in Carbonate Rocks</i>	175
<i>USA Oil Industry Directory</i>	66
USGS OCS estimates	111
USGS resource-appraisal meeting	169

Wayne Fault trapping	210
well-stimulation study, Reydon-Cheyenne area	41
Woodford chert and Arkansas Novaculite reservoirs	209
Pliocene, Ogallala Formation	47, 122, 203
Posey, Harry H.—A Potential Heat Source for Mississippi Valley Type Deposits—an Example from the Arbuckle Mountains, Oklahoma [abs.]	72
Prater, M. Lynn—Statistics in Oklahoma's Petroleum Industry, 1979	241
Prater, Mahota Lynn, joins OGS staff	264
Precambrian, Tishomingo Granite	78
Presley, Mark W., <i>see</i> Handford, C. Robertson, Presley, Mark W., and Dutton, Shirley P.	
Preston, Donald A.—Black Mesa State Park [cover-photo description]	177, 178
Bursting Natural-Gas Bubble, Woods County, Oklahoma [cover-photo description]	1, 2
Geologists and Field Trips—Hats Off to a Long Tradition [cover-photo description]	46
Puglio, Donald G., <i>see</i> Iannacchione, Anthony T., and Puglio, Donald G.	
Quaternary, paleogeomorphology, northeastern Oklahoma	79
Rascoe, Bailey, Jr., and Adler, Frank J.—Controls on Pennsylvanian Hydrocarbon Accumulations in Mid-Continent [abs.]	41
Reddy, Raja Palpunuri, joins OGS staff	264
Reimer, G. M., Roberts, A. A., and Hinkle, M. E.—Recent Advances in Helium Analysis as Exploration Tool for Energy "Deposits" [abs.]	207
Rhodes, Lorna K.—Correlation between Vegetation and Geologic Formations in Oklahoma	47
roadside-geology guidebooks	195
Roberts, A. A., <i>see</i> Reimer, G. M., Roberts, A. A., and Hinkle, M. E.	
Roberts, John F., co-author of OGS Circular 80, <i>Disposal of Industrial Wastes in Oklahoma</i>	219, 238
rock types, general, association with vegetation	47
Rocky Mountain Association of Geologists, publishes book on Colorado geology	195
<i>Salt Domes: Gulf Region, United States and Mexico</i>	106
Sandberg, Phillip A., <i>see</i> Bailey, J. Bowman, and Sandberg, Phillip A.	
Sancaktar, Emre, joins OGS staff	173
seismicity	
earthquake recordings	95, 179, 219
Oklahoma Geological Survey programs	219
Shelton, John W., principal author of OGS Bulletin 128, <i>Geology and Mineral Resources of Noble County, Oklahoma</i>	43
Shoup, Robert C.—Correlation of Landsat Lineaments with Basement Structure and Earthquake Epicenters in Oklahoma [abs.]	212
Rain Doesn't Take Shine Off of 1980 OU Alumni Day	112
Silurian	
Blaylock Sandstone	47
Henryhouse Formation, bryozoan	73
Hunton Group, Arkoma Basin	219, 238
Missouri Mountain Shale	47
Silver, Burr A., Bernard, Bernie B., and Drexler, Timothy— Oswego Limestone, Aline-Lambert Fields, Oklahoma—Source, Reservoir, and Trap [abs.]	207

Simon, D. E., and Parker, R. G.—Stimulation Design for Upper Morrow Reservoirs in Reydon–Cheyenne Area, Western Oklahoma [abs.]	41
Smith, Connie—New Director to Oversee School's Five-Year Plan	170
Smith, Connie G., joins OGS staff	116
Smith, Susan L.—Environmental Pollutant Management Case History: Oil Well Production Pollution in the George M. Sutton Urban Wilderness, Section 20, Township 9 North, Range 2 West, Cleveland [County], Oklahoma [abs.]	213
Society for American Archaeology, annual meeting	213
Southern Oklahoma Aulacogen	203, 204, 210
Stearns, David Winrod, named to Monnett Chair	69
Stout, John, and Bradley, Reta—United States Province Overviews [abs.]	208
Strimple, H. L.—The Camerate Crinoid Genus <i>Dichocrinus</i> in Morrowan Rocks of Oklahoma	107
Sutherland, Patrick K., and Manger, Walter L.—The Mississippian– Pennsylvanian Boundary in North America [abs.]	37
Sutherland, Patrick K., <i>see</i> Manger, Walter L., and Sutherland, Patrick K.	
Sutherland, Patrick K., <i>see</i> Morris, Robert C., and Sutherland, Patrick K.	
Tertiary	
Laverne Formation	47
Ogallala Formation	47, 122, 203
Thompson, Thomas L., <i>see</i> Feinstein, Shimon, Harrison, William E., and Thompson, Thomas L.	
Thompson, Thomas L., <i>see</i> Manger, Walter L., and Thompson, Thomas L.	
Toomey, Donald Francis—Distribution of Lower Ordovician <i>Ceratopea</i> (Gastropod Opercula) in the Kindblade Formation, Wichita Mountains, Southwestern Oklahoma	19
Triassic, Dockum Formation	47
Tulsa Geological Society, new officers	197
U.S. Board on Geographic Names decisions	63, 109, 184
U.S. Bureau of Mines, <i>Methane Content and Geology of the Hartshorne</i> <i>Coalbed in Haskell and Le Flore Counties, Oklahoma</i>	115
U.S. Department of Energy	
Oklahoma geothermal-energy-project grant	240
open-file reports	66, 75, 114, 183, 184
<i>Uranium Industry Proceedings, October 16–17, 1979</i>	70
U.S. Geological Survey	
Arkansas River Basin report	195
Circular 805, <i>Principal Thorium Resources in the United States</i>	44
<i>Index to Water-Data Acquisition</i>	196
land-classification map of Dalhart Quadrangle	195
land-use and land-cover maps	194
open-file reports	68, 106, 175, 195
Outer Continental Shelf resource estimates	111
Philip Cohen named chief hydrologist	29
Professional Paper 1010, <i>Paleotectonic Investigations of the</i> <i>Mississippian System in the United States</i>	71
Professional Paper 1110—M-DD, <i>The Mississippian and Pennsylvanian</i> <i>(Carboniferous) Systems in the United States</i>	193
publications	44, 68, 71, 106, 175, 193, 194, 195, 196
resource-appraisal meeting	169

