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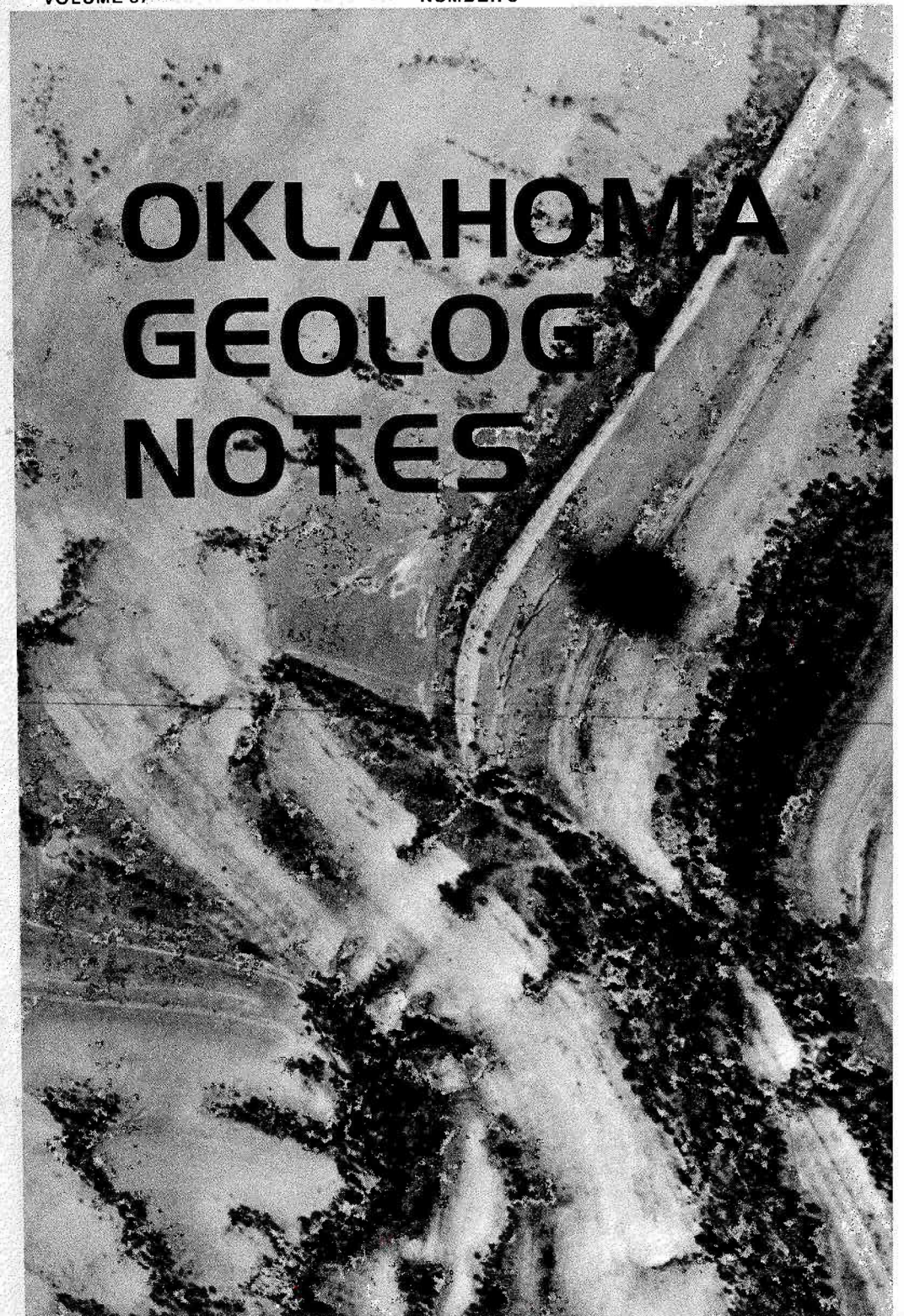
OKLAHOMA GEOLOGY NOTES



Cover Picture

LIMESTONE AND SHALES ON THE SOUTHWESTERN EDGE OF THE ARBUCKLE ANTICLINE

Paleozoic limestones and shales of the Arbuckle Mountains are shown on the cover photograph for this issue. The Viola Limestone (Ordovician) forms the prominent ridge on the left (north) side of the photograph, and this rock unit dips to the right (south) at an angle of 30 degrees beneath the Sylvan Shale (broad valley with pond and partial tree cover), Hunton Group (ridge), Woodford Shale (tree-covered valley), and lower part of Sycamore Limestone (ridge at far right).

The photograph covers part of the southwest edge of the Arbuckle Anticline, near the town of Woodford. It shows a single fault that extends from just left of center toward the lower right and cuts the Hunton Group.

The area covered by the photograph includes the SW¼ sec. 25 and the SE¼ sec. 26, T. 2 S., R. 1 W., in Murray County, with the long axis of the picture being about 1 mile. The photograph was taken by the U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service.

—*Kenneth S. Johnson*

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

Oklahoma Geology Notes is published bimonthly by the Oklahoma Geological Survey. It contains short technical articles, mineral-industry and petroleum news and statistics, an annual bibliography of Oklahoma geology, reviews, and announcements of general pertinence to Oklahoma geology. Single copies, seventy-five cents; yearly subscription, $4.00. All subscription orders should be sent to the address on the front cover.

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

This publication, printed by the Transcript Press, Norman, Oklahoma, is issued by the Oklahoma Geological Survey as authorized by Title 70, Oklahoma Statutes 1971, Section 3310, and Title 74, Oklahoma Statutes 1971, Sections 231-238. 1,500 copies have been prepared for distribution at a cost to the taxpayers of the State of Oklahoma of $1,760.80.

OCCURRENCE OF *AGASSIZOCRINUS PATULUS* IN OKLAHOMA AND ARKANSAS

H. L. Strimple[1] and C. J. Brown[2]

The free-swimming inadunate crinoid species *Agassizocrinus patulus* Strimple (1951) has heretofore been reported only from the Pitkin Limestone (Chesterian) exposed on Braggs Mountain, Muskogee County, Oklahoma. An additional specimen from the same formation, exposed on Lick Mountain, Newton County, Arkansas, is reported herein (fig. 1).

Agassizocrinus, characterized primarily by fused infrabasal cones, is a widely distributed, cladid inadunate crinoid genus found in Chesterian (Upper Mississippian) rocks of the continental United States. Because the infrabasal plates are fused, they do not become disarticulated after the animal's demise. Articulated cups are seldom found, and crowns (cups with arms attached) are even more rare.

