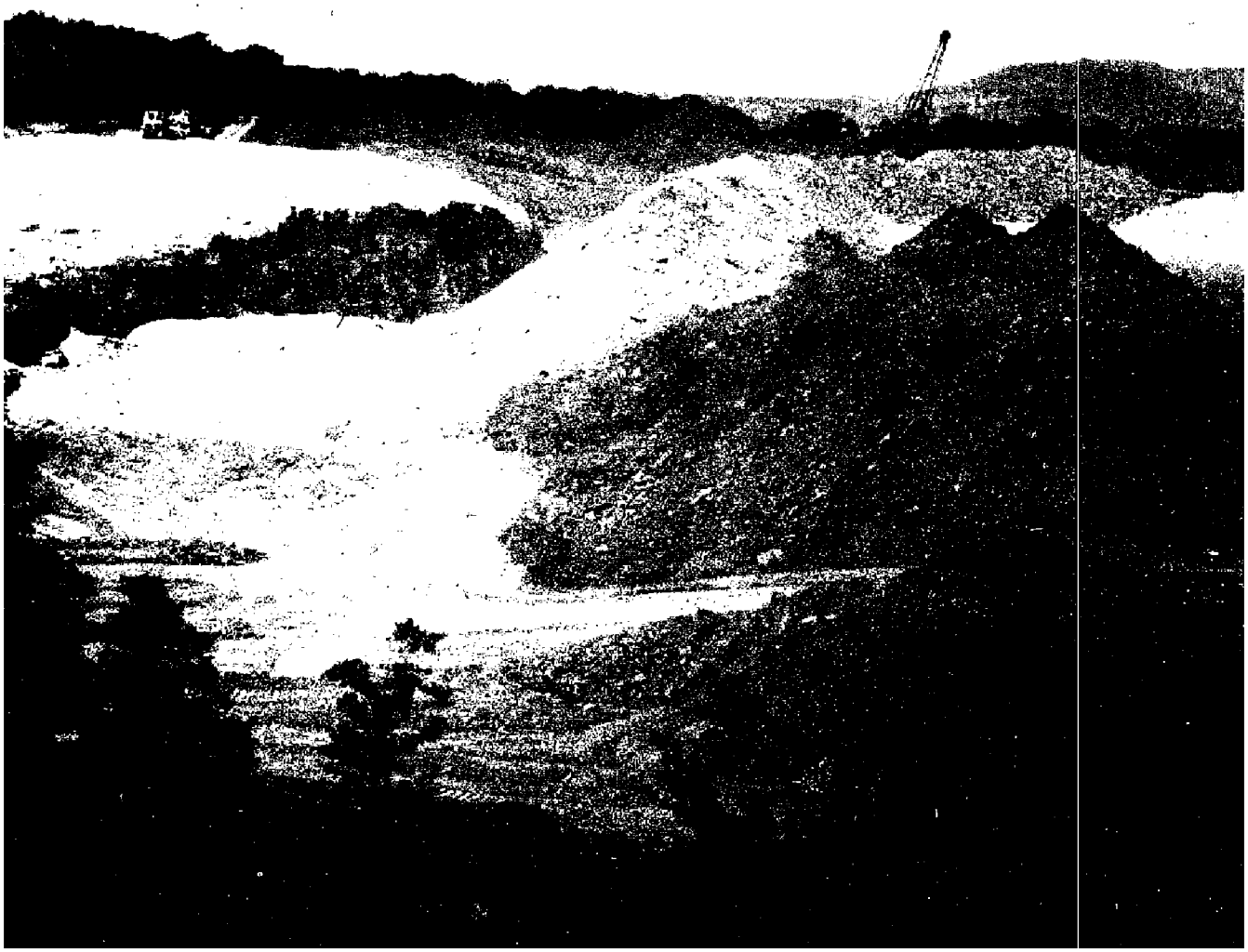
)L. 42, NO. 5 OCTOBER 1982

OKLAHOMA GEOLOGY NOTES

OKLAHOMA GEOLOGICAL SURVEY, THE UNIVERSITY OF OKLAHOMA



On the cover—

Pollyanna No. 1 Mine, Henryetta, Oklahoma

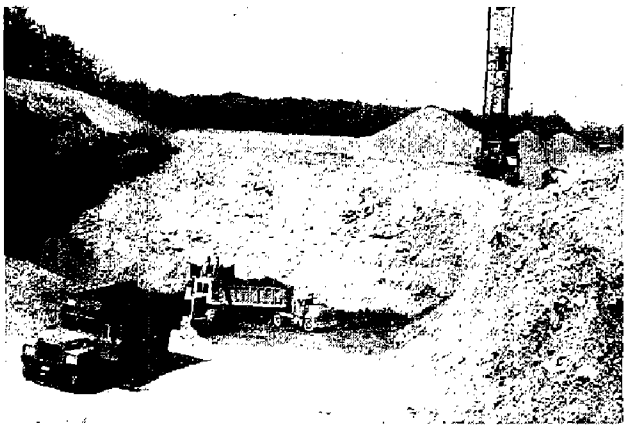


Photo by LeRoy Hemish

Travelers who frequently drive on Interstate Highway 40 in east-central Oklahoma (including Connie Smith, editor of *Oklahoma Geology Notes,* and photographer of the cover picture) have been following the progress of a giant earth-moving project on the outskirts of the city of Henryetta since last January. What they have been seeing is a surface (open-pit) mine, named Pollyanna No. 1, from which Pennsylvanian-age bituminous coal is being produced by the P & K Coal Co., Ltd. Kenneth Richardson, operator of the mine, reports that approximately 600 tons of coal is mined daily from a 3-ft-thick seam known as the Croweburg (Henryetta) coal bed. Richardson says that the coal is of good quality, averaging 12,500 Btu per pound and having an average sulfur content of approximately 1.6 percent.

The overburden (strata covering the coal) is removed by a dragline excavator that has a 120-ft boom and a 7.5-cubic-yd bucket. The dragline boom can be seen in the background of the photograph at the far end of the cut. Richardson reports that the maximum depth of the cut (or thickness of overburden removed) is about 80 ft. The highwall (nearly vertical side of the cut covering unmined coal) extends approximately through the center of the photograph. The photo on this page shows some of the other types of heavy equipment, such as bulldozers, front-end loaders, and carryall scrapers, that are also used in the mining and reclamation processes. Mined-out pits are quickly filled with spoils and regraded (right side of photograph), which Richardson said emphasizes the high quality of reclamation he wants in all his mining operations.

A mine such as the Pollyanna No. 1 plays an important role in keeping the economy of Oklahoma healthy, not only by providing jobs at a local level for people who work in the operation but also for people who provide services for the mine employees. The coal produced from the mine is transported to and consumed in cement-manufacturing plants within the State, thus providing further jobs and demonstrating that a chain reaction can be produced from coal as well as from other energy sources.

