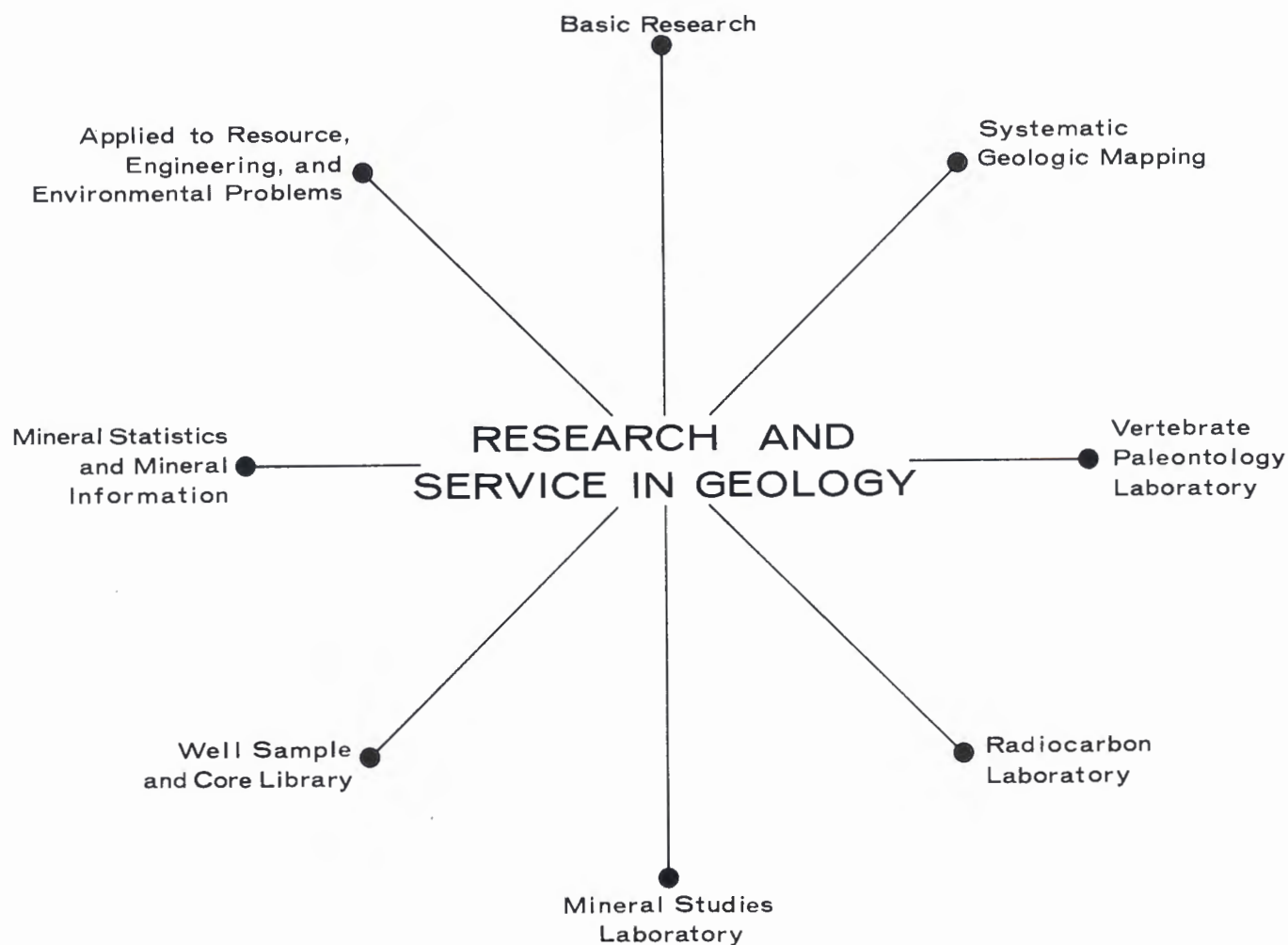




BUREAU OF ECONOMIC GEOLOGY

Report For 1968

BUREAU OF ECONOMIC GEOLOGY



Aerial view of Santa Elena Canyon. Rio Grande at bottom of canyon is International Boundary between Mexico and the United States. Sierra Ponce (Mexico) on left, Mesa de Anguila (United States) on right. (Photograph by Hunter's, Alpine, Texas.)

**BUREAU OF ECONOMIC GEOLOGY
THE UNIVERSITY OF TEXAS AT AUSTIN
University Station, Box X
Austin, Texas 78712**

**RESEARCH AND ADMINISTRATIVE OFFICES
GEOLOGY BUILDING, MAIN CAMPUS**

**LABORATORIES
BALCONES RESEARCH CENTER**

THE BUREAU OF ECONOMIC GEOLOGY is one of the organized research bureaus of The University of Texas at Austin. Established in 1909, it has for 59 years carried out the function of a State Geological Survey; its Director fills the position of State Geologist. The Bureau is engaged in a four-point program of research and public service in earth science and Texas mineral resources as follows: (1) basic geological research, (2) geology applied to resource, engineering, and environmental problems, (3) systematic geologic mapping, and (4) public-service mineral information, identification and testing, and compilation of mineral statistics. The Bureau participates in other University research efforts in the fields of resources and earth sciences, such as the Center for Research in Water Resources. As a part of its effort, the Bureau publishes major reports in The University of Texas Publication series; it also has its own series of Reports of Investigations, Geologic Quadrangle Maps, Guidebooks, Geological Circulars, and Mineral Resource Circulars. The Guidebooks include nontechnical publications of general interest. A complete list of publications is available on request.

The basic geologic data developed by the Bureau of Economic Geology in the form of scientific reports and geologic maps are used by many State and Federal organizations in carrying out investigations in the public service. These include the Texas Water Development Board, Railroad Commission of Texas, Parks and Wildlife Department, Texas Highway Department, Texas Industrial Commission, and numerous other State boards, conservation organizations, water districts, and Chambers of Commerce. The Bureau also cooperates formally and informally with Federal agencies, such as the Geological Survey, Bureau of Mines, Bureau of Reclamation, Corps of Engineers, and National Park Service. The mineral and geological information service offered by the Bureau of Economic Geology is used by public and private groups, corporations, and citizens through correspondence and conference.

Publications in 1968

Report of Investigations No. 63. LITHOLOGY AND PETROLOGY OF THE GUEYDAN (CATAHOULA) FORMATION IN SOUTH TEXAS, by E. F. McBride, W. L. Lindemann, and P. S. Freeman. 122 pp., 7 text figs., 28 pls., January 1968 \$2.00

This report describes sedimentary rock composed largely of debris derived from ancient explosive volcanic eruptions. The authors report that volcanoes in West Texas and northern Mexico erupted 20 to 30 million years ago, and that wind and streams carried debris toward the Gulf of Mexico. Much of this debris is preserved as tuff, clay, and sandstone of the Gueydan Formation, which crops out east and south of San Antonio in the Gulf Coastal Plain.

Guidebook No. 7. THE BIG BEND OF THE RIO GRANDE, A Guide to the Rocks, Geologic History, and Settlers of the Area of Big Bend National Park, by Ross A. Maxwell. 138 pp., 117 text figs., geologic map in color, February 1968 \$2.00

This Guidebook includes the geologic map of Big Bend National Park which was printed for University of Texas Publication 6711. It is in color at a scale of 1:62,500. A geographic place name map of the Big Bend country, a panorama of the Chisos Mountains Basin, and other photographs accompany the text.

Cover photographs are views of Santa Elena Canyon of the Rio Grande and a canyon at Big Hill. The author was the first superintendent of Big Bend National Park and drew from his vast knowledge of that area in writing this Guidebook.

Titles of main subdivisions of the Guidebook are Introduction, Geologic Processes, Geology, Place Names, and Legends, Natural Uses of Plant Life, Native Healers, and Frontier Towns. A bibliography, a glossary, and a comprehensive index are included.

GEOLOGIC ATLAS OF TEXAS—Scale 1:250,000, in color, topographic base, 1968 \$2.50 each
(Compiled under the direction of V. E. Barnes)

BEAUMONT SHEET. Harold Norman Fisk Memorial Edition. Includes parts or all of Madison, Houston, Walker, Trinity, San Jacinto, Polk, Tyler, Jasper, Newton, Grimes, Montgomery, Waller, Harris, Liberty, Hardin, Orange, and Jefferson counties. Published as a memorial to the late Harold Norman Fisk, distinguished geologist who was associated with Humble Oil & Refining Company at the time of his death in 1964. Dr. Fisk, a specialist in Pleistocene and Recent geology of the southern United States, identified and named the Montgomery and Bentley Formations which are mapped on the Beaumont and Houston Sheets.