Agassizocrinus patulus Strimple (1951) is readily distinguished from other species of the genus, because it possesses a small, supernumerary or plug plate that is visible at the proximal extremity of the infrabasal cone. The plug is surrounded by the five normal infrabasal plates. Although it has not been observed in this species, other *Agassizocrinus* species possess a stem in their youthful stages. All but a short, proximal portion of the stem is discarded during growth. Infrabasals grow downward, and in mature specimens of some species, they can eventually overgrow the rudimentary stem segments (see Burdick and Strimple, 1971, plate 5, fig. 15).

Apparently, the minute calcite plug formed at the termination of the stem in *A. patulus* functioned as a discrete entity and grew downward with the infrabasals. The plug is an independent element rather than a basic cup plate, and it is not derived by fusion of the captured proximal columnals, or at least in some species it is not. In *A. patulus* the plug develops five facets and is in the form of a pentagon at the base of the cup (fig. 2b). Because of the nearly vertical sides, the plug is rarely preserved; it is generally represented only by the opening it once occupied. In other species where the infrabasals fail to entirely overgrow the remnant stem, a shallow, depressed area is formed or (in rare instances) a minute, rudimentary stem may be retained.

The Arkansas specimen is characteristic of *A. patulus* in all respects. The infrabasal cone is less than twice as wide as high (ratio 0.65), and although the individual plates form a solid cone, interinfrabasal sutures

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Figure 1. Sketch map of Oklahoma-Arkansas showing approximate localities where specimens of *Agassizocrinus patulus* have been found. Oklahoma locality is Braggs Mountain; Arkansas locality is Lick Mountain.

are not obliterated. Cup height is more than twice the height of the cone (ratio 0.47). Maximum cup width is attained at the juncture of infrabasals and basals and is maintained to the cup summit. The specimen lacks both swelling in mid-portion of cup and constriction of the summit; absence of these features is among the diagnostic characteristics of *A. patulus* (Strimple, 1951).

One other example of a supernumerary (plug) plate in the infrabasal circlet has been reported by Strimple (1961). The specimen is from southern Oklahoma, the lower part of the Goddard Formation, which has been correlated with the Fayetteville Formation (upper Hombergian-lower Elviran). It is reposited in the Museum of Invertebrate Paleontology, The University of Oklahoma, catalogue number OU 3919. The plug plate is large, relative to cone diameter (ratio 0.32). In the Arkansas specimen of *A. patulus,* the ratio is only 0.11. It has not been possible to identify the Goddard specimen at the specific level.

The type locality of *A. patulus* is a road cut along Oklahoma State Highway 10, well up on the northwest slope of Braggs Mountain (SW¼SW¼ sec. 21, T. 15 N., R. 20 E., Muskogee County). There the Pitkin Limestone was exposed in a 50-foot section during road construction (Taylor, 1972). Just below this horizon, 20 feet above the base of the formation, the ammonoids *Arcanoceras furnishi* (Saunders, 1964) and *Cravenoceras hesperium,* Miller and Furnish (1940) were found. At the base of the formation, *Cravenoceras inyoense* (Gordon, 1964), specimens have been recovered.

The presently considered hypotype of *A. patulus* is from a 150-foot-thick natural exposure of the Pitkin formation on the northeast side of Lick Mountain, Newton County, Arkansas (NE¼ sec. 17, T. 15 N., R. 19 W.). It was recovered by John D. McFarland of the Arkansas

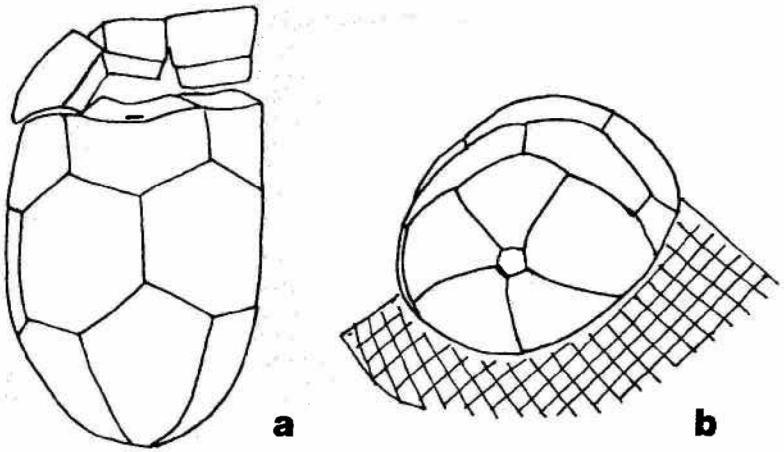

Figure 2. Camera lucida drawing of hypotype specimen (UA 77-206) of *Agassizocrinus patulus*: (*a*), anterior view of cup; (*b*), oblique basal view showing small supernumerary or plug plate in proximal position, ×3.5.

Geological Survey from a large gray mudstone block about 7 feet above a conformable Fayetteville-Pitkin contact. An ammonoid-bearing grainstone lies about 17 feet above the contact. A single, bilayered oolitic lens has yielded thousands of ammonoids and nautiloids, as well as gastropods, pelecypods, crinoid stems, and bryozoa. Cephalopod taxa thus far identified include *Cravenoceras hesperium, C. inyoense, Metadimorphoceras* aff. *saleswheelense* (Moore, 1939), *Trizonoceras* sp., *Liroceras* sp., *Posterioceras* sp., *Stroboceras* sp., *Tylonautilus* sp., and several orthoconic nautiloids.

Both ammonoid faunas indicate a lower Pitkin formation assignment. The Pitkin Limestone has been correlated with the upper portion of the Elvira Group of Illinois, including part of the Menard, Kinkaid, and Grove Church Limestones of the Illinois standard section (Furnish and Saunders, 1971; Saunders, 1973; Horowitz and Strimple, 1974). A study is currently in progress correlating these fauna with equivalents in the Great Basin.

Acknowledgments

Particular thanks are due to John D. McFarland of the Arkansas Geological Commission, who found the hypotype specimen. W. M. Furnish and T. J. Frest, The University of Iowa, were kind enough to read the paper and offer suggestions.

