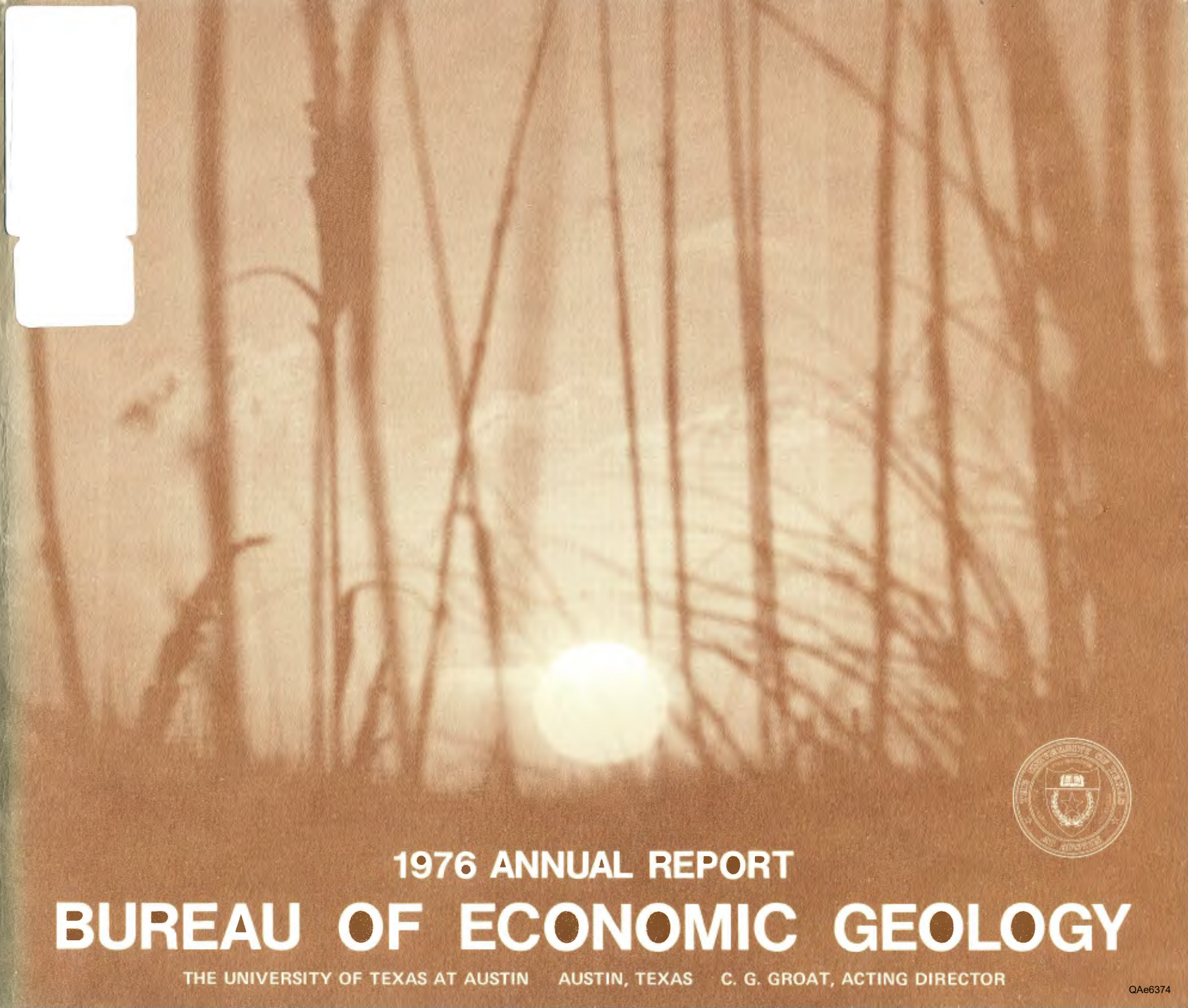

1976 ANNUAL REPORT

BUREAU OF ECONOMIC GEOLOGY

THE UNIVERSITY OF TEXAS AT AUSTIN AUSTIN, TEXAS C. G. GROAT, ACTING DIRECTOR

Cover photograph:
Sea-oats (*Uniola paniculata*)
and sand dunes on Padre Island,
north of Mansfield Pass.
Photo courtesy Jon P. Herber.

FOREWORD

The Bureau of Economic Geology, established in 1909 as the successor to the Texas Geological Survey and the Texas Mineral Survey, is a research entity of The University of Texas at Austin. It functions also as the State Geological Survey—a quasi-state agency—with membership on the State Interagency Council on Natural Resources and the Environment. The Bureau Director serves as State Geologist and represents Texas in the Association of American State Geologists.

The Bureau provides extensive advisory, technical, and information services relating to the geology and resources of Texas. In addition, it conducts a large number of basic and applied research projects in energy resources, mineral resources and mineral statistics, land resources, systematic geologic and land resource mapping, and a variety of other research programs in such areas as geohydrology, basin analysis, and geochemistry. Certain projects are conducted jointly with other units of the University as well as with State, Federal, and local governmental agencies.

The Bureau of Economic Geology publishes results of its research in Reports of Investigations, Environmental Geologic Atlases, Geological Circulars, Handbooks, Land Resources Laboratory Series, Geologic Quadrangle Maps, Mineral Resource Circulars, Guidebooks, and Special Publications. Publications are sold for a nominal price designed to recover printing costs. A complete list of publications is available on request.

The Annual Report of the Bureau of Economic Geology outlines the scope and status of current research progrems and projects, publications, personnel activities, and special services in the area of Texas geology and resources available to agencies, corporations, and the citizens of Texas. The Annual Report is available on request.

East Mall and Geology Building (r) on the UT Austin campus.

1976 ANNUAL REPORT

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THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS
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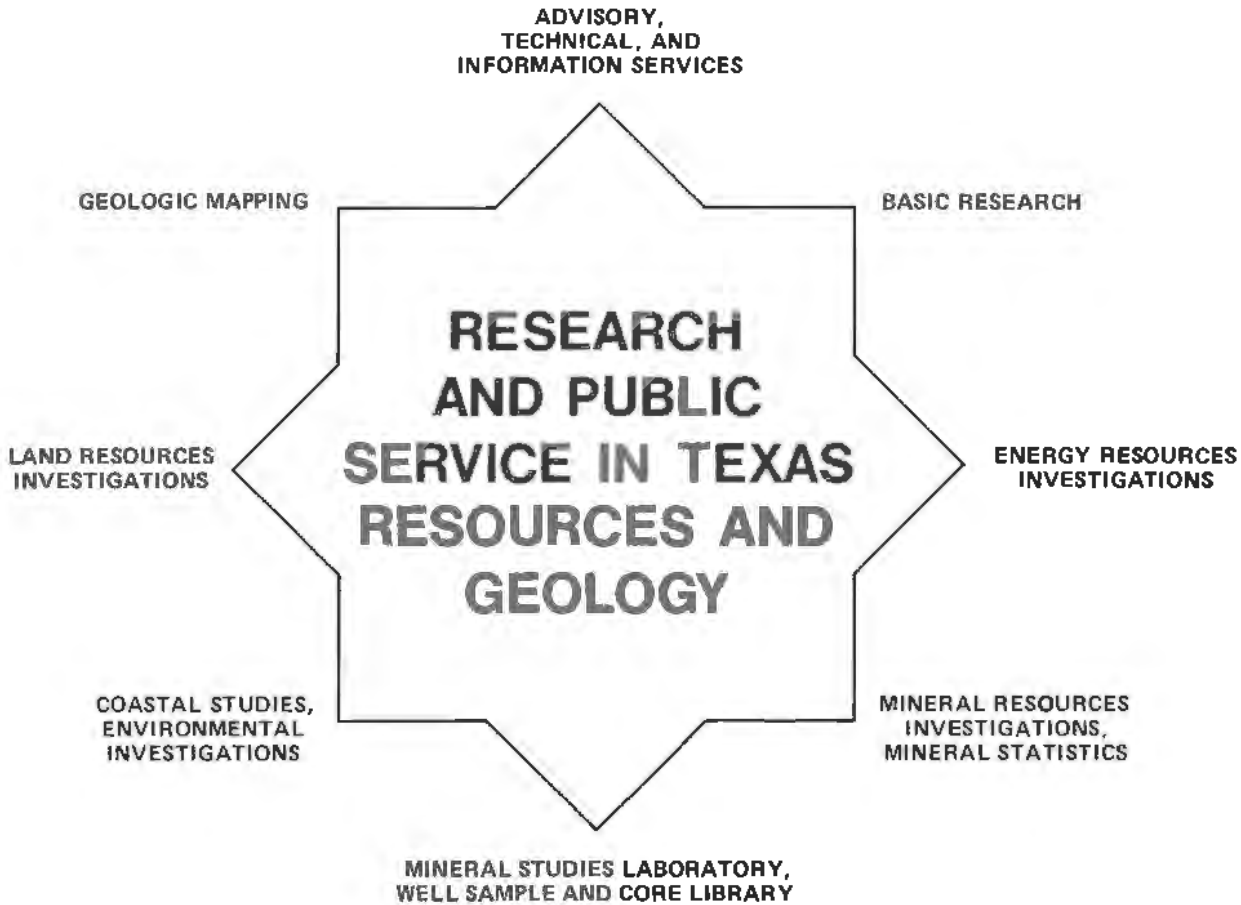

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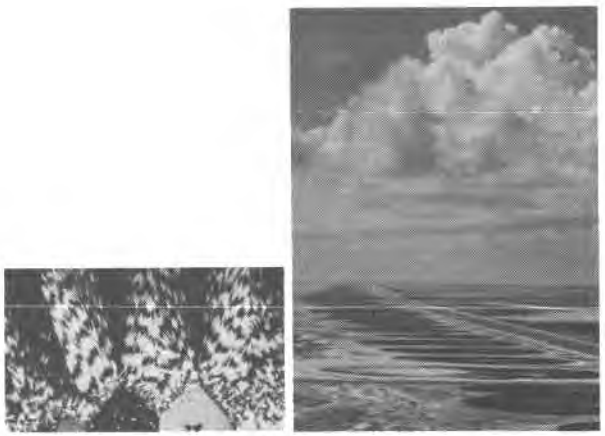

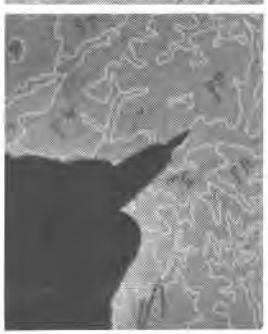

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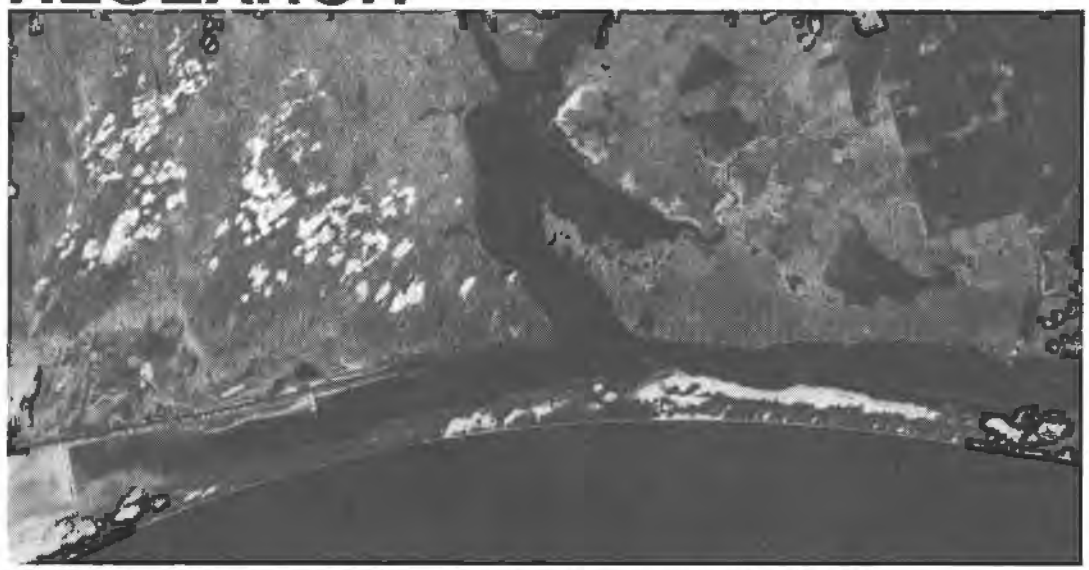


Aerial photograph of Texas Gulf coast, Baffin Bay and northern Laguna Madre.
Imagery provided by National Aeronautics and Space Administration.

Bureau research programs and projects attempt to address many of the State's major concerns in the areas of geological, mineral, land, and environmental resources. Through the years, an extensive research program in energy and mineral resource investigations has been maintained. This program includes continuing appraisal of the State's mineral and energy resources, investigations of resources that may be of importance in the future, and basic research aimed at developing new and better understanding of the distribution, occurrence, and potential development of Texas energy and mineral resources.

Geological studies in the Texas Coastal Zone received an additional impetus with the State-owned submerged lands program going into full swing. This is a massive effort to gather samples and seismic data from Texas bays and lagoons and from the inner continental shelf to a distance of 3 leagues (10.2 miles) from the coastline. Data collected from this program will provide a detailed inventory of State-owned submerged lands prior to the anticipated increase in offshore activities and multipurpose utilization of these lands.

Mineral and energy resource programs continued in uranium and lignite. Assessment of mineral production value of Texas school districts was completed; compilation of the Texas energy and mineral resources atlas and the curriculum materials on energy for public schools progressed. Geothermal studies proceeded toward the selection of a test site. The environmental aspects of the development of lignite, uranium, and geopressured geothermal resources are being evaluated through the Land Resources Laboratory.

The Land Resources Laboratory continues to coordinate the Bureau's numerous land resources programs. Of significance in 1976 are the Land Resources Laboratory programs providing land resource data to county governments. Information developed through land resource mapping is presented to county officials, organizations, and interested citizens in the form of workshops. These workshops bring Bureau scientists together with potential users of land resource information in order to transmit this information in a format that allows for clear understanding of the concepts inherent in land resource mapping, as well as the potential benefits in applying this information within a particular county.

In addition to projects that are parts of these major programs in basic research, projects in systematic geologic mapping, mineral statistics, and cataloging are maintained.

COASTAL STUDIES

GEOLOGY OF STATE-OWNED SUBMERGED LANDS

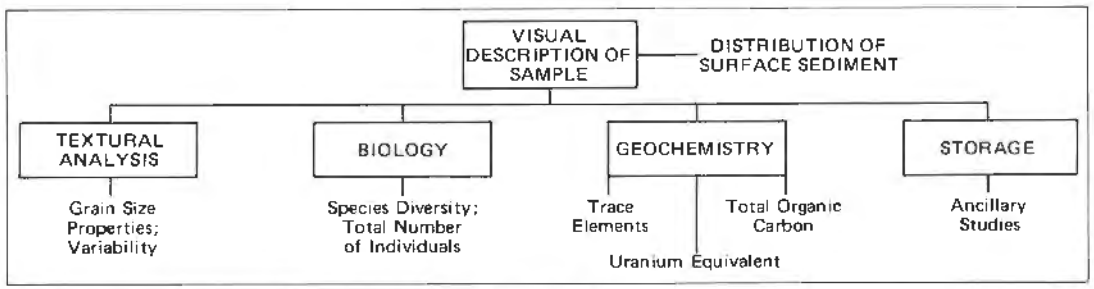
J. H. McGowen and Robert A. Morton, project coordinators, Richard L. Andersen, L. Chester Safe, Thomas R. Calnan, Mary J. Pieper, William A. White, John L. Chin, Carl S. Christiansen, Charles J. Greene, Jon P. Herber, John A. Kieschnick, C. Russell Lewis, Dale E. Solomon, and Dwight E. Williamson, assisted by Bahman Sepassi.

This comprehensive 2-year geological investigation, funded through May 1977, is designed to provide a detailed baseline inventory of State-owned submerged lands prior to the anticipated increase in offshore activities and multipurpose utilization of these lands. State-owned submerged lands include the inner continental shelf, extending from the Texas Gulf shoreline seaward for 10.2 miles (3 leagues), and the bays, estuaries, and lagoons of the Coastal Zone from the Rio Grande to Sabine Lake. Research is being conducted in cooperation with the Marine Geology Branch of the U. S. Geological Survey and is funded through the Coastal Management Program of the General Land Office of the State of Texas.

During 1976, approximately 3,500 nautical miles of high-resolution seismic-reflection data were obtained during three cruises over the inner continental shelf. The resulting grid of 235 dip lines (oriented perpendicular to the coastline) and several strike lines (oriented parallel to the coastline) provides extensive information on shallow structure (faults, folds, and so forth) and sediment character. Fifteen lines transect the outer continental shelf and intercept carbonate reefs or extend to the shelf-slope break. Geophysical surveys are complete for Corpus Christi Bay and at yearend are in progress in adjacent areas.

Extensive sample collecting is the second major aspect of this study. Nearly 4,000 shelf samples, spaced at 1-mile intervals, were collected on the inner continental shelf. Approximately 2,000 bay samples have been collected from the following bays: Trinity, Galveston, Chocolate, East, West, Bastrop, Christmas, Espiritu Santo, San Antonio, Hynes, Guadalupe, Aransas, Copano, Mission, St. Charles, Carlos, Mesquite, Corpus Christi, Redfish, Nueces, and Baffin. At yearend, sampling was being conducted in Sabine Lake and Laguna Madre. Following initial macroscopic description, sediment samples are subsampled for textural analysis, geochemical analysis, and description of benthic fauna. A portion of the sample is cataloged and stored at Balcones Research Center of The University of Texas at Austin for future supplementary investigations.

Preliminary results include maps depicting the nature and distribution of (1) surficial sediments,



Schematic of sample processing, State-owned submerged lands project (above).

Dredged spoil along Intracoastal Waterway in Laguna Madre (above left).

Research assistants lowering shelf-bottom sampler for sediment retrieval (left).

(2) potentially active faults, and (3) total organic carbon. Maps showing bathymetric changes between the late 1800's and late 1930's are complete now for the inner continental shelf from Yarborough Pass south to the International Boundary with Mexico.

Final maps will be constructed following analysis of sediment samples and geophysical data. These maps will include shallow geologic structure, sediment type and grain size, organic carbon, trace elements, and biologic assemblages. A brief interpretive report will accompany these maps.

LANDSAT INVESTIGATION FOR THE TEXAS COASTAL ZONE

Robert J. Finley, assisted by Robert W. Baumgardner.

The LANDSAT project, supported by NASA through the Texas General Land Office, completed mapping of four test sites and developed a land cover/land use classification for the Coastal Zone and a procedure for mapping from satellite imagery. The mapping procedure is based on optical enlargement of standard 1:1,000,000 LANDSAT scenes to a scale of 1:125,000. The LANDSAT products most used have been false-color composite, visible red, and far infrared band images.

The 23-category classification scheme emphasizes wetlands monitoring and includes topographically high and low marshes, tidal flats, grass/algal flats, and vegetated spoil. Based on turbidity, water has been separated into four classes to emphasize flow patterns and suspended sediment distribution. Evaluation of the test-site mapping indicates that category delineation is primarily dependent on size of the map unit relative to the satellite's limit of resolution and on reflectivity contrast with surrounding units. With the preparation of a final report, the project was completed at the end of 1976.

DEVELDPMENT OF A MODEL COASTAL NATURAL HAZARDS DISCLDSURE STATEMENT

Robert J. Finley.

In 1976, the Texas Coastal and Marine Council contracted with the Bureau of Economic Geology to prepare a demonstration copy of a Coastal Natural Hazards Disclosure Statement for Galveston County. The statement consists of a county map depicting historical data on hurricane effects, flooding, shoreline erosion, land subsidence, and surface faulting. The reverse side of the map sheet includes a brief explanation of these processes. The disclosure statement is designed for potential purchasers of property in Texas coastal counties. It will inform them of natural hazards associated with the coastal region. Data are derived primarily from "Natural Hazards of the Texas Coastal Zone," a special atlas published by the Bureau of Economic Geology in 1974. Two copies of the Galveston County map were provided for the Texas Coastal and Marine Council at the end of 1976.

SEDIMENT BUDGET OF GULF SHORELINE GALVESTON ISLAND

Robert A. Morton, assisted by James M. Casey and Cynthia L. Haynes.

This 1-year project was supported in part by the National Oceanic and Atmospheric Administration Sea Grant Program, administered through Texas A & M University. It was designed to utilize and augment the data gathered for the historical shoreline monitoring project (which has been completed) in order to determine the volume of material removed from and added to the Gulf shoreline of Galveston Island.

A map showing volumetric changes along the Gulf shoreline and at the entrance to Galveston harbor was developed by comparing hydrographic surveys made in the mid-1800's with more recent surveys by the U. S. Army Corps of Engineers and the National Ocean Survey of the National Oceanic and Atmospheric Administration. Continuing work involves comparison of the net volume of material with the net areal change (as determined by shoreline change) which is being made to calculate the ratio of areal change to volume change.

The ultimate goals of this project are to document the volumetric changes of beach sand through time, to determine the source of the sediment, and to understand the processes that cause shoreline erosion on Galveston Island. The continuation of this kind of investigation is anticipated so that, eventually, the sediment sources and sinks of the entire Texas Gulf shoreline will be identified, and quantitative estimates of their individual contributions will be made.

GEOLOGY OF PADRE ISLAND NATIONAL SEASHDRE

Bonnie R. Weise and William A. White.

Initiated in September 1975 under the direction of L. F. Brown, Jr., this project of mapping from recent color-infrared aerial photos will serve to update the Padre Island National Seashore portion of the Bureau's Environmental Geologic Atlas of the Texas Coastal Zone. One final product will be a full-color environmental geologic map to accompany a nontechnical guidebook containing descriptions of the origin, present morphology, environments, and active processes of Padre Island, plus historical information provided by Keene Ferguson, a former Bureau staff member. To be produced in cooperation with the National Park Service, the guidebook will stress the dynamic character of the island and the importance of maintaining balances among the sensitive natural environments.

During 1976, mapping and field checking of environments were completed, and the map color-separation process and text preparation were initiated. Guidebook completion is projected for the spring of 1977.

Sand dunes in Padre Island National Seashore.