LeRoy Hemish

Oklahoma Geology Notes

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

Oklahoma Geology Notes, ISSN 0030-1736, is published bimonthly by the Oklahoma Geological Survey. It contains short technical articles, mineral-industry and petroleum news and statistics, reviews, and announcements of general pertinence to Oklahoma geology. Single copies, $1; yearly subscription, $4. All subscription orders should be sent to the Survey at 830 Van Vleet Oval, Room 163, Norman, Oklahoma 73019.

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

VOL. 42, NO. 5 OCTOBER 1982

OKLAHOMA GEOLOGY NOTES

OKLAHOMA GEOLOGICAL SURVEY, THE UNIVERSITY OF OKLAHOMA

Contents

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 $1,920.

AN EXCEPTIONAL INADUNATE CRINOID CROWN FROM THE MORROWAN (LOWER PENNSYLVANIAN) OF OKLAHOMA

H. L. Strimple[1]

Crinoid crowns are sparse in rocks of Morrowan (Early Pennsylvanian) age. Persistent collecting through the years by many individuals, however, has disclosed an appreciable number of them in northwestern Arkansas and eastern Oklahoma. Extensive radiation in the family Cromyocrinidae during Morrowan time has created much confusion in taxonomic studies, which can be fully resolved only when the structure of the arms is known.

The arms of three species of cromyocrinids are now known from the Morrowan of North America; these originally were described as *Metacromyocrinus gillumi* Strimple (1966), *Ethelocrinus oklahomensis* Moore and Plummer (1938), and *Phanocrinus vadosus* Washburn (1968). The first two species have pustulose surface ornamentation and 10 biserial arms. Only *E. oklahomensis* has reduced the number of anal plates to two (radianal and anal *X*); the other two species have three anal plates in the posterior interradius (including *RX*, or right tube plate).

Phanocrinus vadosus was assigned to the genus *Goleocrinus* by Moore and Strimple (1973), a designation that was followed by Webster (1981, p. 1198). *Metacromyocrinus gillumi* was assigned to *Mathericrinus* Webster (1981, p. 1193, 1199); however, the arms of *Cromyocrinus grandis* Mather (1915), the type species of the genus, *Mathericrinus*, are unknown, and the two species may not be congeneric. *Ethelocrinus oklahomensis* was assigned to *Synarmocrinus* Lane (1964) by Webster (1981, p. 1199), which is unacceptable because *S. brachiatus* Lane (1964), the type species of the genus, has 10 uniserial arms as opposed to 10 biserial arms.

The present study deals primarily with *Ethelocrinus oklahomensis* as represented by a nearly perfect crown. The specimen is from the Braggs Member, Sausbee Formation, Morrowan. This stratigraphic zone is slightly younger than the Brentwood Limestone, from which the type specimens (cups and plates) of the species were collected.

Strimple (1966) proposed a genus *Paracromyocrinus* to accommodate species with low, bowl-shaped cups, a marked basal impression, a subhorizontal infrabrasal circlet, and 10 biserial arms. The type species of the genus, *Parulocrinus vetulus* Lane (1964), lacks ornamentation, but Strimple (1966) chose to include in the genus some ornamented species that otherwise met the requirements of the genus, including the species *Ethelocrinus oklahomensis;* Webster (1981, p. 1195) restricted *Paracromyocrinus* to species lacking ornamentation. Webster's generic diagnosis (1981, p. 1195) called

[1]Research investigator (retired), University of Iowa, Iowa City, Iowa.

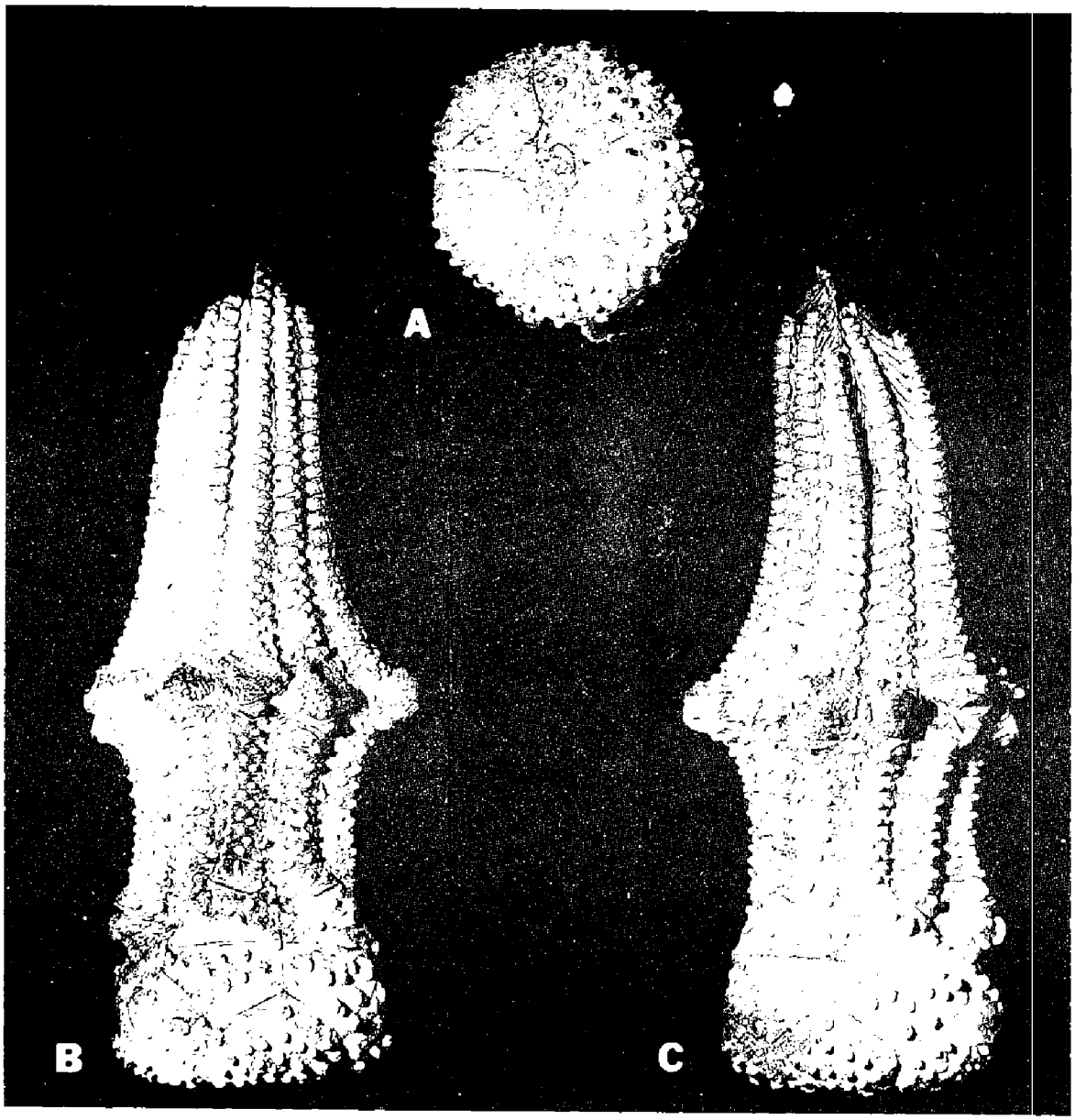


Figure 1. *Aglaocrinus oklahomensis* (Moore and Plummer) from the Sausbee Formation in Cherokee County, Oklahoma. *A*, nearly perfect hypotype crown (OU 7337A) viewed from base of cup (posterior interray at top and basal invagination obscured by extraneous material). *B*, side view of crown (posterior interray to left). *C*, opposite side of crown (anterior radial to left). All natural size.