HOUSTON SHEET. Paul Weaver Memorial Edition. Includes parts or all of Waller, Harris, Liberty, Jefferson, Orange, Chambers, Galveston, Fort Bend, Brazoria, Matagorda, and Wharton counties. Published as a memorial to the late Paul Weaver, distinguished Texas geologist and geophysicist, who was associated with Gulf Oil Corporation in Houston for many

years and later with Texas A&M University. After retirement from Gulf in 1953, Mr. Weaver devoted his attention to water resources and conservation from both the humanitarian and scientific viewpoint.

PALESTINE SHEET. Sidney Powers Memorial Edition. Includes parts or all of Freestone, Anderson, Cherokee, Rusk, Panola, Shelby, Leon, Houston, Trinity, Angelina, Nacogdoches, San Augustine, Sabine, Madison, Walker, Polk, Tyler, Jasper, and Newton counties. Published as a memorial edition honoring Sidney Powers, who was one of the leading geologists of his generation and who was classed by many as the most proficient geologist in the oil industry before his death in 1932. Among his numerous publications concerning Texas, those on the interior salt domes, some of which are within the area of the Palestine Sheet, are of outstanding importance.

PLAINVIEW SHEET. William Fletcher Cummins Memorial Edition. Includes parts or all of Randall, Armstrong, Donley, Collingsworth, Swisher, Briscoe, Hall, Childress, Hale, Floyd, Motley, Cottle, and Foard counties. Published as a memorial to William Fletcher Cummins, who pioneered in mapping West Texas geology and specialized in the study of Permian rocks of West Texas and New Mexico. These rocks occupy the eastern two-thirds of the Plainview Sheet.

VAN HORN—EL PASO SHEET. E. Russell Lloyd Memorial Edition. Includes parts or all of El Paso, Hudspeth, Culberson, Reeves, and Jeff Davis counties. Published as a memorial edition honoring the late E. Russell Lloyd, distinguished Texas independent petroleum geologist, who prior to his death in 1955 edited much of the geological writing concerning the Permian Basin area. His geologic interpretation of the Capitan Limestone as a reef furnished the basis for interpretation of the associated formations and their oil-bearing possibilities. The Capitan Limestone is partly within the Van Horn—El Paso Sheet.

Geologic Quadrangle Map No. 35. GEOLOGY OF APACHE MOUNTAINS, TRANS-PECOS TEXAS, by John W. Wood. Map scale 1:63,360; with 32-page text. March 1968 \$2.00

The Apache Mountains are an exhumed Permian reef complex and form a segment of the reef-rimmed margin of the Permian Delaware Basin, which lies to the northeast of the Apaches. The text includes discussion of regional and local structural features and detailed description of the geologic formations in the map area. A summary of the geologic history of the Apache Mountains is also included. Mineral resources briefly mentioned include barite, zinc, road material, ground water, and petroleum prospects.

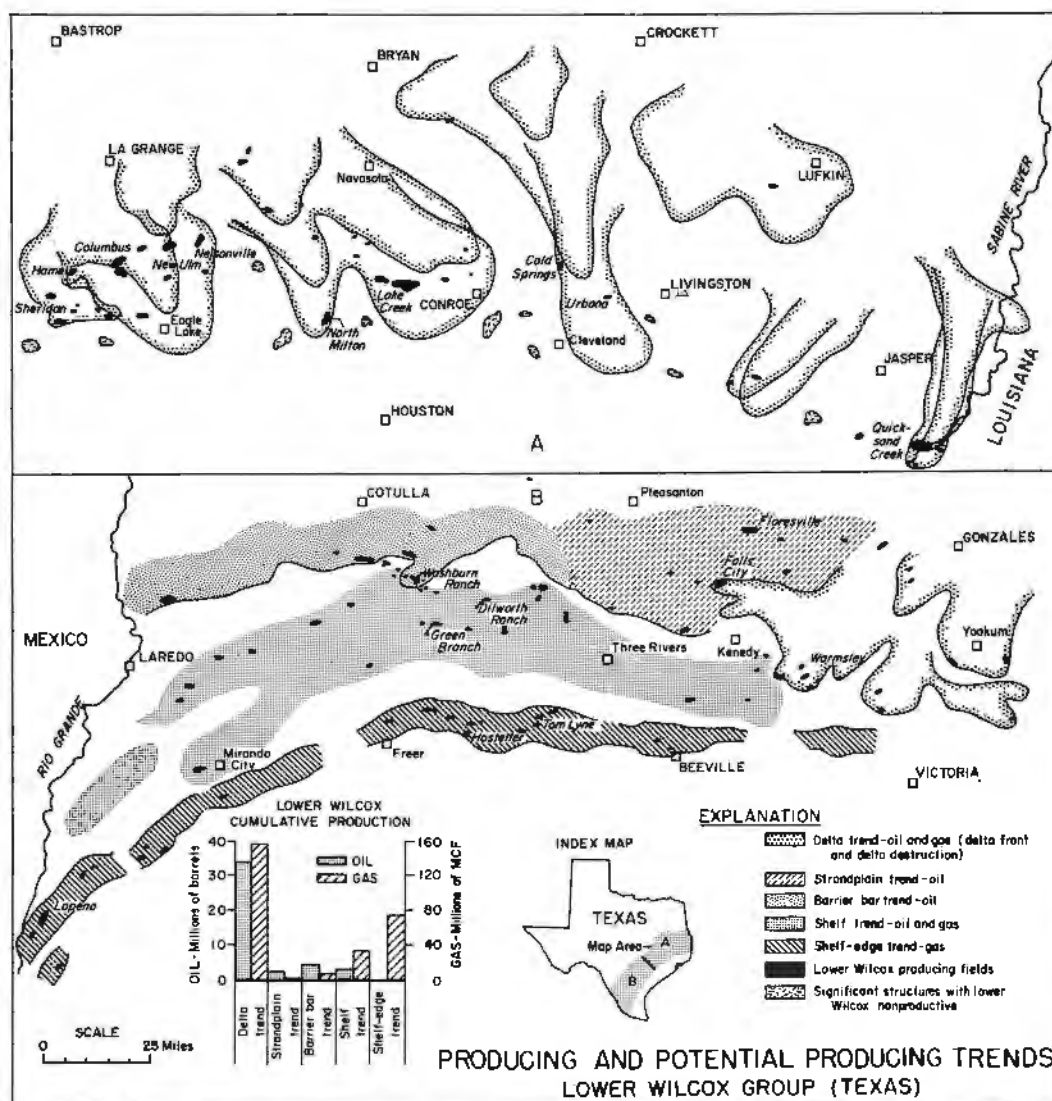
Geologic Quadrangle Map No. 36. IGNEOUS GEOLOGY OF THE CENTRAL DAVIS MOUNTAINS, JEFF DAVIS COUNTY, TEXAS, by Jay Earl Anderson, Jr. Map scale 1:62,500; with 18-page text. May 1968 \$2.00

Text accompanying this geologic quadrangle map contains detailed description of the geologic formations of the central

Davis Mountains, located in Jeff Davis, Presidio, and Brewster counties in Trans-Pecos Texas; the report deals more specifically with about 240 square miles in the highest part of the range. The map is in color and includes three structure sections.

Geological Circular 67-4. DEPOSITIONAL SYSTEMS IN THE WILCOX GROUP OF TEXAS AND THEIR RELATIONSHIP TO OCCURRENCE OF OIL AND GAS, by W. L. Fisher and J. H. McCowen. Reprinted from TRANSACTIONS, GULF COAST ASSOCIATION OF GEOLOGICAL SOCIETIES, Vol. XVII, pp. 105-125, October 1967. March 1968 \$0.50
Preliminary report on a long-term Bureau research project. The 4-year project involved study of 3,000 subsurface well records and description of about 300 outcrop sections throughout a 40,000-square-mile area of the Texas Gulf Coast Basin. Three-dimensional analysis of data permitted reconstruction of sev-

eral depositional systems within the Lower Wilcox similar to large-scale depositional systems in the Holocene northwest Gulf of Mexico. These include fluvial and delta systems comparable in area and make-up to the Mississippi River and its several deltas. Main Wilcox deltas were built into the early Gulf of Mexico by streams flowing approximately along the course of the modern Colorado, Brazos, and Trinity Rivers. Adjacent to the delta system, strandplain and harrier bar systems developed in South Texas; these are similar to the chenier and barrier islands adjacent to the Mississippi Delta along the Holocene southwestern Louisiana and upper Texas Gulf Coast. Bays and lagoons like the modern bays of the Texas Coast developed behind the Wilcox barrier bars of South Texas. Seaward from the barrier bars, much of South Texas existed as an extensive continental shelf similar to the present-day continental shelf of the northwest Gulf of Mexico.