ENERGY RESOURCES INVESTIGATIONS

Dr. Bob Loucks and Dr. Don Bebout (r) prepare regional cross sections for geopressured geothermal resource assessment (left).

Austin Bayou Prospect in the Brazoria-Galveston geothermal fairway (below).

EVALUATION OF GEOTHERMAL RESOURCES, TEXAS GULF COAST: RESOURCE ASSESSMENT, WELL-SITE SELECTION, AND ENGINEERING ASPECTS

Don G. Bebout, principal investigator, Robert G. Loucks and A. R. Gregory, assisted by Ward M. Haggard, Jack E. Loocke, Pamela E. Luttrell, Marianne G. Moseley, Dennis R. Prezbindowski, Mark E. Rusk, Jung H. Seo, and Bahman Sepassi.

The Bureau of Economic Geology has continued its pioneer research efforts in geothermal resource assessment. Funded by the U. S. Energy Research and Development Administration, the Bureau has completed regional evaluation of potential geothermal fairways within the Frio Formation. [See Geological Circulars 75-1, 75-8, and 76-3.] Using the desired sand reservoir parameters of 3 cubic miles, fluid temperatures exceeding 300°F, and permeability of at least 20 millidarcies, potential geothermal fairways identified are expected to be located at depths greater than 13,000 feet. To date, Frio Formation fairways have been identified in Hidalgo, Kenedy, Nueces, Matagorda, Brazoria, and Galveston Counties. More detailed study suggests that insufficient permeability deters further evaluation of fairways in Hidalgo, Kenedy, Nueces, and Matagorda Counties at this time. However, the Brazoria-Galveston fairway has apparently high permeability at the depths necessary for high fluid temperatures and within sand reservoirs of sufficient volume.

The Austin Bayou Prospect has been selected for well-site investigation in the Brazoria-Galveston fairway. Within an area of 60 square miles, sand bodies cumulate to more than 1,200 feet, bottom-hole temperatures are at least 320°F, and core permeabilities exceed 100 millidarcies. The specific well site for Frio Formation geothermal resource testing will be selected in January 1977. Regional investigations will then resume for geothermal resource evaluation of the older Vicksburg and Wilcox Formations.

A. R. Gregory is responsible for evaluation of the engineering aspects of the Frio Formation test-site selection investigations. The focus of this research is to evaluate the key factors of fluids capacity, flow rate, and driving force of prospective geopressured geothermal reservoirs. Using geophysical logs and core analysis data, the critical parameters of potential reservoirs can be determined. Porosity is the key in determining fluid capacity and should exceed 20 percent; permeability must be sufficient to allow a flow rate of 40,000 barrels per day per well of geothermal water. The driving force, which is evaluated from the compressibilities of the water and the host rock, must be known to estimate the depletion rate of the potential reservoir. At yearend the Austin Bayou Prospect was the focus of these engineering evaluations.

An open-pit mine in the uranium deposits of the Texas Coastal Plain.

RECONNAISSANCE GEOTHERMAL RESOURCE ASSESSMENT OF THE RIO GRANDE VALLEY, TRANS-PECOS TEXAS

Christopher D. Henry, assisted by Neil T. Bockoven.

This project to evaluate the potential of geothermal energy in Trans-Pecos Texas, particularly along the Rio Grande Valley between El Paso and Big Bend National Park, began in June 1976. Specific goals of the project are to (1) identify all hot springs and wells in the area, (2) determine their geologic control through synthesis of available regional geologic mapping and detailed mapping of individual spring areas, (3) determine maximum temperatures in subsurface reservoirs through geochemical analysis, and (4) identify possible sources of heat for the geothermal systems.

During the summer and early fall of 1976, detailed maps of the structure and distribution of igneous rocks in the Rio Grande Valley were completed, and numerous hot springs were identified. Detailed geologic mapping of individual hot springs was completed during the fourth quarter of 1976. The hot springs were sampled and analysis was underway to determine major ion and trace element chemistry. The extent of mixing with nonthermal ground water and the subsurface reservoir temperatures also were being determined.

The areas with greatest potential for geothermal energy development will be identified based on the results of this work, and plans will be formulated for possible gravity, seismic, and heat-flow studies to determine precisely the potential for electric power generation or other uses.

URANIUM POTENTIAL OF THE CATAHOULA FORMATION, TEXAS COASTAL PLAIN—A STRATIGRAPHIC, DEPOSITIONAL, AND GEOCHEMICAL EVALUATION

William E. Galloway, assisted by Robert C. Belcher, T. Dennis Murphy, Stanley M. Sutton, and Bruce D. Johnson.

Continuing exploration has expanded the limits of the coastal plain uranium belt areally and stratigraphically. In addition to active surface mining, seven in situ leach mining facilities are operative or being permitted; the technology is unique to Texas at this time. The Catahoula Formation is a principal target of current exploration.

Begun in late 1975, the Catahoula project is a 2-year program designed to examine the stratigraphic, structural, and geochemical systems controlling the distribution of uranium ore and to provide basic data on these parameters for the entire coastal province. Funding for the first year was through a grant by the U. S. Energy Research and Development Administration (ERDA).

During the first year of the study, regional facies maps of host and uranium source facies were completed, along with maps showing major depositional systems, subjacent fault trends, petrofacies, and modern ground-water flow patterns. Reconnaissance petrographic and geochemical analyses indicate early mobilization of the uranium, and reconstruction of ground-water flow patterns may enhance predictions of exploration potential of untested portions of the Catahoula and other coastal plain uranium host units. A report will be published in early 1977.

Emphasis in 1977 will shift to more detailed geochemical analysis of uranium mobilization and concentration processes. Increased effort will be placed on determination of interactions between

ground waters and host sands in natural flow systems and their possible implications for resource evaluation and exploration. Funding for the second year by ERDA is pending.

URANIUM POTENTIAL AND GENETIC STRATIGRAPHY OF THE TRIASSIC GROUP OF THE TEXAS PANHANDLE

J. H. McGowen, assisted by George E. Granata, Steven J. Seni, Carolyn E. Kirschner, and Patricia A. Mench.

This study of fundamental facies distribution and mineralization within the Dockum Group began in December 1974 as a joint project funded in part by the U. S. Geological Survey, Uranium/Thorium Branch. The project involves investigations of the surface and subsurface continental Triassic facies in Texas.

The project is concerned chiefly with the development of a stratigraphic framework and depositional models, as well as with the accurate delineation of uranium mineralization and the determination of probable controlling or localizing factors. Both surface and subsurface trends are being considered. The entire sequence of terrigenous clastic facies in the Texas Panhandle will be evaluated.

At the end of the first year of the project, field reconnaissance was completed within an area extending from Santa Rosa, New Mexico, to Scurry and Borden Counties, Texas; detailed field work was conducted in Crosby, Dickens, Garza, and Kent Counties, Texas; subsurface reconnaissance was completed over most of the Triassic sedimentary basin; and detailed subsurface work was completed downdip from Garza and Crosby Counties. In 1976, during the second year of the investigation, outcrop work was conducted in Palo Duro Canyon, and detailed subsurface work throughout the basin was almost completed.

A rather complex sedimentologic-stratigraphic picture is developing from this study. A preliminary report describing the depositional facies and depositional style of the Dockum Group was in directoral review at yearend.

URANIUM IN VOLCANIC TERRANES, TRANS-PECOS TEXAS

Charles G. Groat and Anthony W. Walton.

Bureau of Economic Geology support of field and laboratory studies of tuffaceous sediments in the Big Bend area of western Texas continued during 1976. The study is aimed at mapping lithologic and geochemical facies in intervolcanic basins and relating the occurrence of uranium to these frameworks. A. W. Walton of the University of Kansas spent the summer of 1976 in the field completing work on the Tascotal Formation. He has presented oral papers on his work and is preparing a report.

IN SITU GASIFICATION OF TEXAS LIGNITE

W. R. Kaiser, assisted by Joyce M. Basciano and John E. Johnston III.

This 3-year study, in conjunction with Thomas F. Edgar (Department of Chemical Engineering) and Thomas W. Thompson (Department of Petroleum Engineering), is funded in part by the National Science Foundation, Research Applied to National Needs Program (NSF-RANN). The project, initiated in November 1974, is a study of the geology and geohydrology of the deep-basin lignite (more than 200 ft deep) of the upper coastal plain.

Exploration models have been developed for the Wilcox Group (north of the Colorado River) and the Yegua Formation (between the Colorado and Angelina Rivers). In 1977, a model will be developed for the Jackson Group (between the Colorado and Angelina Rivers). Investigation of the environmental impact of in situ gasification continues. In 1977, work will concentrate on monitoring techniques and water-quality restoration strategies.

Objectives of this project are the selection of prospective gasifier sites and the preparation of an environmental impact assessment. Part of the Wilcox work was published in late 1976, the remainder is scheduled for 1977 publication. Yegua-Jackson results are not expected to be published until 1978. A preliminary report on the environmental impact is planned for late 1977.

TEXAS PUBLIC LANDS—ESTIMATE OF FUTURE OIL AND GAS PRODUCTION FROM ESTABLISHED FIELDS OF TEXAS GULF COAST, BAYS, ESTUARIES, AND OFFSHORE

W. R. Stearns, assisted by Christine R. Gever.

The project is an investigation of oil and gas reserves of State-owned lands in the Gulf coast and offshore areas. Necessary oil and gas data have been acquired and processed. The aim of this long-term project is to survey and evaluate the mineral resources of all lands owned by the State of Texas.

MINERAL RESOURCES INVESTIGATIONS

Ann St. Clair checks the final proof of the Energy Resources of Texas map prior to printing.

MINERAL AND ENERGY RESOURCES OF TEXAS ATLAS

Thomas J. Evans, L. E. Garner, and Ann E. St. Clair, assisted by Patricia K. Bettis, M. John Droddy, Debra L. Richmann, Sandra L. Waisley, and Joseph C. Cepeda.

This atlas project consists of the preparation of an energy resources map, a mineral resources map, and a series of approximately 60 mineral/commodity data sheets. The first part of the project was completed in 1976 with the publication of the "Energy Resources of Texas" map at a scale of 1:1,000,000.

At yearend, the second part of the project, the "Mineral Resources of Texas" map, was in cartographic preparation. This map will show current and historical production sites and mineral occurrences throughout the State of Texas. In addition, the distribution of major kinds of rocks, such as limestone, clay, and sand and gravel, will be indicated. The map is scheduled for publication by mid-1977 at a scale of 1:1,000,000.

Work on another part of the Atlas project, the "Texas Mineral Commodity Data Sheets," was in progress during 1976. The sheets will summarize the nature and importance of more than 60 minerals and commodities of the State. They will include information on mineral occurrences, production history, uses, geographic distribution, and critical references. Cross-indexing of the sheets will permit quick reference to related commodities and minerals and to commodities within the same geographic area. Designed for distribution individually or as a complete set, the data sheets will be released as they are completed. First sheets of the series are expected to be published during 1977.

SAND AND GRAVEL RESOURCES OF TEXAS

Thomas C. Gustavson, assisted by John P. Ferguson.

This project, initiated in the fall of 1973, was designed to develop a sand and gravel resources map of the entire State of Texas. By yearend 1976, sand and gravel resources and mining operations had been identified, and the "Sand and Gravel Resources of Texas" map had been prepared. The map, showing both resources and areas where mining activity has been intensive, will be printed in full color at a scale of 1:1,000,000. Cartographic preparation of the map was completed during the fourth quarter of 1976, and a short descriptive text was written. Text and map are scheduled for publication in early 1977.

EVALUATION OF MINERAL PRODUCTION VALUES IN TEXAS SCHOOL DISTRICTS

L. E. Garner, Ann E. St. Clair, Thomas J. Evans, assisted by Carolyn E. Kirschner, Patricia K. Bettis, M. John Droddy, Joseph C. Cepeda, Sandra L. Waisley, and Debra L. Richmann.

This project was initiated on January 15, 1976, when the Education Resources Commission of the Governor's Office designated the Bureau of Economic Geology the performing agency to provide mineral production statistics for all school districts in Texas.

The project included the identification of all mineral commodities produced in Texas school districts and the evaluation of total mineral production value for each school district, including petroleum liquids, natural gas, and all other minerals. The mineral producer inventory and production evaluation was based on data for the 1974 calendar year.

Sources of data for the project include the U. S. Bureau of Mines, U. S. Mining Enforcement and Safety Administration, Bureau of Economic Geology, Texas Railroad Commission, and some individual producers. County base maps, provided by the Education Resources Commission of the Governor's Office, were used in conjunction with location data to compile an accurate inventory of mineral producers. The maps and inventory compilations are on open file at the Bureau of Economic Geology.

The final report was transmitted to the Education Resources Commission, Governor's Office, on August 31, 1976.

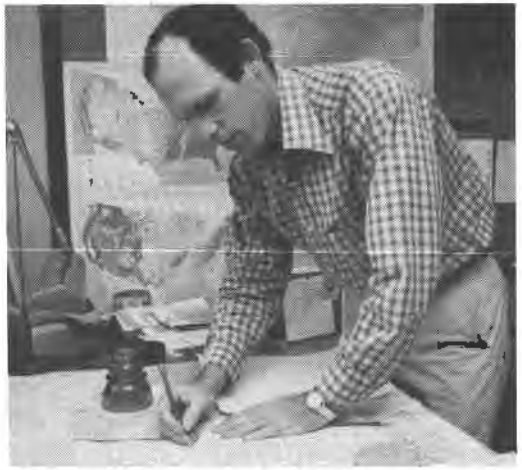
MINERAL PRODUCTION IN TEXAS

Thomas J. Evans, in cooperation with the staff of the U. S. Bureau of Mines.

This project involves the annual compilation of Texas mineral production data and other mineral information. During 1976, a report on 1975 production of industrial minerals in Texas was prepared for publication in the Texas chapter of the U. S. Bureau of Mines "Minerals Yearbook 1975." A preprint of the chapter is expected to be issued as a Bureau of Economic Geology Mineral Resource Circular, "The Mineral Industry of Texas in 1975." Compilation of Texas mineral production data is a continuing cooperative program between the Bureau of Economic Geology and the U. S. Bureau of Mines providing information on Texas' mineral economy.

A sand and gravel processing plant in Colorado County.

LAND RESOURCES LABORATORY PROGRAMS



Dr. Charles Woodruff checks the compilation of the Kendall County land resources map.

LAND RESOURCES OF FAYETTE COUNTY, TEXAS

Charles M. Woodruff, Jr., and Thomas C. Gustavson.

A land resources map of Fayette County has been prepared as part of a Bureau contract with the Texas Department of Community Affairs. The map (scale 1:125,000) is modified, in part, from existing unpublished mapping by Charles M. Woodruff, Jr., and Thomas C. Gustavson. Additional aerial photographic study augmented existing mapping. This map shows the locations affected by active processes such as flooding. It also shows sensitive lands, such as aquifer recharge zones, and areas that have been intensively used and altered, such as pits and quarries.

Fourteen units make up the land resources map of Fayette County, which is located on the Gulf Coastal Plain about halfway between Austin and Houston. The map and accompanying explanation have been presented to citizens of the county in order for them to better understand the natural factors that present possibilities for or pose problems with various uses of the land. Two workshops were convened in Fayette County by Bureau personnel and by members of the Department of Community Affairs. These workshops are intended to translate and disseminate the map-based information in a nontechnical format to interested local citizens.

The map and a brief report will be published as part of the Land Resources Laboratory Series.

LAND RESOURCES OF KENDALL COUNTY, TEXAS

Charles M. Woodruff, Jr., Robert A. Morton, and E. G. Wermund.

A land resources map of Kendall County has been prepared as part of a Bureau contract with Kendall County. The map (scale 1:125,000) is modified from unpublished mapping by Robert A. Morton and Charles M. Woodruff, Jr. The project is scheduled for completion at yearend.

The map shows the location of sensitive lands such as areas of recharge to the Edwards aquifer. It delimits potentially hazardous areas such as stream bottoms subject to frequent or occasional flooding. Also mapped are other features of the terrain or substrate that may interact to impose limitations on human activities.

Kendall County is in the Central Texas Hill Country about 20 miles north of San Antonio. Population influx from this nearby metropolitan area is posing new possibilities as well as problems for Kendall County. Many of these problems and possibilities can be more fully understood in terms of natural features of the land. It is the purpose of this map to show how the land in Kendall County varies from place to place, and what this variation means to the people who use the land. Two workshops are to be held in Kendall County to transfer the map information to concerned citizens. In addition, the Bureau of Economic Geology will provide ongoing consultation to county officials in the use of the map.

The map and a brief report will be published as part of the Land Resources Laboratory Series.

ENVIRONMENTAL GEOLOGIC ATLAS OF THE TEXAS COASTAL ZONE

L. F. Brown, Jr., project director, Thomas J. Evans, J. H. McGowen, W. L. Fisher, and Charles G. Groat, assisted by Anita R. Trippet and Bonnie R. Weise.

Essentially completed, this atlas series comprises seven publications covering seven areas of the Coastal Zone: Galveston-Houston (1972), Beaumont-Port Arthur (1973), Bay City-Freeport (1976), Port Lavaca (1976), Corpus Christi (1976), Kingsville, and Brownsville-Harlingen. At yearend, texts for the Kingsville and Brownsville-Harlingen areas were in preparation; maps for those areas have been printed. Each atlas of the series consists of a descriptive text, a basic environmental geologic map (scale 1:125,000), and eight special-use maps (scale 1:250,000). All maps are multicolored on a specially constructed base.

The Environmental Geologic Atlas of the Texas Coastal Zone is the product of an extensive study conducted by the Bureau of Economic Geology during the past 7 years. The entire Atlas covers approximately 20,000 square miles of the Texas Coastal Zone within an area extending from about the 5-fathom line offshore to 50 miles inland. Mapping was accomplished with the use of detailed photographic mosaics, topographic maps, and existing maps of many types. Photomapping was supplemented by many hours of low-level aerial reconnaissance and selected field studies. The special-use maps were derived from basic mapping and from compilation of diverse existing data.

The Environmental Geologic Atlas of the Texas Coastal Zone was designed to provide a thorough inventory of natural and man-made resources and to serve as a basic document in planning, development, and conservation of the Texas Coastal Zone. It provided much of the basic data for the Coastal Management Program directed by the General Land Office of Texas (1974-1976), and it continues to be a principal source of information for citizens, firms, and governmental agencies involved in coastal zone problems and programs. The current investigation of submerged State lands being conducted by the Bureau of Economic Geology will complete the total assessment of the coastal environments and land resources out to the offshore 3-league (10.2 miles) line on the continental shelf.

LAND RESOURCES OF TEXAS: MAPPING AND CLASSIFICATION

Robert S. Kier, L. E. Garner, L. F. Brown, Jr., assisted by Barbara A. Herber, Jon P. Herber, Leslie P. Jones, Mary J. Pieper, Anita R. Trippet, Bonnie R. Weise, and Sandra L. Waisley.

The project, initiated in April 1972 with partial support from the Texas Water Development Board and the Division of Planning Coordination, Office of the Governor, is designed to provide a statewide classification of Texas lands. A wall map (scale 1:500,000) will show distribution of the various land types and their natural capacity to sustain diverse kinds of land use. This statewide analysis complements detailed environmental mapping programs of the Bureau of Economic Geology and provides a regional technical base for land and natural resource conservation and development.

The classification includes 71 land capability units broadly grouped as (1) hydrogeologic units, (2) mineral land units, (3) physical properties units, (4) geomorphic units and structural features, (5) active process units, (6) biologic units, (7) subaqueous coastal units, and (8) man-made units. Each of the 71 capability units is indicated by a unique color and symbol on a U. S. Geological Survey topographic, physical, and cultural base map (scale 1:500,000). A legend—including 11 color inset maps depicting such features as regional physiography, generalized soils distribution, climate, and major drainage basins—and a table delineating natural suitability, economic potential, and limiting-use factors will be included on the map. The accompanying text will contain numerous tables showing characteristics of each resource unit, areas of the resource units by county, and kinds of special-use maps that can be derived from the land resource map. As an example of the kind of special-use map that can be derived, the Bureau, in conjunction with the Texas Water Quality Board and the Texas Department of Health Resources, produced a guide to the suitability of various areas of the State for solid waste disposal. A hand-colored map showing four categories of units was prepared for the Texas Department of Health Resources.

A scribed, hand-colored copy of the "Land Resources of Texas" map was completed in 1974. Color separation of the northeast and southeast quadrants, preparatory to printing, was completed in 1976. Color separation of the remaining two quadrants was in progress.

THE GUADALUPE-SAN ANTONIO-NUECES RIVER BASINS REGIONAL STUDY

E. G. Wermund, project director, Robert A. Morton, Richard L. Andersen, Joyce M. Basciano, L. E. Garner, Thomas C. Gustavson, and Charles M. Woodruff, Jr., assisted by Gwendolyn L. Macpherson, Scott A. Holden, Elizabeth D. Orr, Richard T. Martin, and Bruce R. Van Allen. Cartography by Richard L. Dillon.

This long-term project is a comprehensive environmental geologic analysis of 30,558 square miles of the Nueces, San Antonio, Guadalupe, and Lavaca river basins of South Texas. It was initiated in June 1972 under contract with the Texas Water Development Board.

The first phase of the project was concerned with an area that includes the southern Edwards Plateau and Cretaceous coastal plain. The region is of prime environmental significance as it includes the recharge and productive areas for the subsurface Edwards Limestone aquifer, which supplies water to nearly one million people in metropolitan San Antonio, San Marcos, New Braunfels, Hondo, and Uvalde. The aquifer also supplies irrigation water for about 2,000 square miles of croplands.

Man-made structures, such as this highway, are subject to damage or loss in flood-prone areas.

In the second phase, maps showing environmental geology, biologic assemblages, slope, and mineral and energy resources (except sand and gravel resources) were completed for the area of Cretaceous substrate. The map data were compiled on topographic sheets (scale 1:24,000) and controlled aerial photographic prints of the same scale, augmented by stereoscopic pairs of black-and-white photographs (scale 1:40,000). Interpretations were checked both on the ground and by means of low-level flights.