for 19 biserial arms, which must have been a typographical error. Most of the involved, ornamented species with 10 biserial arms were assigned by him to *Aglaocrinus,* but as has been noted previously, he assigned *Ethelocrinus oklahomensis* to *Synarmocrinus,* a genus that has 10 uniserial arms.

The species *E. oklahomensis* is referred to *Aglaocrinus* for the present study, pending a detailed reevaluation of the family.

The most distinguishing feature of *P. oklahomensis* is the enlargement and outward projection of brachial plates at about midheight of the arms. Inwardly, there is no expansion of the ambulacral groove, but there is com-

monly a gentle curvature of the entire arm from the lowermost element to the summit of the expanded brachials, which has the effect of causing the group to appear even more protuberant (see Moore and Strimple, 1973, pl. 1(figs. 2–4). The expanded brachial sections are more inclined to remain articulated in specimens from the Wapanucka Formation in Pontotoc County, Oklahoma, than they are in those from the Sausbee Formation of northeastern Oklahoma or in the Bloyd Formation of northwestern Arkansas. This appears to be due to the interlocking elaborate surficial ornamentation rather than to anchylosis. Individual brachials show ligamental fossae between all arm segments. Medial parts of each group of expanded brachials are marked by one or more spinelike tubercles. The lateral sides of each arm slope toward the ambulacral grooves and are sharply delineated from the rounded exteriors. Sutures of secundibrachs are deeply impressed in narrow, troughlike grooves that connect with slitlike canals in the ambulacral canals. Each brachial bears a small pustule near the juncture with the opposing brachial, so that two longitudinal rows of pustules are present on each arm except in the expanded sections. Pinnules are small and rather closely packed and are exposed in the upper part of the crown (see fig. 1C).

The arms of *Aglaocrinus oklahomensis* were first reported by Strimple (1940, pl. 1, fig. 1) in specimens recovered on Canyon Creek, southeast of Fittstown, Oklahoma (locality 12 of Moore and Strimple, 1973, p. 79), from the massive shale in the lower part of the Wapanucka Formation. The arms above the protruded section appear to be larger, less tapered, and somewhat shorter than those of the specimen presently reported.

The species *A. oklahomensis* is well described by Moore and Plummer (1938) except for the arms, and the description is not repeated here. The illustrated crown (OU7737a) is 85.0 mm high; cup height is 13.4 mm, maximum width 29.0 mm, and minimum width 27.5 mm. Collected by T. W. Henry at Singin' T Acres, E½SE¼ sec. 7, T. 15 N., R. 23 E., Cherokee County, Oklahoma.

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PUBLIC-AFFAIRS HANDBOOK AVAILABLE

The Rocky Mountain Association of Geologists and the Colorado Section of the American Institute of Professional Geologists have issued *A Public Affairs Handbook for Geoscientists*. Michelle Michot Foss, of the Colorado School of Mines, chaired a committee responsible for preparation and production of the book, which contains several sections and chapters by 15 contributors.

Although aimed somewhat toward the specific needs and applications of professional geological scientists in the Rocky Mountain region, the 613-page handbook is valuable to any scientist who wants to get involved in public affairs. The authors state in the preface: "Our goal for this *Handbook* was to develop a public affairs resource package geared towards professional geoscientists. We are striving to reach especially those professionals who are interested in public affairs but need a little 'encouragement.' "

The book's five chapters present a comprehensive treatment of various aspects of public-affairs involvement.

A chapter on "Public Affairs Resources" covers such items as public speaking, speaking before school groups, geoscience writing for the public, and a resource list for obtaining information on issues and programs.

Another chapter treats several facets of interacting with the political process as a professional and a citizen, and the next chapter deals with the important link between awareness and action—knowledge of the issues. This chapter gives especially helpful background information on such topics as employment and career trends, mineral and energy economics, synthetic fuels, severance taxes, the distinction between resources and reserves, environmental compliance, and natural-gas decontrol.

A concluding chapter explores effective ways for the individual geological scientist to get involved in political affairs.

Interested professionals can obtain free single copies of the 72-page handbook by writing: Rocky Mountain Association of Geologists, 217 Colorado Building, 1615 California St., Denver, CO 80202. For orders to be sent by first-class mail, the publishers would appreciate the enclosure of a 9- by 12-inch, self-addressed envelope with $1.39 worth of postage affixed.

Jay T. Edwards

Francis G. Stehli

OU'S BOARD OF REGENTS NAMES TWO TO ENERGY CENTER POSTS

Nationally respected educator and scientist Francis G. Stehli has been named dean of The University of Oklahoma's new College of Geosciences, while retired Tinker Air Force Base Commander Maj. Gen. Jay T. Edwards was selected as executive director of the center.

Edwards, who is retiring after 28 years in the Air Force, was recommended for the position by former OU President William S. Banowsky, and was appointed July 22 by the Board of Regents.

Banowsky said that Edwards has "the vast administrative and leadership experience needed to direct the development of the Energy Center," adding that "he is an able administrator; he is well-versed in technology; and he has developed good ties with many leaders in the oil and gas industry in Oklahoma."

Edwards is a mechanical engineering graduate of the U.S. Military Academy at West Point, New York, and has earned master's degrees in aeronautical engineering, from Texas A&M University, and management, from George Washington University.

Stehli, who has almost 30 years of teaching experience, comes to OU from the University of Florida, where he was dean for Graduate Studies and Research.

"Stehli's task—one he is aptly capable of accomplishing with excellence —is to build the College of Geosciences to world-class dimensions," Banowsky said.

OU Provost J. R. Morris added that "Frank Stehli is everything we wanted in a dean. He is a first-rate scientist, a skilled and experienced ad-

ministrator, and a nationally respected geoscience educator. He has experience in industry; he has the kind of academic standards and judgment essential to the task of leading this college to national stature."

Stehli was graduated cum laude with a degree in biology and minors in geology and English in 1949 from St. Lawrence University, Canton, New York. He also earned his master of science degree at St. Lawrence University with a major in paleontology and a minor in igneous and metamorphic petrology. His doctorate, earned in 1953 at Columbia University, was in the area of paleontology and stratigraphy. He has been a Boese Fellow of the National Science Foundation and completed a six-week Institute for Educational Management course at Harvard in 1978.