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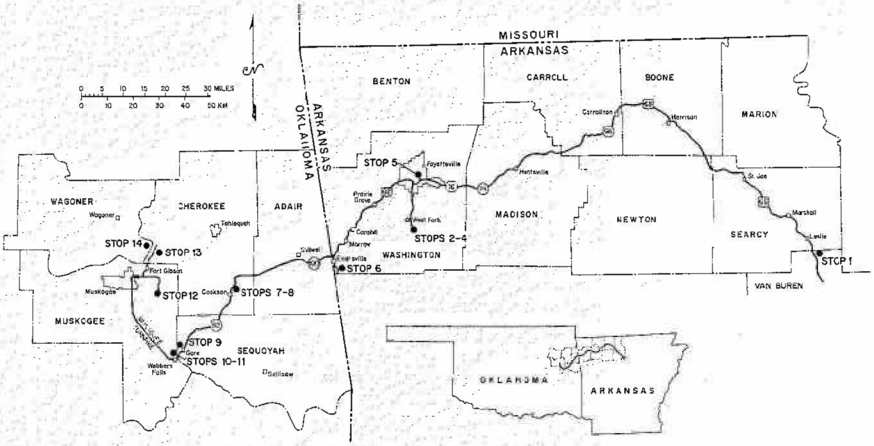
Paleontologists Plan Convention and Field Trips

The Second North American Paleontological Convention will be held at Lawrence, Kansas, August 7-10, 1977. Paleontologists from all over North America will gather to attend symposia ranging in subject from phylogenetic models to echinoderm paleobiology. In addition to the formal part of the convention, there will be a series of informal meetings to allow members of various specialty groups to exchange information about their research activities.

Eight field trips are planned prior to the Lawrence meeting. Four of these trips will be devoted to examining Ordovician sections in conjunction with the Third International Symposium on the Ordovician System, also



LOCALITY AND ROUTE MAP

held this summer. The remaining four trips provide opportunities to examine the stratigraphy and paleontology of exposures in the Texas Panhandle, Arkansas and Oklahoma, Kansas and Nebraska, and the western interior.

Participants for the Arkansas-Oklahoma trip will meet in Harrison, Arkansas, Thursday evening, August 4, will spend 2½ days examining the biostratigraphy of upper Chesterian and Morrowan strata in northwestern Arkansas and northeastern Oklahoma (see illustration), and will terminate the trip August 7 in Lawrence, Kansas. Co-leaders for the trip are P. K. Sutherland, professor of geology at OU, and W. L. Manger, assistant professor of geology at the University of Arkansas, Fayetteville. Localities in the Chesterian Fayetteville, Pitkin, and Imo Formations and the Morrowan Hale and Bloyd Formations plus their Oklahoma equivalents will be visited. Particular emphasis will be placed on the paleontological criteria used for age assignment and correlation of these strata and on an analysis of the Mississippian-Pennsylvanian boundary.

A guidebook for the field trip is being prepared by Drs. Sutherland and Manger. The guidebook features roadlogs and descriptions of each stop on the trip plus 18 contributed papers summarizing many aspects of the lithostratigraphy and biostratigraphy seen on the field trip. The guidebook will be published by the Oklahoma Geological Survey, and copies will be available from the address on the front cover, at a cost of $8.00 apiece, by the end of July.

JOHN ALEXANDER ERDELYI-FAZEKAS NORDEN
(1912–1977)

Dr. John Alexander Erdelyi-Fazekas Norden died in his home in Norman, Oklahoma, March 25, 1977. His sudden death at the age of 64 came as a severe shock to his many friends and colleagues. Memorial services were held at Primrose Chapel in Norman on Tuesday, April 5, and the remains were later cremated in Dallas, Texas.

John Norden was born in Transylvania, a region and former province in central Rumania, formerly part of Hungary, August 31, 1912. His undergraduate studies were done at Bolyai College, Targu Mures, Rumania. He attended graduate school at Eötvos Royal Hungarian State Geophysical Institute in Budapest, Hungary, and at the Royal Hungarian Palatine Joseph Technical and Economic University, also in Budapest, where he served as teaching assistant from 1936 to 1939. He graduated summa cum laude and received his doctorate in 1940.

Dr. Norden's professional career began in 1940, when he accepted a position as geologist and geophysicist with the Hungarian American Oil Industrial Co., Ltd. (a subsidiary of Standard Oil of New Jersey), in Budapest, Hungary. He remained in that position until 1947, when he became a geologist-geophysicist with the Danish American Prospecting Company, a subsidiary of the Gulf Oil Corporation, Copenhagen, Denmark, where he served from 1947–48. He was employed as a photogeologist with the Gulf Oil Corporation in New York City during the summer of 1949.

John accepted a position as assistant professor of geology at The University of Oklahoma in 1948. He was promoted to associate professor in 1952 and to full professor in 1959. He became a naturalized citizen in 1954 and requested that his last name be changed officially to Norden. He retained his earlier name, Erdelyi-Fazekas, for identification and continuity of his ties with his former country and family. Dr. Norden organized and taught the

first course in geophysical exploration at The University of Oklahoma in 1950 and subsequently developed a program in exploration geophysics consisting of 3 courses: (1) Gravimetric and Ground Magnetic Methods in Petroleum Exploration, (2) Seismic and Electric Methods in Petroleum Exploration, and (3) Airborne Photogrammetric and Geophysical Exploration for Petroleum. In 1955 he organized a new curriculum for the B.S. degree in petroleum geophysics. This program attracted many students, both graduate and undergraduate, and several of them completed theses and dissertations in that area.

In addition to his teaching duties, Dr. Norden applied his expertise in geophysical research on differential compaction and microtectonic strain patterns on aerial photographs to the discovery of several oil and gas fields in Texas and Oklahoma. His electronic skill enabled him to rebuild and rewire the School's seismic equipment into a serviceable field unit. He was also active in designing and constructing various instruments and devices to be used in geophysical research and teaching. Among his inventions are (1) gravity-gradient variometer, (2) horizontal magnetometer, (3) magnetic inclinometer, (4) a pipeline locator, (5) a theta-angle compass, (5) an automatic model of Earth's precession motion under lunar and solar effects, and (6) automatic model of the Earth-moon motion. These instruments and devices were all donated to The University of Oklahoma. At the time of John's death, he was completing work on a prototype model of a seismic-shooting catapult system, a multi-spring device mounted on the back of the seismic truck. The impact of this catapult device on a heavy steel plate resting on the ground surface is capable of generating high-energy signals through unconsolidated surface materials, and it can be used along highways and in densely populated areas without the use of explosives or damage to the property and environment.

Dr. Norden was a member of The American Association of Petroleum Geologists, American Society of Photogrammetry, American Geophysical Union, Society of Exploration Geophysicists, Sigma Xi, the Oklahoma Academy of Science, and Pi Epsilon Tau (petroleum-engineering society). He is the author of some 18 scientific articles in geology and geophysics. Oklahoma Geological Survey Geologic Map 16, *Vertical-Intensity Magnetic Map of McClain and Southern Cleveland Counties, Central Oklahoma* (published in 1972), represents a compilation of magnetic mapping by five OU graduate students under the direction of Dr. Norden, who was the senior author of the map. In addition, he presented a number of papers to various scientific groups at The University of Oklahoma, including Pick and Hammer, Sigma Gamma Epsilon, Society of Geological Engineers, and the Society of Engineering Physics. He traveled extensively and maintained a collection of color slides depicting the geology of many parts of the world. He was well-versed in many languages and was capable of conversing in some seven different tongues.