In 1974, environmental geologic mapping included areas having Tertiary and Pleistocene substrates. Those areas are important as they include several major and numerous minor sand aquifers. Therefore, many recharge (or infiltration) zones are critical elements in the environmental mapping. The most important sand aquifer is the Carrizo-Wilcox aquifer, which extends over about 10,000 square miles (including both the infiltration and productive zones). The aquifer yields potable water to eight or more of the prominent communities in South Texas. In recent years, there also has been an increasing demand for irrigation water from the Carrizo-Wilcox sand aquifer.

In 1975, mapping and initial cartography were completed for the region of Tertiary and Pleistocene substrates. Available maps are hand colored on stable plastic sheets. The environmental geologic and slope maps are drawn at a scale of 1:125,000. The derivative maps of active processes and physical materials and also the maps of biologic assemblages, economic resources, and land use are drawn at a scale of 1:250,000. The base (showing culture and drainage) that was used for these maps was prepared from U. S. Army Map Service maps.

In 1976, final cartographic work was completed

for maps of the environmental geology, physical materials, active processes, slopes, and economic geology. Maps of biologic assemblages and land use were in final stages of cartographic editing. The up-to-date land use map was compiled from data obtained from recent (1974-1975) color-infrared photography (scale 1:120,000). It includes approximately 20 map units.

Each map category consists of 16 sheets. Individual sheets are bounded by 1° of longitude and 1° of latitude unless such a quadrangle would contain only a small portion of a river basin. Sheets showing smaller areas are used to depict these portions. On the southeast margin of the region, areas included in another of this Bureau's mapping projects, the Environmental Geologic Atlas of the Texas Coastal Zone, were not remapped.

The hand-colored maps will be deposited at the Texas Water Development Board and will be available for study by interested persons. Topographic maps (scale 1:24,000) and controlled photographic mosaics with original compilation and interpretation will remain at the Bureau of Economic Geology. These data are expected to be the bases for numerous Bureau reports in the future.

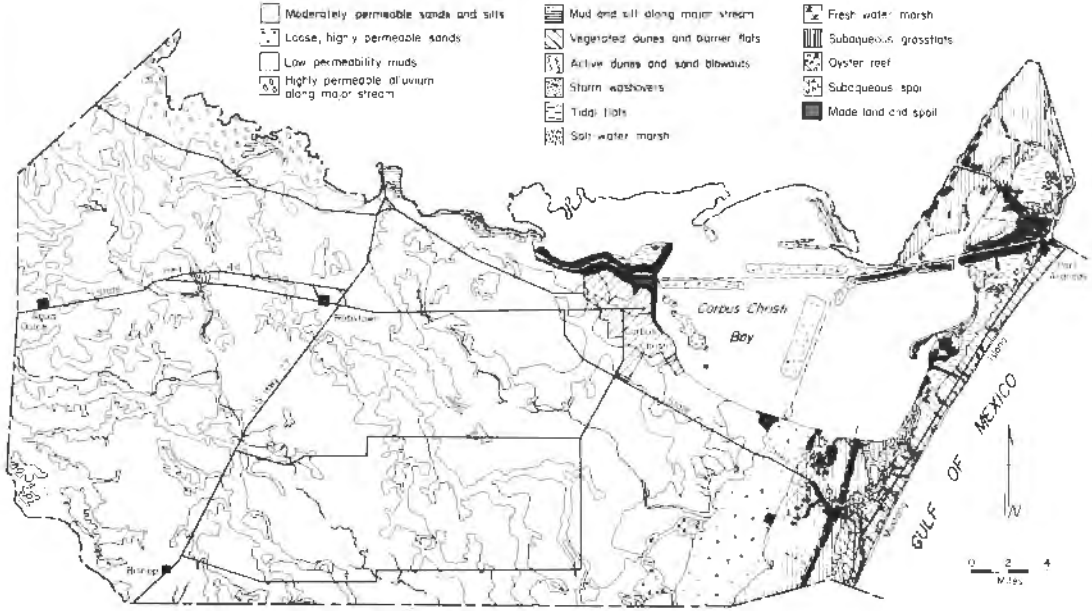
FRACTURE ZONES OF THE SOUTHERN EDWARDS PLATEAU

E. G. Wermund, assisted by Raymond C. Leonard.

To gain an understanding of the vertical movement of water in the recharge and productive zones of the Edwards Limestone aquifer, a project was initiated in 1973 to map surface fractures (lineations) in the southern Edwards Plateau and Cretaceous coastal plain—an area that includes 177 quadrangles (7.5-minute). As surface fractures or lineations provide passageways for rainwater and other surface water to enter and recharge the underground aquifers, those areas containing greatest concentrations of fractures are the areas of highest infiltration. The fracture data are of importance in locating recharge zones, and they supplement the environmental geologic mapping. The quantitative fracture data will be an essential part of the Texas Water Development Board computer model of the Edwards Limestone aquifer.

In 1974, all the mapped fracture zones (lineations) in the southern Edwards Plateau and Cretaceous coastal plain were digitized at the Texas Water Development Board and made available for computer processing. Preliminary programs were written to calculate the number and length of fractures per unit area and also the number of fracture intersections per unit area. An additional program described orientation of fractures in each 7.5-minute quadrangle by means of rose diagrams. All known caves were located, their orientation measured, and the data encoded for computer processing; water levels and production data for all ground-water wells in the Edwards area were located and encoded.

In 1975 and 1976, computer programs to display the incidence and orientation of fracture zones for the entire region were finalized. Comparison of the various types of fracture displays with tectonic elements, karstic features including caves, and ground-water production resulted in four reports on fracture zones in the southern Edwards Plateau, Texas. They are: part I, regional distribution of fractures and their relation to tectonics and caves; part II, a test to predict regional movement of ground water through fractured carbonate rocks; part III, a comparison of fracture patterns and post-Paleozoic structural features; and part IV, local variations in the incidence and orientation of fracture zones. All reports are on file at the Texas Water Development Board and will be published as geological circulars by the Bureau of Economic Geology in 1977.



A generalized land resources map for Nueces County.

LAND AND WATER RESOURCES OF THE CORPUS CHRISTI AREA

Robert S. Kier and William A. White, assisted by Sandra L. Waisley.

This project was initiated in 1972 as part of the Bureau's work with a university-based multidisciplinary research effort, Criteria for Coastal Zone Management, described in this Annual Report. The project is nearing completion, and a report is to be issued as part of the Bureau's Land Resources Laboratory Series.

Thirty-nine natural land and water resource units were delineated in the Corpus Christi area, which encompasses Nueces, San Patricio, Aransas, and Refugio Counties. The units are depicted on a full-color map at a scale of 1:125,000. Also indicated on the map are topography, culture, urban areas, and lineations (noted on aerial photographs) that may represent fracture zones or potentially active faults. Texts and tabular descriptions accompanying the map present geological and biological origins, distribution, and relationship of the units to adjacent land and water areas. Natural suitability for use and potential hazards (to persons and the

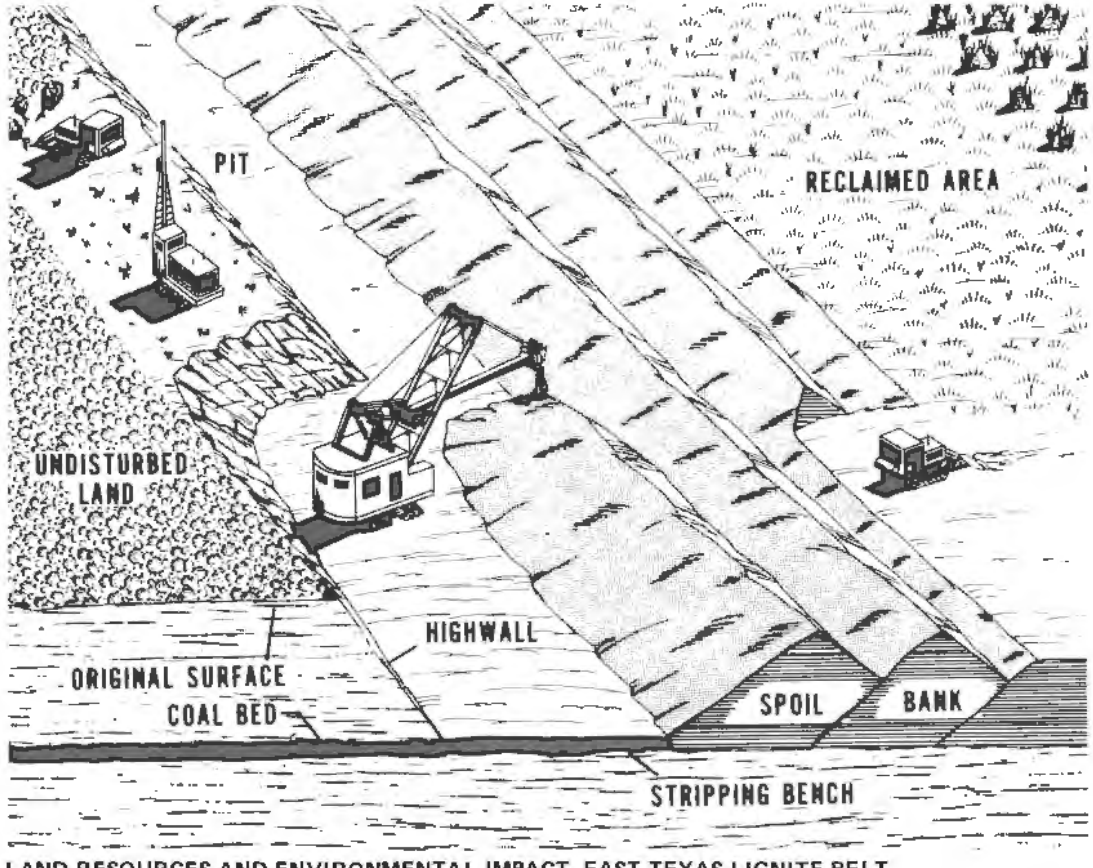
environment) associated with the use of the land and water areas are detailed.

Two aspects of natural environmental carrying capacity are emphasized: (1) quantification of physical properties of land resource units, and (2) the hydrogeologic character of the units. Soils test data obtained from various public agencies and private firms provided a means to determine representative values for important physical parameters, such as those used to assess foundation strength and permeability. Water-well data collected by the U. S. Geological Survey and Texas Water Development Board formed the basis for determining the distribution and quality of ground water in the Corpus Christi area (data derived in part from Master of Science thesis work by Dennis L. Bell and James T. Woodman). The map has been printed and the text is expected to be completed in early 1977.

CURRENT LAND USE MAP AND ENVIRONMENTAL CONSTRAINTS MAP, 208 PLANNING AREA FOR PARTS OF ARANSAS, NUECES, REFUGIO, AND SAN PATRICIO COUNTIES

Thomas C. Gustavson, E. G. Wermund, Scott A. Holden, Elizabeth D. Orr, and Bruce R. Van Allen.

This project was initiated and completed during 1976. One of its aims was to provide current land use mapping (utilizing 1975 aerial photographs) of 1,137 square miles within portions of Aransas, Nueces, Refugio, and San Patricio Counties. The area also was mapped to produce an environmental constraints map, essentially describing land areas in terms of their physical character and their suitability as waste disposal sites. The maps and a statistical summation of the area covered by the map units were prepared for the Coastal Bend Council of Governments. A workshop to instruct council planning and management personnel in the use of the maps was presented in Corpus Christi at the termination of the project.



Strip mining with concurrent reclamation—typical of East Texas lignite mines (in Geological Circular 76-2, p. 3) (above right).

LAND RESOURCES AND ENVIRONMENTAL IMPACT, EAST TEXAS LIGNITE BELT

Christopher D. Henry, Ernst H. Kastning, and Shirley M. Seagle.

Initiated in 1974 under contract with the U. S. Geological Survey, the project is concerned with providing a geologic mining inventory of the extensive lignite belt in East Texas and with evaluating environmental and economic aspects of exploitation of these lignite deposits. Objectives of the project are: (1) preparation of a suite of environmental geologic and land use maps for the lignite belt; (2) location of historical, operating, and planned lignite strip mines; (3) measurement of the physical and chemical properties of overburden and evaluation of its reclamation potential; and (4) examination of systematic mapping of sedimentary facies of overburden as a predictive tool.

During 1975, environmental geologic maps (scale 1:24,000) were compiled from air-photo interpretation for an area extending from the Colorado River to the Trinity River and containing outcrops of the Wilcox Group and Carrizo Sand. Mappable units were derived from studies of the substrate, geologic processes, geomorphology, and biologic assemblages. Interpretations were checked in the field and compared with existing data such as geologic, soil, and flood-prone-area maps.

During 1976, environmental geologic maps (scale 1:24,000) were compiled for an area containing the same stratigraphic intervals and extending from the Trinity River to the eastern edge of Franklin County. Mapping procedures established earlier were used. Supplemental work included

(1) descriptions of the flora in the southern half of the study region, (2) descriptions of algae occurring in streams that drain the actively mined areas, (3) trace element analysis of consumed algae, and (4) collection and chemical analysis of more than 100 water samples from streams that are outside of, but adjacent to, mined areas. By yearend, three reports had been published.

As a result of recognized expertise developed during the first 2 years of the investigation, project scientists have served as ad hoc consultants to the several Texas agencies having direct legislative mandates to evaluate environmental aspects of surface mining.

Project plans for 1977 are: (1) to complete the environmental geologic mapping of the Wilcox-Carrizo outcrop belt between the eastern edge of Franklin County and the Texas-Arkansas boundary, (2) to measure and evaluate water quality of representative streams of the entire region, and (3) to prepare a regional base map and initiate scribing and color separation.

IDENTIFICATION OF ECOLOGICAL IMPLICATIONS OF DEVELOPMENT OF GEOTHERMAL ENERGY FROM THE GULF COAST GEOPRESSURED ZONE

Thomas C. Gustavson, project director, and R. Mills Tandy; Faust Parker and Donald E. Wohlschlag (The University of Texas Marine Science Institute).

This study is an interdisciplinary approach to evaluate types and extent of environmental intrusions that could result from the development of geothermal resources along the Texas and Louisiana Gulf coast. This project was initiated in October 1976 and is supported by the Fish and Wildlife Service, U. S. Department of the Interior.

The Bureau of Economic Geology is assessing terrestrial impacts, providing an overview of facilities and ancillary systems associated with geothermal production. The University of Texas Marine Science Institute is assessing potential intrusions into marine and coastal bay environments. Thomas C. Gustavson and R. Mills Tandy of the Bureau of Economic Geology are evaluating the potential terrestrial impacts; Faust Parker and Donald E. Wohlschlag of the Marine Science Institute are evaluating marine and bay impacts.

CRITERIA FOR COASTAL ZONE MANAGEMENT (METHODOLOGY TO EVALUATE IMPACTS OF ALTERNATIVE POLICY DECISIONS: APPLICATIONS IN THE TEXAS COASTAL ZONE)

Robert S. Kier, project coordinator, E. G. Wermund, principal investigator, and William A. White, assisted by Sandra L. Waisley.

During 1971, a multidisciplinary team of scientists, engineers, and economists was formed at The University of Texas at Austin under the auspices of the Division of Natural Resources and Environment. The research team was charged with outlining criteria for land and water management of the Texas Coastal Zone and establishing a methodology by which the environmental and economic consequences of management policies can be assessed. The team began work in early 1972 under funding from the Coastal Resources Management Program of the Division of Planning Coordination, Office of the Governor (transferred to Governor's Budget and Planning Office). In June 1972, the project received a 2-year grant from the RANN (Research Applied to National Needs) Program of the National Science Foundation; the grant was augmented by funds from the Office of the Governor. In 1974, renewal proposals were successful, and funding was secured for an additional 2 years. Work on the project was completed in the summer of 1976.

In addition to Bureau of Economic Geology staff members, participants in the multidisciplinary research team were: E. Gus Fruh, project director, J. F. Malina, Jr., and James E. Dailey (Department of Civil Engineering and Environmental Health Engineering Laboratories); Carl H. Oppenheimer (Marine Science Institute); Kingsley E. Haynes (LBJ School of Public Affairs); and Herbert Grubb (Texas Water Development Board).

During 1976, the research team completed a study of community development and public park utilization on Mustang and northern Padre Islands. The Bureau of Economic Geology: (1) prepared, with the Port Aransas Marine Laboratory, an updated land and water resource map at a scale of 1:24,000; (2) documented historical shoreline changes of Gulf and bay, including directions and rates of change; (3) established standards by which dunes can be evaluated in terms of importance and identified critical dune areas; (4) determined natural stability of certain environments (including grassflats, marshes, and washover channels) and interpreted historical changes in those environments; and (5) delineated historical land use patterns and associated changes in natural environments. A report on the study was issued by the RANN research team. The Bureau's portion will be issued as a separate Bureau report in 1977.

In 1975, current land use and resource capability units of land and water were mapped for Cameron, Hidalgo, and Willacy Counties. Based on estimated 1990 statistics, the impact of an increased population on land use and resource capability was estimated. A report on the Lower Rio Grande Valley was issued by the RANN research team. The maps are on open file at the Bureau; separate hand-colored maps were prepared for the Lower Rio Grande Development Council.

Finally, during the last year of work, the research team prepared several kinds of final reports, including (1) a comprehensive description of the methodology, (2) complete documentation of all analytical tools used, (3) executive and layman's summaries of all work accomplished, and (4) technical summaries of the analytical procedures. Specific reports in which Bureau staff were authors or coauthors are given elsewhere in this Annual Report. Robert S. Kier served as editor for most of the RANN reports.

REACTOR SITING HAZARDS: FAULTING AND FAULT ACTIVATION IN THE TEXAS COASTAL ZONE

Charles W. Kreitler, assisted by Dawn G. McKalips.

This project is a continuing, comprehensive investigation of the interrelationship of groundwater withdrawal, oil and gas production, land subsidence, and fault activation in the Texas Coastal Zone. The research is conducted with partial funding from the U. S. Geological Survey.

The study, to date, shows that all active faults are associated with fluid production. A detailed ground-water production map of Harris and Galveston Counties has been prepared. Horizontal resistivity profiles, prepared with Texas Water Development Board equipment, appear to be effective tools for identifying active faults.

One report (Bureau of Economic Geology Report of Investigations No. 85) on lineations and faults in the Texas Coastal Zone and another (Bureau of Economic Geology Research Note No. 5) on fault control of land subsidence in Harris and Galveston Counties were published in 1976. A comprehensive report on the relationship of faulting and subsidence to ground-water and oil and gas production in the Texas Coastal Zone was in preparation at yearend.

Sand and gravel strip mines are developed extensively along the Trinity River in the Dallas area.

MINERAL RESOURCES AND MINED LAND RECLAMATION, CITY OF DALLAS

Ann E. St. Clair.

In many urban areas of the United States that are undergoing rapid growth, nearby sources of construction aggregate not only are being exploited but also are being rapidly covered by real estate development. The loss of nearby aggregate sources generally leads to exploitation of resources at increasing distances from construction sites and results in increased construction costs. Until recent enactment of the Texas Surface Mining and Reclamation Act (which pertains to the reclamation of lands mined only for lignite, coal, or uranium), the reclamation of sand and gravel pits generally was not attempted. As a result, large areas of disturbed land have been left unsuitable for most uses.

Recognizing the need to use its mineral resources and mined lands properly, the City of Dallas requested the Bureau of Economic Geology to initiate a 12-month study of mined lands and mineral resources within that city. The project involves identification of all active and inactive mineral production localities and areas of potential mineral production in the City of Dallas. Resources in this area are principally sand and gravel, limestone, and clay. Maps of mineral resources and mined lands will be prepared at a scale of 1:62,500.

Following this inventory, the reclamation potential of mined lands will be analyzed. This will include evaluation of soils, vegetation, flood potential, availability and nature of fill material, and costs. The evaluation will be conducted in terms of three possible reclamation programs: (1) returning mined land to its original state, (2) using the mined land for recreational purposes, or (3) developing the mined land for real estate or industrial purposes.

The final phase of the project will analyze the economic impact of zoning in relation to mining or potential mining operations within the city. Included will be an evaluation of land development after the mining of mineral resources versus development without prior mining (which would require importation of mineral commodities from other areas).

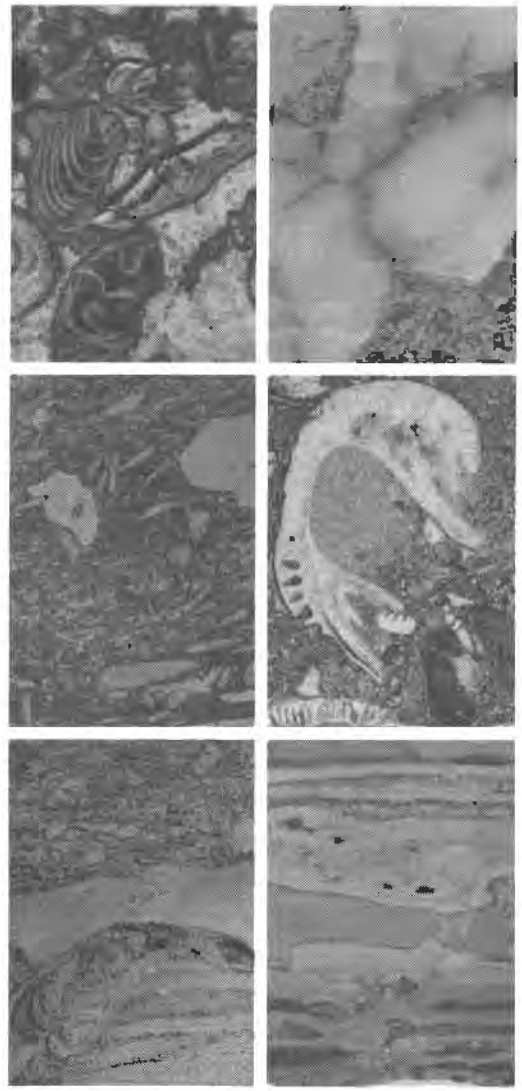
Begun in August 1976, the project is scheduled for completion by August 1977.

BASIC RESEARCH

COMPOSITION AND ORIGIN OF TEKTITES

Virgil E. Barnes, Director of Tektite Research, The University of Texas at Austin, and Stanley V. Margolis, University of Hawaii, Honolulu.

This project is a phase of a long-term investigation, initiated in 1935, of the small glassy objects that are found in Texas and other parts of the world. The tektite investigation has resulted in numerous publications, and others are planned. During 1976, research on Libyan Desert glass was completed, and results were presented at the 25th International Geological Congress in Sydney, Australia.