UNIVERSITY OF KANSAS ISSUES MONOGRAPH ON BROMIDE ECHINODERMS

"The Middle Ordovician Bromide Formation of southern Oklahoma contains perhaps the largest and most diverse echinoderm fauna ever collected from a single Ordovician formation," says James Sprinkle, associate professor at the University of Texas, Austin, and editor of a new 369-page volume on these fossils.

Issued by the University of Kansas Paleontological Institute as Monograph 1 of the University of Kansas Paleontological Contributions series, *Echinoderm Faunas from the Bromide Formation (Middle Ordovician) of Oklahoma* contains contributions from Sprinkle; Bruce M. Bell, former director of the Stovall Museum of Science and History at The University of Oklahoma; Jon W. Branstator, of Joseph Moore Museum of Earlham College, Richmond, Indiana; James C. Brower and Julia Veinus, of Syracuse University; Robert O. Fay, of the Oklahoma Geological Survey; A. Allen Graffham, of Geological Enterprises, Ardmore, Oklahoma; Porter M. Kier, of the U.S. National Museum of Natural History; Dennis R. Kolata, of the Illinois Geological Survey; Ronald D. Lewis, of Knox College, Galesburg, Illinois; Mark Longman, of Buttercup Energy, Denver, Colorado; Ronald L. Parsley, of Tulane University; and John M. Warn, of Jordan Oil and Gas Co., Santa Rosa, California.

The book includes several articles offering concise information on the Bromide Formation itself—lithofacies, depositional environments, stratigraphy, echinoderm zonation, paleoecology of the echinoderms that inhabited the area at the time of deposition, regional setting, depositional history, geologic and geographic history of the region during and before the time of deposition, history of previous studies, and even some human history.

All this is prelude to the 21 articles of detailed descriptions and discussions of crinoids, paracrinoids, eocrinoids, rhombiferans, diploporitans, edrioasteroids, edrioblastoids, cyclocystoids, holothurians, asteroids, and homalozoans (or "carpoids") that make up the Bromide

echinoderm fauna in a remarkable collection of fossils retrieved from this one formation in the Arbuckle Mountains and Criner Hills areas of south-central Oklahoma.

More than 11,000 partial or complete specimens were collected from the two members (Mountain Lake and Pooleville) of the Bromide in these areas, with most of the collecting done by Fay and Graffham in 1965–67. Almost 6,100 of these specimens have been retained in the collections of The University of Oklahoma, and it is on these specimens that the study is based. The collection represents 61 genera and 13 of the 17 echinoderm classes. Descriptions by the various authors include two new families, 17 new genera, and 39 new species.

The echinoderm zones where the fossils occur are identified in 16 measured sections described and located in an appendix and shown graphically on a large sheet of correlation diagrams folded in a pocket in the back of the publication.

The volume is profusely illustrated with 113 figures, 42 plates, and 41 tables. The plates are outstanding—beautifully prepared specimens, excellent photography. Also noteworthy is the scarcity of "typos."

This book is a significant contribution to the literature and should prove of value not only to echinoderm specialists but also to invertebrate paleontologists in general and to stratigraphers, sedimentologists, explorationists, and amateur collectors.

The publication can be ordered from the Exchange and Gifts Department (Library Sales Office), University of Kansas Libraries, Lawrence, KS 66045. The price is $15, plus $1 for postage.

NEW THESES ADDED TO LIBRARY

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

Lithostratigraphy and Environments of Deposition of the Upper Dornick Hills Group (Middle Pennsylvanian) of the Southern Part of the Ardmore Basin, Oklahoma, by Elizabeth H. Bartlett. 207 p., 12 figs., 4 pls., 1981.

Stratigraphic and Structural Investigation of the Eola Klippe, Garvin County, Oklahoma, by Elizabeth Brownlee. 133 p., 20 figs., 1981.

Pennsylvanian Stratigraphy and Conodont Biostratigraphy of the Mill Creek Syncline, Central Arbuckle Mountains, Oklahoma, by R. Kent Grubbs. 227 p., 8 figs., 12 pls., 1981.

Lithostratigraphy and Depositional Environments of the Pitkin Limestone (Chesterian, Mississippian) in Portions of Cherokee, Muskogee, and Sequoyah Counties, Oklahoma, by A. Lee Nageotte. 197 p., 24 figs., 13 pls., 1981.

Lithostratigraphy and Depositional Environments of the Upper Dornick Hills Group (Lower Pennsylvanian) in the Northern Part of the Ardmore Basin, Oklahoma, by Steven H. Tennant. 291 p., 24 figs., 14 pls., 1981.

Source Rock Geochemistry and Liquid and Solid Petroleum Occurrences of the Ouachita Mountains, Oklahoma, by Joseph Anthony Curiale. 286 p., 72 figs., 1981 (Ph.D. dissertation).

Paul H. Foster

FOSTER HONORED BY CO-WORKERS

Paul H. Foster, senior electronics technician at the Oklahoma Geophysical Observatory at Leonard, Oklahoma, was honored by his co-workers with a July 21 luncheon given in recognition of his 21 years on the Observatory staff.

The event was described as a "non-retirement party" to express the staff's hope that Foster, who partially retired and assumed the role of half-time consultant in 1980, will never completely retire.

James E. Lawson, Jr., chief geophysicist at the Observatory, said that Foster was presented a camera "in recognition of the 21 years he has spent at the Observatory, and in anticipation of many more years of dedicated and outstanding work."

Foster began working at the Observatory in 1961, when the facility was built by Jersey Production Research Co. Jersey Production later merged with Humble Oil & Refining, which donated the Observatory to The University of Oklahoma in 1965. The Observatory was transferred to the Oklahoma Geological Survey in 1978. Foster served as an electrical engineer until 1970, when he became superintendent. Since then, Foster has helped the Observatory expand and become one of the most complete earthquake and magnetic observatories in the world.

BOOK EXAMINES WATER ISSUES

Water and Western Energy: Impacts, Issues, and Choice, a new book by Steven C. Ballard, Michael D. Devine, and Associates, examines the availability of water in the western states and engages in a lengthy discussion of the policy alternatives available for its management.

The authors have assembled 321 pages of text, tables, and figures that follow a foreword written by Charles Howe. Howe is a professor of economics at the University of Colorado and is also editor of Westview Press' Water Policy and Management Series, of which this is the first issue.

Chapters in the "Energy Development and Water: Impacts and Issues" section of the book include: "Water and Energy Development in the West"; "Water Availability: Impacts and Issues"; and "Water Quality: Impacts and Issues."

Part two, "Analysis of Policy Alternatives," includes: "Conservation of Water"; "Augmentation of Water Supply"; "Water Quality Protection"; "State Water Administration and Management"; "Regional and Federal Roles in Water Management"; and "Summary, Conclusions, and Comparison with Other Studies."