Producing and potential-producing oil and gas trends, lower part of Wilcox Group, Texas. (Bureau of Economic Geology Geological Circular 67-4, fig. 10, p. 123.)

Geological Circular 68-1. GLEN ROSE CYCLES AND FACIES, PALUXY RIVER VALLEY, SOMERVELL COUNTY, TEXAS, by J. Stewart Nagle. 25 pp., 7 text figs., June 1968 \$0.75

This circular presents a reconstruction of ancient lagoonal environment in the area of Dinosaur Valley, near Glen Rose, Somervell County.

Mineral Resource Circular No. 50. THE MINERAL INDUSTRY OF TEXAS IN 1967, by F. F. Netzeband and Roselle M. Girard. December 1968 Free on request

Special Publication. PROCEEDINGS OF THE 4TH ANNUAL FORUM ON GEOLOGY OF INDUSTRIAL MINERALS, L. F. Brown, Jr., Editor. December 1968.

INTRODUCTION: Peter T. Flawn

KEYNOTE PAPER—The View from the Forum: John B. Patton

PART I: GEOLOGY OF CHEMICAL RAW MATERIALS

Resource and Economic Importance of Gulf Coastal Salt Deposits: M. E. Hawkins and S. O. Wood, Jr.

Phosphate in the Atlantic and Gulf Coastal Plains: James B. Cathcart

Chemicals from the Sea: W. F. McIlhenny

Industrial Carbonates of the Texas Gulf Coastal Plain: G. K. Eifler, Jr.

Gulf Coast Sulfur Resources: John C. Myers

The Louann Salt of the Gulf Coastal Region (abstract): George C. Hardin, Jr.

Caprock Genesis and Occurrence of Sulphur Deposits: Ralph E. Taylor

Internal Structure of Salt Domes: William R. Muehlberger and Patricia S. Clabaugh

Exploration of Program of a Major Chemical Company: W. N. McNulty, Sr.

The Structure of the Gulf Coast Chemical Industry: Stanley A. Arbingast

PART II: DEPOSITIONAL MODELS IN ECONOMIC STRATIGRAPHY

Coordinate Evaluation of Evaporite Deposits by Dynamic Modelings and Simulation: Louis J. Briggs and Dariuka Zigic-Toshich

Environments of Phosphorite Deposition in the Central Florida Phosphate District: Donald H. Freas and Stanley R. Riggs

Environmental Factors Controlling Oyster Shell Deposits, Texas Coast: Alan J. Scott

Gravel Deposits of the Minneapolis Quadrangle, Minnesota: Rudolph K. Hogberg

Utilization of Depositional Models in Exploration for Non-metallic Minerals: J. H. McCowen

Publication 6120 Reprinted

THE OUACHITA SYSTEM, by P. T. Flawn, August Goldstein, Jr., P. B. King, and C. E. Weaver. Originally published in 1962; 401 pages with 13 text figures, 15 plates, and two geologic maps in color. This report

has been out of print and unavailable from the Bureau for some months; it was reproduced by xerography and in that form is available from University Microfilms Library, Ann Arbor, Michigan. However, there has been strong demand for a second printing, and copies will be available early in 1969. [This is not a revision.]

Open-File Reports

1. Mineral Resources of Proposed Reservoir Sites, Northeast and South Texas, by W. L. Fisher, W. R. Stearns, L. E. Garner, G. L. Dawe, and D. A. Schofield, 162 pp., 13 pls. Report prepared under contract by Bureau of Economic Geology for Texas Water Development Board. Includes description of location, general geology, principal rock units, surface mineral deposits, oil and gas, and conclusions for the following proposed reservoir sites: Bois d'Arc, Pecan Bayou, Big Pine, Sulphur Bluff, Naples, Franklin, Titus, Texarkana Enlargement, Marshall, Black Cypress, Palmetto Bend, Cuero, Goliad, and Choke Canyon. May be consulted at Bureau office.

2. In October 1968 the U. S. Geological Survey placed on open-file status with the Bureau of Economic Geology a Gemini Mosaic along the 32nd degree of latitude from Baja California to Central Texas. This mosaic consists of 3 photomaps and may be consulted at the Bureau office.

3. The U. S. Geological Survey also placed the following materials on open file with the Bureau; these are available for consultation and/or reproduction:

(a) Tabular summary showing estimated coal resources of the United States as of January 1, 1967. Resources are tabulated by states and categorized by rank of coal and amount of overburden.

(h) Subsurface data on thicknesses and distribution of some Upper Jurassic formations in adjacent parts of Texas, Louisiana, and Arkansas, by Kendell A. Dickinson. This 26-page typescript supplements U. S. Geological Survey Professional Paper 594-E, "Upper Jurassic Stratigraphy of Some Adjacent Parts of Texas, Louisiana, and Arkansas," by Dickinson.

4. In September 1968 the Atlantic Richfield Company deposited for open-file use detailed sample and core descriptions for and metallurgical analyses of samples and cores from six holes drilled to evaluate phosphate deposits in Collin, Hopkins, and Hunt counties, Texas.

Publications in Press

Report of Investigations. Physical Stratigraphy and Facies Analysis, Lower Cretaceous Formations, Northern Coahuila, Mexico, by Charles I. Smith.

Report of Investigations. Facies and Genesis of a Hurricane-Washover Fan, by Peter B. Andrews.

Report of Investigations. Palynology of the Eddleman Coal (Pennsylvanian) of North-central Texas, by J. Fred Stone.

Geological Circular 69-1. Edwards Formation (Lower Cretaceous) Texas: Dolomitization in a Carbonate Platform System, by W. L. Fisher and P. U. Rodda. Reprinted from BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, vol. 53.

Guidebook No. 8. The Geologic Story of Palo Duro Canyon, by William H. Matthews III.

Geologic Atlas of Texas. Amarillo Sheet. Leroy Thompson Patton Memorial Edition.

Publications by Bureau of Economic Geology Staff in Scientific Journals

Barnes, V. E. (1968) Mineral resources, in Eastern Hill Country Resource Conservation Project of Texas, pp. 73-83, U. S. Department of Agriculture, Soil Conservation Service, 4-26613, 6-68, Fort Worth, Texas.

Barnes, V. E. (1968) Petrography of new tektite localities in Thailand and the Philippines: International Geological Congress, 23rd, Prague, Proceedings, vol. 13, pp. 27-36. Abstract in International Geol. Congress, 23rd, Report (Abstracts), p. 328, 1968.

Barnes, V. E. (1968) Tektites, in International Dictionary of Geophysics, S. K. Runcorn, Editor, vol. 2, 1967, pp. 1507-1518, Pergamon Press, Inc., New York, N. Y.

Barnes, V. E., and Garner, L. E. (1968) Guidebook, Field excursion, Burnet County, March 15, 1968: Fourth Annual Forum on Geology of Industrial Minerals, sponsored by Bureau of Economic Geology of The University of Texas at Austin.

Barnes, V. E., and Hyder, S. B. (1968) Electron microprobe analysis of inhomogeneities in tektites (abst.): American Geophysical Union, Transactions, vol. 49, no. 1, p. 243.

Brown, L. F., Jr. (1968) Shelf model for Late Pennsylvanian—Early Permian deposition in North-central Texas (abst.): Program, Geological Society of America, South-Central Section, Meeting, Dallas.

Fisher, W. L. (1968) Basic delta systems in Eocene of Gulf Coast Basin (abst.): Gulf Coast Association of Geological Societies, Transactions, vol. 18, p. 48;

Bulletin, American Association of Petroleum Geologists, vol. 52, no. 9, p. 1826.

Fisher, W. L. (1968) Nonmetallic industrial minerals—examples of diversity and quantity (abst.): Program, American Mining Congress, Las Vegas, Nevada.

Fisher, W. L. (1968) Variation in lignites of fluvial, deltaic, and lagoonal systems, Wilcox Group (Eocene) Texas (abst.): Geological Society of America, Annual Meeting, Program with Abstracts, Mexico City, p. 97.