A group of Lower Cretaceous Sligo Formation cores showing a variety of carbonate facies.

LOWER CRETACEOUS CARBONATE FACIES AND DEPOSITIONAL ENVIRONMENTS—SOUTH TEXAS

Don G. Bebout, assisted by Richard A. Schatzinger.

Preliminary results of a phase of this project—a

study of cores of the Lower Cretaceous Sligo Formation to determine the distribution of carbonate facies and to interpret depositional and diagenetic environments—were reported by D. G. Bebout at the American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists Annual Meeting in New Orleans. The abstract of his presentation is published in American Association of Petroleum Geologists Bulletin; the complete report will be issued by the Bureau of Economic Geology during 1977.

In another phase of the project, logs of deep wells that penetrate the Lower Cretaceous rocks were used to construct regional dip-and-strike sections of an area extending from the San Marcos arch to the Rio Grande. The sections are scheduled for publication in early 1977.

The Lower Cretaceous Glen Rose Formation is the subject of yet another part of this project. The objectives of this phase are to determine the relationship of carbonates of the Glen Rose Formation to shales and carbonates of the underlying Pearsall Formation, to study the relationship of porosity distribution to depositional facies, and to develop a depositional model of the Glen Rose Formation. During the fourth quarter of 1976, information about the availability of cores from the Glen Rose Formation of South Texas was being compiled. (Any information about the location of Glen Rose cores is being solicited by Bebout.)

PENNSYLVANIAN/PERMIAN FACIES, EASTERN SHELF, NORTH-CENTRAL TEXAS

L. F. Brown, Jr., assisted by Raul F. Solis, and Arthur W. Cleaves II.

This regional study of the surface and subsurface in a 30-county area of north-central Texas involves the examination of approximately 6,000 well logs. The goal of the project is the mapping and recognition of fluvial, deltaic, and related marine depositional systems and their component facies. The resulting regional picture of Pennsylvanian and Early Permian depositional features will serve as a guide in the search for oil, water, clay, and other resources in the study area and in similar depositional systems elsewhere. Final data were tabulated during late 1976; maps are expected to be completed in 1977.

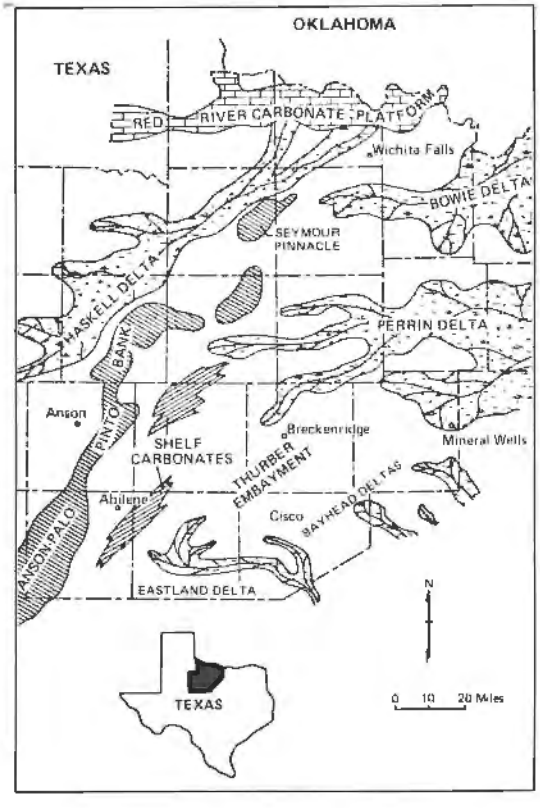
A Ph.D. dissertation by Arthur W. Cleaves on the Strawn Group of north-central Texas was completed in late 1975; this study, which developed from the project, will be published as a report of investigations in 1977.

CAVE RESOURCES OF TEXAS—GEOLOGIC ASPECTS

Ernst H. Kastning.

The Texas Natural Areas Survey of The University of Texas at Austin has undertaken an inventory of the caves of Texas, including those developed in carbonate rocks and gypsum and also in other rocks that are less soluble. The purposes of the project are to outline the variety and distribution of Texas caves and to describe their value as geologic, biologic, paleontologic, archaeologic, and historic resources to the State of Texas.

The Bureau of Economic Geology is providing interpretation of the geologic setting and processes involved in cave evolution and is evaluating caves as a geologic resource. This information is scheduled for publication as a chapter of a comprehensive book on the cave resources of Texas to be issued by the Texas Natural Areas Survey.



Principal depositional elements of the Pennsylvanian Strawn Group in north-central Texas. From report in preparation by Arthur W. Cleaves II.

NITROGEN ISOTOPES OF NITROGEN SPECIES FROM SURFACE AND GROUND WATER, CENTRAL TEXAS

Charles W. Kreitler, Lynton S. Land (Department of Geological Sciences), assisted by Dennis R. Prezbindowski.

This project began in November 1974 with a 2-year grant from the National Science Foundation. Its aim is to determine the source of nitrate in surface and ground waters.

Preliminary results indicate that the nitrate in the ground water in the gravel fan deposits of Lockhart (Caldwell County) and Taylor (Williamson County) is a mixture of nitrate from cultivation and animal waste sources; there does not appear to be a direct flushing of fertilizer into the ground water.

In late 1976, studies were continuing on the nitrogen isotopes of various nitrogen species in the Highland Lakes of Central Texas.

CORE STUDY OF THE PRE-PENNSYLVANIAN CARBONATES OF WEST TEXAS

Robert G. Loucks, assisted by Patricia A. Mench.

The collection of data for a core-based study of the subsurface pre-Pennsylvanian section in West Texas began in October 1976. The investigation emphasizes the relationship of depositional facies and diagenetic environments to porosity of the carbonate rocks. The initial task of this project is the construction of regional pre-Pennsylvanian stratigraphic cross sections. These cross sections will be used as a framework for more detailed studies of carbonate rock units beginning with those of the Ellenburger Group.

(It is hoped that much of the pre-Pennsylvanian core material can be located and studied. Any help or information concerning the location or availability of such core would be appreciated.)

GEOLOGIC MAPPING

GEOLOGIC ATLAS OF TEXAS

Virgil E. Barnes, project director, L. F. Brown, Jr., Robert S. Kier, Arthur W. Cleaves II, and Anita R. Trippet. Cartography by James W. Macon, Richard L. Dillon, and Dan F. Scranton.

A new geologic map of Texas, showing the extent of outcropping rock units, is being published as a series of separate map sheets. Each sheet is printed in multicolor on a topographic base at a scale of 1:250,000 (1 inch on the map represents almost 4 miles). Most of the sheets pertain to areas within 1° of latitude by 2° of longitude, but some include larger or smaller areas. Current plans call for the publication of a total of 38 separate map sheets.

Twenty-seven of the sheets have been issued, including the Laredo, McAllen-Brownsville, Brownwood, Pecos, and Hobbs Sheets published in 1976. At yearend, the Crystal City-Eagle Pass, Del Rio, Clovis, and Marfa Sheets were in the color-separation phase in the cartographic section. Other sheets were in various stages of completion as indicated on the index map. Only small areas on the Llano, Fort Stockton, Wichita Falls-Lawton, and Tucumcari (New Mexico part) Sheets had not been geologically mapped by the close of 1976. The geologic atlas project is expected to be completed in 1978 or 1979.

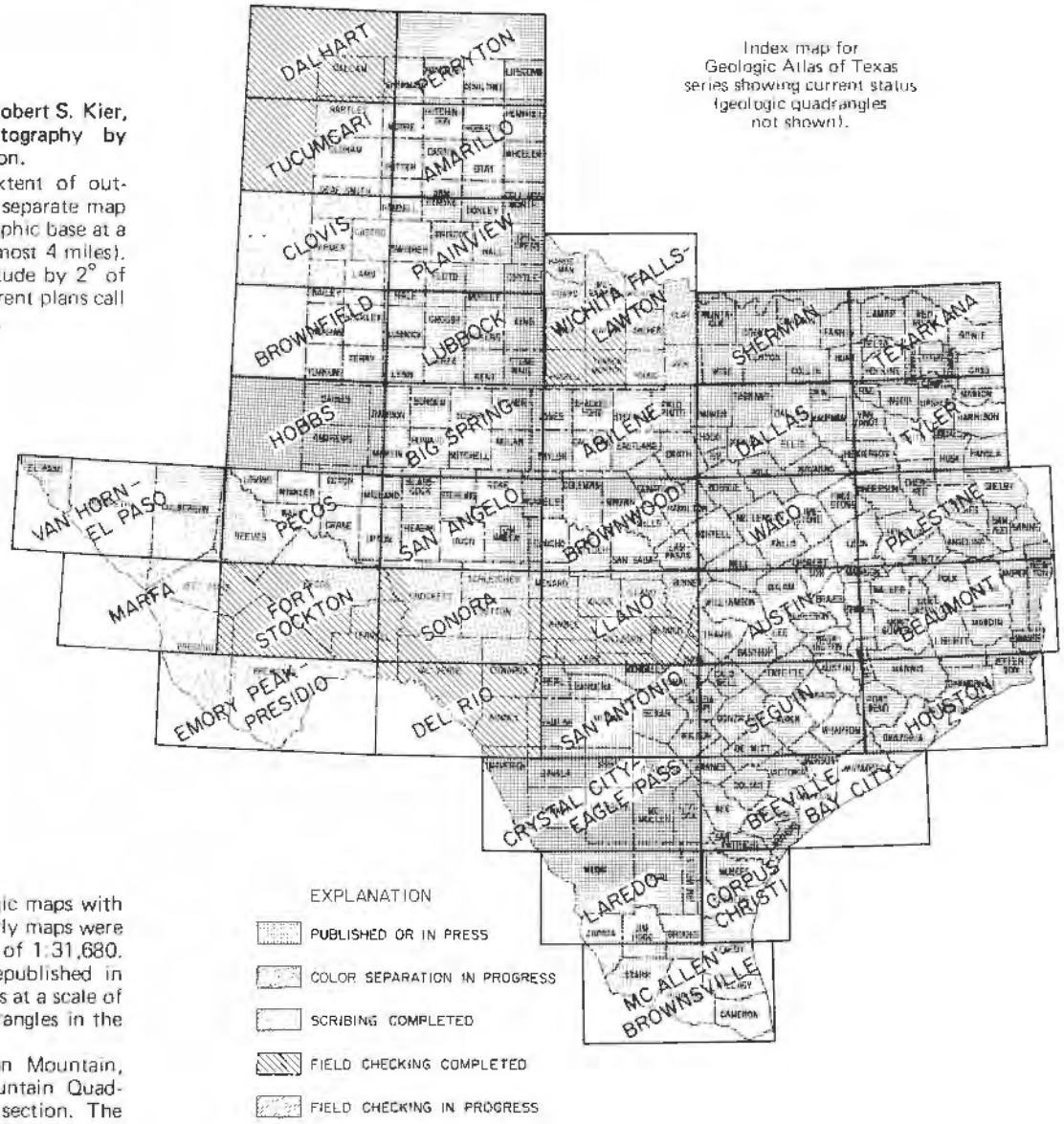
GEOLOGIC QUADRANGLE MAPPING IN CENTRAL TEXAS

Virgil E. Barnes and cartographic section.

The project involves geologic mapping of quadrangles in Central Texas, including portions of Blanco, Burnet, Gillespie, Hays, Kendall, Kerr, Kimble, Llano, Mason, and Travis Counties. It was initiated in 1939 and will continue until all of the remaining maps are published on U. S. Geological Survey topographic bases at a scale of 1:24,000.

From 1952 to 1956, the Bureau published geologic maps with accompanying texts of 20 of the quadrangles. These early maps were printed in multicolor on planimetric bases at a scale of 1:31,680. Three of these original 20 maps have since been republished in multicolor on U. S. Geological Survey topographic bases at a scale of 1:24,000, and four additional geologic maps of quadrangles in the area have been published on similar topographic bases.

At yearend, the Cap Mountain, Click, Dunman Mountain, Howell Mountain, Pedernales Falls, and Round Mountain Quadrangle maps had been scribed by the cartographic section. The Hammets Crossing, Marble Falls, and Spicewood Quadrangle maps were ready for drafting. Field work has been completed on the Longhorn Cavern Quadrangle, but the accompanying text has not yet been written.



Index map for Geologic Atlas of Texas series showing current status (geologic quadrangles not shown).

CONTRACTS AND GRANT SUPPORT

The Bureau of Economic Geology maintains formal and informal cooperative arrangements with several governmental entities. A part of the Bureau research program is supported by contracts and grants with State agencies, local units of government, and Federal agencies. Contracts and grants in effect during all or part of 1976 include:

Criteria for Coastal Zone Management (Methodology to Evaluate Impacts of Alternative Policy Decisions: Applications in the Texas Coastal Zone): project supported by National Science Foundation, Research Applied to National Needs Program (RANN), and Governor's Budget and Planning Office.

Delineation of Composite Resource Areas within Coastal Waters and Shorelands: project supported by the Texas General Land Office, Coastal Management Program.

Development of a Model Coastal Natural Hazards Disclosure Statement: project supported by Texas Coastal and Marine Council.

Environmental Aspects of Geothermal Energy Production: project supported by U. S. Energy Research and Development Administration and Center for Energy Studies of The University of Texas at Austin.

Environmental Geology of the Austin Area, Texas: project supported, in part, by the City of Austin.

Evaluation of Mineral Production Values in Texas School Districts: project supported by Office of the Governor of Texas, Education Resources Commission.

Geologic Atlas of Texas: project supported, in part, by Texas Water Development Board.

Geology of State-Owned Submerged Lands. project supported by Texas General Land Office, Coastal Management Program.

Guide to Natural Suitability of Land Areas in Texas for Solid Waste Disposal: project supported by Texas Department of Health Resources.

Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects: conference supported, in part, by U. S. Energy Research and Development Administration and National Science Foundation, Research Applied to National Needs Program (RANN).

Identification of Ecological Implications of Development of Geothermal Energy from the Gulf Coast Geopressure Zone: project supported by Fish and Wildlife Service, U. S. Department of the Interior.

In Situ Gasification of Texas Lignite: project supported, in part, by National Science Foundation, Research Applied to National Needs Program (RANN).

Land Resources and Environmental Impact, East Texas Lignite Belt: project supported by U. S. Geological Survey.

Land Resources of Fayette County, Texas: project supported by Texas Department of Community Affairs.

Land Resources of Kendall County, Texas: project supported by Kendall County.

Land Resources of Texas: project supported, in part, by the Governor's Budget and Planning Office.

LANDSAT Investigation for the Texas Coastal Zone: project supported by National Aeronautics and Space Administration, administered through the Texas General Land Office.

Mineral Resources and Mined Land Reclamation, City of Dallas: project supported by City of Dallas.

Nitrogen Isotopes in Surface Waters and Ground Waters of Central Texas: project supported by National Science Foundation.

Reactor Siting Hazards: Faulting and Fault Activation in the Texas Coastal Zone: project supported, in part, by U. S. Geological Survey.

Reconnaissance Geothermal Resource Assessment of the Rio Grande Valley, Trans-Pecos Texas: project supported by U. S. Energy Research and Development Administration.

Resource Assessment of the Geopressured Geothermal Resources of the Texas Gulf Coast: project supported by U. S. Energy Research and Development Administration.

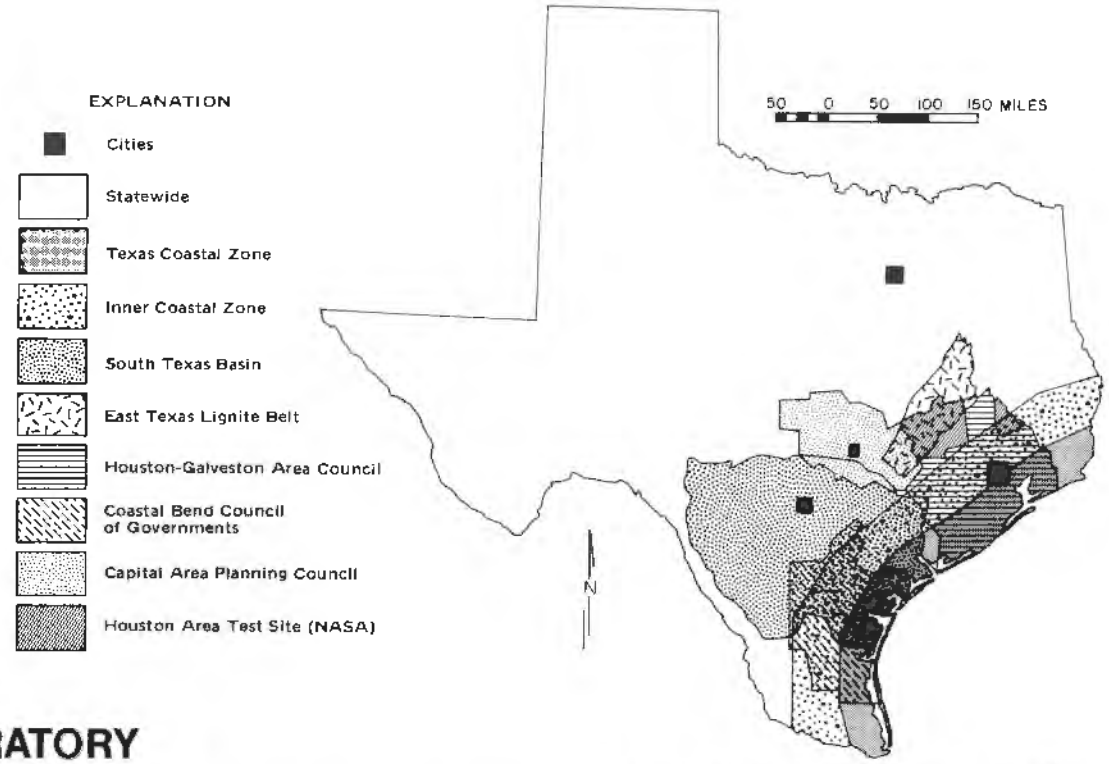
Sediment Budget of Gulf Shoreline Galveston Island: project supported, in part, by National Oceanic and Atmospheric Administration Sea Grant Program, administered through Texas A & M University.

Selection of a Geopressured Geothermal Test Well Site, Texas Gulf Coast: project supported by U. S. Energy Research and Development Administration.

Uranium Potential and Genetic Stratigraphy of the Triassic Dockum Group of the Texas Panhandle: project supported, in part, by U. S. Geological Survey, Uranium/Thorium Branch.

Uranium Potential of the Catahoula Formation, Texas—A Stratigraphic, Depositional, and Geochemical Evaluation: project supported by U. S. Energy Research and Development Administration.

Waste Disposal Suitability and Current Land Use Maps, Corpus Christi Area: project supported by Coastal Bend Council of Governments.



Index map of Land Resources Laboratory programs.

LAND RESOURCES LABORATORY

The Land Resources Laboratory of the Bureau of Economic Geology was created in 1974 to establish a continuing program of land resources and environmental research at The University of Texas at Austin. The Laboratory is a natural outgrowth of the special land and geologic resource studies begun in 1967 by W. L. Fisher and L. F. Brown, Jr. These initial studies culminated in the Bureau's Environmental Geologic Atlas of the Texas Coastal Zone.

Thomas C. Gustavson is the Acting Coordinator of the Land Resources Laboratory. This administrative position carries the responsibilities of an associate director of the Bureau of Economic Geology.

The Land Resources Laboratory has completed projects in the following areas: (1) regional and statewide land resources inventories; (2) comprehensive inventories of major critical areas; (3) evaluation of land areas associated with major water resources; (4) evaluation of hazard-prone lands; (5) studies of unique mineral and agricultural lands; (6) councils of government land resource inventories; (7) county land resource inventories; and (8) studies to investigate management criteria in the Coastal Zone.

As part of its service function, the Laboratory has participated for the last two years with Texas State agencies in formulating a remote-sensing plan and in developing the conceptual design of a natural resources information system (TNRIS). In 1975 and 1976, the Laboratory expanded its role in communicating land resource information to Texas citizens by means of workshops. Workshops provide local governmental officials, planners, and private land owners with the skills necessary to use and understand land resource maps and to develop their own specialized derivative maps. Workshops have been presented to the Houston-Galveston Area Council, Coastal Bend Council of Governments, Lower Rio Grande Council of Governments, and the Community Planning Councils of Fayette and Kendall Counties. Workshops for presenting land resource information will continue in the future.

The land resource investigations designed for county governments, organizations, and interested citizens have significantly broadened the scope of the Land Resources Laboratory. A complete presentation of land resources information, including a land resources map of each county and preliminary and follow-up workshops, is designed for this program. Workshops are intended to translate and disseminate the map-based information in a nontechnical format and to inform interested citizens of the potential utility of land resource information. The map (scale 1:125,000) is based on detailed land resource mapping by Bureau research staff. Each map and accompanying explanation show (1) areas affected by active processes such as flooding, (2) sensitive lands such as aquifer recharge zones, and (3) other categories that may also affect man's relationship to his environment. To date, the map and workshop presentations have been completed for Fayette County, and the Kendall County map is complete with workshops scheduled in the near future. Funding by the Texas Department of Community Affairs (Fayette County report) and Kendall County government has supported this research. County maps and a brief report will be published as part of the Bureau's Land Resources Laboratory Series.

PUBLICATIONS

In its role as a public geologic research unit, the Bureau of Economic Geology disseminates the results of research programs and projects primarily through its own publication series. During the 67-year history of the Bureau, hundreds of reports, bulletins, circulars, and maps have been published covering all major aspects of the geology and natural resources of Texas. Publications are made available to interested persons at prices designed to recover printing costs. To date, approximately one million publications have been distributed, principally through direct sales. During 1976, the Bureau issued the following publications.