A lengthy bibliography and index are also included.

The book is available from Westview Press, 5500 Central Ave., Boulder, CO 80301. The price is $27.50.

NOTES ON NEW PUBLICATIONS

Applied Geophysics, 2d Edition

The new second edition of Gerhard Dohr's *Applied Geophysics* gives priority to techniques that play an important part in petroleum and natural-gas exploration, with emphasis on modern seismic methods.

This 256-page book has been reorganized. Rewritten chapters on digital processing of seismic data to reflect new developments are included, and more space is devoted to magneto-telluric methods.

Order from: Wiley Professional Books-By-Mail, John Wiley & Sons, Inc., Dept. 0328, P.O. Box 063, Somerset, NJ 08873. Price: $21.95, paperback.

Economic Mineral Deposits, Revised 3d Edition

The revised third edition of *Economic Mineral Deposits* contains an updated examination of world mineral deposits, as well as statistical data on production, reserves, and mineral resources. The authors, Mead L. Jensen and Alan M. Bateman, have added chapters on mineral economics and ex-

ploration, and the newly recognized bacteriogenic and exhalative volcanogenic processes.

Order this 593-page volume from: Wiley Professional Books-By-Mail, John Wiley & Sons, Inc., Dept. 0328, P.O. Box 063, Somerset, NJ 08873. Price: $26.95.

Physical Principles of Exploration Methods

Discussion of modern geophysical exploration techniques, with information explaining their physical principles, is included in *Physical Principles of Exploration Methods*, a 256-page book by A. E. Beck. The author covers electrical, spontaneous, and induced polarization, along with gravity, magnetic, electromagnetic, seismic, radioactive, and logging methods.

Order from: Wiley Professional Books-By-Mail, John Wiley and Sons, Inc., Dept. 0328, P.O. Box 063, Somerset, NJ 08873. Price: $34.95.

Composition and Properties of Petroleum

The composition and characteristics of various types of petroleum, natural gas, and oil-field waters are reviewed in a new 208-page volume by H. J. Neumann, B. Paczynska–Lahme, and D. Severin. Also described through the use of phase diagrams are the physical properties of petroleums, condensates, and natural gases.

Order from: Wiley Professional Books-By-Mail, John Wiley & Sons, Inc., Dept. 0328, P.O. Box 063, Somerset, NJ 08873. Price: $16.95.

Paleoecology, Concepts and Applications

In a new 544-page book that stresses application as well as theory, J. Robert Dodd and Robert J. Stanton have reconstructed ancient depositional environments using paleontologic techniques.

Discussion includes taxonomic uniformitarianism, biogeochemistry, skeletal structure, adaptive functional morphology, and populations, ecosystems, and communities.

Order from: Wiley Professional Books-By-Mail, John Wiley & Sons, Inc., Dept. 0328, P.O. Box 063, Somerset, NJ 08873. Price: $39.95.

The 1980 Eruptions of Mount St. Helens, Washington

Sixty-two separately authored reports summarizing results through 1980 of studies of volcanic events, geophysical monitoring of activity, and studies of volcanic deposits, effects, and potential hazards document the reawakening of Mount St. Helens volcano in March 1980 and its cata-

strophic eruption of May 18. Illustrations in this 844-page book consist of 470 figures, 117 tables, and a color geologic map (scale 1:50,000) showing proximal deposits and features of the 1980 eruptions. Nontechnical introductions and extensive illustrations make this volume useful for readers lacking formal geologic training.

Order Professional Paper 1250 from: Eastern Distribution Branch, Text Products Section, U.S. Geological Survey, 604 S. Pickett St., Alexandria, VA 22304. Price: $35.

Guide to the Use of PACER, the Data Retrieval and Update System for the National Coal Resources Data System (NCRDS)

This 101-page report, OF 82–0291, is available from the Open-File Services Section (OFSS), Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Price: microfiche $3.50, paper copy $13.

Map Showing Relation of Carbon Dioxide-Rich Springs and Gas Wells to the Tectonic Framework of the Conterminous United States

This 30- by 51-inch map covers latitude 24° to 48° and longitude 78° to 120°, scale 1:5,000,000, and is accompanied by a 9-page text.

Order Miscellaneous Investigations Series Map I-1301 from: Western Distribution Branch, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225. Price: $2.50.

Modern Igneous Petrology

Mohan K. Sood, in his recent 244-page publication, *Modern Igneous Petrology*, discusses the application of phase equilibrium data in silicate systems to explain magmatic crystallization. Components representing the major rock-forming mineral groups conforming to the bulk chemistry of the igneous rocks are included in the systems described.

Also, new data are given on magma generation, volatile solubility, and petrological implications of plate tectonics. Significant features of major systems are summarized for easy reference and are illustrated with polythermal diagrams.

Order from: Wiley Professional Books-By-Mail, John Wiley & Sons, Inc., Dept. 0328, P.O. Box 063, Somerset, NJ 08873. Price: $27.50.

Petroleum Geology of the Fort Worth Basin and Bend Arch Area

The Dallas Geological Society has announced that pre-publication orders are being accepted for this new publication. The book contains 29 papers,

which have been classified into four groups: general interest, regional and general geology, logging and seismic, and field papers.

The society said that the objective of the publication is to provide as much usable information as possible in an easily read format. There are 250 illustrations to augment the text. The book will also contain, in microfiche form, a bibliography of geology pertaining to the Fort Worth Basin.

Order from: Dallas Geological Society, Suite 100, One Energy Square, 4925 Greenville Ave., Dallas, TX 75206. Price: $45. All orders must be prepaid. Texas residents must include 5 percent sales tax.

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation, Part I: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basin Through 1978

Issued as report PB-82 138 835 (Water-Resources Investigations 81-33), this publication by J. D. Stoner consists of 303 pages.

Order from: National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. Price: $24 hard copy; $4 microfiche.

Rainfall-Runoff Hydrographs and Basin Characteristics Data for Small Streams in Oklahoma

Written by D. L. Bergman and T. L. Huntzinger, USGS Open-File Report OF 81-0824 consists of 323 pages and one oversized sheet.

Order from: Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225. Price: $4 microfiche, $42 paper copy.

An Illustrated Guide to Fossil Collecting

Authors Richard Casanova and Ronald P. Ratkevich provide a book deemed suitable for both the hobbyist and the professional paleontologist. The 240-page book deals with subjects such as classification, collection, and preparation of fossils.

Order from: Naturegraph Publishers, Inc., P.O. Box 1075, Happy Camp, CA 96039. Price: $6.95 paperback.

Natural Gas Pipeline Map of the U.S. and Canada

Produced by PennWell Maps, this map identifies more than 200 major pipelines, each of which is numerically and color coded to determine the operator. Helpful features include pipe diameter, compressor-station locations, latitude and longitude, offshore lease grids for the Gulf of Mexico, and an inset for northern Canada.