✕ Fisher, W. L., McGowen, J. H., and Nagle, J. S. (1968) Indio Lagoon System, Wilcox Group, South Texas, in Environments of Deposition, Wilcox Group, Texas Gulf Coast: Field Trip Guidebook, Houston Geological Society, pp. 28-43.

✕ Fisher, W. L., and McGowen, J. H. (1968) Depositional systems in the Wilcox Group of Texas and their relationship to occurrence of oil and gas (abst.): Corpus Christi Geological Society Bulletin, vol. 8, no. 5, p. 4; South Texas Geological Society Bulletin, vol. 9, no. 5, p. 1.

Flawn, P. T. (1968) The environmental geologist and the body politic: The Professional Geologist, vol. 5, no. 1, pp. 5-7; Geotimes, vol. 13, no. 6, pp. 13-14.

Flawn, P. T. (1968) The challenge and opportunity in environmental geology (abst.): Program, Geological Society of America, South-Central Section, Meeting, Dallas.

Flawn, P. T. (1968) AAPG Basement Project re-

viewed: *Bulletin, American Association of Petroleum Geologists*, vol. 52, no. 2, pp. 350-353.

Nagle, J. S. (1968) *Stepping Stair Hills: Texas Parks and Wildlife Magazine*, vol. 26, no. 6, pp. 16-19.

Rodda, P. U., and Fisher, W. L. (1968) A model for chert deposition, Edwards Formation (Lower Cre-

taceous), Texas (abst.): *Geological Society of America, Annual Meeting, Program with Abstracts*, Mexico City, p. 250.

Rodda, P. U. (1968) [Review of] *Stereogram book of fossils*, by Philip A. Sandberg: *Journal of Geological Education*, vol. 16, p. 75.

Proposed Public Lands Project

The Bureau of Economic Geology has initiated planning for a comprehensive, long-term study of the public lands of Texas including fee lands, mineral classified lands, royalty interest lands, and submerged lands. The State currently knows very little about its public lands and yet they represent Texas' greatest asset—a trust of enormous value for future generations. At present, the State's knowledge of the mineral resource potential of any particular tract is derived chiefly from the amount of money bid to lease it in a competitive sale.

The proposed Bureau project envisions a broad study of mineral resource potential going beyond an evaluation of oil and gas possibilities to include metals and nonmetallic industrial minerals. For example, information on the distribution of sand and gravel deposits in river beds and estuaries owned by the State is necessary to any planning for use of these submerged lands. The State needs more information on mineral deposits already discovered and in production. What will be

the productive life of the deposit? What income can the State expect? What reclamation work will be required to restore the mined land for other beneficial use?

Deposits of ground water, including brackish ground water and brines, should be studied in the light of other possible uses for the land. Much of this information has already been developed. It needs only to be considered in terms of the State's ownership and interest in planning for future development.

Beyond mineral deposits, the State's submerged lands are affected by geologic processes that change the land-water interface in relatively short periods of time. Quantitative studies of erosion and sediment transport are fundamental to planning for any engineering modifications of these lands.

If Texas is going to manage its trust intelligently over the years to come, it must work from knowledge about the character of the lands over which it exercises stewardship.

Bureau Enters Contract With U. S. Geological Survey

During 1968 a contract between the U. S. Geological Survey and The University of Texas at Austin was negotiated for a 10-month study of the Van Horn Sandstone (Precambrian) of Culberson and Hudspeth counties in Trans-Pecos Texas. Geologists on the project, initiated November 1, are Alan J. Scott, Department of Geological Sciences, The University of Texas at Austin, and J. H. McGowen and Charles G. Groat of

the Bureau staff. Main field objectives include mapping and three-dimensional reconstruction of component facies in the Van Horn fluvial system to determine local changes in ancient stream deposits associated with potential heavy metal concentrations. Assaying and testing of samples is being conducted by the Bureau's Mineral Studies Laboratory. Report is scheduled for completion in the early Fall of 1969.



W. R. Stearns

Stearns Joins Bureau Staff

Mr. W. R. Stearns, formerly a geological and engineering consultant, joined the Bureau of Economic Geology staff effective September 1, 1968. Mr. Stearns received a B.A. degree in geology from Pomona College and later attended Stanford University. From 1940 to 1945 Stearns served as a pilot and engineering officer in the U. S. Army Air Corps. From 1945 to 1947, Mr. Stearns was geological and engineering examiner for the Railroad Commission of Texas. Since 1947 he has been a consultant in Austin with particular interest in oil and gas property evaluation, exploratory subsurface geology, and secondary recovery studies. Mr. Stearns will function as an oil and gas geologist for the Bureau.



W. L. Fisher

Appointed Associate Director

Dr. W. L. Fisher, a research scientist with the Bureau of Economic Geology since 1960, has been named Associate Director. Fisher received a B.S. degree from Southern Illinois University in 1954 and M.S. in 1958 and Ph.D. in Geology in 1961 from the University of Kansas. He is also a Lecturer in the Department of Geological Sciences and an associate member of the Graduate Faculty of The University of Texas at Austin. Fisher is the author or co-author of more than 40 geologic reports, papers, and abstracts dealing principally with the Gulf Coast Basin. His current research interests are mainly reconstruction of depositional systems in the Eocene of the Texas Gulf Coast Basin.

Mineral Resources of Proposed Reservoir Sites Prepared for Texas Water Development Board

A 162-page report entitled "Mineral Resources of Proposed Reservoir Sites, Northeast and South Texas" inventorying oil and gas and surface mineral resources of 14 proposed reservoir sites in Texas was prepared for the Texas Water Development Board by the Bureau of Economic Geology under terms of a contract negotiated during 1967. The report includes a lithologic and mineral resource map for each reservoir site at a scale of 1:62,500, descriptions of existing and potential mineral deposits, tests and analyses of 270 surface samples,

and 115 oil and gas production decline graphs.

Northeast Texas sites included are Bois d'Arc, Big Pine, Pecan Bayou, Sulphur Bluff, Naples, Texarkana Enlargement, Titus, Franklin, Black Cypress, and Marshall. South Texas sites investigated are Goliad, Cuero, Palmetto Bend, and Choke Canyon.

The report was prepared under the direction of W. L. Fisher, assisted by W. R. Stearns, L. E. Garner, G. L. Dawe, and D. A. Schofield, all of the Bureau staff. (A copy of the report has been placed on open file at the Bureau of Economic Geology.)

Bureau of Economic Geology Projects

Basic Geology

The Moore Hollow Group of Central Texas. V. E. Barnes and W. C. Bell. A study of the paleontology and stratigraphy of outcropping Cambrian rocks and contiguous overlying strata. Work is progressing on the systematic paleontology and paleoecology for this long-term project.

Relict Paleozoic of Central Texas. V. E. Barnes, A. J. Boucot, P. E. Cloud, Jr., Helen Duncan, R. H. Flower, and Mackenzie Gordon. A comprehensive investigation of the rocks that make up the sequence from the top of the Ellenburger to the base of the Marble Falls. These strata are preserved only at scattered localities. Specialists in various fossils are studying the paleontology of the sequence; Cloud and Barnes are studying the stratigraphy. Work is progressing on this long-term project, which is expected to be finished in about three years.

Tektites. V. E. Barnes. Long-term, continuous research of world tektites, with emphasis on petrography of tektites. During 1968 an electron microprobe study of inhomogeneities in tektites (with S. B. Hyder) was made, results of which were presented at the annual meeting of the American Geophysical Union in Washington, D. C. Durvis Roherts, using activation analyses, is now analyzing for tin content of southeast Asia tektites. Some of these tektites are from areas of tin production associated with large stanniferous granite masses and others are far from tin-bearing areas. If tektites are locally derived by melting of surficial material, tin should be more abundant in tektites from tin-bearing areas.

Petrographic study of new tektite localities in Thailand and the Philippines was completed, results of which were presented at the International Geological Congress in Prague. Additional field work on the occurrence of Czechoslovak tektites was accomplished during the summer of 1968. Specimens acquired during that time will give statistical significance to the petrography study reported in preliminary form at the annual meeting of the Meteoritical Society in 1967. This study in completed form will be presented to the 3d International Symposium on Tektites to be held in April of 1969 in Corning, New York.