The University of Oklahoma and the School of Geology and Geophysics have lost a valuable friend and a capable teacher. He was totally dedicated to the success of the exploration-geophysics program and the School. In addition to providing his teaching talents, he gave freely of his time, his ingenuity, his

technical skills, and in some cases his own money to build and repair geological and geophysical instruments and to develop new ones. His loss will be felt keenly by his friends, colleagues, and former students. In summarizing his many accomplishments, we say, "well done, good and faithful teacher and friend."

Dr. Norden had planned to retire from teaching at the end of the current academic year in order to devote his time to research and development of his seismic-catapult system. Plans for a suitable memorial are presently under consideration by the Alumni Advisory Council of the School of Geology and Geophysics. Dr. Norden's photograph will be placed on the wall of the conference room in the School, along with those of other members of our staff who have provided dedicated service.

—George G. Huffman

OGS Director Chairs OCS-Gas Committee

Oklahoma Geological Survey director Charles J. Mankin has been appointed by Cecil D. Andrus, Secretary of the U.S. Department of the Interior, to head a committee that will analyze methods of increasing natural-gas production from federal oil and gas leases on the Outer Continental Shelf (OCS).

At the height of last winter's natural-gas shortage, Secretary Andrus ordered a private consulting firm to make a preliminary study involving production leases in the Gulf of Mexico. The company concluded that some offshore fields could have been producing more gas. Their report did not speculate on whether or not producers were deliberately holding gas back in an effort to lift the ceiling on gas prices, but some people made that conclusion.

The review that Dr. Mankin's committee will conduct as an outgrowth of the preliminary investigation will focus on increasing gas production and thereby preventing future shortages; there is no intention to look for scapegoats. Committee members will be selected by the National Research Council of the National Academy of Sciences from a list of scientists, engineers, economists, lawyers, and other experts in various aspects of gas production. The group will organize and conduct the study, select gas fields for analysis, supervise consultants and subcontractors, and prepare reports summarizing the findings. The public will be kept posted on the committee's recommendations as they are prepared.

In a news release prepared by the Department of the Interior, Secretary Andrus praised Dr. Mankin by saying that his appointment "should help insure that the review is conducted with fairness and scientific accuracy."

WASTE-TREATMENT-MANAGEMENT PLANNING IN OKLAHOMA

Kenneth V. Luza[1]

Introduction

One of the principal goals of Public Law 92-500, the federal Water Pollution Control Act of 1972, is to make the nation's waters suitable for fishing and swimming by 1983. Section 208 of this law establishes the procedure for developing a comprehensive, areawide, waste-treatment-management plan. The initial phase usually involves the collection of information that will guide planning toward meeting or maintaining the 1983 water-quality standards. Generally, this activity is referred to as 208 planning.

In December 1975, the Oklahoma Department of Pollution Control (DPC), under the direction of Dr. Denver Tally, was designated by the governor as the agency to administer our statewide 208 planning. In May 1976, the Environmental Protection Agency (EPA) awarded DPC a $1-million grant, under section 208, to develop and implement a statewide waste-treatment-management plan.

Oklahoma was fortunate to have its statewide 208-planning agency become the first in the nation to receive federal EPA funding. During the course of the 36-month project, 208 planning will provide (1) a statewide water-quality plan, (2) an evaluation of alternatives for future water-management programs, and (3) establishment of policies that will aid in solving water-quality problems in Oklahoma on both a short- and a long-term basis.

The planning effort is designed to involve industry; local elected officials; and local, state, and federal agencies involved or interested in water-quality programs. Public participation is an important aspect of the program, because action taken within one region may well affect water quality in other places. Therefore, during the course of the project, interim reports will be evaluated by the public through a highly structured review and approval process.

Planning Area and Function

DPC's planning area, which has a population of 1,107,729 (1970 census), involves all or parts of 61 counties and 9 substate-planning districts covering 65,535 square miles (fig. 1). ARKOMA (which includes Sebastian and Craw-

[1]Geologist, Oklahoma Geological Survey.