Southard, R. B., named new mapping chief	196
summary report of water-resources activities	194
water-resources data reports	195
U.S. Office of Surface Mining (OSM), awards federal mining-regulation grant to Oklahoma	169
University of Oklahoma, The	
abstracts	118
Alumni Day 1980	112
energy-research exchange agreement with West Berlin Technical University	174
Monnett Chair, Stearns named to professorship	69
New College of Geosciences established	266
OU Press, publishes <i>The Greatest Gamblers: The Epic of American Oil Exploration</i>	194
theses and dissertations	18, 114, 118, 200, 253
Wickham named new director of geology and geophysics	170
uranium	
DOE hydrogeochemical and stream-sediment reports	66, 183
DOE NURE program	66, 114, 184
DOE radiometric and magnetic reports	75, 114, 184
helium analysis in prospecting	207
Oklahoma Geological Survey programs	219
relation to volcanic-ash deposits	203
uranium-seminar proceedings	70
vegetation, association with bedrock	47
von Bitter, P. H., and Munro, I.—Correlation of Conodont Biofacies with Lithofacies in the Core Members of the Oread Megacyclothem (Virgilian), Southern Kansas and Northern Oklahoma [abs.]	39
water resources	
Oklahoma Geological Survey programs	219, 238
Oklahoma Water Resources Board, comprehensive water plan	75
<i>Reconnaissance of the Water Resources of the Enid Quadrangle, North-Central Oklahoma</i>	238
USGS reports	68, 106, 175, 193, 194, 195, 196
<i>Waste Disposal Effects on Ground Water, A Review</i>	189
Wayne Fault	210
Wichita Mountains	
gastropod	19
hydrologic report	183
La Harpe expedition	255
tectonics	117
Wickersham, Ginia— <i>Waste Disposal Effects on Ground Water, A Review</i>	189
Wickham, John S., named new director of OU School of Geology and Geophysics	170
Williamson, Gwen C., assumes position of OGS office manager	263
Wilson, Leonard R.—Comparison of the Compression and Palynological Floras of the Henryetta (Pennsylvanian) Coal of Oklahoma [abs.]	37
Palynological and Plant Compression Evidence for a Desmoinesian-Missourian (Pennsylvanian) Series Boundary in Northeastern Oklahoma [abs.]	38
Wreford Megacyclothem	33
zinc	
mineralization, Butterly Formation	72
zinc and cadmium in coals	33

OKLAHOMA GEOLOGY NOTES

Volume 40

December 1980

Number 6

Page

<i>Oklahoma Geological Survey Annual Report, July 1, 1979–June 30, 1980</i>	
CHARLES J. MANKIN	219
<i>Statistics in Oklahoma's Petroleum Industry, 1979</i>	
M. LYNN PRATER	241
<i>Geologic and Historic Notes on the La Harpe Expedition into Oklahoma</i> <i>in 1719</i>	
ROBERT O. FAY	255
<i>Kirkidium</i> Biofacies of Henryhouse Formation (Silurian), Central Oklahoma Subsurface	218
Three New Publications Issued by Survey	238
Funds Allocated for Geothermal-Energy Project	240
New Theses Added to OU Geology Library	253
Oklahoma Editors Attend AESE Meeting in Halifax	262
Survey Employees Receive Promotions	263
Three Geologists Join OGS Staff	264
OU College of Geosciences to Open for Fall Semester	266
Index to Volume 40	267