Depositional Patterns, Upper Pennsylvanian—Lower Permian, North-central Texas. L. F. Brown, Jr. A stratigraphic study of Upper Pennsylvanian and Lower Permian rocks of North-central Texas with the aim of developing a depositional model. Analyses of vertical sequence, sandstone distribution, and principal facies relationships indicate main depositional control is deltaic. Results of parts of this project were contributed to the West Texas Geological Society Cyclic Symposium and Dallas Geological Society Guidehook, presently in press. Manuscript is complete and in final editing with publication planned during 1969.

Geometry of Pennsylvanian-Permian Sandstones, North-central Texas. L. F. Brown, Jr. A study of the effect of compaction and geologic structure on areal and vertical distribution of superposed elongate Pennsylvanian-Permian sandstone bodies of North-central Texas. Manuscript is complete and in final editing; publication as a Bureau report is planned during 1969.

Stratigraphy of Graham and Thrifty Rocks, North-central Texas. L. F. Brown, Jr., and T. H. Waller. Project involves part of a detailed geologic mapping project covering approximately 1,200 square miles in the type Cisco area of North-central Texas. Cartography is complete; manuscript is currently in preparation.

Virgil-Wolfcamp Facies, Eastern Shelf, North-central Texas. L. F. Brown, Jr., and A. R. Smith. A regional project including surface and subsurface studies of depositional systems within approximately 30 counties in North-central Texas. Deltaic, fluvial, interdeltaic, and open-shelf facies are being mapped within 1,500 feet of section from outcrop to eastern flank of the West Texas Basin. Recognition of these ancient facies involves comparison of faunal, sedimentary, and geometric data with modern environmental analogs. Principal goal of the project is reconstruction of a depositional model for these rocks. The relationship of the depositional systems to coal, clay, oil and gas, and water supplies is a major objective. Several graduate students have initiated dissertation studies of specific depositional units within the shelf province.

Depositional Systems in the Jackson-Yegua Groups of

Texas. W. L. Fisher, J. S. Nagle, and W. E. Gallo-way. A regional investigation of the main depositional units in the Jackson Group and Yegua Formation in Texas. The project includes outcrop and sub-surface study throughout the Texas Gulf Coast Basin. Investigation has been under way for about 8 months, utilizing approximately 1,000 well records and the construction of 40 stratigraphic dip sections. Regional maps that have been prepared, along with composition of main facies, indicate predominantly deltaic deposition in the central part of the Texas Gulf Coast Basin with chiefly barrier bar, lagoon, and strandplain systems laterally associated in South Texas for both Jackson and Yegua units. Relationship of main depositional units to occurrence and distribution of mineral deposits (oil, gas, lignite, uranium, clay, and water) is indicated. A preliminary report is scheduled for the Fall of 1969 with the final report to be published at a later date.

Depositional Systems in the Wilcox Group of Texas. W. L. Fisher and J. H. McGowen. Manuscript of a comprehensive study of the Wilcox Group in outcrop and subsurface of the Texas Gulf Coast Basin is now nearly complete. Delineation and description of 13 depositional systems in the lower and upper Wilcox of Texas has been based on five years of investigation utilizing surface mapping, description of about 300 outcrop sections, and analysis of nearly 3,000 subsurface wells. Thirty basic maps of the various depositional systems, about 65 stratigraphic dip and strike cross sections, and numerous text figures will accompany the report.

Basic approach in study of the Texas Wilcox has been the delineation of three-dimensional facies analysed in regard to composition, distribution, geometry, and relationship to other rock units. Specific facies have been integrated into large-scale genetic units or depositional systems with these compared to process-defined modern analogs. Special emphasis is placed on criteria for recognizing ancient depositional systems and their component facies, including two basic kinds of delta systems, fluvial systems, barrier bar systems, strandplain systems, lagoon-bay systems, delta flank systems, and shelf and embayment systems. Component facies of certain of these systems show distinct relationships to the occurrence, distribution, and quality of mineral deposits, including oil and gas (subsurface), fresh water (subcrop),

and lignite, ceramic clay, and industrial sand (outcrop). Publication as a Bureau report is anticipated during 1969.

Depositional Facies of Colorado River System. L. E. Garner. A study of sediment dispersal pattern as related to specific fluvial depositional environments in the Colorado River from Austin to the Gulf of Mexico. Principal aims are to define a regional fluvial model applicable particularly to ancient Gulf Coast Basin fluvial systems and to evaluate principal sand and gravel deposits. Project will involve regional mapping of fluvial environments and detailed study of the major depositional units.

Volcanic Rocks of Trans-Pecos Texas. R. A. Maxwell. A study of outcropping Tertiary volcanic rocks primarily in Brewster, Presidio, and Jeff Davis counties. Emphasis on correlation and subdivision of main volcanic units. Project is scheduled for completion in the Fall of 1969.

Gum Hollow Fan-Delta, Nueces Bay, Texas. J. H. McGowen. Study of the evolution of Gum Hollow fan-delta along the north shore of Nueces Bay from its initial phase of construction in the early 1940s through the last major depositional event caused by Hurricane Candy in June 1968. Project involved study of sediment characteristics (chiefly textures and sedimentary structures) of the various depositional environments; mechanics of fan-delta development as related to rainfall distribution, prevailing wind conditions, and tropical storms and hurricanes; general survey of sedimentary processes operative on specific areas of the fan and in the adjacent shallow bay; and the significance of directional features as a means of determining flow directions across the fan-delta. Manuscript is complete and currently under review.

Stratigraphic Studies of Lower Cretaceous Rocks. P. U. Rodda and W. L. Fisher. A long-term study of stratigraphy, paleontology, depositional systems, and resources of Lower Cretaceous in Texas. Principal investigation during 1968 concerned origin and distribution of chert in the Edwards Formation. Studies of basal Cretaceous terrigenous rocks in the Gulf Coast Basin are being planned.

Geology of Presidio Bolson, Presidio County, Texas, and adjacent Mexico. C. G. Groat. Stratigraphic and geomorphic study of a filled intermontane basin that has been dissected by the Rio Grande and its tribu-

taries. Emphasis placed on study of areal distribution of sedimentary facies particularly in regard to ground water occurrence in bolson deposits. Undissected bolsons are important aquifers in the southwestern United States. Geomorphic surfaces related to the establishment and subsequent entrenchment of the Rio Grande are also being studied to determine history of the river in the Presidio area. Field work is complete and manuscript is being prepared. (Doctoral dissertation partly supported by Bureau of Economic Geology.)

Geology of Bofecillos Mountains, Presidio and Brewster counties, Texas. J. F. McKnight. An areal geologic study with special emphasis on origin of extrusive igneous rocks and on the stratigraphy of the region. Cartography is complete; manuscript is in final editing. Publication planned as a Bureau Geologic Quadrangle Map. (Doctoral dissertation partly supported by Bureau of Economic Geology.)

Geology of Hood, Somervell, and Erath counties, Texas. J. S. Nagle. Study of Lower Cretaceous rocks (Glen Rose and Twin Mountains Formations) of Hood and Somervell counties and the Paluxy Drainage in Erath County. Emphasis on reconstruction of depositional environments in outcrop and shallow subsurface. Results of a part of this project have been published as Bureau of Economic Geology Geological Circular 68-1. (Doctoral dissertation partly supported by Bureau of Economic Geology.)

Geologic Mapping

Geologic Atlas Project. V. E. Barnes and others. The Texas Geologic Atlas project is a long-term Bureau project involving geologic mapping of the State on one by two degree sheets at a scale of 1:250,000. Since initiation of the project in 1962, nine sheets have been published. Sheets published during 1968 are Beaumont, Houston, Palestine, Plainview, and Van Horn—El Paso. The Amarillo Sheet is currently in press. Scribing has been completed for the Abilene, Dallas, Waco, Beeville—Bay City Sheets, the Texas portion of the Tucumcari Sheet, and the Edwards Plateau area of the Llano and San Antonio Sheets. Field checking was completed during 1968 for the Texas portion of the Clovis and Brownfield Sheets, the Oklahoma portion of the Perryton and Dalhart Sheets, the New Mexico portion of the Tucumcari Sheet, the post-Wilcox part of the Austin

and Seguin Sheets, and a portion of the Brownwood Sheet.