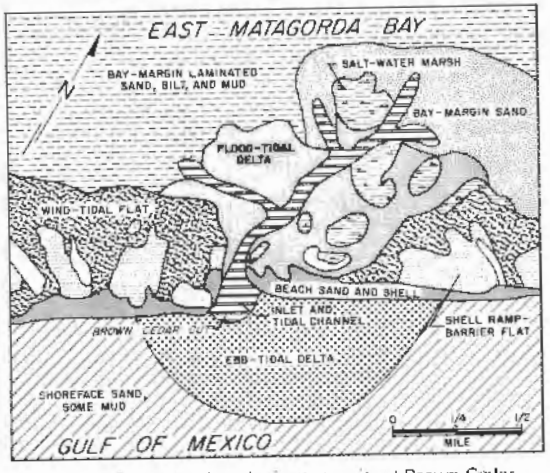
ENVIRONMENTAL GEOLOGIC ATLASES

The Environmental Geologic Atlas of the Texas Coastal Zone is a comprehensive, innovative series of seven atlases that provides an urgently needed inventory of environments and resources. Each atlas includes an environmental geologic map and eight special-use maps, all in full color. The maps delineate over 150 units determined on the basis of substrate characteristics, active processes, biologic activity, and man-made alteration. Besides providing much of the natural resource inventory base for Texas coastal management programs, the Environmental Geologic Atlas has also provided the basis for other more specialized studies on subsidence and faulting, shoreline erosion, coastal hazards, and land and water resources.

Environmental Geologic Atlas of the Texas Coastal Zone—Bay City-Freeport Area, by J. H. McGowen, L. F. Brown, Jr., T. J. Evans, W. L. Fisher, and C. G. Groat. 98 p., 29 figs., 13 tables, 9 full-color maps ($8.75).

The Bay City-Freeport area is a microcosm of the conflicts, challenges, and opportunities realized throughout the Texas Coastal Zone. The mapped area stretches northeastward from Palacios to Freeport and extends inland from the Gulf shore to Wharton.

Abundant mineral and energy resources and a vast agricultural potential interface with growing urban-industrial development along this central Texas Gulf coast region. Major chemical-processing and metal-refining industries lie amidst the urban clusters of the Freeport-Brazosport area. Though mineral and energy production is the prime focus of businesses in the Bay City-Freeport area, agriculture-related businesses and tourism contribute importantly to the area's economy.



Natural environmental geologic map units at Brown Cedar Cut, a tidal pass in the Bay City-Freeport map area.

Environmental Geologic Atlas of the Texas Coastal Zone—Corpus Christi Area, by L. F. Brown, Jr., J. L. Brewton, J. H. McGowen, T. J. Evans, W. L. Fisher, and C. G. Groat. 123 p., 32 figs., 13 tables, 9 full-color maps ($8.75).

The Corpus Christi area extends from Kleberg County on the south to Refugio County on the north and includes many urban clusters in addition to the Greater Corpus Christi area. A wide variety of natural environments is present including loess-covered uplands, Modern coastal barrier islands, shallow bays and related wind-tidal flats and fringing marshes, and flat sand and mud uplands stretching for tens of miles inland from the elongate sand deposits of Encinal Peninsula, Live Oak Ridge, and Live Oak Peninsula.

Land use in the Corpus Christi area is varied. Urban-industrial lands fringe Nueces and Corpus Christi Bays, recreational lands extend along north Padre, Mustang, and San Jose Islands, and fertile croplands support profitable agriculture businesses in the area.

Environmental Geologic Atlas of the Texas Coastal Zone—Port Lavaca Area, by J. H. McGowen, C. V. Proctor, Jr., L. F. Brown, Jr., T. J. Evans, W. L. Fisher, and C. G. Groat. 107 p., 33 figs., 13 tables, 9 full-color maps ($8.75).

The Port Lavaca area is situated between the marshy coastal lands of the upper Texas coast and the arid lands of the South Texas coast. As the transitional region between these two radically different areas, it exhibits most of the characteristics identified along the Coastal Zone.

The Port Lavaca area is composed of vast, sparsely developed coastal plains and some of the least modified bays and estuaries in the Texas Coastal Zone. Though abundant natural resources are being utilized and urban complexes dot the area, hundreds of coastline miles remain essentially undeveloped and in their original natural state. A large tonnage of both deep-water and intracoastal shipping flows into and out of the Port Lavaca area.

REPORTS OF INVESTIGATIONS

Report of Investigations No. 85. Lineations and Faults in the Texas Coastal Zone, by Charles W. Kreitler. 32 p., 25 figs. ($1.25).

Over 7,000 miles of lineations have been observed on aerial photographic mosaics of the Texas Coastal Zone. This report explores the relationships among lineations, active surface faults, extrapolations of subsurface faults to the ground surface, and zones of differential land subsidence. A network of faults, lineations, and differential subsidence occurs where there is extensive ground-water withdrawal, as in the Houston area.

Development of ground-water resources in other areas, potential exploitation of geopressured geothermal resources, and continued fluid withdrawal related to oil and gas production are potential causes of land subsidence and fault activation. This potential should not preclude future development of these resources, but identifying lineations as possible foci for differential subsidence or active faulting allows prediction and instigation of mitigating procedures in advance of any eventual difficulties.

Report of Investigations No. 86. Environmental Geology of the Austin Area: An Aid to Urban Planning, by L. E. Garner and Keith P. Young. 39 p., 21 figs., 7 tables, 7 plates including 3 in full color ($3.00).

This two-part report focuses on the geology and physical setting of the Austin area. The role of various planning requisites—physiography, soils, vegetation, drainage basins and flooding, various physical properties, and rock types—for comprehensive, regional land resource evaluation is detailed. Rock and mineral resources and the historical and projected growth of Austin are also delineated.

Three full-color maps display rock types, land use and natural vegetation assemblages, and general geology. Utilization of these and other information resources for land use planning is given in an example.

GEOLOGICAL CIRCULARS

Geological Circular 76-1. Hydrogeologic Significance of Depositional Systems and Facies in Lower Cretaceous Sandstones, North-Central Texas, by W. Douglas Hall. 29 p., 19 figs., 2 tables ($1.00).

The Lower Cretaceous Hosston and Hensel Sandstones are important sources of ground water in north-central Texas. Delineation of major depositional systems and their component facies within these formations provides a useful method for predicting the quantity, movement, and chemical composition of water in these aquifers.

Geological Circular 76-2. Land Resources Inventory of Lignite Strip-Mining Areas, East Texas—An Application of Environmental Geology, by Christopher D. Henry. 28 p., 19 figs., table ($1.00).

Concern over potential environmental degradation from present and future lignite mining in Texas increases with expanding use of lignite for power generation in the State. This report explains the use of environmental geologic mapping to avoid or alleviate potential problems from mining and illustrates the various considerations that enter into effective environmental planning and environmental geologic mapping.

Geological Circular 76-3. Geothermal Resources—Frio Formation, Upper Texas Gulf Coast, by D. G. Bebout, R. G. Loucks, S. C. Bosch, and M. H. Dorfman. 47 p., 52 figs. ($1.50).

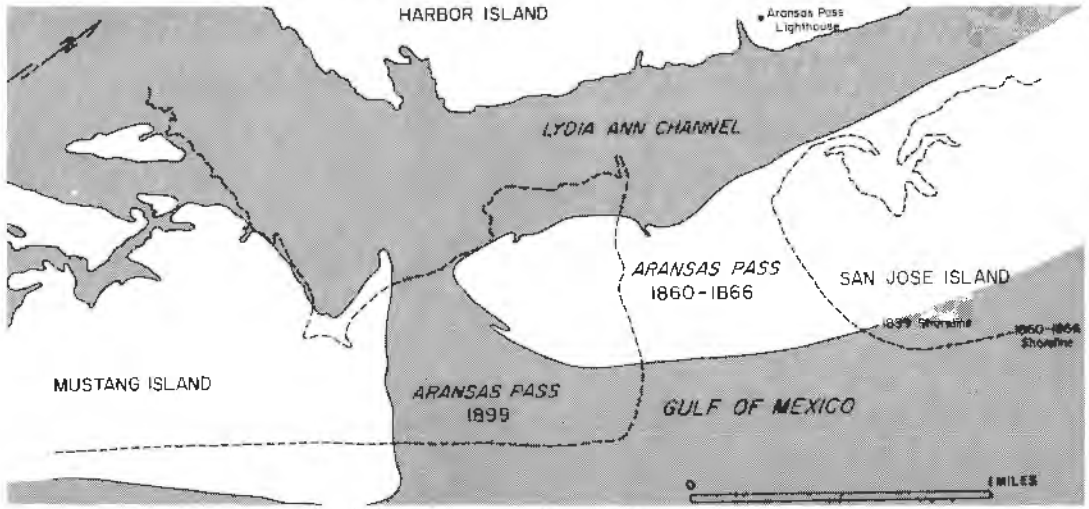
This is the third in a three-part series of reports on the assessment of geothermal resources in the Frio Formation. Major sand trends are identified by elevated subsurface temperatures and pressures to pinpoint geothermal fairways.

Geothermal fairways are defined by the boundaries of major sand bodies having a volume greater than 3 cubic miles and uncorrected fluid temperatures in excess of 250°F. Using those criteria, a broad band in Brazoria and Galveston Counties has been identified and, it is suggested, should become the primary focus for further evaluation of potential Frio Formation geothermal resources.

Geological Circular 76-4. Shoreline Changes on Matagorda Island and San Jose Island (Pass Cavallo to Aransas Pass)—An Analysis of Historical Changes of the Texas Gulf Shoreline, by Robert A. Morton and Mary J. Pieper. 42 p., 9 figs., table, 3 appendices ($1.00).

Geological Circular 76-6. Shoreline Changes on Matagorda Peninsula (Brown Cedar Cut to Pass Cavallo)—An Analysis of Historical Changes of the Texas Gulf Shoreline, by Robert A. Morton, Mary J. Pieper, and Joseph H. McGowen. 37 p., 9 figs., table, 3 appendices ($1.00).

These circulars are the fifth and sixth reports of eight that chronicle historical changes of the Texas Gulf shoreline from the mid-1800's to the present. Descriptions of the methods and procedures used in shoreline monitoring are fully covered in each report. Present beach characteristics are described and changes in shoreline position in Late Quaternary time and historic time (mid-1800's to



Historical shoreline changes in the vicinity of Aransas Pass.

present) are documented. In addition, changes in the position of the vegetation line—an important dynamic, natural boundary in Texas—are discussed. Human alteration of natural conditions centers on tidal passes and channels. Evaluation of factors affecting shoreline and vegetation line changes and predictions of future changes conclude each report.

Geological Circular 76-5. Regional Tertiary Cross Sections—Texas Gulf Coast, by D. G. Bebout, P. E. Luttrell, and J. H. Seo. 10 p., 7 figs., table ($1.25).

The Bureau's regional studies of the Frio Formation in conjunction with its geothermal resource assessment project have generated detailed information on subsurface geology along the Texas Gulf coast. Cross sections included in this report show gross regional distribution of sand and shale facies both laterally and vertically throughout the entire Tertiary section along the Gulf coast. These sections have been constructed from published cross sections, unpublished sections from several major oil companies, extensive micropaleontological and electric-log files at the Bureau, and Frio Formation studies.

Geological Circular 76-7. Geothermal Resources of the Texas Gulf Coast—Environmental Concerns Arising from the Production and Disposal of Geothermal Waters, by Thomas C. Gustavson and Charles W. Kreitler. 35 p., 23 figs., 7 tables ($1.25).

Disposal and temporary surface storage of spent geothermal fluids and surface subsidence and faulting are the major environmental problems that could arise from geopressured geothermal water production. Besides these concerns, geothermal resource production facilities on the Texas Gulf coast could be subject to a series of natural hazards: (1) flooding, (2) winds, (3) coastal erosion, or (4) expansive soils. This investigation of the nature and scope of these potential environmental problems is a natural outgrowth of the Bureau's programs concerning geothermal resource assessment and test-site selection.

MINERAL RESOURCE CIRCULAR

Mineral Resource Circular No. 58. The Mineral Industry of Texas in 1973, by Charles J. Jirik and Roselle Girard. 36 p., fig., 26 tables (free on request).

This circular is a preprint from the U. S. Bureau of Mines, "Minerals Yearbook 1973." It was prepared through a cooperative agreement between the U. S. Bureau of Mines and the Bureau of Economic Geology. The circular is an annual issue of the Bureau.

GUIDEBOOK

Guidebook 16. Guide to Points of Geologic Interest in Austin, by A. R. Trippet and L. E. Garner. 23 figs., 2 plates (price to be determined).

This guidebook was prepared as part of the Bureau's Educational Services program. An informal guidebook was prepared for the Austin Independent School District, and a field trip for Austin area earth science teachers was held on August 13, 1976. Because of the limited distribution of the field guide, the entire guidebook is now being printed in the Bureau's Guidebook series and will be available in early 1977.

Guidebook 16 includes an extensive 10-stop road log with 25 additional stops described and keyed to various themes for construction of a variety of thematic field trips. A full-color geologic map of the Austin area is included (scale 1:62,500). Information contained in the guidebook provides a thorough review of geologic features within the vicinity of Texas' capital city.

SPECIAL PUBLICATIONS

INDEX SERIES

Addendum to Index to Well Samples and Cores, 1963-1973, by M. L. Morrow and Elizabeth T. Moore. 196 p. ($4.25).

This comprehensive addition to the index of the Bureau's extensive resources in the Well Sample and Core Library covers the acquisitions over 11 years during which the Library grew and entered a period of sophistication in facilities and data retrieval. The addendum includes listings of well cuttings from 251 Texas counties and cores from over 200 counties.

Bibliography and Index to Texas Geology, 1961-1974, by Elizabeth T. Moore. 446 p. ($7.00).

The proliferation of literature dealing with Texas geology is documented and indexed in this extensive volume. It is the fourth bibliography and index of Texas geology published by the Bureau of Economic Geology.

SYMPOSIA

Proceedings, Gulf Coast Lignite Conference: Geology, Utilization, and Environmental Aspects, W. R. Kaiser, editor. 28 papers, plus summary of workshops presented in Austin, Texas, on June 2-4, 1976 (price to be determined).

The Conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects includes presentations by representatives of public and private research groups, State and Federal government, energy exploration and mining companies, industrial users, and energy consulting firms. This diversified group reflects the broad front on which research, exploration, development, and consumption of lignite has been pursued in the Gulf Coastal Plain.

Geologic topics included discussions of modern analogs of lignite beds, such as the Mississippi delta peats and swamps, and regional framework of lignite-bearing strata in Texas and other Gulf coast states. Utilization topics ranged from specific mining localities to mining techniques to combustion characteristics and conversion potential of lignite. Environmental aspects of lignite utilization included presentations on the application of environmental geologic mapping to lignite lands, the relative utility of flue-gas desulfurization versus coal cleaning, and several other topics.

ENERGY AND MINERAL RESOURCES OF TEXAS SERIES

Energy Resources of Texas. Mapping compiled by A. E. St. Clair, T. J. Evans, and L. E. Garner; assisted by K. E. Nemeth and W. P. Bartow. Scale 1:1,000,000, in full color ($3.50).

This large-scale map of Texas displays the full range and scope of energy resources in the State. Oil and gas fields are shown and color coded according to the age of the producing reservoir. Lignite resources, both near surface and deep basin, are delineated as are the outcrops of bituminous coal-bearing strata. Sites of old coal mines, present and proposed lignite mines, uranium-bearing strata and uranium mines, potential geothermal resources, and potential oil shale resources are also shown.

Resource-distribution systems noted on the map include railroads, principal highways, waterways, petroleum liquids pipelines, natural gas pipelines, electric-transmission lines, and electric-power generation sites.

EDUCATIONAL MATERIALS

Energy Resources of Texas Curriculum

Materials. Unit I: Energy from Start to Finish, by Jay Earl Anderson, Jr. 130 p., includes Energy Resources of Texas map ($3.50).

Curriculum materials prepared for use with the "Energy Resources of Texas" map are designed for earth science classes in junior and senior high schools. Though geared to Texas' energy resources, materials included can be easily adapted to fit out-of-state programs.

Unit I includes a suggested teaching schedule, a discussion of opening teaching strategies, four modules of subject matter, evaluation suggestions, field trip ideas, and sources of supplementary materials. Principal subject matter includes: (1) What are the energy resources of Texas? (2) How do nature and people produce energy? (3) How are energy resources found and extracted? and (4) How much fossil fuel is left? Unit II will focus on energy, economics, and the environment, and Unit III will deal with energy and the future.

RESEARCH NOTES

This is a series of informal, limited-distribution reports based on the research of the Bureau staff. Information included in these reports covers a wide range of topics, but because of the narrow scope of some of the information or the availability of the data in other sources, only a limited number of copies of each report is available.

In 1975, "A Preliminary Study of Biologic Assemblages of East Texas Lignite Belt," by Melody Holm was released as the first in this series (23 p., 5 figs., $.75). Research Notes published in 1976 are listed below:

Research Note 2. Calvert Bluff (Wilcox Group) Sedimentation and the Occurrence of Lignite at Alcoa and Butler, Texas, by W. R. Kaiser. 10 p., 6 figs. ($1.00).

This field guide describes regional aspects of Wilcox deposits in Central Texas, including stratigraphy, depositional systems, controls on lignite accumulation, and patterns of sedimentation. The field trip was held in June 1976 as part of the Gulf Coast Lignite Conference. Discussion of stops at Alcoa and Butler is included.

Research Note 3. Reclamation at Big Brown Steam Electric Station Near Fairfield, Texas: Geologic and Hydrologic Setting, by C. D. Henry, W. R. Kaiser, and C. G. Groat. 10 p., 4 figs. ($1.00).

This field guide, prepared in conjunction with a field trip of the Gulf Coast Lignite Conference, describes the geologic and hydrologic setting in the vicinity of a major lignite strip mine. Big Brown is a 1,150-megawatt generating facility, and annual lignite production approaches 6 million tons.

Research Note 4. Aggregate Resource Conservation in Urban Areas, by L. E. Garner. [Reprinted from 26th Annual Highway Geology Symposium held in August 1975.] 12 p., 6 figs., table ($.50).

Originally prepared for the Highway Geology Symposium, this report discusses the Austin area as an example of how urban growth can affect the availability and cost of local resources.

Research Note 5. Fault Control of Subsidence, Houston-Galveston Area, Texas, by Charles W. Kreitler. [Preprint of article in *Geoscience and Man*.] 17 p., 13 figs. ($.50).

This Research Note shows the relationship of land-surface subsidence and surface and subsurface faults in Harris and Galveston Counties. In this coastal area, land-surface subsidence results primarily from ground-water production.

Research Note 6. South Texas Uranium Province: Geology and Extraction, by W. E. Galloway and C. G. Groat. [Prepared for Fall Meeting, Interstate Mining Compact Commission, October 6-8, 1976.] 10 p., 4 figs. ($.50).

This report is a brief summary of South Texas uranium activity. Included are a history of uranium production to date, general geologic setting, and characteristics of ore deposits. Mining aspects covered in this report include reclamation of open pit mines and in situ leaching operations.

MAPS AND CHARTS

GEOLOGIC ATLAS OF TEXAS

Geologic Atlas of Texas. Brownwood Sheet, Monroe George Cheney Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base ($3.00).

The Brownwood Sheet covers all or part of Brown, Burnet, Coleman, Comanche, Concho, Coryell, Erath, Hamilton, Lampasas, McCulloch, Menard, Mills, Runnels, and San Saba Counties. Mapping was compiled by R. S. Kier, Peggy Harwood, L. F. Brown, Jr., and J. L. Goodson. The map was reviewed by the Geologic Atlas Committee of the Abilene Geological Society.

The Brownwood Sheet is a memorial edition honoring Monroe George Cheney (1893-1952). Cheney was a central figure in unravelling the complex stratigraphy of upper Paleozoic rocks in north-central Texas. His vigorous study of Pennsylvanian-age strata in this region led to the classic stratigraphic classification and organization of these rocks, which has persisted to the present time.

Geologic Atlas of Texas. Hobbs Sheet, William Battle Phillips Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base ($3.00).

The Hobbs Sheet covers all or part of Andrews, Dawson, Ector, Gaines, Lynn, Martin, Midland, Terry, Winkler, and Yoakum Counties in Texas, and Chaves, Eddy, and Lea Counties in New Mexico. Mapping was compiled by G. K. Eifler, Jr. (Texas), and C. C. Reeves, Jr. (New Mexico). The map was reviewed by the Geologic Atlas Committee of the West Texas Geological Society.

The Hobbs Sheet is a memorial edition honoring William Battle Phillips (1857-1918). Dr. Phillips was the first Director of the Bureau of Economic Geology [and Technology] and his term in this position from 1909 to 1915 firmly established the Bureau within The University of Texas System. Besides his accomplishments as Director, Dr. Phillips is noted for his contributions in the field of economic geology in Texas, particularly the utilization of lignite, coal, petroleum, and natural gas and the development of the mercury deposits in Brewster County.

Geologic Atlas of Texas. Laredo Sheet, Julia Gardner Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base ($3.00).

The Laredo Sheet includes all or part of Brooks, Duval, Jim Hogg, Jim Wells, Kleberg, Webb, and Zapata Counties. Mapping was compiled by J. L. Brewton and reviewed by the Geologic Atlas Committee, Corpus Christi Geological Society.

The Laredo Sheet is a memorial edition honoring Julia Gardner (1882-1960). Dr. Gardner was a recognized authority on the stratigraphy of the Gulf and Atlantic Coastal Plain. A noted paleontologist, she made significant contribution to present understanding of molluscan faunas and the lowermost Tertiary stratigraphy of Texas.

Geologic Atlas of Texas. McAllen-Brownsville Sheet, Arthur Carleton Trowbridge Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base ($3.00).

The McAllen-Brownsville Sheet includes all or part of Brooks, Cameron, Hidalgo, Jim Hogg,

Kenedy, Starr, Willacy, and Zapata Counties. Mapping was compiled by J. L. Brewton and authors of the Brownsville-Harlingen and Kingsville Environmental Geologic Atlases of the Texas Coastal Zone. The map was reviewed by the Geologic Atlas Committee of the Corpus Christi Geological Society.

The McAllen-Brownsville Sheet is a memorial edition honoring Arthur Carleton Trowbridge (1885-1971). Dr. Trowbridge made significant contributions to understanding the geology of the Texas Coastal Plain and, in particular, to the Tertiary and Quaternary history of the lower Rio Grande Valley.

Geologic Atlas of Texas. Pecos Sheet, Johan August Udden Memorial Edition, Virgil E. Barnes, **project director. Scale 1:250,000, in full color, topographic base ($3.00).**

The Pecos Sheet includes all or part of Crane, Crockett, Ector, Loving, Midland, Pecos, Reeves, Upton, Ward, and Winkler Counties. Mapping was compiled by G. K. Eifler, Jr., and reviewed by J. B. Brown, consultant for the Geologic Atlas Committee, West Texas Geological Society.