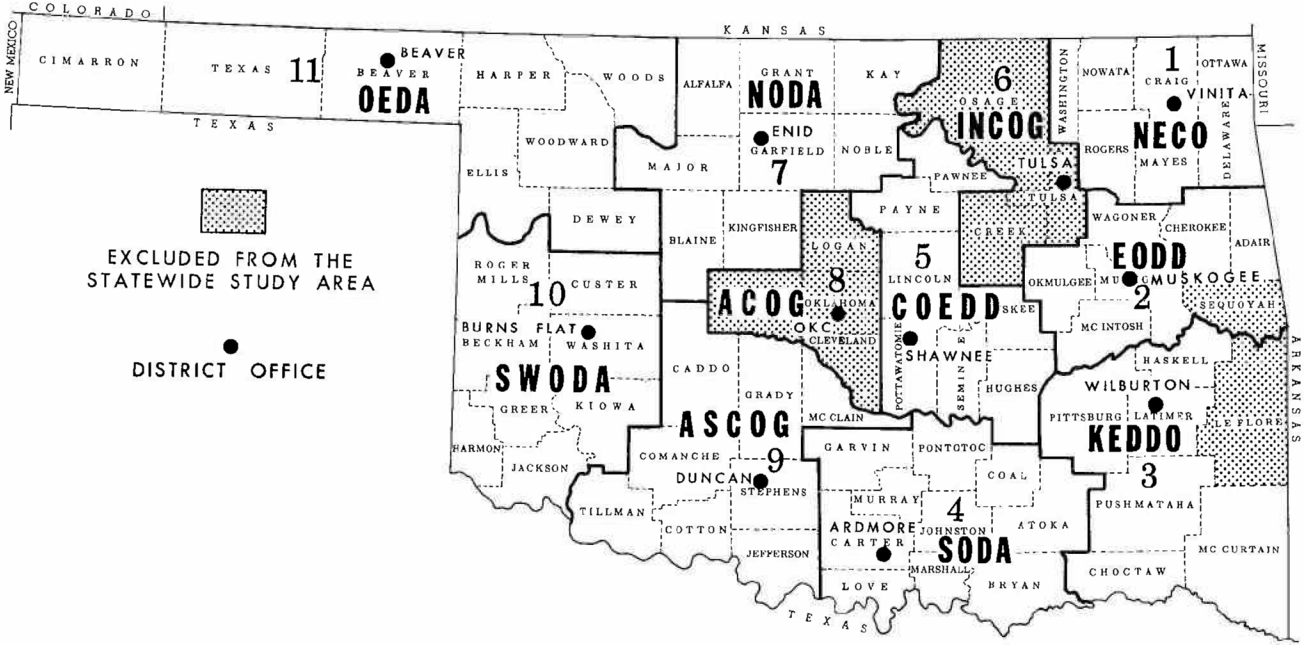


Figure 1. Map showing Oklahoma's 11 substate planning districts: 1 - Northeast Counties of Oklahoma Economic Development Association; 2 - Eastern Oklahoma Development District; 3 - Kiamichi Economic Development District of Oklahoma; 4 - Southern Oklahoma Development Association; 5 - Central Oklahoma Economic Development District; 6 - Indian Nations Council of Governments; 7 - Northern Oklahoma Development Association; 8 - Association of Central Oklahoma Governments; 9 - Association of South-Central Oklahoma Governments; 10 - Southwestern Oklahoma Development Association; 11 - Oklahoma Economic Development Association.

ford Counties in Arkansas as well as Sequoyah and Le Flore Counties in Oklahoma), INCOG (Indian Nations Council of Governments), and ACOG (Association of Central Oklahoma Governments) planning districts are excluded from the project, because they have 208-planning programs under way. However, their results will be integrated into Oklahoma's statewide plan.

The initial plan will include (1) an inventory of land use, (2) a 20-year construction plan and schedule for waste-water-treatment systems, (3) storm-runoff-control systems, (4) both point and nonpoint source-pollution assessment (the former refers to the discharge of pollutants by a discernible and confined method such as a pipe, ditch, and/or channel), (5) a program delineating management agencies, and (6) regulatory systems necessary to implement the plan.

Once the plan is approved, all subsequent permits must conform to it, and all future EPA construction-grant programs will be evaluated by the appropriate management agency or agencies designated within each area. The initial plan will be completed by November 1, 1978.

Planning Process

The Oklahoma DPC serves as the program-management agency for statewide 208 planning; the Oklahoma Water Resources Board, the Oklahoma State Department of Health, and the Oklahoma Conservation Commission serve as agency consultants. These agencies have primary responsibility for the preparation of reports relevant to the project study. Such reports will include a land-use inventory, water-quality studies of most of the major river systems (the reports on East Cache Creek and the Illinois River have been completed), and assessment of the major contributors to water pollution. It is anticipated that a variety of engineering firms and other agencies will serve as engineering, management, and planning consultants. Available resource material and relevant data from water-basin studies, waste-treatment-facility projects, and related water-quality-management information will be utilized to develop the plan. Additional data specifically from water-quality-monitoring programs will be generated in order to aid in developing a feasible plan.

The planning process begins with the development of a work outline, with the principal goal being the implementation of a final plan (fig. 2). An 11-step list that summarizes the planning process is listed below.

1. Identification of point and nonpoint sources of pollution and their individual and composite impact on water quality in a specific area.
2. Establishment and verification of a comprehensive point- and nonpoint-source waste-load-allocation methodology.
3. Identification of anticipated municipal and industrial treatment systems, over a 20-year period, consistent with existing State construction-grants programs.
4. Planning of facilities necessary for steps 2 and 3 and therefore eligible for grant assistance during the 5-year period following plan approval.

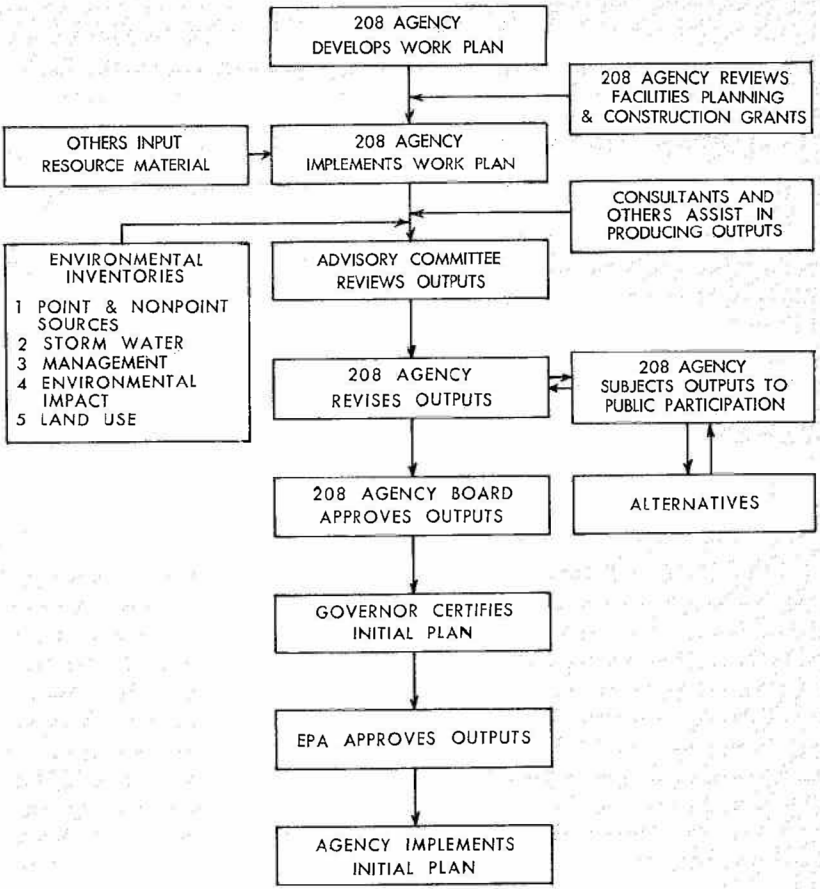


Figure 2. Flow chart for planning process, Oklahoma's areawide water-treatment-management plan.

5. Grouping and assessing facility plans as to impact within each specific area.
6. Development of procedures and methods to control point and nonpoint sources of pollution, specifically including nonstructural alternatives as well as processes for controlling the disposition of residual waste products.
7. Identification of agencies necessary to finance, construct, operate, and maintain facilities identified in the plan and to otherwise implement all facets of the plan.
8. Development of alternative management systems and management agencies to implement the plan.

9. Utilization of the comments of representatives of local governmental units and the public in formulating recommendations.
10. Submission of the plan to the governor for certification and to EPA for approval.
11. Development of alternative regulatory programs to provide for (a) waste-treatment management on a local and areawide basis, (b) regulation of the location, modification, and construction of all waste-discharge facilities, (c) assurance that industrial waste discharge into municipal-treatment works meets pretreatment requirements, (d) establishment of an equitable means of assigning user charges, and (e) establishment of a schedule delineating the costs and benefits of implementing the various plan elements.