Bureau staff members who worked on the project during the year under the direction of Dr. V. E. Barnes were Dr. G. K. Eifler, Jr. (Amarillo and Texas part of Perryton, Dalhart, Tucumcari, Clovis, and Brownfield Sheets); Dr. L. F. Brown, Jr., Mr. J. L. Goodson, and Mrs. Peggy Harwood (Abilene and Brownwood Sheets); Mr. C. V. Proctor, Jr. (Waco, Austin, and Dallas Sheets); and Mr. J. H. McGowen (Dallas Sheet). Other personnel working on the project included Dr. T. E. Brown, Stephen F. Austin State College (post-Wilcox portion of Seguin and San Antonio Sheets); Dr. R. O. Fay, Oklahoma Geological Survey (Oklahoma portion of Perryton and Dalhart Sheets); and Dr. Waldemere Bejnar, Highlands University (New Mexico portion of the Tucumcari Sheet). The Geologic Atlas Committee of the West Texas Geological Society is continuing compilation on the Big Spring Sheet.

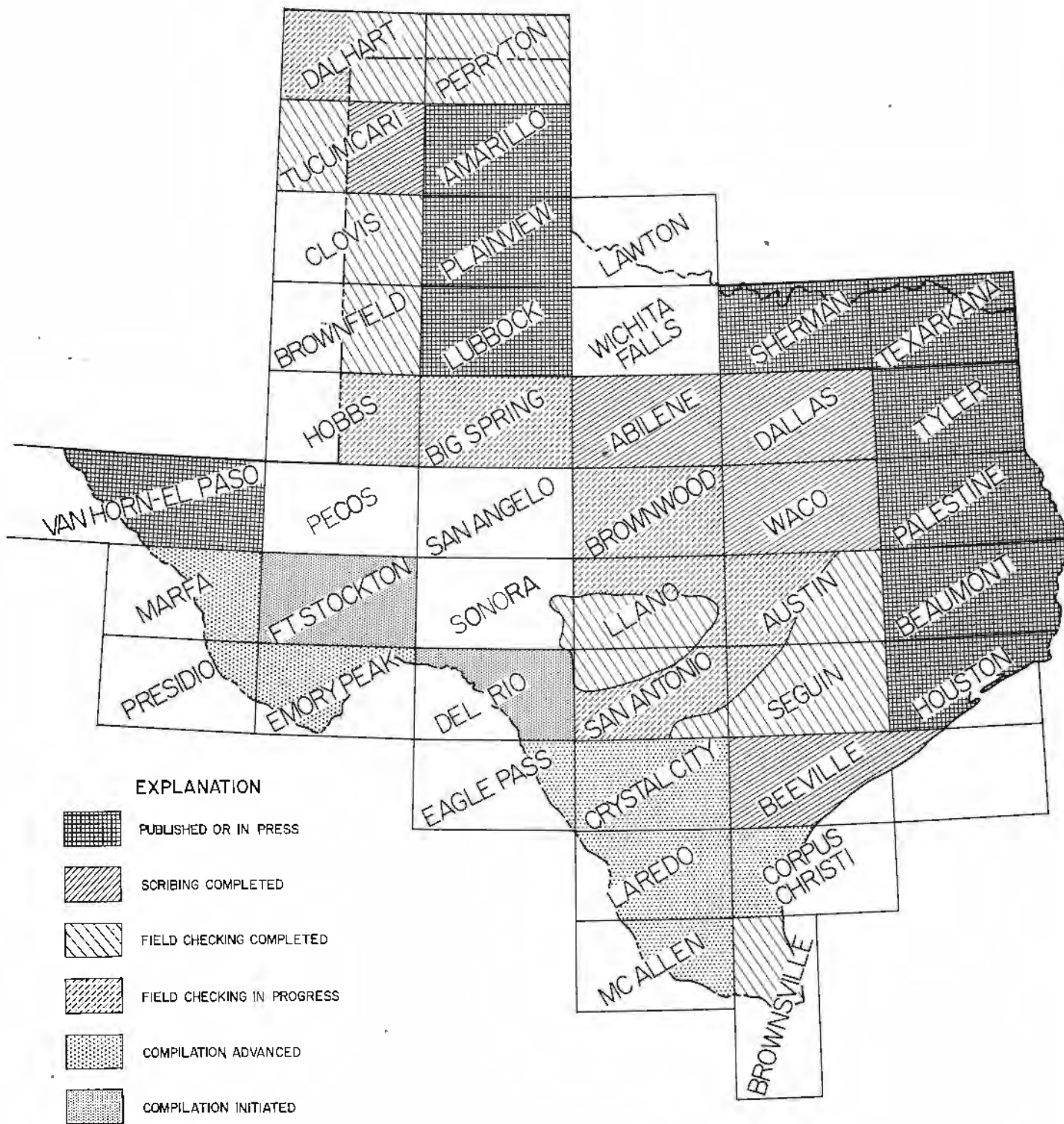
Publication during 1969 is anticipated for the Abilene, Dallas, Waco, Seguin, Beeville—Bay City, Perryton, and Tucumcari Sheets.

Environmental Geology and Mineral Resources

Urban Geology of Austin and Vicinity. P. U. Rodda, K. P. Young, and L. E. Garner. A study of the geology and resources of the Austin, Texas, area. Field mapping has been completed for eight 7.5 minute quadrangles; mapping is advanced for two others and has been initiated for the remaining two quadrangles. Engineering data such as moisture content, plasticity index, shrink-swell, and compressive strength have been obtained from State and Municipal agencies and private laboratories. Final report will focus on environmental and engineering geology and will provide data for planners, engineers, and others. Basic data will be a series of 12 geological maps compiled on 7.5 minute topographic quadrangle bases, several derivative land use maps, and mineral resource maps.

Completion of the project is anticipated in 1969, with final report scheduled for publication during 1970.

Van Horn Sandstone, Culberson and Hudspeth counties, Texas. J. H. McGowen, A. J. Scott, and C. G. Groat. A stratigraphic, sedimentologic, and mineral



Current status of Geologic Atlas of Texas

resource study of the Van Horn Sandstone (Precambrian) of Trans-Pecos Texas. Emphasis on mapping and three-dimensional reconstruction of component facies in the Van Horn fluvial-alluvial fan system and the delineation of potential heavy metal concentrations. The project, initiated in November 1968, is scheduled for completion in the early Fall of 1969.

Uranium in Texas. P. T. Flawn. Preparation of map showing known occurrence of uranium deposits in Texas, with summary descriptions. Project conducted in cooperation with Southern Interstate Nuclear Board.

Talc Deposits of the Allamoore District. R. G. Rohrbacher. A study of the distribution, occurrence, and origin of talc deposits in Precambrian rocks of the Allamoore District, Culberson and Hudspeth counties, Texas. (Doctoral dissertation partly supported by Bureau of Economic Geology.)

Mineral Statistics, Bibliographies, Catalogs, and Popular Geology

Mineral Production in Texas. R. M. Girard, in cooperation with the U. S. Bureau of Mines. Annual com-

pilation of Texas mineral production statistics and other mineral information. In progress as a continuing project.

Bibliography and Index of Texas Geology, 1951-1960. M. D. Brown and E. T. Moore. Manuscript complete for bibliographic listing, with index, of publications pertaining to Texas geology. This is a continuation of earlier bibliographies (University of Texas Bulletin 3232 and Publication 5910).

Catalog of Type Specimens. P. U. Rodda. An annotated catalog of type specimens of invertebrate fossils in the collections of the Bureau of Economic Geology. Catalog of about 5,000 specimens that have been described in scientific publications. Final editing is in progress. Finished report will be placed on open file at the Bureau of Economic Geology.

Geologic Guide to the State Parks of Texas. R. A. Maxwell, with contributions by L. E. Garner, G. K. Eifler, and L. F. Brown. A nontechnical description of the geology of 58 Texas state parks. Manuscript is completed and in final stage of review. Also included in the report are features of historical and scenic interest along with information for park visitors. Publication anticipated late in 1969.

Bureau Hosts 4th Annual Forum on Geology of Industrial Minerals

The 4th Annual Forum on Geology of Industrial Minerals was sponsored by the Bureau of Economic Geology March 14-15, 1968, with technical sessions held in the Villa Capri Motor Hotel. Fifteen technical papers were presented by geologists and engineers from industry, universities, and State and Federal surveys concerning two main themes—Geology of Chemical Raw Materials and Depositional Models in Economic Stratigraphy. Technical sessions were followed by a

half-day field trip to the Central Texas Mineral Region. An attendance of 145 individuals was the highest in the history of the Forum and included representatives from 60 mineral companies, 10 universities, 10 State surveys, and 2 Federal organizations.