The Pecos Sheet is a memorial edition honoring Johan August Udden (1859-1932). Dr. Udden's many contributions to geological science include pioneer work in the description of subsurface materials, analysis of controls on the accumulation of quicksilver, investigations and recommendations concerning the occurrence of oil on University Lands, and studies of the occurrence and distribution of West Texas potash deposits. Dr. Udden was one of the first scientists to realize the potential value of seismology for locating subsurface geologic structures. Dr. Udden was Director of the Bureau of Economic Geology from 1915 to 1932.

GEOLOGIC QUADRANGLE MAPS

Geologic Quadrangle Map No. 41. Geology of the Kingsland Quadrangle, Llano and Burnet Counties, Texas, by Virgil E. Barnes. **Scale 1:24,000; 25-page text ($2.25).**

A 7.5-minute topographic quadrangle map and accompanying text describe the surface geology within the Kingsland Quadrangle, located in the eastern part of the Llano region. The map area is dominated by exposures of Precambrian rocks (about 76 percent); Paleozoic rocks (16.5 percent) and Quaternary deposits (7.5 percent) compose the remainder of the area. In addition to surface geology, subsurface geology and mineral resources in the Kingsland Quadrangle are described.

This full-color map is prepared on a topographic base with 20-foot contour intervals and covers parts of Llano and Burnet Counties. Within the map area are portions of three lakes of the Lower Colorado River Authority—Lake Buchanan, Inks Lake, and Lake Lyndon B. Johnson.

Geologic Quadrangle Map No. 42. Geology of Midcities Area, Tarrant, Dallas, and Denton Counties, Texas, by Leo Hendricks. **Scale 1:62,500; 20-page text, with contribution by Henry H. Sampson, Jr., 7 figs., table ($2.25).**

The geologic map and accompanying text describe surface geology of the region between Fort Worth and Dallas. Engineering properties of some of the formations exposed in the map area are also described. Publication of the geology and engineering properties of the rocks in this urban area is relevant to an understanding of the interrelationship of the physical environment with human activities.

Aerial photograph of a part of the Midcities area, east-central Tarrant County.

FINAL EDITING/IN PRESS

Report of Investigations. The Moore Hollow Group of Central Texas, by Virgil E. Barnes and **W. Charles Bell.**

This major monograph on the Cambrian strata in the Llano region includes detailed discussions of stratigraphic and petrologic characteristics, depositional history, biostratigraphic relationships, geologic structure, and economic resources.

Report of Investigations. Paleoautecology in an Interdeltaic Marine Embayment: Megafauna of the Pennsylvanian Wolf Mountain Shale in the Possum Kingdom Area, Palo Pinto County, Texas, by Edward Heuer.

This report is an extensive investigation of the ecology of megafossil taxa in the Wolf Mountain Shale. It includes discussions of depositional environments and the environmental significance of variation in species diversity.

Geological Circular. Shoreline Changes on Mustang Island and North Padre Island (Aransas Pass to Yarborough Pass)—An Analysis of Historical Changes of the Texas Gulf Shoreline, by Robert A. Morton and Mary J. Pieper.

Geological Circular. Shoreline Changes on Central Padre Island (Yarborough Pass to Mansfield Channel)—An Analysis of Historical Changes of the Texas Gulf Shoreline, by Robert A. Morton and Mary J. Pieper.

These are the last two reports of an eight-part

series of reports on the direction and magnitude of shoreline changes along the Texas Gulf coast. Included in each report is a discussion of general methodology and local beach characteristics.

Environmental Geologic Atlas of the Texas Coastal Zone—Kingsville Area, by L. F. Brown, Jr., J. H. McGowen, T. J. Evans, C. G. Groat, and W. L. Fisher.

The Kingsville Environmental Geologic Atlas is sixth in a series of seven comprehensive reports forming an extensive inventory of land and water resources within the delicately balanced Texas Coastal Zone. The Kingsville area report includes a unique part of the Coastal Zone—an area characterized by strong onshore wind regimes, which have created the South Texas Eolian System, and by shallow, hypersaline water bodies, including Laguna Madre and Baffin Bay.

Geologic Atlas of Texas. Crystal City-Eagle Pass Sheet, Dolan Hoye Eargle Memorial Edition, Virgil E. Barnes, project director. Scale 1:250,000, in full color, topographic base.

Surface geology of this south-central Texas area, which includes all or part of Atascosa, Bee, Dimmit, Duval, Frio, Jim Wells, Karnes, La Salle, Live Oak, Maverick, McMullen, Webb, and Zavala Counties, is shown on this map.

Geologic Quadrangle Map. Geology of the Click Quadrangle, Llano and Blanco Counties, Texas, by Virgil E. Barnes.

Surface geology, including Precambrian metamorphic and igneous rocks, as well as lower Paleozoic sedimentary rocks, is described in the Click Quadrangle area, which includes parts of the Riley Mountains, Cedar Mountain, and Packsaddle Mountain. Map scale is 1:24,000.

Mineral Resource Circular. The Mineral Industry of Texas in 1974, by Murphy E. Hawkins and Roselle Girard.

One of a continuing series of annual summaries of mineral industry activity in Texas, this report includes public-sector information on mineral production and value.

REPRINTED PUBLICATIONS

Report of Investigations No. 73. Depositional Systems in the Woodbine Formation (Upper Cretaceous), Northeast Texas, by William B. Oliver. 28 p., 15 figs., 1971 (2nd printing; $1.50).

Report of Investigations No. 79. Texas Lignite: Near-Surface and Deep-Basin Resources, by W. R. Kaiser. 70 p., 22 figs., 7 tables, appendix, 1974 (2nd printing; $2.50).

Geological Circular 70-4. Depositional Systems in the Jackson Group of Texas—Their Relationship to Oil, Gas, and Uranium, by W. L. Fisher, C. V. Proctor, Jr., W. E. Galloway, and J. S. Nagle. Reprinted from Transactions of the Gulf Coast Association of Geological Societies, v. XX, p. 234-261, 15 figs., 1970 (3rd printing; $1.00).

Geological Circular 74-4. Potential Geothermal Resources of Texas, by Myron Dorfman and Ralph O. Kehle. 33 p., 17 figs., 3 tables, 1974 (2nd printing; $.75).

Geological Circular 75-1. Geothermal Resources—Frio Formation, South Texas, by D. G. Bebout, M. H. Dorfman, and O. K. Agagu. 36 p., 25 figs., 1975 (2nd printing; $.95).

Guidebook 2. Texas Fossils: An Amateur Collector's Handbook, by William H. Matthews III. 123 p., 26 figs., 49 pls., 1960 (6th printing; $1.00).

Guidebook 6. Texas Rocks and Minerals: An Amateur's Guide, by Roselle M. Girard. 109 p., 76 figs., 1964 (3rd printing; $1.25).

Guidebook 10. Geologic and Historic Guide to the State Parks of Texas, by Ross A. Maxwell, with contributions by L. F. Brown, Jr., Gus K. Eifler, Jr., and L. Edwin Garner. 197 p., 98 figs., 2 tables, pl., 1970 (2nd printing; $3.00).

Guidebook 11. Recent Sediments of Southeast Texas—A Field Guide to the Brazos Alluvial and Deltaic Plains and the Galveston Barrier Island Complex, by H. A. Bernard, C. F. Major, Jr., B. S. Parrott, and R. J. LeBlanc, Sr., *and* [Appendix] Resume of the Quaternary Geology of the Northwestern Gulf of Mexico Province, by H. A. Bernard and R. J. LeBlanc, Sr. 132 p., 97 figs., 1970 (3rd printing; $5.00).

Guidebook 13. Geology of the Llano Region and Austin Area, by Virgil E. Barnes, W. C. Bell, S. E. Clabaugh, P. E. Cloud, Jr., R. V. McGehee, P. U. Rodda, and Keith Young. 77 p., 29 figs., 3 tables, 1972 (2nd printing; $1.50).

Guidebook 14. Pennsylvanian Depositional Systems in North-Central Texas, A Guide for Interpreting Terrigenous Clastic Facies in a Cratonic Basin, by L. F. Brown, Jr., A. W. Cleaves II, and A. W. Erxleben. 122 p., 79 figs., table, pl., 1973 (2nd printing; $3.00).

Special Publication. Delta Systems in the Exploration for Oil and Gas, by W. L. Fisher, L. F. Brown, Jr., Alan J. Scott, and J. H. McGowen [Syllabus for Research Colloquium held in Austin, August 27-29, 1969.] 212 p., 168 figs., 1969 (8th printing; $5.00).

OPEN-FILE MATERIAL

The Bureau of Economic Geology maintains an open file of reports, maps, manuscripts, and other materials obtained from various sources. Most are unpublished, although a few are progress reports of projects that ultimately will be published. Work maps and data developed in connection with Bureau of Economic Geology projects currently underway may be examined and studied at the Bureau offices. Materials placed on open file during 1976 include the following:

Aerial Radiometric and Magnetic Survey: Amarillo National Topographic Map, Texas; Brownfield National Topographic Map, Texas and New Mexico; Clovis National Topographic Map, Texas and New Mexico; Tucumcari National Topographic Map, Texas and New Mexico: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-33(76), Amarillo [quadrangle], v. 1, 72 p. and 56 microfiche cards, v. 2, 65 p.; Brownfield [quadrangle], v. 1, 74 p. and 56 microfiche cards, v. 2, 65 p.; Clovis [quadrangle], v. 1, 68 p. and 58 microfiche cards, v. 2, 65 p.; Tucumcari [quadrangle], v. 1, 75 p. and 56 microfiche cards, v. 2, 65 p., 1976. (Information concerning reproductions of this report may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

Geologic Controls of Uranium Deposition, Karnes County, Texas, by Kendell A. Dickinson: U. S. Geological Survey Open-File Report 76-331, 16 p., 2 figs., 2 pls., 1976. (Available from U. S. Geological Survey Public Inquiries Office, Room 1-C-45, Federal Building, 1100 Commerce Street, Dallas, Texas 75202.)

National Uranium Resource Evaluation, Preliminary Report: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJO-111(76), 132 p., 37 figs., 11 tables, 2 pls.,

1976. (Information concerning reproductions of this report may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

National Uranium Resource Evaluation Program: Hydrogeochemical and Stream Sediment Pilot Survey of Llano Area, Texas, by C. E. Nichols, V. E. Kane, S. C. Minkin, and G. W. Cagle: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-36(76), 151 p., 3 figs., 3 tables, 9 appendices, and a microfiche card with 137 pages of field and laboratory data for the geochemical survey, 1976. (Information concerning reproductions of this report may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

National Uranium Resource Evaluation Program: Hydrogeochemical and Stream Sediment Survey in Central United States: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-29(76), Part 1, April 1, 1975 through June 30, 1975, 15 p.; GJBX-30(76), Part 2, July 1, 1975 through September 30, 1975, 47 p.; GJBX-31(76), Part 3, October 1, 1975 through December 31, 1975, 67 p; GJBX-32(76), Part 4, January 1, 1976 through March 31, 1976, 59 p.; GJBX-52(76), Part 5, April 1, 1976 through June 30, 1976, 30 p. [with title, National Uranium Resource Evaluation Program: Hydrogeochemical and Stream Sediment Reconnaissance Program in Central United States]; prepared by ERDA's Oak Ridge Gaseous Diffusion Plant (ORGDP), Oak Ridge, Tennessee, for the Grand Junction Office, ERDA. (Information concerning reproductions of these reports may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501; also available from the National Technical Information Service, Springfield, Virginia 22161.)

Northwest Texas Pilot Geochemical Survey, by C. E. Nichols, V. E. Kane, M. T. Browning, and G. W. Cagle [samples collected in Lynn, Garza, Crosby, Kent, Dickens, Stonewall, and King Counties]: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-60(76), 58-p. text, 169-p. appendix, and a microfiche card with 123 p. of field and laboratory data, 1976. (Information concerning reproductions of this report may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States, by S. T. Algermissen and David M. Perkins: U. S. Geological Survey Open-File Report 76-416, 45 p., 8 figs., 2 pls., 1976.

Report on Airborne Radioactivity Surveys and the Uranium Deposits in the Red River Region of Texas and Oklahoma, compiled by R. A. Levich: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-13(76), 16 p., 1973. (Information concerning reproductions of this report may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

Results of Preliminary Reconnaissance of Uranium Potential in Woodbine and Tokio Formations (Cretaceous) in Southwest Arkansas and Adjacent Areas of Texas, by J. Dan Powell: U. S. Geological Survey Open-File Report 75-645, 15 p., 7 figs., table, 1975.

Schlumberger Soundings in the Lower Mesilla Valley of the Rio Grande, Texas and New Mexico, by Adel A. R. Zohdy, Robert J. Bisdorf, and Joseph S. Gates: U. S. Geological Survey Open-File Report 76-324, 77 p., including appendix with 72 figs., 1976.

Selected References on Alkalic Igneous Rocks of the United States, compiled by Charlene R. Hall: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-4(76), 87 p., 1976. (Information concerning reproductions of this report may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

Summary of the Stratigraphy, Sedimentology, and Mineralogy of Pennsylvanian and Permian Rocks of Oklahoma in Relation to Uranium-Resource Potential, by John W. Shelton and Zuhair Al-Shaieb of the Department of Geology of Oklahoma State University: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJBX-20(76), 156 p., 46 figs., 5 pls., 1976. (Information concerning reproductions of this report may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

Supplementary Data Relating to Bureau of Economic Geology Geological Circular 76-1, "Hydrogeologic Significance of Depositional Systems and Facies in Lower Cretaceous Sandstones, North-Central Texas," by W. Douglas Hall. (The 28 pages of data, compiled by Hall in 1974, consist of Appendix I, "Texas Well Numbering System"; Appendix II, "Index to Subsurface Electric Log Control" (Bell, Bosque, Comanche, Coryell, Erath, Falls, Hamilton, Hill, Hood, Johnson, McLennan, and Somervell Counties); Appendix III, "Water Level Measurements"; and Appendix IV, "Results of Water Analyses.")

Survey of Lands Held for Uranium Exploration, Development and Production in Fourteen Western States: U. S. Energy Research and Development Administration (ERDA) Open-File Report GJO-109(76-1), report for six-month period ending June 30, 1975; GJBX-11(76), report for six-month period ending December 31, 1975. (Information concerning reproductions of these reports may be obtained from U. S. Energy Research and Development Administration, Grand Junction, Colorado 81501.)

Unevaluated Preliminary Geologic Cross Section of Uranium-Bearing Upper Triassic Rocks Extending from Palo Duro Canyon Across the Matador Arch, through the Type Locality of Dockum Group, to the White River Reservoir, Crosby County, Texas, by Warren I. Finch, James C. Wright, and Beth Ogden Davis: U. S. Geological Survey Open-File Report 76-376, plate, 1976. (Available from U. S. Geological Survey Public Inquiries Office, Room 1-C-45, Federal Building, 1100 Commerce Street, Dallas, Texas 75202.)

Unevaluated Preliminary Geologic Cross Section of Uranium-Bearing Upper Triassic Rocks Extending from Ute Reservoir, New Mexico, to Palo Duro Canyon, Texas, by Warren I. Finch, James C. Wright, and Beth Ogden Davis: U. S. Geological Survey Open-File Report 76-205, plate, 1976. (Available from U. S. Geological Survey Public Inquiries Office, Room 1-C-45, Federal Building, 1100 Commerce Street, Dallas, Texas 75202.)

User's Guide to the Radiometric Age Data Bank (RADB), by Robert E. Zartman, James C. Cole, and Richard F. Marvin: U. S. Geological Survey Open-File Report 76-674, 77 p., 1976.

Water-Quality Data from Oil and Gas Wells in Part of the Permian Basin, Southeastern New Mexico and Western Texas, by W. L. Hiss (prepared in cooperation with the Office of the New Mexico State Engineer): U. S. Geological Survey Open-File Report 75-579, 10 microfiche, 1975.

SERVICES

WELL SAMPLE AND CORE LIBRARY

The Bureau's Well Sample and Core Library, under the supervision of Doug Ratcliff, is one of the largest public collections of geological information. Within its facilities at Balcones Research Center are housed cuttings from over 68,000 wells and cores from 1,840 wells—all totalling over 20,000 miles of geological section. In addition to the well samples and cores, the Library maintains a collection of driller's logs, electric logs, and oil scout tickets; over 2,000 brine samples, reports, and accompanying data of the Rittenhouse Brine Collection are also stored at the Library.

Growth and increasing need for ready access have necessitated the modernization of facilities and scope of services. All holdings of the Library are being computerized for rapid data retrieval; to date, all core information is accessible by these data-processing techniques. Eventually all information at the Library will be accessible by computer, thereby increasing the efficiency of data availability for the public.

A second area of expanded service is a rock thin-sectioning capability, initiated in 1975. Harry J. Madsen heads up this area; productivity has increased to 1,500 sections per year. Friable or porous samples can now be impregnated for thin-sectioning.

A fully equipped sedimentation lab also has been established for complete textural analysis of sediments. A digitized settling tube for rapid sediment analysis was placed into operation this year.

In 1976, cores from 97 wells and cuttings from another 34 wells were donated by 21 operators. Modern facilities, updated equipment for easy data access, and new policies enhancing core availability have all combined to increase the flow of public-sector geological information into and out of the Well Sample and Core Library. The Library is open from 8 a.m. to 5 p.m. Monday through Friday.

Cores being slabbed before storing (left).

Rock thin sections are prepared for detailed petrographic investigations (above right).

MINERAL STUDIES LABORATORY

The Mineral Studies Laboratory provides critical chemical and spectrographic analysis and physical testing support for Bureau research projects. Occasionally, the Laboratory performs similar work for various departments at UT Austin, for Texas State agencies, and under certain conditions, for Texas residents. Daniel A. Schofield is Chemist-in-Charge, Laurence C. McGonagle is Chemist, and Kelly Street is Assistant Chemist; three part-time lab assistants complete the Mineral Studies Laboratory

staff. The Laboratory is located at the Balcones Research Center in Austin.

Major analyses performed in 1976 included determination of acid-soluble uranium using the reflectance fluorometer for the Bureau's Dockum Group and Catahoula Formation projects. Over 575 samples were analyzed for these studies.

Water analysis requirements resulted in the complete reorganization of the Laboratory. Water samples, collected in conjunction with the Bureau's environmental investigations of lignite lands, were analyzed for major constituents; trace elements in the evaporated residue were identified by semi-quantitative emission spectrographic techniques.

Rock and mineral analyses included complete chemical and physical analysis of limestones in support of the limestone suitability for SO_2-removal investigations, complete chemical analysis of silicate rock samples, and a variety of other chemical testing of Texas rocks and minerals.

Public samples are submitted to the Mineral Studies Laboratory through L. E. Garner of the Bureau's research staff. In 1976, public samples processed included gold/silver determination, calcium and magnesium determinations, and trace-element analysis of an acid-soluble extract from a clay.

Kay Atteberry, lab assistant, lights the rotating burner for fusion of sodium fluoride pellets for fluorometric determination of uranium (right).

Larry McGonagle standardizes the flame atomic absorption unit for a lithium determination (below).

INFORMATION AND EDUCATION SERVICES

PUBLIC INFORMATION SERVICES

In addition to conducting basic and applied research programs, the Bureau of Economic Geology provides a variety of advisory, technical, and information services related to the geological, mineral, and land resources of the State. These services are available to individuals, companies, and governmental bodies and agencies. Staff members respond to individual requests for information that are received daily by letter, phone, and from visitors. Two members of the Bureau's research staff, in particular, respond to the many requests for information from the general public.

Roselle Girard handles most of the written requests for information on Bureau programs, publications, and general Texas geology and responds to a steady flow of visitors seeking available information. She is in charge of the Reading Room, which is located in the Bureau's offices on the fifth floor of the Geology Building on the main campus of The University of Texas at Austin. This facility is open to the public and houses a variety of publications pertinent to Texas geology and natural resources.

L. E. Garner responds to requests for rock and mineral identification and handles all public-sample testing in cooperation with the Mineral Studies Laboratory. He also coordinates the Bureau's participation in review of environmental impact statements and similar preliminary project reports as part of the interagency cooperation necessary for complete and adequate review of proposed projects in the State.

EDUCATION SERVICES

The Bureau of Economic Geology continued to expand its participation in a public school education program in 1976 through workshops and numerous public addresses.

A set of curriculum materials to accompany the Bureau's new "Energy Resources of Texas" map is being produced. To date, Unit I: Energy from Start to Finish is published, and Unit II: Energy, Economics, and the Environment will be ready by spring 1977. Unit III: Energy in the Future is scheduled for publication in late 1977.

Bureau staff led a field trip for Austin Independent School District teachers in August 1976. This trip to points of geologic interest in the Austin area can serve as a model for other interested groups throughout the State. To supplement field trip experiences, the Bureau is initiating production of slide-tape presentations on various topics of interest in Texas geology. Slide-tapes on State and National Parks, points of geologic interest, and other topics or areas not readily accessible to the public are planned. The first series is a five-part set on Energy Resources of Texas.

Guided by a comprehensive "Needs Assessment Questionnaire" sent to 2,000 Texas teachers and administrators in earth science, the Bureau of Economic Geology will continue to expand its activities in the area of educational services. Requests for information, resource materials, and references are welcome; suggestions and comments from Texas earth science teachers are also needed and welcome.

PERSONNEL

RESEARCH STAFF

GROAT RESIGNS TO ACCEPT NEW POSITION

Dr. Charles G. Groat resigned as Acting Director of the Bureau to become Chairman of the Department of Geological Sciences at The University of Texas at El Paso. Dr. Groat served as Acting Director since May 1975.

Dr. Groat joined the Bureau of Economic Geology staff in November 1968 as a Research Scientist, and from 1971 to 1975 was Associate Director for Administration. During his tenure at the Bureau, he published reports on Texas mineral and energy resources, geology of the Presidio bolson, mining and land reclamation, and environmental geology of the Texas Coastal Zone.

Dr. Groat also was an Associate Professor in the Department of Geological Sciences at The University of Texas at Austin. He holds membership in the following professional organizations: American Institute of Professional Geologists, American Quaternary Association, Association of American State Geologists, Geological Society of America, Society of Economic Geologists, Society for Environmental Geochemistry and Health, and the Society of Mining Engineers of AIME. He served as president of the Austin Geological Society during 1976.