Map P5157 is printed in nine colors and measures 40 x 57 in. Order from: PennWell Publishing Co., P.O. Box 1260, Tulsa, OK 74101. Price: $40.

Mineral Deposits and Global Tectonic Settings

Authors A. H. G. Mitchell and M. S. Garson present an up-to-date description of this subject with a number of original ideas from themselves in addition to a reappraisal of generally accepted recent concepts. The book identifies the major settings at plate boundaries and within plates, and the treatment of rocks as ores is emphasized. The book is illustrated and consists of 404 pages.

Order from: Academic Press, Inc., 111 Fifth Ave., New York, NY 10003. Price: $48.50.

Principles and Applications of Microearthquake Networks

This volume reviews the fundamentals of microearthquake networks: instrumentation systems, data-processing procedures, methods of data analysis, and examples of applications. It also includes information on earthquake seismology, seismic-ray tracing, generalized inversion, and nonlinear optimization. Written by W. H. K. Lee and S. W. Stewart, the volume contains 296 pages. Order ISBN 0-12-018862-7.

Order from: Academic Press, Inc., 111 Fifth Ave., New York, NY 10003. Price: $32.

Hydrogeochemical and Stream-Sediment Reconnaissance Reports

The Grand Junction Area Office, U.S. Department of Energy, has placed on open file 13 hydrogeochemical and stream-sediment reconnaissance reports as part of the National Uranium Resource Evaluation (NURE) program. They are all reports by the Oak Ridge Gaseous Diffusion Plant (ORGDP), Oak Ridge, Tennessee, on the analyses of sediment samples collected by Savannah River Laboratory, Aiken, South Carolina. Field data and the concentrations of uranium and 31 other elements are reported. Reports on areas in and near Oklahoma are:

Hydrogeochemical and Stream Sediment Reconnaissance Basic Data for Sherman, Texarkana, El Dorado, and Greenwood Quadrangles; Oklahoma, Texas, Arkansas, and Mississippi: ORGDP K/UR-424, dated June 9, 1982, 100 p. Analyses are reported for 992 sediment samples. The uranium concentration ranged from 1.20 to 21.90 ppm. Order GJBX-69(82).

Hydrogeochemical and Stream Sediment Reconnaissance Basic Data for Ardmore, McAlester, Little Rock, and Helena Quadrangles; Oklahoma, Arkansas, Mississippi: ORGDP No. K/UR-425, dated June 9, 1982, 65 p. Analyses are reported for 638 sediment samples. The uranium concentration ranged from 1.20 to 6.50 ppm. Order GJBX-70(82).

Hydrogeochemical and Stream Sediment Reconnaissance Basic Data for Oklahoma City, Fort Smith, and Russellville Quadrangles; Oklahoma, Arkansas: ORGDP No. K/UR-426, dated June 9, 1982, 30 p. Analyses are reported for 260 sediment samples. The uranium concentration ranged from 1.30 to 7.90 ppm. Order GJBX-71(82).

Hydrogeochemical and Stream Sediment Reconnaissance Basic Data for Enid,

Tulsa, and Harrison Quadrangles; Oklahoma, Arkansas, Missouri: ORGDP No. K/UR 427, dated June 9, 1982, 95 p. Order GJBX-72(82).

Order from: Bendix Field Engineering Corp., Technical Library, P.O. Box 1569, Grand Junction, CO 81502. The price is $4 per report for each microfiche copy. Check or money orders must accompany order and should be made payable to Bendix Field Engineering Corp. For orders outside the U.S. and Canada, add $3.

The report is also on file at the Oklahoma Geological Survey office and a number of other locations throughout the U.S.

Water Reports Issued

Altitude and Configuration of the Predevelopment Water-Table in the High Plains Regional Aquifer, Northwestern Oklahoma. Open-File Report 82-275 contains two maps of the altitude and configuration of the predevelopment water-table in the Panhandle. This report, by John S. Havens, is the second of a series presenting hydrologic information on the High Plains aquifer. The report can be inspected at the U.S. Geological Survey's Water Resources Division office, Room 621, 215 Dean A. McGee St., Oklahoma City, OK 73102.

Altitude and Configuration of the 1980 Water Table in the High Plains Regional Aquifer, Northwestern Oklahoma. Open-File Report 82-100 consists of two maps showing the altitude and configuration of the water table in the Oklahoma Panhandle and in the eastern section of the High Plains aquifer. By John S. Havens, this report is the third of a series and can be inspected at the U.S. Geological Survey, Water Resources Division, Room 621, 215 Dean A. McGee St., Oklahoma City, OK 73102.

Generalized Altitude and Configuration of the Base of the High Plains Aquifer, Northwestern Oklahoma. Open-File Report 81-1117 is the first of a series presenting hydrologic information on the High Plains aquifer in Oklahoma. The report, by John S. Havens, consists of two maps and can be inspected at the U.S. Geological Survey, Water Resources Division, Room 621, 215 Dean A. McGee St., Oklahoma City, OK 73102.

CRC Handbook of Physical Properties of Rocks

Edited by Robert S. Carmichael, this handbook provides data on various properties of rocks, minerals, and other related materials. Volume I contains 416 pages and provides information on mineral composition, electrical properties, and spectroscopic properties. Volume II contains 360 pages and provides information on seismic velocities, magnetic properties, and engineering properties.

Order from: CRC Press, Inc., 2000 Corporate Blvd., N.W. (NW 24th St.), Boca Raton, FL 33431. Volume I is $69.50. Volume II is $64.

Marine Slides and Other Mass Movements

Edited by Svend Saxov and J. K. Nieuwenhuis, this publication contains a series of papers examining the nature of marine sedimentology and the

mechanics of marine slides and other undersea mass movements. These papers are from the proceedings of a NATO workshop held in Algarve, Portugal. The illustrated book contains 188 pages, including an index.

Order from: Plenum Publishing Corp., 233 Spring St., New York, NY 10013. Price: $32.50 ($39 outside U.S. and Canada).

National Uranium Resource Evaluation, Lawton Quadrangle, Oklahoma and Texas

Within the Lawton 1° X 2° Quadrangle, five areas of uranium favorability were delineated. These areas consist of diagenetically altered sandstones in the Cement district, the Post Oak Conglomerate south of the Wichita Mountains, sedimentary rocks of Early Permian age in the Grandfield–Burkburnett–Waurika area, subsurface rocks of Permian-Pennsylvanian age in the Altus area, and the Cambrian Quanah Granite and related dikes in the Wichita Mountains. The report was written by Z. Al-Shaieb, R. G. Thomas, and G. F. Stewart, Oklahoma State University.

Report GJQ-017(82) contains 49 pages, 4 figures, 4 appendixes, and 37 plates.