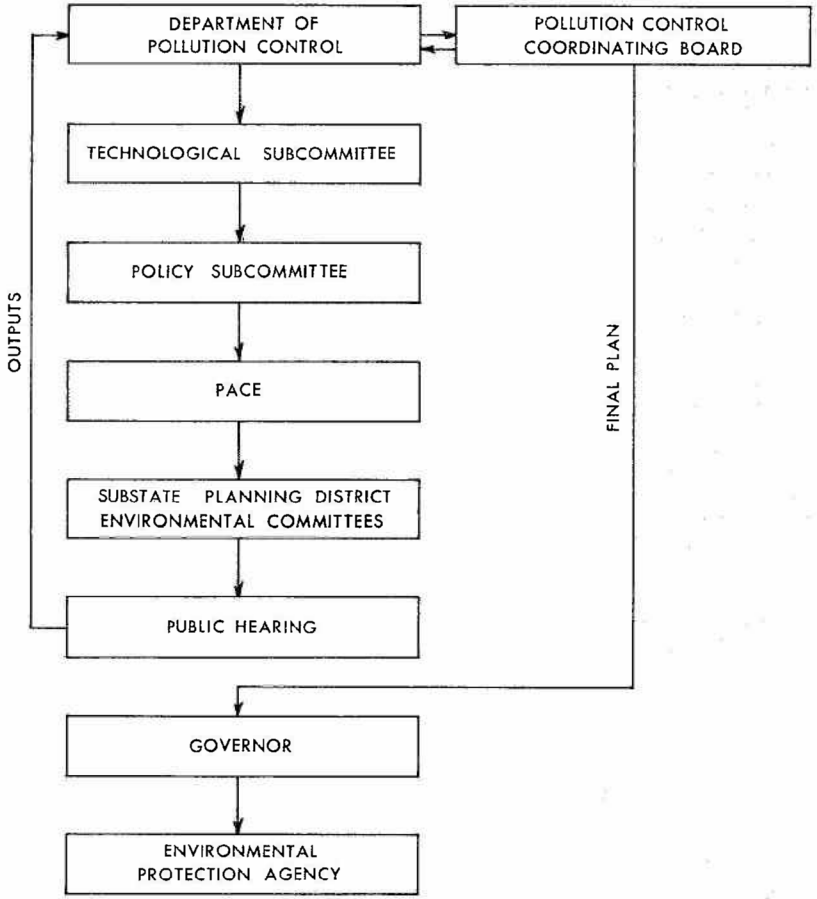


Figure 3. Operational format for public-participation program, Oklahoma's areawide water-treatment-management plan.

The planning and engineering information and the alternatives in the final plan will be subjected to a review system prior to final approval by the Oklahoma Pollution Control Coordinating Board. A Policy Advisory Committee on the Environment (PACE) has been established as one of the principal elements of the review system (fig. 3). The committee is composed of approximately 80 persons who represent a cross section of industrial, agricultural, and environmental and developmental interests—as well as representatives from all levels of government.

PACE is charged with advising DPC on all 208 planning. Additionally, the committee functions as a liaison between DPC and the local areas from which PACE members come. They are, in fact, the DPC's 208-planning representatives throughout the State, and they take an active role in providing a forum for discussions with citizens on the local level.

In addition to PACE, each of the 9 substate-planning districts under contract with DPC has established local environmental committees. These committees are composed in a manner similar to that of PACE, but their role is somewhat different. Once problems are identified and a list of alternatives to the problems are generated, these local committees will invite public discussion at meetings in their own areas. It is at these meetings that decisions are made as to which alternative solutions to problems will be attempted. Because these decisions will be made by citizens working through the local committees, all committee members play an extremely important role. It will be their responsibility (along with the citizens who attend the public meetings) to determine the future of clean water in their area.

For additional information on Oklahoma's waste-treatment-management planning program in specific areas, readers can contact either a local substate-planning district office (fig. 1) or the Oklahoma Department of Pollution Control, Box 53504, NE 10th and Stonewall, Oklahoma City, Oklahoma 73105.

1977 Petroleum Encyclopedia Available

International Petroleum Encyclopedia 1977—the 10th edition of a valuable reference book—has been published, and orders are being filled. The volume exceeds 400 pages and contains 50 maps plus more than 100 charts, tables, and graphs. The price is $42.50 per copy. For additional information or to reserve copies, address correspondence to Oil & Gas Journal—IPE/77, P.O. Box 1260, Tulsa, Oklahoma 74101.

ROAD-BANK EROSION—A CENTRAL OKLAHOMA CASE STUDY

Martin J. Haigh[1]

Introduction

Road-bank erosion is a conspicuous and widespread problem in Oklahoma. However, the devegetation and gullying of roadside land is more than just unsightly. Road-bank gullies damage road surfaces, roadside lands, and structures. The development of deep hollows in road margins is a traffic hazard that costs lives. High sediment yields lead to blocked ditches and culverts and to accelerated sedimentation in streams, ponds, and reservoirs (see de Belle, 1971; Scheidt, 1967; Lierboe, 1967; and Parizek, 1971).

Nationwide, there is about one kilometre of roadway for each square kilometre of land. In the United States, 5.8 million kilometres of roadway are flanked by 6.9 million hectares of road bank (Mowbray, 1969; Disecker and Richardson, 1961). Highways under construction have been found to yield between 250 and 730 metric tons of sediment per hectare (Wolman, 1964). Road banks in Georgia (Dimensions: relief, 3-5 metres; surface length, 61-107 metres) have been found to yield 228 metric tons per hectare annually from south-facing slopes and 515 metric tons per hectare annually from north-facing slopes (Disecker and Richardson, 1961 and 1962; Disecker and McGinnis, 1967). Sediment yields were greatest in the spring.

This study is concerned with a single, south-facing road bank (Dimensions: relief, 3 metres; surface length, 6 metres; mean slope, 30°). This bank was selected for examination because it seemed to be typical of the smaller road banks in Oklahoma. The erosion of such road banks has not yet been subjected to detailed examination, and this study should help establish local criteria for the estimation of road-bank sediment yield.

Site Description

The site for the experiment is in the catchment of Lake Thunderbird, in Cleveland County. It is adjacent to a paved road and abuts an area of seminatural scrub woodland dominated by oak species. The bank is underlain by poorly cemented, fairly coarse-grained, red Garber Sandstone of Lower Permian age (Wood and Burton, 1968) that outcrops over a dis-

[1]Assistant Professor, Department of Geography, University of Chicago.

tance of about 0.2 metres on the upper part of the road-bank profile. The soils that comprise the road bank proper appear to be directly derived from the native sandstone. They are entirely unvegetated, and they sport a hard and smooth upper surface above a well developed, washed-in layer.