Prior to receiving his Ph.D. in geology at The University of Texas at Austin in 1968, Dr. Groat earned his A. B. (geology) from the University of Rochester and his M. S. (geology) from the University of Massachusetts.

Dr. Charles G. Groat

FISHER CONTINUES ON LEAVE

Dr. W. L. Fisher, Director of the Bureau of Economic Geology, continued on leave of absence in 1976. Dr. Fisher is presently serving as Assistant Secretary for Energy and Minerals of the U. S. Department of the Interior. As this report goes to press, Dr. Fisher plans to return to the Bureau on February 1, 1977.

Dr. Fisher has been a leader in the development of genetic concepts in the interpretation of ancient rocks and has helped pioneer the application of those concepts to energy and mineral resources exploration and development. In addition, he has been instrumental in the conception of and initial research for the Environmental Geologic Atlas of the Texas Coastal Zone. This major research program has spawned numerous environmental geologic and land resource projects at the Bureau and has contributed significantly to the Bureau's position in the fields of environmental geology and land resource evaluation.

WOODRUFF AND KIER RETURN TO BUREAU

Dr. Charles M. Woodruff, Jr., and Dr. Robert S. Kier returned this year from leave of absence. Dr. Woodruff has been serving since 1974 as geologist in the Coastal Management Program of the Texas General Land Office. Dr. Woodruff still provides consultation on a courtesy basis for this important State program. Dr. Kier coordinated a research project at The University of Texas at Austin to develop criteria for coastal zone management. This multidisciplinary approach to criteria identification for coastal management programs was sponsored by the RANN (Research Applied to National Needs) Program of the National Science Foundation.

WERMUND HEADS 1977 G.C.A.G.S. MEETINGS

Dr. E. G. Wermund has accepted the position of general chairman for the 1977 annual meeting of the Gulf Coast Association of Geological Societies to be held in Austin, Texas, in October 1977. As general chairman, Dr. Wermund will be responsible for the overall coordination of the largest regional geologic meeting in the country. Over 2,000 registrants, including geologists and guests, are expected to attend.

Dr. Wermund is presently Acting Associate Director for Administration at the Bureau. Formerly, he was Coordinator of the Land Resources Laboratory. Dr. Wermund's research activities are presently concentrated on aspects of the environmental geology and hydrogeology of the Edwards Limestone aquifer.

Dr. E. G. Wermund

PAPERS BY BUREAU OF ECONOMIC GEOLOGY STAFF IN OUTSIDE PUBLICATIONS

Barnes, Virgil E., and **Margolis, Stanley V.,** 1976, Cathode luminescence and microprobe studies of Libyan Desert glass and australites (abstract): Sydney, Australia, 25th International Geological Congress, Abstracts, p. 611.

Barnes, Virgil E., and **Underwood, James R., Jr.,** 1976, New investigation of the strewn field of Libyan Desert glass and its petrography: Earth and Planetary Science Letters, v. 30, p. 117-122.

Barnes, Virgil E., Young, Keith, and **Kaiser, W. R.,** 1976, Field trip road log, second day, October 31, 1976, Stops 6-9, in Economic geology of south central Texas, a guidebook for the 1976 South Texas Geological Society field trip, October 30-31: San Antonio, Texas, South Texas Geological Society, p. 36-57.

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Bebout, Don G., 1976, Geothermal energy from the Frio Formation—a new resource from an old trend (abstract): Geological Society of America, Abstracts with Programs, v. 8, no. 1, p. 4.

Bebout, Don G., 1976, Subsurface techniques for locating and evaluating geopressured geothermal reservoirs along the Texas Gulf Coast: The University of Texas at Austin, Center for Energy Studies, Second Geopressured Geothermal Energy Conference, Proceedings, v. II, Resource assessment, 44 p.

Bebout, Don G., 1976, Transgressive sandstone/carbonate sequence—Hosston/Sligo Formations of South Texas (abstract): American Association of Petroleum Geologists Bulletin, v. 60, no. 4, p. 648.

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Galloway, William E., 1976, Sediments and stratigraphic framework of the Copper River fan delta, Alaska: Journal of Sedimentary Petrology, v. 46, no. 3, p. 726-737.

Garner, L. E., 1976, Aggregate resource conservation in urban areas: Coeur d'Alene, Idaho, 26th Annual Highway Geology Symposium, Proceedings, p. 291.

Girard, Roselle M. (with **Jirik, Charles J.**), 1976, The mineral industry of Texas, in Minerals yearbook 1973, V. II, Area reports, Domestic: United States Department of the Interior, Bureau of Mines, p. 669-704.

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Kier, Robert S., and others, 1976, Environmental and economic impacts of recreational community development, Mustang Island and north Padre Island—Example application III of Methodology to evaluate alternative management policies: application in the Texas Coastal Zone: [prepared for] Research Applied to National Needs Program, National Science Foundation and Division of Planning Coordination, Office of the Governor of Texas, [coordinated through] The University of Texas at Austin, Division of Natural Resources and Environment, v. I, Report, by Robert S. Kier, William A. White, Robert A. Morton, Ralph S. Kerr, and others; v. II, Technical support data, including Chapter I, part b, Revision of peak-season day visitor projections, by Robert S. Kier (with James S. Sherman); Chapter I, part c, Scenario II population projections, by Robert S. Kier; Chapter IV, Private drive concept, Robert S. Kier, editor, 4 p.; Chapter VIII, Structural engineering calculations, Robert S. Kier, editor, 14 p.

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White, William A., Holm, Melody R., Kerr, Ralph S., and **Waisley, Sandra L.,** 1976, Resource capability units task group, in Transferability of methodology to the Lower Rio Grande Valley—Example application IV of Methodology to evaluate alternative management policies: application in the Texas Coastal Zone: [prepared for] Research Applied to National Needs Program, National Science Foundation and Division of Planning Coordination, Office of the Governor of Texas, [coordinated through] The University of Texas at Austin, Division of Natural Resources and Environment, Chapter IV, p. IV1-IV60.

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Cecille Haynie and Dr. Bill Kaiser review lignite proceedings galleys prior to printing.

GULF COAST LIGNITE CONFERENCE DRAWS DIVERSIFIED ATTENDANCE

On June 2-4, 1976, the Bureau of Economic Geology, the U. S. Energy Research and Development Administration, and RANN (Research Applied to National Needs) of the National Science Foundation held a conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects. This conference, held in cooperation with the Center for Energy Studies, drew over 500 registrants from a broad cross section of energy, environment, and geology interests. Presentations were given by representatives of public and private research groups, State and Federal government, exploration and mining companies, industrial consumers, and environmental consulting firms. A series of informal workshops focused on the geology, utilization, and environmental topics covered in the formal presentations. Two field trips were held, one to the active lignite mine and outcrops of lignite-related strata near Rockdale, Texas, and the second to Big Brown lignite mine and the large lignite-fueled steam-electric power plant near Fairfield, Texas.

At yearend, the Proceedings volume for the lignite conference was in press. Dr. W. R. Kaiser was program chairman for the meetings and handled primary editing responsibilities. Cecille Haynie is the technical editor of the Proceedings volume. Dr. Charles G. Groat was the general chairman for the conference.

LECTURES AND PUBLIC ADDRESSES

A measure of the interest in Bureau of Economic Geology research programs and their results is shown by the number of public lectures presented each year. Lectures are given to a wide audience, including professional societies, universities, and Federal, State, and local units of government.

Although the prime means of disseminating the results of Bureau research is through publication, formal and informal lectures are important means of presenting information prior to final publication.

Following are lectures given by Bureau staff members during 1976.

Virgil E. Barnes

Cathode luminescence and microprobe studies of Libyan Desert glass and australites: presented at 25th International Geological Congress, Section on Planetology, Sydney, Australia.

Don G. Bebout

Geothermal energy from the Frio Formation—A new resource from an old trend: presented at Geological Society of America, South-Central Section, Annual Meeting, Houston, Texas.

Subsurface techniques for locating and evaluating geopressured reservoirs along the Texas Gulf Coast: presented at Second Geopressured Geothermal Energy Conference (sponsored by U. S. Energy Research and Development Administration and Center for Energy Studies of The University of Texas at Austin), Austin, Texas.

Transgressive sandstone/carbonate sequence—Hosston/Sligo Formations of South Texas: presented at American Association of Petroleum Geologists, Annual Meeting, New Orleans, Louisiana.

L. F. Brown, Jr.

Depositional systems on the eastern flank of the Midland Basin: presented at Society of Economic Paleontologists and Mineralogists, Permian Basin Section, Meeting, Midland, Texas.

Petroleum potential of the Barreirinhas Basin, northern Brazil: presented at Petrobras (Petroleo Brasiliero), Rio de Janeiro, Brazil.

Thomas J. Evans

Suitability and availability of Texas limestones for flue-gas desulfurization: presented at Conference on Gulf Coast Lignite: Geology, Utilization, and

Environmental Aspects (sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S. Energy Research and Development Administration, and Research Applied to National Needs Program of the National Science Foundation, in cooperation with the Center for Energy Studies of The University of Texas at Austin), Austin, Texas.

Texas mineral and energy resources—Their nature, use, and impact on the environment: presented at Environmental Education Workshop (sponsored by Texas Education Agency and East Texas State University), Commerce, Texas.

Robert J. Finley

Interpretation of unenhanced LANDSAT imagery for wetland and land use delineation in the Texas Coastal Zone: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Shreveport, Louisiana.

William E. Galloway

Seismic stratigraphic model of a platform margin—Anadarko Basin: presented at Tulsa Geological Society, Meeting, Tulsa, Oklahoma.

L. E. Garner

Environmental geology of Austin area: presented before class in Urban Planning at the School of Architecture, The University of Texas at Austin, Austin, Texas.

Mineral resources and conservation in Texas: presented at Environmental Education Workshops (sponsored by Texas Education Agency and East Texas State University), Texarkana, Texas; and (sponsored by Texas Education Agency and Tarleton State University), Stephenville, Texas.

Projects and progress of the Bureau of Economic Geology: presented at Soil Survey Technical Work-Planning Conference (sponsored by Texas A & M University), College Station, Texas.

Utilization of environmental geologic maps of the Austin area: presented before City of Austin Planning Department, Austin, Texas.

A. R. Gregory

Fluid saturation effects on dynamic elastic properties of sedimentary rocks: presented at Society of Exploration Geophysicists, 29th Annual Midwestern Exploration Meeting, Dallas, Texas.

Charles G. Groat

Bureau of Economic Geology research programs: presented at Department of Geology of the University of Houston, Houston, Texas.

Coal data sources in Texas: presented at Workshop on ERDA's Fossil Energy Program (sponsored by Oak Ridge Associated Universities) at the University of Kentucky, Lexington, Kentucky.

Development of Texas energy resources—Implications for state agency planning: presented before Interagency Council on Natural Resources and the Environment, Austin, Texas.

Development of Texas mineral resources—Environmental challenges: presented at Earth Science Teacher Day Conference (sponsored by the Department of Geological Sciences of The University of Texas at Austin, the Austin Independent School District, the Texas Education Agency, the National Association of Geology Teachers, the Science Education Center of The University of Texas at Austin, and Region XIII Education Service Center), Austin, Texas; and at Conservation and Environmental Education Workshop (sponsored by the Texas Education Agency and The University of Texas at El Paso), El Paso, Texas.

Overview of lignite mining and markets in Texas: presented at Associated General Contractors Meeting, Austin, Texas.

Research challenges in the development of Texas' energy resources: presented at Symposium on Energy Resources and Public Policy (sponsored by the Austin Independent School District), Austin, Texas.

Role of resource assessment in energy research programs: presented at Second Geopressured Geothermal Energy Conference (sponsored by U. S. Energy Research and Development Administration and Center for Energy Studies of The University of Texas at Austin), Austin, Texas.

Role of state geological surveys in Environmental Impact Statement review: presented at Association of American State Geologists, Central Region Meeting, Vail, Colorado.

Texas energy alternatives: presented at Panhandle Geological Society, Meeting, Amarillo, Texas; Fort Worth Geological Society, Meeting, Fort Worth, Texas; West Texas State University, Canyon, Texas; and The University of Texas at El Paso, El Paso, Texas.

Texas energy resources—Diverse and plentiful: presented at Texas Energy Forecast Conference (sponsored by the University of Houston Energy Institute), Houston, Texas.

Texas lignite and bituminous coal—Geology and development: presented at Coal Geology Fundamentals short course (sponsored by the Oklahoma Geological Survey) at the University of Oklahoma, Norman, Oklahoma.

Thomas C. Gustavson

Applications of environmental data for land resource assessment: presented at public meeting convened by the County Judge of Fayette County (sponsored by the Texas Department of Community Affairs), La Grange, Texas.

Bedforms and stratification types of modern gravel point bars, Nueces River, Texas: presented at American Association of Petroleum Geologists, Annual Meeting, New Orleans, Louisiana.

Environmental geologic mapping of Texas: presented at a Penrose Conference (Function of the Geologist in Society) of the Geological Society of America, Waterwood National Conference Center, Texas.

Environmental mapping in Texas: presented before Department of Geology, Kent State University, Kent, Ohio.

Fluvial and lacustrine processes of sedimentation in the proglacial environment: presented before Department of Geology, Kent State University, Kent, Ohio.

Geothermal resources of the Texas Gulf Coast—Environmental concerns arising from the production and disposal of geothermal waters: presented at Second Geopressured Geothermal Energy Conference (sponsored by U. S. Energy Research and Development Administration and Center for Energy Studies of The University of Texas at Austin), Austin, Texas; and to U. S. Bureau of Land Management, New Orleans, Louisiana.

Christopher D. Henry

Environmental geology of the East Texas lignite belt: presented at Conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects (sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S. Energy Research and Development Administration, and Research Applied to National Needs Program of the National Science Foundation, in cooperation with the Center for Energy Studies of The University of Texas at Austin), Austin, Texas.

W. R. Kaiser

Depositional systems in the Wilcox Group (Eocene) of east-central Texas and the occurrence of lignite: presented at Conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects (sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S.

Energy Research and Development Administration, and Research Applied to National Needs Program of the National Science Foundation, in cooperation with the Center for Energy Studies of The University of Texas at Austin), Austin, Texas; and at South Texas Geological Society, Monthly Meeting, San Antonio, Texas.

Ernst H. Kastning

Development of pseudokarst features with examples from East, Central, and northwest Texas: presented at Texas Academy of Science, 79th Annual Meeting, College Station, Texas.

Faults as positive and negative influences on ground-water flow and conduit enlargement within karst aquifers: presented at International Symposium on Hydrologic Problems in Karst Regions (sponsored by Western Kentucky University), Bowling Green, Kentucky.

Granitic pseudokarst, Llano County, Texas, with special reference to Enchanted Rock Cave: presented at National Speleological Society, Annual Meeting, Morgantown, West Virginia.

Hydrologic and geomorphic aspects of karst features in the Blaine Gypsum (Permian), Red River Basin, northwest Texas: presented at National Speleological Society, Annual Meeting, Morgantown, West Virginia.

Robert S. Kier

Methodology to evaluate impacts of coastal zone management: presented at special meeting, Division of Ecology, State of Washington, Olympia, Washington

Charles W. Kreitler

Active surface faulting, a consideration for land use planning: presented at Geological Society of America, South-Central Section, Annual Meeting, Houston, Texas.

Active surface faulting, Texas Coastal Zone: presented at American Association of Petroleum Geologists, Annual Meeting, New Orleans, Louisiana.

Fault control of land subsidence, Texas Coastal Zone: presented at Second International Symposium on Land Subsidence (sponsored by International Association of Hydrological Sciences), Anaheim, California.

Faulting and subsidence, Texas Coastal Zone: presented before class in hydrogeology at the Department of Geological Sciences, The University of Texas at Austin, Austin, Texas.

Nitrogen isotopes in hydrology: presented before class in hydrogeology at the Department of Geological Sciences, The University of Texas at Austin, Austin, Texas.

Robert G. Loucks

Geopressured geothermal prospects in the Frio Formation of the Texas Gulf Coast—Ideal vs. actual models: presented at Gulf Coast Association of Geological Societies, Annual Meeting, Shreveport, Louisiana.

Relation of early carbonate porosity to depositional and diagenetic facies, subsurface Cow Creek Limestone (Lower Cretaceous), South Texas: presented at American Association of Petroleum Geologists, Annual Meeting, New Orleans, Louisiana.

Laurence C. McGonagle, Jr.

Comparison of densitometric methods used to obtain spacial or temporal characteristics of spectroscopic sources from spectral lines: presented at American Chemical Society, Southwestern Regional Meeting, Fort Worth, Texas.

Robert A. Morton

Characteristics and hurricane vulnerability of Texas bay and Gulf shorelines: presented at Texas Coastal and Marine Council, Meeting, Houston, Texas.

Geologic setting and physical processes affecting barrier islands of the central Texas coast: presented at League of Women Voters, Meeting, Corpus Christi, Texas.

Hydrology and sedimentology of modern and ancient channels of the Guadalupe fluvial-deltaic model: presented at Field Conference on Ancient and Modern Fluvial Systems (sponsored by U. S. Geological Survey), Austin, Texas.

Large-scale bed forms and sedimentary structures developed under supercritical flow during hurricane flooding: presented at American Association of Petroleum Geologists, Annual Meeting, New Orleans, Louisiana.

Natural hazards of the Texas Coastal Zone: presented at the Department of Environmental Sciences of the University of Virginia, Charlottesville, Virginia.

Ann E. St. Clair

Mineral resources of Texas (other than oil and gas): presented at Environmental Education Workshop (sponsored by Texas Education Agency and Abilene Christian College), Abilene, Texas.

Anita R. Trippet

Energy resources of Texas: presented before classes in Earth Science Education at the Department of Geology, Baylor University, Waco, Texas.

Geology as a profession: presented at Martin Junior High School, Austin, Texas.

Houston-Galveston area land and water inventory mapping: presented before Institute of Environmental Science class at Department of Geology, Baylor University, Waco, Texas.

Use of tools in geology: presented at Doss Elementary School, Austin, Texas.

E. G. Wermund

Introduction to resource capability mapping: presented at public meeting convened by the County Judge of Fayette County (sponsored by the Texas Department of Community Affairs), Flatonia, Texas.

Land resources mapping for regional planning: presented before the Regional Planning Board of Nassau and Suffolk Counties (sponsored by Research Applied to National Needs Program of National Science Foundation), Hauppauge, New York.

Petroleum potential and depositional systems in Tucano Basin, Brazil: presented at Petrobras (Petroleo Brasiliero), Rio de Janeiro, Brazil.

Remote sensing in Texas agencies, past and present: presented at Symposium on Remote Sensing for Land and Resource Management in the South and Southwest (sponsored by Remote Sensing Center, Texas A & M University), College Station, Texas.

Resource capability map of Kendall County: presented at public meeting convened by the County Judge of Kendall County, Boerne, Texas.

Toward solving regional movement of ground water through fractured limestones in the Edwards aquifer: presented at Geological Society of America, Annual Meeting, Denver, Colorado.

C. M. Woodruff, Jr.

Land resources of Fayette County, Texas: presented at public meeting convened by the County Judge of Fayette County (sponsored by the Texas Department of Community Affairs), La Grange, Texas.

Natural areas in the CAPCO region: presented at Natural Areas of Texas Workshop (sponsored by the Division of Natural Resources and Environment of The University of Texas at Austin), Winedale, Texas.

Resource assessment and coastal management: presented before Texas Mid-Continent Oil and Gas

Association, Subcommittee on Coastal Zone Management, Houston, Texas.

MEETINGS ATTENDED

Staff members represented the Bureau of Economic Geology or The University of Texas at numerous scientific and professional meetings in 1976. Principal meetings attended during the year include:

American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, New Orleans, Louisiana—Virgil E. Barnes, Don G. Bebout, William E. Galloway, Charles G. Groat, Thomas C. Gustavson, Charles W. Kreitler, Robert G. Loucks, Robert A. Morton, E. G. Wermund.

American Chemical Society, Southwestern Regional Meeting, Fort Worth, Texas—Laurence C. McGonagle, Jr.

Association of American State Geologists, Central Region Meeting, Vail, Colorado—Charles G. Groat.

Earth Science Teacher Day, Conference (sponsored by the Department of Geological Sciences of The University of Texas at Austin, the Austin Independent School District, the Texas Education Agency, the National Association of Geology Teachers, the Science Education Center of The University of Texas at Austin, and Region XIII Education Service Center), Austin, Texas—Charles G. Groat, Anita R. Trippet.

Energy and the Future: The Cities of Texas, Conference (sponsored by the Lyndon B. Johnson School of Public Affairs of The University of Texas at Austin), Austin, Texas—Anita R. Trippet.

ERDA's (U. S Energy Research and Development Administration) Fossil Energy Program, Workshop (sponsored by Oak Ridge Associated Universities), Lexington, Kentucky—Charles G. Groat.

Faulting and Subsidence in the Texas Coastal Zone, Workshop (sponsored by the Bureau of Economic Geology of The University of Texas at Austin and the U. S. Geological Survey), Austin, Texas—L. F. Brown, Jr., Charles G. Groat, Charles W. Kreitler, Dawn G. McKalips, E. G. Wermund.

Function of the Geologist in Society, Penrose Conference (sponsored by the Geological Society of America), Waterwood National Conference Center, Texas—Thomas C. Gustavson.

Geological Programs in the Central Region of the United States, Seminar (sponsored by U. S. Geological Survey and State Geologists), Vail, Colorado—Charles G. Groat, E. G. Wermund.

Geological Society of America, Annual Meeting, Denver, Colorado—Virgil E. Barnes, Don G. Bebout, Robert J. Finley, Charles G. Groat, Thomas C. Gustavson, Christopher D. Henry, Ernst H. Kastning, E. G. Wermund.

Geological Society of America, South-Central Section, Annual Meeting, Houston, Texas—Don G. Bebout, Charles G. Groat, Christopher D. Henry, Charles W. Kreitler.

Geology of Rocky Mountain Coal, Symposium (sponsored by U. S. Geological Survey, Colorado Geological Survey and energy companies), Golden, Colorado—W. R. Kaiser.

Geopressured Geothermal Energy Conference, Second (sponsored by U. S. Energy Research and Development Administration and Center for Energy Studies of The University of Texas at Austin), Austin, Texas—Joyce M. Basciano, Don G. Bebout, Charles G. Groat, Thomas C. Gustavson, Dawn G. McKalips, Ann E. St. Clair.