Order from: Bendix Field Engineering Corp., Technical Library, P.O. Box 1569, Grand Junction, CO 81502. Price: $15 paper copy, $10.50 microfiche.

OKLAHOMA PLACE NAMES APPROVED

The U.S. Board on Geographic Names approved five Oklahoma place names that were published in the October through December 1981 issue of *Decisions on Geographic Names in the United States* (Decision List 8104).

Cedar Creek: stream, 12.9 km (8 mi) long, heads on the N. slope of Tram Ridge at 34°44′32″ N., 94°42′34″ W., flows NE. through Cedar Lake to Black Fork 12.9 km (8 mi) SSW. of Heavener; Le Flore Co., OK; sec. 36, T. 4 N., R. 25 E., Indian Meridian; 34°46′48″ N., 94°38′05″ W. Not: Red Lick Creek.

Post Mountain: mountain, highest elevation 306 m (1,005 ft), extends W. 7.2 km (4.5 mi) from Crooked Branch 13.7 km (8.5 mi) SW. of Heavener; Le Flore Co., OK; secs. 24, 25, and 26, T. 24 E., and secs. 24, 25, and 26, T. 25 E., R. 4 N., Indian Meridian; 34°48′00″ N., 94°41′30″ W. (E. end), 34°47′15″ N., 94°45′45″ W. (W. end).

Red Lick Creek: stream, 6.4 km (4 mi) long, heads on the N. slope of Tram Ridge at 34°37′00″ N., 94°42′04″ W., flows NE. to Cedar Creek 13.7 km (8.5 mi) SW. of Heavener; Le Flore Co., OK; sec. 34, T. 4 N., R. 25 E., Indian Meridian, 34°46′40″ N., 94°40′29″ W.

The following decision was announced in the January through March 1982 issue of *Decisions on Geographic Names in the United States* (Decision List 8201).

East Ninnekah: populated place (incorporated town), 17.7 km (11 mi) N. of the community of Rush Springs and 32 km (20 mi) NW. of Lindsay; Grady County, OK; Tps. 5 and 6 N., R. 7 W., Indian Meridian; 34°56′52″ N., 97°55′25″ W. Not: Ninnekah.

OKLAHOMA ABSTRACTS

AAPG Annual Meeting
Calgary, Alberta, Canada, June 27–30, 1982

The following abstracts are reprinted from the *AAPG Bulletin* of the American Association of Petroleum Geologists, v. 66, no. 5. Page numbers are given in brackets below the abstracts. Permission of the authors and of Myron K. Horn, editor, to reproduce the abstracts is gratefully acknowledged.

Influence of Grain Size and Thermal Maturity on Intergranular Pressure Solution and Quartz Cementation in a Quartz-Rich Sandstone

DAVID W. HOUSEKNECHT, University of Missouri, Columbia, MO

Detailed cathodoluminescent petrography and scanning electron microscopy reveal that grain size and thermal maturity have significantly influenced intergranular pressure solution and quartz cementation in the quartz-rich Hartshorne Sandstone of the Arkoma basin. Mean grain size of Hartshorne sandstones ranges from very fine to medium-grained. In any stratigraphic section, a negative, linear relationship exists between grain size and volume of silica dissolved via intergranular pressure solution. In contrast, either a positive, linear relationship or no significant relationship exists between grain size and volume of quartz cement. These relationships indicate that silica was selectively dissolved via intergranular pressure solution in finer grained sandstones and that, at least locally, quartz cement was selectively precipitated as overgrowths on detrital grains in coarser grained sandstones. Little primary porosity is preserved in the pressolved, finer grained sandstones, whereas appreciable primary porosity may be retained in coarser grained sandstones that contain more quartz cement.

These relationships are also sensitive to thermal maturity, which increases eastward across the basin. This thermal trend is probably related to elevated temperatures associated with intrusions in as much as maximum burial depth of the Hartshorne decreases eastward. As thermal maturity in-

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

creases, more intergranular pressure solution is evident for a given grain size whereas the volume of quartz cement does not change significantly. Thus, primary porosity tends to be preferentially preserved in areas of lower thermal maturity.

In areas of higher thermal maturity, the sandstones have lost more silica via intergranular pressure solution than has been precipitated as quartz cement whereas the opposite is true in areas of lower thermal maturity. [583–584]

Deep-Water Stratigraphic Traps in Interior Basins: Examples from Anadarko Basin, Oklahoma

NARESH KUMAR, ARCO Exploration Co., Denver, CO; and ROGER M. SLATT, ARCO Oil and Gas Co., Dallas, TX (present address: Cities Service Research, Tulsa, OK)

As in modern oceans, there is ample evidence that sands bypassed shelf-edges of ancient interior basins and accumulated in deeper parts of the basins. Although water depths in these basins were never in the abyssal zone, these deposits are today recognizable as "deep-water" sands.

Based on a seismic, subsurface, and sedimentologic study of the Tonkawa Sandstone (Missourian), we have developed a seismic-stratigraphic model for Pennsylvanian sands in the Anadarko basin. Typically, the Tonkawa and other sands are regressive and cyclic and are bounded at the base and top by transgressive limestones. The sands consist of three facies: (1) an upper shallow-water shelf facies, (2) a middle submarine slope-channel facies, and (3) a lower submarine fan-lobe facies. Each sandstone unit exhibits characteristic electric log and seismic signatures and distinctive sedimentary structures and textures. For each depositional cycle, the shelf edge may be formed by a contemporaneous reef, and the break in bathymetric gradient at the base-of-slope may be marked by an older reef. Besides the Tonkawa Sandstone, this model is applicable to the following formations: (1) Springer/Morrow (Springeran/Morrowan); (2) Red Fork (Desmoinesian); and (3) Cleveland and Cottage Grove (both Missourian).

The model predicts that both individual slope sands and submarine fan lobes are potential stratigraphic traps. Associated carbonate banks may also form traps. We suggest that many deep-water traps remain to be found in the Anadarko basin. [591]

Vitrinite Reflectance of Woodford Shale in Anadarko Basin, Oklahoma

MICHAEL W. LAMBERT, Chevron U.S.A. Inc., New Orleans, LA

The Woodford Shale (Upper Devonian–Lower Mississippian) is a black shale thought to be an important oil-source bed in the Anadarko basin of western Oklahoma. The reflectance in immersion oil (R_o) of first-generation vitrinite particles found in this stratigraphic unit is related to temperature history and thus hydrocarbon-generating potential. Samples of the Wood-

ford Shale were obtained from 18 wells drilled in the Anadarko basin by various operators, and polished sections of the shale were prepared and interpreted by the author while working at the Oklahoma Geological Survey. A minimum of 60 vitrinite reflectance measurements were recorded for each well. The Woodford was sampled at depths of from 5,060 ft (1,542 m) in the northeastern shelf to 20,308 ft (6,190 m) in the deepest part of the basin in Beckham County, southwestern Oklahoma. A systematic increase in mean vitrinite reflectance (mean R_o) with depth was observed. From northeast to southwest across the Anadarko basin mean R_o increased from 0.51 to 2.60%. An isoreflectance map for the Woodford Shale in the Anadarko basin was prepared using data collected during this study. The Woodford Shale should have generated commercial quantities of oil in those areas of the basin where the shale has a mean R_o of from 0.60 to 1.35%. In Kiowa County, Oklahoma, the Woodford Shale was sampled in a fault block bordering the Wichita uplift on the southern boundary of the basin. It has, in this well, an anomalously low mean R_o of 0.48%, possibly due to a shallow depth of burial throughout its history. [591–592]