The soils sport numerous desiccation cracks, so they obviously have a high clay-silt content. Wet-sieve, particle-size analysis indicates the mean size of these sediments: D^{50} is 0.06 mm, while D^{10} is less than 0.002 mm.

This area receives, on the average, 850 mm of rainfall each year. Precipitation occurs mainly in association with intense thunderstorm activity and tends to be concentrated in the spring and summer months. The year of observation, 1976, was relatively dry. Total rainfall amounted to only 675 mm (fig. 1).

The precise morphology of the road bank is depicted by figure 2. This profile was constructed from 150-mm-unit slope measurements averaged

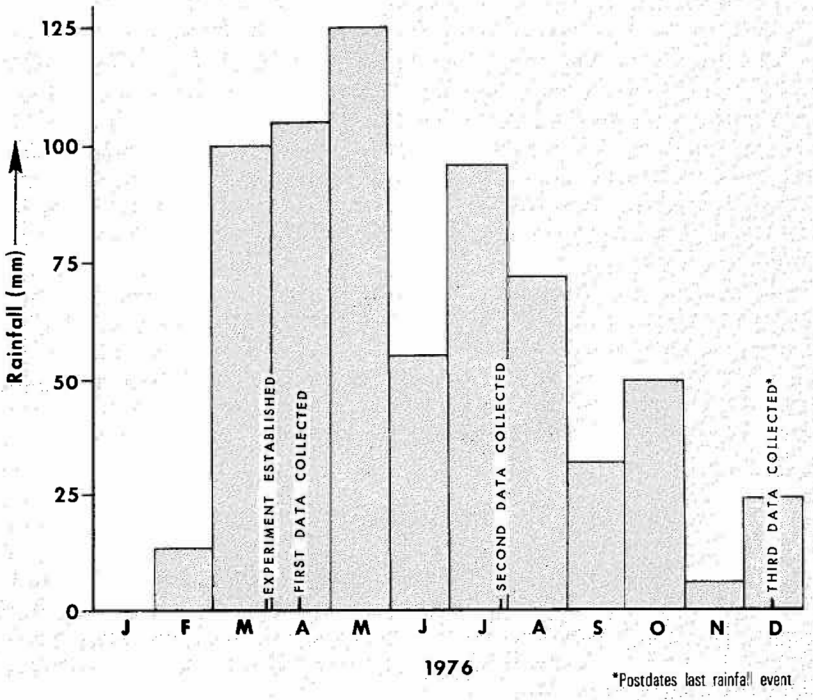


Figure 1. Monthly precipitation totals for Norman, Oklahoma (near experimental road bank), during year of observation (1976).

from each of the 2 nongully profiles. Desiccation cracks and associated rills have their maximum development midslope and extend into the lower midslope. The lower concavity has been truncated by outwash from a neighboring, parallel (0.2–0.4-metre-deep) gully channel. Steepenings in the upper profile are due to the exposure of bedrock and the junction of the road bank with the undisturbed vegetated soil of the neighboring scrublands.

Procedure

Erosion is being monitored at the site of the experiment by means of erosion pins (Haigh, 1977a). Three profiles, including one located in a gully channel, have been monumented at metre intervals with 600-mm × 15-mm metal pins (Haigh, 1977b). Changes in the exposure of these pins are recorded to the nearest millimetre and are accurate to ± 2.00 mm.

The experiments were established in late March 1976, and data collections were undertaken in mid-April, late July, and mid-December 1976. The observation period encompassed a period of 8½ months and 87 percent (587 mm) of the area's rainfall.

Discussion

Preliminary results from this experiment are depicted numerically, figure 2. It can be seen that erosion was concentrated on the steeper sections of the profile. The rectilinear main-slope segment, thus, underwent a mean retreat of approximately 25 mm, while the average retreat of the rest of the profile was only 7 mm. Results from the two nongully profiles were surprisingly similar. The average retreat of each of the 2 profiles was 18.7 and 18.5 mm, respectively, for the 8-month period. Strangely, the results from the gully-channel profile were much smaller: 8.6 mm. Field observations suggest that this differential was the result of litter accumulations in the channel that inhibited flow such that deposition became the dominant mode in the upper part of the profile. At present, however, the data are not sufficient to determine whether this is a trend or a temporary condition.

Extrapolation, based on precipitation distribution, suggests that the annual surface lowering of this road bank is on the order of 21.4 mm per annum. These results, which were gathered on a short, steep, south-facing slope, are comparable to those gathered on 35°- to 40°-slope erosion plots on longer, south-facing road banks in Georgia. Disecker and Richardson (1961, 1962) and Disecker and McGinnis (1967), however, discovered that the sediment yields from similar erosion plots on north-facing road banks in Georgia might be substantially greater than those on slopes of opposed aspect (24.4 versus 22.4 mm), and this possibility must be admitted for Oklahoma.

Torrential rainfall seems to be the main source of geomorphological activity. Removal seems related to sheet-flood activity and occurs, often,

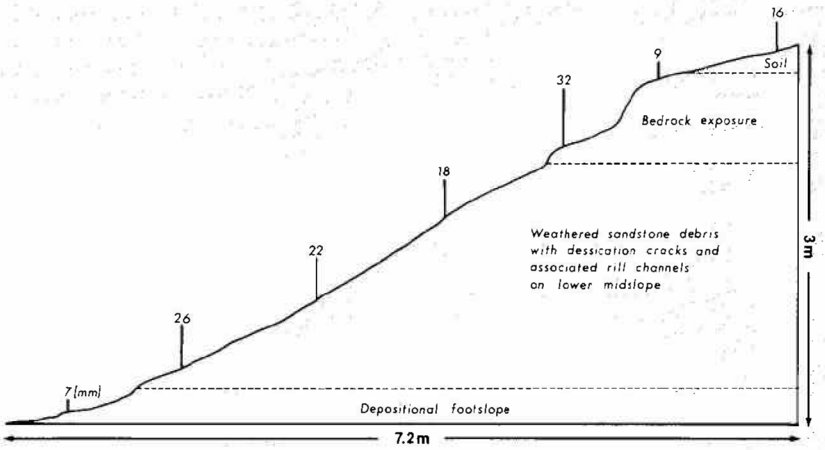


Figure 2. Morphology of experimental road bank: profile is based on 150-mm unit-slope measurements; vertical lines represent erosion-pin sites and actual ground retreat.

in association with the development of rill systems along the lines of dessication cracks (Engelen, 1973, Haigh, 1977b).