Geothermal Energy Potential of the Rio Grande Area, Texas and New Mexico, Workshop (sponsored by ERDA and the states of Texas and New Mexico), El Paso, Texas—Charles G. Groat, Christopher D. Henry.

Ground Water Quality Symposium, Third National Meeting (sponsored by the National Water Well Association), Las Vegas, Nevada—Charles W. Kreitler.

Gulf Coast Association of Geological Societies, Annual Meeting, Shreveport, Louisiana—Don G. Bebout, Robert J. Finley, Robert G. Loucks, E. G. Wermund.

Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects, Conference (sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S. Energy Research and Devel-

PENROSE CONFERENCE ON LAND USE PLANNING HELD

The Geological Society of America, through the R. A. F. Penrose endowment, and the Bureau of Economic Geology sponsored a conference on the Implementation of Geological Information in Land-Use Planning. B. W. Troxel, California Division of Mines and Geology, and G. D. Robinson, U. S. Geological Survey, convened the conference, which was held on December 13-17, 1976, in Austin, Texas. This conference included 75 participants from across the Nation who are acknowledged leaders in the application of geologic data to the effective and prudent planning of land utilization. The Bureau's sponsorship of this meeting reflects its highly regarded land resources and environmental geology programs.

BUREAU TO SPONSOR SYMPOSIUM ON CRETACEOUS CARBONATES

D. G. Bebout and R. G. Loucks, Bureau of Economic Geology, will co-chair a symposium on Cretaceous carbonate rocks in Texas and Mexico, in conjunction with the 1977 Annual Meeting of the Gulf Coast Association of Geological Societies to be held in Austin in October 1977. Present plans call for a day of technical presentations to be followed by an informal evening discussion focusing on future directions in Cretaceous carbonate research.

Papers solicited to date from industry and university researchers cover outcrop and subsurface studies, regional and local scale investigations, carbonate diagenesis and geochemistry, and age and environmental significance of Cretaceous faunas. Symposium papers will be published for this meeting.

FAULTING AND SUBSIDENCE WORKSHOP

The Bureau of Economic Geology held a workshop on Faulting and Land Subsidence in the Texas Coastal Zone on September 23 and 24, 1976. Bureau staff, researchers from the U. S. Geological Survey, and other scientists active in faulting and subsidence research met to discuss and evaluate research efforts in (1) characterization of the surface expression of growth faults, (2) analysis of mechanisms of fault activation by fluids withdrawal, and (3) interrelationships of active faulting and land subsidence. Charles W. Kreitler, Bureau research geologist, organized the workshop. Dr. Kreitler has been responsible for the Bureau's programs on Coastal Zone faulting and subsidence. Representatives from the Texas Water Development Board, Harris-Galveston Coastal Subsidence District, and NASA attended the meetings. A field trip to view faults and examples of subsidence in the Houston area concluded the symposium.

opment Administration, Research Applied to National Needs Program of the National Science Foundation, in cooperation with Center for Energy Studies of The University of Texas at Austin), Austin, Texas—Joyce M. Basciano, L. F. Brown, Jr., Thomas J. Evans, L. E. Garner, Roselle M. Girard, Charles G. Groat, Thomas C. Gustavson, Christopher D. Henry, W. R. Kaiser, Ernst H. Kastning, Robert G. Loucks, Dawn G. McKalips, Mary J. Pieper, Ann E. St. Clair, Anita R. Trippet.

Habitat '76: The United Nations Conference on Human Settlements, Southwest Regional Conference (sponsored by the Graduate Program in Community and Regional Planning of the School of Architecture of The University of Texas at Austin), Austin, Texas—L. E. Garner.

Highway Geology Symposium, 27th Annual Meeting, Orlando, Florida—L. E. Garner.

Hydrologic Problems in Karst Regions, International Symposium (sponsored by Western Kentucky University), Bowling Green, Kentucky—Ernst H. Kastning.

Implementation of Geological Information in Land-Use Planning, Penrose Conference (sponsored by the Geological Society of America and the Bureau of Economic Geology of The University of Texas at Austin), Austin, Texas—L. F. Brown, Jr., L. E. Garner, Thomas C. Gustavson, E. G. Wermund, C. M. Woodruff, Jr.

In-Situ Leaching of Uranium, Conference (sponsored by American Association of Petroleum Geologists), Vail, Colorado—William E. Galloway.

International Geological Congress, 25th, Sydney, Australia—Virgil E. Barnes.

Interstate Mining Compact Commission, Fall Meeting, San Antonio, Texas—Charles G. Groat.

Land Subsidence, Second International Symposium (sponsored by International Association of Hydrological Sciences), Anaheim, California—Charles W. Kreitler.

National Cartographic Information Center, Workshop (sponsored by U. S. Geological Survey), Austin, Texas—E. G. Wermund.

National Speleological Society, Annual Meeting, Morgantown, West Virginia—Ernst H. Kastning.

Natural Areas of Texas, Workshop (sponsored by the Division of Natural Resources and Environment of The University of Texas at Austin), Winedale, Texas—C. M. Woodruff, Jr.

Pacific Southwest Minerals, Conference (sponsored by Society of Mining Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers), San Francisco, California—Charles G. Groat.

Remote Sensing for Land and Resource Management in the South and Southwest, Symposium (sponsored by Remote Sensing Center, Texas A & M University), College Station, Texas—E. G. Wermund.

Research Techniques in Coastal Environments, Inaugural Symposium in the R. J. Russell Lectureship Series (sponsored by the Department of Geography and Anthropology, School of Geosciences, Louisiana State University), Baton Rouge, Louisiana—Robert J. Finley, Charles W. Kreitler.

Society of Exploration Geophysicists, 46th Annual Meeting, Houston, Texas; and 29th Annual Midwestern Exploration Meeting, Dallas, Texas—A. R. Gregory.

Soil Survey Technical Work-Planning Conference (sponsored by Texas A & M University and the U. S. Soil Conservation Service), College Station, Texas—L. E. Garner, Christopher D. Henry.

Standards for Measuring Shoreline Changes, Workshop (sponsored by Coastal Plains Center for Marine Development Services), Atlanta, Georgia—Robert A. Morton.

Stratigraphic Interpretation of Seismic Data, Short Course (sponsored by American Association of Petroleum Geologists and Society of Exploration Geophysicists), Houston, Texas—Don G. Bebout, A. R. Gregory, Robert G. Loucks; Vail, Colorado—L. F. Brown, Jr.

Texas Academy of Science, 79th Annual Meeting, College Station, Texas—Ernst H. Kastning, Anita R. Trippet.

Texas Advisory Committee on Conservation and Environmental Education, Meeting, Belton, Texas—Charles G. Groat.

Texas Coastal and Marine Council, Meeting, Houston, Texas—Robert A. Morton; Galveston, Texas—Charles G. Groat.

Texas Energy Forecast, Conference (sponsored by University of Houston Energy Institute), Houston, Texas—Thomas J. Evans, Charles G. Groat.

Thermal Evolution of Sedimentary Basins, Penrose Conference (sponsored by Geological Society of America), Vail, Colorado—Don G. Bebout.

COMMITTEE SERVICE, OFFICES, AND OTHER PROFESSIONAL RESPONSIBILITIES

Virgil E. Barnes

Co-leader of field trip, Economic Geology of South Central Texas, for the South Texas Geological Society.

Commissioner (representing Association of American State Geologists), American Commission on Stratigraphic Nomenclature.

Delegate (representing Austin Geological Society, 1974-1976), House of Delegates, American Association of Petroleum Geologists.

Don G. Bebout

Chairman of Technical Program Committee, 1976-1977, Austin Geological Society.

Delegate (representing Austin Geological Society, 1976-1979), House of Delegates, American Association of Petroleum Geologists.

L. F. Brown, Jr.

Associate editor, American Association of Petroleum Geologists Bulletin.

Co-leader of field conference on Depositional Systems in a Cratonic Setting—Models for Mineral/Energy Exploration [North-Central Texas], sponsored by the Society of Economic Paleontologists and Mineralogists, Permian Basin Section.

Lecturer for Continuing Education Program, American Association of Petroleum Geologists and Society of Exploration Geophysicists.

Member of Sea Grant Advisory Council for Texas, Texas A & M University.

Member of Subcommittee on Coastal Zone Management, Interagency Council on Natural Resources and Environment (Advisory to General Land Office).

Panelist at Penrose Conference on Implementation of Geological Information in Land-Use Planning, sponsored by the Geological Society of America, held in Austin, Texas.

Thomas J. Evans

Chairman of Publications Committee, 1976-1977, Austin Geological Society.

Co-author of an unpublished report, Mineral

Production Values in Texas School Districts, prepared for the Governor's Office, Education Resources Commission, the State of Texas.

Member of Entertainment Committee, 1975-1976, Austin Geological Society.

L. E. Garner

Co-author of an unpublished report, Mineral Production Values in Texas School Districts, prepared for the Governor's Office, Education Resources Commission, the State of Texas.

Co-leader of field trip, Environmental Problems, Austin Area, Texas, for a Penrose Conference (Implementation of Geological Information in Land-Use Planning), Geological Society of America.

Co-leader of field trip, Points of Geologic Interest in the Austin Area, for Austin Independent School District earth science teachers.

Co-presenter of workshop on Use of the Land Resources of Fayette County Map at public meeting in La Grange, Texas, sponsored by Texas Department of Community Affairs.

Member of Board of Directors, Austin Natural Science Association.

Member of the Publicity Committee for 1977 Annual Meeting, Gulf Coast Association of Geological Societies.

Member of Steering Committee, Highway Geology Symposium.

Roselle M. Girard

Member of Publications Committee, 1975-1976, Austin Geological Society.

Charles G. Groat

Alternate member of Liaison Committee, Association of American State Geologists.

Chairman of Government, Energy, and Minerals Committee, Society of Mining Engineers, South Texas Section, American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME).

Chairman of Nuclear Waste Disposal Advisory Committee to ERDA (U. S. Energy Research and Development Administration), Association of American State Geologists.

Chairman of Steering Committee for the Workshop on Geothermal Energy Potential of the Rio Grande Area, Texas and New Mexico, sponsored by ERDA and the states of Texas and New Mexico.

General chairman of conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects, sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S. Energy Research and Development Administration, Research Applied to National Needs Program of the National Science Foundation, in cooperation with Center for Energy Studies of The University of Texas at Austin, Austin, Texas.

Member of the Advisory Council of Balcones Research Center, The University of Texas at Austin.

Member of Coal Slurry Pipeline Advisory Panel, Office of Technology Assessment, U. S. Congress.

Member of Definitions Committee, Petroleum Resources Appraisal Project, American Association of Petroleum Geologists.

Member of Environmental Steering Committee, Texas Utilities Generating Company.

Member of Executive Committee, Geology Foundation, The University of Texas at Austin.

Member of Interagency Council on Netural Resources and the Environment of the State of Texas.

Member of Mining Task Force for Coal and Lignite Studies, Governor's Energy Advisory Council.

Member of Nuclear Fuel Cycle Task Force, Governor's Energy Advisory Council.

Member of Steering Committee for Interdisciplinary Energy Policy Studies, sponsored by Exxon Foundation, at the Center for Energy Studies of The University of Texas at Austin.

Member of Technical Advisory Committee, Texas Water Resource Conservation and Development Task Force of Texas Governor's Office.

Member of Texas Advisory Committee on Conservation and Environmental Education, Texas Education Agency.

Member of Texas Mapping Advisory Committee.

President, June-December 1976, Austin Geological Society.

Christopher D. Henry

Chairman of Environmental Aspects Workshop of conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects, sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S. Energy Research and Development Administration, Research Applied to Netional Needs Program of the National Science Foundation, in cooperation with Center for Energy Studies of The University of Texas at Austin, Austin, Texas.

W. R. Kaiser

Co-leader of field trip, Economic Geology of South Central Texas, for the South Texas Geological Society.

Leader of field trip, Calvert Bluff (Wilcox Group) Sedimentation and the Occurrence of Lignite at Alcoa and Butler, Texas, held in conjunction with conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects, sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S. Energy Research and Development Administration, Research Applied to National Needs Program of the National Science Foundation, in cooperation with Center for Energy Studies of The University of Texas at Austin.

Program chairman of conference on Gulf Coast Lignite: Geology, Utilization, and Environmental Aspects, sponsored by Bureau of Economic Geology of The University of Texas at Austin, U. S. Energy Research and Development Administration, Research Applied to National Needs Program of the National Science Foundation, in cooperation with Center for Energy Studies of The University of Texas at Austin, Austin, Texas.

Robert S. Kier

Chairman of the Public Relations Committee, 1975-1976, Austin Geological Society.

Co-presenter of workshop on Use of the Land Resources of Fayette County Map at public meeting in La Grange, Texas, sponsored by Texas Department of Community Affairs.

Charles W. Kreitler

Convener of workshop on Faulting and Subsidence in the Texas Coastal Zone, sponsored by the Bureau of Economic Geology end the U. S. Geological Survey, in Austin, Texas.

Panelist for U. S. Congress, Office of Technology Assessment to review environmental aspects of the U. S. Energy Research and Development Administration's National Plan for Energy Research, Development and Demonstration: Creating Choices for the Future, in Washington, D. C.

Robert A. Morton

Consulted with Texas Coastal and Marine Council on development of building code for Texas coast as called for in Texas Senate Resolution 268.

Member of Technical Program Committee, Austin Geological Society.

Ann E. St. Clair

Co-author of an unpublished report, Mineral Production Values in Texas School Districts, prepared for the Governor's Office, Education Resources Commission, the State of Texas.

Co-leader of field trip, Points of Geologic Interest in the Austin Area, for Austin Independent School District earth science teachers.

Co-presenter of workshop on Use of the Land Resources of Fayette County Map at public meeting in La Grange, Texas, sponsored by Texas Department of Community Affairs.

Anita R. Trippet

Co-leader of field trip, Points of Geologic Interest in the Austin Area, for Austin Independent School District earth science teachers.

Co-presenter of four workshops at Conference for the Advancement of Science Teaching, sponsored by the Science Teachers Association of Texas and the National Association of Geology Teachers, in Bryan, Texas.

Co-presenter of two workshops on the Bureau of Economic Geology's Earth Science Education Program held in Austin, Texas, during Earth Science Teacher Day Conference sponsored by the Department of Geological Sciences of The University of Texas at Austin, the Austin Independent School District, the Texas Education Agency, the National Association of Geology Teachers, the Science Education Center of The University of Texas at Austin, and Region XIII Education Service Center.

Member of the Finance Committee, Austin Geological Society.

E. G. Wermund

Co-leader of field conference on Depositional Systems in a Cratonic Setting—Models for Mineral/Energy Exploration [North-Central Texas], sponsored by the Society of Economic Paleontologists and Mineralogists, Permian Basin Section.

General chairman of the 1977 Annual Meeting, Gulf Coast Association of Geological Societies.

Member of Ad Hoc Committee on Remote Sensing to advise Vice President of Research at The University of Texas at Austin.

Member of the Environmental Geology Committee, American Association of Petroleum Geologists.

Member of the Remote Sensing Committee of the Task Force for the Texas Natural Resources Information System, Texas Interagency Council on Natural Resources and the Environment.

Member of the Task Force for the Texas Natural Resources Information System, Texas Interagency Council on Natural Resources and the Environment.

Reviewer, Councils of Governments (Alamo Area Council of Governments, Capital Area Planning Council, Houston-Galveston Area Council, Coastal Bend Council of Governments, North Central Texas Council of Governments), 1976-1977 Programs for the U. S. Department of Housing and Urban Development.

C. M. Woodruff, Jr.

Consultant on matters regarding land resources and land capabilities for the Coastal Management Program, Texas General Land Office.

Panelist at Penrose Conference on Implementation of Geological Information in Land Use Planning, sponsored by the Geological Society of America, in Austin, Texas.

TEACHING ACTIVITIES

Information developed in various research projects at the Bureau of Economic Geology is included in continuing education short courses and in regularly scheduled university courses that are taught each year by members of the Bureau staff. During 1976, eight staff members were involved in such activities:

Don G. Bebout taught Geology 383N, Biogenic and Evaporite Depositional Systems, a regularly scheduled course at the Department of Geological Sciences, The University of Texas at Austin. He also taught two short courses: Carbonate Facies Seminar (sponsored by the University of Miami, Comparative Sedimentology Laboratory) was taught in Miami, Florida; Carbonates (sponsored by the Geology Foundation, the Bureau of Economic Geology, and the Department of Geological Sciences, The University of Texas at Austin) was taught with Robert L. Folk, Lynton S. Land, Robert G. Loucks, and Alan J. Scott in Austin, Texas.

L. F. Brown, Jr., taught a number of short courses, including Ancient Delta Systems (sponsored by Home Oil Company) in Calgary, Alberta, Canada; Ancient Fluvial-Deltaic Facies and Their Petroleum Potential (sponsored by Mobil Research Laboratories) in Dallas, Texas; Facies Analysis for Geophysicists (sponsored by Society of Exploration Geophysicists) in Dallas, Texas; Recognition and Interpretation of Ancient Fluvial and Deltaic Systems (sponsored by Amoco Stratigraphic Seminars and Field Program) in Houston and Mineral Wells, Texas; Recognition and Interpretation of Ancient Fluvial and Deltaic Systems (sponsored by Chevron Stratigraphic Field Seminars) in Abilene and Mineral Wells, Texas; Reevaluation of Petroleum Potential in Amazonas Continental Shelf Area, and Terrigenous Clastic Depositional Systems (sponsored by Petroleo Brasiliero) in Rio de Janeiro, Brazil; and The Nature of Fluvial and Deltaic Depositional Systems (sponsored by Chevron Management Seminars) in Santa Barbara, California. He also taught a continuing education course, Seismic-Stratigraphic Analysis of Petroleum Potential, Barreirinhas Basin, Brazil (sponsored by Petroleo Brasiliero Training and Research Program) in Austin, Texas; and a portion, Seismic-Stratigraphy and Depositional Systems, of a short course on Stratigraphic Interpretation of Seismic Data (sponsored by American Association of Petroleum Geologists and Society of Exploration Geophysicists) in Vail, Colorado, and Houston, Texas.

A. R. Gregory taught a portion, Some Aspects of Rock Physics from Laboratory and Log Data that are Important to Seismic Interpretation, of a short course on Stratigraphic Interpretation of Seismic Data (sponsored by American Association of Petroleum Geologists and Society of Exploration Geophysicists) in Houston, Texas.

Charles G. Groat taught, with Stephen H. Spurr and Marlan Blissett, in the Lignite Policy Research Project at the LBJ School of Public Affairs, The University of Texas at Austin. He also taught a portion of the Coal Geology Fundamentals short course (sponsored by Oklahoma Geological Survey) at the University of Oklahoma, Norman, Oklahoma.

Robert G. Loucks taught—with Don G. Bebout, Robert L. Folk, Lynton S. Land, and Alan J. Scott—a short course, Carbonates (sponsored by the Geology Foundation, the Bureau of Economic Geology, and the Department of Geological Sciences, The University of Texas at Austin) in Austin, Texas.

J. H. McGowen taught a portion, Ancient Fan Complexes, of a short course on The Fluvial System with Applications to Economic Geology (sponsored by the Department of Earth Resources, Colorado State University) in Fort Collins, Colorado.

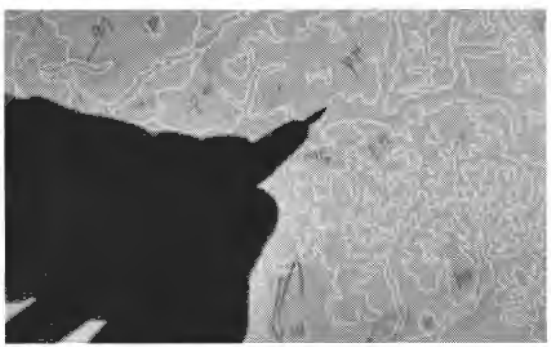
E. G. Wermund taught Overview of Remote Sensing, a short course (sponsored by the Task Force on Texas Natural Resources Information System) in Austin, Texas.

Charles M. Woodruff, Jr., taught Geology 401, Introductory Physical Geology, a regularly scheduled course at the Department of Geological Sciences, The University of Texas at Austin.

SUPPORT STAFF

SECRETARIAL/CLERICAL STAFF

As the Bureau of Economic Geology has increased its research staff and its research activities, the support required from Secretarial/Clerical Staff has also expanded. These staff members are, in many respects, the Bureau's closest contact with the public, and their contribution to the Bureau's role as a public geologic research group is immeasurable. This section is under the direction of Mrs. Eloise Hill, Executive Assistant.



CARTOGRAPHY

Geologic mapping has always been an important part of the Bureau's research efforts. Full-color maps of high quality are, perhaps, the most significant accomplishment of the Cartography Section. Under the direction of James W. Macon, the Cartography Section has expanded with the Bureau in size, capability, and production. The present staff produces a full range of maps, illustrations, slide copy, and display materials.

PUBLICATIONS

Publications of the Bureau of Economic Geology are the focal point of Bureau research, as the dissemination of the results of public-sector research is its most important function. Camera-ready copy is prepared within the Bureau. Manuscript typing, technical editing, and composing are the three primary groups within the Publications Section.

MOORE RETIRES IN APRIL

Following 18 years of service to the Bureau of Economic Geology, Mrs. Elizabeth T. Moore retired in April 1976. She was primarily responsible for manuscript preparation and initial editing of papers. Mrs. Moore also contributed to the Bureau's overall research programs through publication of two comprehensive bibliographies and indexes of Texas geology and the addendum to the index of the Bureau's well samples and cores.

PHOTOGRAPHY

Technical photographic support for publications, lectures and public addresses, and research projects is an important aspect of the Bureau's overall program. David Stephens is the photographer for the Bureau and also works for the Department of Geological Sciences. Most of the photographic work centers on slides, cover photos, and text photos.

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*Research assistants are generally half-time staff.

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*Maria I. Mendoza
*Elizabeth T. Moore
*Sharon E. Polensky

Photographer
*David M. Stephens

†Dr. W. L. Fisher, Director, is on leave of absence. Dr. Fisher is presently serving as Assistant Secretary of the Interior for Energy and Minerals.
*Part-time staff or full-time staff for less than 6 months.

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