Proceedings of the 4th Forum on Geology of Industrial Minerals have been published by the Bureau of Economic Geology and will be available early in 1969 (see "Publications in 1968," p. 5).

Staff Activities

Scientific Meetings

Staff members represented the Bureau of Economic Geology at numerous scientific and professional meetings in 1968. Principal meetings attended during the year include:

American Association of Petroleum Geologists, Annual Meeting, April, Oklahoma City, Oklahoma—L. F. Brown, Jr., W. L. Fisher, P. T. Flawn

American Geological Institute, Board of Directors Meeting, February, Washington, D. C.; April, Oklahoma City, Oklahoma; July, Denver, Colorado; November, Mexico City, Mexico; *and* House of Representatives Meeting, April, Oklahoma City, Oklahoma; November, Mexico City, Mexico—P. T. Flawn

American Geophysical Union, Annual Meeting, April, Washington, D. C.—V. E. Barnes

American Institute of Professional Geologists, Texas Section, 4th Annual Meeting, September, Austin, Texas—G. K. Eifler, Jr., P. T. Flawn, L. E. Garner, R. A. Maxwell, J. S. Nagle, W. R. Stearns

American Mining Congress, October, Las Vegas, Nevada—W. L. Fisher

Association of American State Geologists, Annual Meeting, May, Tuscaloosa, Alabama—V. E. Barnes, P. T. Flawn, W. L. Fisher

Conference on Environmental Geology, The University of Texas at Arlington, May, Arlington, Texas—P. U. Rodda, W. L. Fisher

Federal Water Pollution Control Administration, Public Meeting, October, Galveston, Texas—J. H. McGowen

Forum on Geology of Industrial Minerals, 4th Annual, March, Austin, Texas—V. E. Barnes, L. F. Brown, Jr., G. K. Eifler, Jr., W. L. Fisher, P. T. Flawn, L. E. Garner, R. M. Girard, J. H. McGowen, J. S. Nagle, P. U. Rodda

Geological Society of America, Annual Meeting, November, Mexico City, Mexico—V. E. Barnes, L. F. Brown, Jr., W. L. Fisher, P. T. Flawn, R. A. Maxwell, P. U. Rodda

Geological Society of America, South-Central Section, Meeting, March, Dallas, Texas—V. E. Barnes, L. F. Brown, Jr., G. K. Eifler, Jr., P. T. Flawn, C. G. Groat

Gulf Coast Association of Geological Societies, Annual Meeting, October, Jackson, Mississippi—W. L. Fisher, C. G. Groat, J. H. McGowen

Gulf Universities Research Corporation, Meeting of Advisory Board, May, Galveston, Texas; *and* Conference on Law and the Coastal Margin, September, Bayview, Texas—P. T. Flawn

International Geological Congress, 23rd, August, Prague, Czechoslovakia—V. E. Barnes

Interstate Oil Compact Commission, Annual Meeting, December, Miami Beach, Florida—W. R. Stearns

Marine Sciences and Business Potentials Conference, 2d, September, Corpus Christi, Texas—P. T. Flawn

Philosophical Society of Texas, Meeting, December, San Antonio, Texas—P. T. Flawn

Soil Survey Technical Work-Planning Conference, Texas A&M University, April, College Station, Texas—L. E. Garner, P. U. Rodda

Texas Advisory Committee on Conservation Education, Meeting, April, Lake Travis, Texas—P. T. Flawn

U. S. Atomic Energy Commission, Uranium Workshop, January, Grand Junction, Colorado—J. H. McGowen

Lectures and Public Addresses

V. E. Barnes—

Petrography of new tektite localities in Thailand and the Philippines: International Geological Congress, 23rd, Prague, Czechoslovakia

Tektites: Tomball Junior High School Students, visit to Bureau of Economic Geology, Austin, Texas; *and* Class in Short Course on Meteoritics, Rice University, Houston, Texas; *and* Austin Gem and Mineral Society, Austin, Texas

L. F. Brown, Jr.—

Geologic mapping: American Society of Photogrammetrists, San Antonio, Texas

Shelf model for Late Pennsylvanian—Early Permian

deposition in North-central Texas: The University of Texas at Austin, Department of Geological Sciences, Technical Sessions, Austin, Texas; *and* Geological Society of America, South-Central Section, Meeting, Dallas, Texas

G. K. Eifler, Jr.—

Industrial carbonates of the Texas Gulf Coastal Plain: Forum on Geology of Industrial Minerals, 4th Annual, Austin, Texas

W. L. Fisher—

Depositional history of the Wilcox Group in Texas: Sigma Gamma Epsilon Chapter at The University of Texas at Arlington, Arlington, Texas

Depositional systems in the Wilcox Group of Texas: Austin Geological Society, Austin, Texas

Essential features of nonmetallic industrial minerals: A.I.M.E., Texas Coast Section, Houston, Texas

Basic delta systems in the Eocene of the Gulf Coast Basin: Gulf Coast Association of Geological Societies, Annual Meeting, Jackson, Mississippi

Nonmetallic industrial minerals—examples of diversity and quantity: American Mining Congress, Annual Meeting, Las Vegas, Nevada

Variation of lignites of fluvial, deltaic, and lagoonal systems, Wilcox Group (Eocene), Texas: Geological Society of America, Annual Meeting, Mexico City, Mexico

Mineral industry potential of Fort Stockton area, Texas: Texas Industrial Commission, Industrial Planning Seminar, Austin, Texas

Depositional systems of the Wilcox Group of Texas and their relationship to the occurrence of oil and gas: Corpus Christi Geological Society, Corpus Christi, Texas; *and* East Texas Geological Society, Tyler, Texas; *and* International Geological Society, Rio Grande Valley, McAllen, Texas; *and* South Texas Geological Society, San Antonio, Texas; *and* Houston Geological Society, Houston, Texas

P. T. Flawn—

The challenge and opportunity in environmental geology [keynote address]: Geological Society of America, South-Central Section, Meeting, Dallas, Texas

L. E. Garner—

Operation and uses of the portable seismograph in

engineering and geologic investigations: The University of Texas at Austin, Department of Geological Sciences, Engineering Geology class

J. H. McGowen—

Gum Hollow fan-delta, a new and otherwise interesting sand pile: The University of Texas at Austin, Department of Geological Sciences, Technical Sessions, Austin, Texas

Utilization of depositional models in exploration for nonmetallic minerals: Forum on Geology of Industrial Minerals, 4th Annual, Austin, Texas

J. S. Nagle—

Glen Rose Limestone in the Paluxy Valley, North-central Texas: The University of Texas at Austin, Department of Geological Sciences, Technical Sessions, Austin, Texas

P. U. Rodda—

Report from the Bureau of Economic Geology: Soil Survey Technical Work-Planning Conference, Texas A&M University, College Station, Texas

A model for chert deposition, Edwards Formation (Lower Cretaceous), Texas: Geological Society of America, Annual Meeting, Mexico City, Mexico

Committee Service and Offices

G. K. Eifler, Jr.—

Austin Geological Society: Nominations Committee, 1967-68; Program Committee, 1967-68, Chairman

American Institute of Professional Geologists, Texas Section: General Chairman of 4th Annual Meeting, 1968, Austin

W. L. Fisher—

Forum on Geology of Industrial Minerals: Steering Committee; General Chairman of 4th Annual Forum, 1968, Austin

P. T. Flawn—

American Association of Petroleum Geologists: Group Insurance Program, Trustee; State and Federal Agencies Advisory Committee, Vice-Chairman

American Geological Institute: Board of Directors; House of Representatives (representing Association of American State Geologists)

American Institute of Professional Geologists: Commission on Geologic Hazards

Association of American State Geologists: Vice-President, 1967-68; President-elect, 1968-69; Environmental Geology Committee, Chairman

Gulf Universities Research Corporation: Advisory Board

National Academy of Science—National Research Council: Committee on Space Programs for Earth Observations, Advisory to the U. S. Geological Survey

Texas Advisory Committee on Conservation Education: Chairman

Texas Mapping Advisory Committee

The University of Texas at Austin: Faculty Council, Member (January-August); Institute of Latin American Studies, Advisory Committee, Chairman; Library Committee

L. E. Garner—

Austin Geological Society: Secretary, 1967-68; Executive Committee, 1967-68

R. M. Girard—

Austin Geological Society: Committee for AGS Information & News Report

Forum on Geology of Industrial Minerals, 4th Annual, Austin: Publicity Committee

R. A. Maxwell—

American Institute of Professional Geologists, Texas Section: State Parks Advisory Committee, Chairman