Conclusion

Soil losses from an Oklahoma road bank were measured as 18.6 mm between late March and mid-December 1976. Recalculated, this suggests an annual soil loss of 21.4 mm. If one grants eroded soil a specific gravity of 2.6 (Judson, 1968), a retreat of 21.4 converts to a soil loss of 556 metric tons per hectare per year. If a specific gravity of 2.3 is considered more appropriate for materials derived from a friable sandstone, then this retreat might be taken to imply a soil loss of 492 metric tons per hectare per year. These results are, of course, provisional; they are subject to revision in the light of further investigation.

Acknowledgments

My thanks go to M. Harris and S. Mathis, who assisted in the establishment of this experiment.

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IX-ICC Scheduled for 1979

The Ninth International Congress of Carboniferous Stratigraphy and Geology (IX-ICC) will be the first international Carboniferous congress to be held outside Europe.

Field trips for the congress will begin about the middle of May 1979. Committee meetings and the opening plenary session will be in Washington, D.C. (May 17-19). Technical sessions will be on the campus of the University of Illinois, Urbana, Illinois (May 21-25). Post-congress field trips will begin May 26 and end early in June 1979.

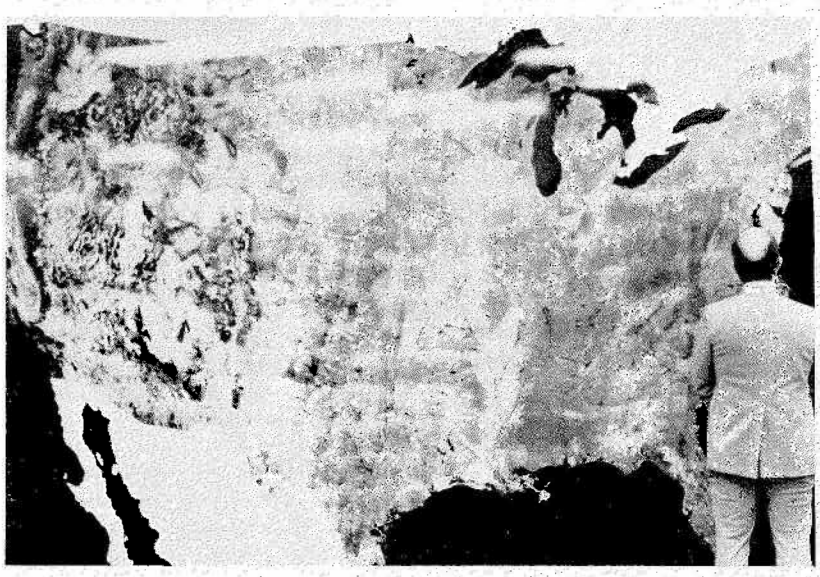
The general purpose of the congress is to discuss all aspects of geology of the Mississippian-Pennsylvanian and equivalent strata throughout the world. The first circular for the congress will be issued early in 1977 and will include a call for papers. To obtain the circular, send your name and address to: IX-ICC, 1979, Museum of Natural History, Washington, D.C. 20560.

Oklahomans Assemble in Washington for AAPG Meeting

The Oklahoma Geological Survey was represented by four staff members at The American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists annual convention, held June 12-16 in Washington, D.C. The OGS delegation was led by Charles J. Mankin, director, and included T. W. Amsden, paleontologist and stratigrapher; S. A. Friedman, coal geologist; and William D. Rose, geologist-editor.

The strong emphasis on energy at the sessions was reflected in the contribution made by members of the Norman group. In a pre-convention meeting, Dr. Mankin presented a report to the Commission on Natural Resources for the National Academy of Sciences (NAS) concerning the activities of the newly-created Gas Production Opportunities Committee. He was appointed in April by Secretary of the Interior Cecil Andrus to serve as chairman of this committee (see item on page 74 of this issue). Dr. Mankin is also a member of the Academic Liaison Committee and the Continuing Education Committee for AAPG.

Dr. Amsden presented a paper, "Mid-Paleozoic History of the Anadarko and Arkoma Basins of Oklahoma," in which he discussed two of



General Electric's spectacular map of contiguous United States, compiled from satellite imagery.

Judy Golasinski (AAPG), Gary Howell (AAPG), Charles Mankin (OGS), and John Frye (GSA) at booth featuring AAPG educational activities.

Oklahoma's most productive regions—which are also among the most potentially productive structural basins in the country for hydrocarbons. The AAPG paper represented a condensed version of one that he gave last April at a meeting of the Tulsa Geological Society; he will offer it in its expanded form at a fall meeting of the Oklahoma City Geological Society.

S. A. Friedman, who is completing a 3-year term as chairman of the coals subcommittee of AAPG's energy-minerals committee, was involved in organizing a 6-session symposium with 40 invited papers on the geology and economic aspects of deposits of coal, uranium, "tar sands," oil shales, and geothermal energy. He presented a paper, "Coking Coal Reserves of Oklahoma," at the symposium, which was designed to coincide with approval of raising the AAPG Committee on Energy Minerals to division status. This was done by vote of the House of Delegates assembled at the annual meeting, and the AAPG Council approved a slate of officers and councilors for the new Energy Minerals Division. Sam was appointed to a 2-year term as councilor and will serve as chairman for programs.

William D. Rose, a member of AAPG's Public Information Committee, participated in pre-convention meetings of that group. As chairman of the news-release subcommittee, he was compiler of *News Release Handbook for Local Public Information Chairmen* (prepared in 1974), an informative publication that can be helpful to anyone who prepares news releases.

OGS staff members have been encouraged to participate in activities of The American Association of Petroleum Geologists, which is the largest geological organization in the world. It has grown since its inception on the OU campus in 1916 to a present membership of over 18,500, and Oklahomans have continued to make valuable contributions to all AAPG programs.

MU Hosts Energy Conference

The University of Missouri at Rolla, in cooperation with the Energy Council of the Missouri Department of Natural Resources, has planned a conference for October 11-13, 1977. The theme "Where Do We Go from Here?" is designed to pique interest in technical, economic, political, and social developments in energy. The conference is organized such that social scientists, scientists, and engineers can communicate their most recent developments, research, and studies on energy problems and offer solutions to local governments, business, industry, and the general public on energy-related problems.

September 1 has been set as the deadline for submission of abstracts; papers must be in by October 11. Send abstracts (or requests for additional information) to Dr. J. Derald Morgan, Conference Director, 108 Electrical Engineering Department, University of Missouri-Rolla, Rolla, Missouri 65401.

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