Evidence of Cross-Formational Flow Above Healdton Oil Field, Carter County, Oklahoma

CHERYL ANN MUZYL, The University of Oklahoma, Norman, OK

An anticlinal trap is the locus of deep-water discharge with hydrocarbons being retained while the water is transmitted vertically through the sediments. The change in the sense of water movement from lateral to vertical at the apex of the anticline is accompanied by temperature- and salinity-gradient changes. Because of this, it might be possible to outline an oil field by an analysis of these gradients over an anticline.

To test this hypothesis, Healdton anticline, Carter County, Oklahoma, a textbook example of an anticline, was selected for study. This paper examines by an analysis of the salinity and geothermal gradients in the shallow beds the probability of cross-formational flow through the anticline. A large amount of data is available from electric logs of wells drilled in Carter County. Using the spontaneous potential curve and a modified computer program, formation-water resistivities were calculated and these resistivities were converted into total dissolved solids (salinity) based on empirical data from the study area. It is anticipated that contour maps of salinity and geothermal gradients will show the outline of the Healdton oil field. [611]

Sedimentation Within Southern Oklahoma Aulacogen: Viola Limestone

THOMAS M. SMITH, Southern Methodist University, Dallas, TX

The Viola Limestone (Middle Ordovician) was deposited within the southern Oklahoma aulacogen in the Arbuckle Mountains of Oklahoma.

The northwest-trending aulacogen is a basement rift which opened in the Late Cambrian (535 to 525 m.y.a.). During the early history of the aulacogen, the thick Cambro-Ordovician Arbuckle Group (2,050 m) was deposited as a predominantly peritidal complex. The comformably overlying Early Ordovician Simpson Group (700 m) shows more variation in water depth but still is dominated by shallow-water deposits. The Viola Limestone rests disconformably on a hard-ground which was developed at the top of the Simpson Group. Early Viola deposition was below wavebase probably with continental slope bathymetry; this time thus represents the deepest carbonate sedimentation within the aulacogen. Initial results show that the oldest microfacies of the Viola Limestone is a laminated calcisiltite deposited within anoxic bottom conditions by weak traction currents. Progressively increasing oxygenation and wave energy resulted in deposition of a bioturbated wackestone which then grades upward into a washed grainstone. These microfacies indicate a general upward shallowing along the axis of the aulacogen. Early workers, however, suggested that the more cratonward Viola microfacies may deepen slightly upward. As noted in earlier studies, the carbonate ramp model seems to fit best the depositional setting of the Viola. The ramp model can deal with the conflicting water depth trend by having a subsidence hinge axis upslope from the upward-deepening and upward-shallowing sections. In addition, sedimentation rates would have been greater in the aulacogen axis than on the marginal platforms. Shallow subtidal deposits cap the Viola of both the aulacogen and platform. In both areas these shallow-water carbonates were subjected to early diagenesis by meteoric water, confirming their proximity to sea level. [632]

Persimmon Creek Field—Anatomy of a Morrow Stratigraphic Trap

ROBERT E. WEBSTER, AMAX Petroleum Corp., Dallas, TX

Persimmon Creek field in T20N, R22W, Woodward County, Oklahoma, on the northern shelf of the Anadarko basin, produces gas and condensate from upper lower Morrow sandstone. The field occurs above a prominent southward-plunging structural nose on the Chester limestone. This and similar noses nearby appear to be paleotopographic highs that strongly influenced subsequent Morrow deposition. A thicker Morrow section overlies Chester lows or paleovalleys and a thinner sequence occurs above the noses.

In this area, the Morrow contains an upper shale section and a lower sand-shale sequence containing four major sandstone units, each of which may contain one or more discrete sandstone beds with interbedded shale. The basal Morrow "Hamilton" sandstone strikes west-northwest, but filling of the subjacent Chester paleovalleys has caused local thicker sand accumulations with good porosity to trend north-south. The overlying "Yellow" sandstone has similar characteristics. In the "Brown" sandstone, this relationship is reversed, and the thickest sand accumulation and best porosity development occur above the plunging Chester noses. The uppermost

"Fritzler" sandstone is more erratic in character, showing little relationship to Chester paleotopography.

Persimmon Creek field, with an area of about 2 mi^2, produces from north-south-trending "Brown" sand bars 8 to 20 ft (2.4 to 6 m) thick with 14 to 22% porosity. By analogy, in this part of the Anadarko basin, Morrow exploration should focus on locating porous upper lower Morrow sandstone above basinward-plunging Chester noses. [641–642]

Petrologic Controls of Reservoir Properties of Mid-Continent Pennsylvanian Sandstones

MARVIN D. WOODY, University of Kansas and Kansas Geological Survey, and ROBERT L. BRENNER, University of Iowa, Iowa City, IA, and Kansas Geological Survey, Lawrence, KS

Petrographic analyses of Middle Pennsylvanian (Desmoinesian) Cherokee Group sandstones in the Mid-Continent show that effective liquid porosities, liquid permeabilities, and pore-size distributions are controlled by sedimentologically influenced petrologic parameters and subsequent diagenetic alterations. Deltaic complexes contain two distinct sandstone-bearing lithologies: (1) subarkosic-quartzarenitic channel sandstones, and (2) sublitharenitic sandstones interstratified with shales representing overbank and interdistributary deposits. The sandstones in these two settings underwent different diagenetic histories, which enhanced original differences in their reservoir properties.

Overbank deposits commonly contain soft, argillaceous rock fragments which underwent plastic deformation during compaction, causing the clogging of some pore-throats and pores. In addition, extensive silica cementation, perhaps due to diagenetic clay mineral conversions, caused further destruction of primary pores. In channel sandstones, porosity reduction was less extensive and apparently proceeded at a slower rate. Chlorite coatings on many grains prevented destruction of original pore spaces by inhibiting further silica cementation. Individual sandstone bodies with abundant coatings fall within a porosity range of 20 to 25%, whereas bodies with uncoated grains rarely exceed 18%. Permeabilities in clay-coated reservoir rocks fall within a 100 to 200 md range, whereas uncoated or sparsely coated rocks are in the 1 to 30 md range. The diagenetic histories of these rocks are further complicated by the development of secondary porosity caused mainly by dissolution of the feldspathic grains and carbonate cements. [644]