Austin Geological Society: Vice-President, 1968-69; Executive Committee, 1968-69

Natural Science Association of the City of Austin: Executive Board

Parks and Recreation Advisory Board of the City of Austin: Member

P. U. Rodda—

Forum on Geology of Industrial Minerals, 4th Annual, Austin: Program Committee, Chairman

Other Professional Responsibilities

V. E. Barnes—

Forum on Geology of Industrial Minerals, 4th Annual, Austin: Co-leader of post-meeting field trip to Burnet County

23rd International Geological Congress, Prague, Czechoslovakia: Chairman, Section 13

L. F. Brown, Jr.—

Forum on Geology of Industrial Minerals, 4th Annual, Austin: Editor of Proceedings

P. T. Flawn—

Dedication of Hal P. Bybee Building of University Lands, Midland, Texas, July: Bureau representative

Geological Society of America: Chairman, General Session of Annual Meeting, Mexico City, Mexico

L. E. Garner—

Forum on Geology of Industrial Minerals, 4th Annual, Austin: Co-leader of post-meeting field trip to Burnet County

Service Awards

At the Eighth Annual Service Awards Program of The University of Texas at Austin, recognition was given to the following Bureau staff members: James W. Macon, for 20 years service; Dan F. Scranton, for 15 years; Peter U. Rodda, for 10 years.



Dr. G. K. Eifler, Jr., demonstrates geologic mapping in High Plains as part of Geologic Atlas project. Standing are Carolyn Leach and Ed Gamer.

Teaching Duties of Bureau Staff

Five Bureau staff members are affiliated with the Department of Geological Sciences at The University of Texas at Austin. These are V. E. Barnes and P. T. Flawn (Professors), P. U. Rodda (Associate Professor), and L. F. Brown, Jr., and W. L. Fisher (Lecturers). Regularly scheduled courses are taught by P. T.

Flawn (Geology 341: Mineral Resources) and P. U. Rodda (Geology 314K: Invertebrate Paleontology). During 1968, L. F. Brown is teaching Geology 335: Geology of Texas, and W. L. Fisher (with A. J. Scott) is teaching Geology 383K: Paleogeology. Various other staff members gave specific lectures or participated in departmental field trips during the year.

Balcones Laboratories

Well Sample and Core Library

The Well Sample and Core Library of the Bureau of Economic Geology is a repository for collections of rock cuttings and cores from wells and boreholes drilled in many Texas counties. These may be examined and

studied by geologists and other interested persons. Microscopes and other facilities for study are available at the Library. In 1937, the State Legislature authorized and appropriated the necessary funds for formal establishment of a Well Sample Library to be placed under the supervision of the Bureau. Since the late

1940s, the collections have been housed at The University's Balcones Research Center, located northwest of Austin.

Samples and cores of about 30,000 wells are presently at the Library. This volume is augmented each year by contributions from oil companies, independent operators, commercial sample services, and other donors.

During 1968, samples from about 500 wells were presented by the Tyler office of Humble Oil & Refining Company. These include material from Anderson, Camp, Cass, Cherokee, Freestone, Henderson, Hopkins, Houston, and Kaufman counties. Montgomery's Stratigraphic Service of San Antonio donated samples from about 50 wells located in Bexar, Frio, Gonzales, Maverick, McMullen, and Medina counties.

The Corpus Christi office of Mobil Oil Corporation contributed cores from eight wells drilled in Austin, Colorado, Maverick, and Zavala counties. The U. S. Bureau of Reclamation donated 11 shallow cores from El Alamo Diversion Dam site in Starr County.

Cores from seven borings made at the Amistad Dam site were contributed to the Library by the International Boundary and Water Commission, Del Rio, Texas.

The Well Sample and Core Library occupies office and storage space in Building 18-B at the Balcones Research Center. Storage facilities at the repository were improved during 1968 when a portion of adjacent Building 1-D was renovated by installation of electric lights and racks for sample storage.

This Library is supervised by an advisory committee composed of Dr. Ross A. Maxwell (Chairman) and Dr. G. K. Eifler, Jr., of the Bureau of Economic Geology, and Dr. S. P. Ellison of the Department of Geological Sciences. Mr. Marce L. Morrow is Administrative Clerk-in-Charge.

Mineral Studies Laboratory

The Bureau's Mineral Studies Laboratory, also housed in Building 18-B at the Balcones Research Center, continued to test, analyze, and evaluate possible commercial use of samples of Texas rocks and minerals in support of research projects of the Bureau of Economic Geology, the Department of Geological Sciences, and other departments of The University of Texas at Austin.

Bureau projects to which this Laboratory has contributed include the Reservoir Sites, the Wilcox, the

Van Horn, and the Simsboro-Amite projects. Samples of volcanic ash are being chemically analyzed for major and minor elements, as well as spectrographically for traces of rare earths.

Samples of rocks submitted to the Bureau's administrative offices by Texas residents are further examined in the Mineral Studies Laboratory if they require physical testing, chemical or spectrographic analysis, or evaluation of commercial value. If possible commercial value is indicated by samples further testing in specialized private testing and research laboratories is recommended. During 1968, samples received at the Laboratory have included a wide variety of materials, such as clay, bentonite, fullers earth, glass sand, black sand, volcanic ash, and asphalt-bearing material.

The many commercial uses of clays (paper filler, paper coating, rubber, insecticide, oil decolorizing, drilling mud, oil-absorbing floor sweep, mineral wool, lightweight concrete aggregate, portland cement, as well as ceramic uses including white-ware, refractories, and brick) require a wide variety of physical tests, chemical analyses, spectrographic analyses, and X-ray diffraction analysis. The X-ray analyses which are essential in determining the mineral composition of a clay are performed by Mr. L. E. Garner.

During 1967 a new technique of chemical analysis was made available to the Laboratory by the acquisition of a Jarrell-Ash dual-purpose atomic absorption and flame spectrophotometer Model 82-526 SP. In 1968 a considerable portion of time was devoted to the adaptation of this technique to the needs of the Laboratory. Recently issued official reference standard samples were acquired.

Internal standards have been selected, tried, and compared with others previously used in the Laboratory for the analysis of glass sands, volcanic ashes, and silicate rocks.

Vertebrate Paleontology Laboratory

The Vertebrate Paleontology Laboratory is a cooperative research organization of the Bureau of Economic Geology, the Department of Geological Sciences, and the Texas Memorial Museum. In 1967, the Bureau was given administrative responsibility for the Laboratory's operation. Dr. John A. Wilson of the Department of Geological Sciences is Director of the Laboratory, which is housed at the Balcones Research Center.

In 1968, the Laboratory made progress along several

fronts. The acquisition of a new 4-wheel drive pick-up truck made summer field work again possible. As a result, Dr. Wilson added significantly to the fossil mammal collections with new material from the Sierra Vieja area of western Texas.

Preliminary arrangements were completed for a co-operative mapping and collecting program with the Instituto de Geologia de Mexico during 1969. General areas for investigation were explored by Dr. Wilson during trips to Mexico in March and July.

Dr. Wann Langston, Jr., continued supervising the preparation of dinosaur material obtained from the Big Bend. He also continued research into the structure and relationships of certain Eocene crocodilians submitted by the American Museum of Natural History of New York, Yale Peabody Museum, and the Chicago Field Museum of Natural History.

Dr. Ernest L. Lundelius continued research on Australian marsupials and is preparing the skull of a Late Pleistocene giant short-faced bear. Dr. Lundelius participated in the American Association for the Advancement of Science *Symposium on Environment and Prehistory—From Woodlands to Desert*.

Radiocarbon Laboratory

The Radiocarbon Laboratory, with facilities at Balcones Research Center, collaborates with research projects in archeology, geology, oceanography, and other fields, by making age estimates on series of organic field samples. Dr. E. Mott Davis of the Department of Anthropology is Director of the Laboratory.

Projects in 1968 included the dating of a long series of paired charcoal and snail shell samples from a site near Austin to determine if the relationship between dates on the two substances is constant. Dating of a series of samples from a peat bog in Gonzales County outlined a tentative sequence of vegetational and climatic changes for that area covering the past 10,500 years.

The radiocarbon chronology project in the Caddoan archeological area of northeastern Texas and environs continued. Most of the samples dated during 1968 were from mound sites in eastern Oklahoma. Since the total span of Caddoan pre-history is not long—probably considerably less than 1,000 years—time divisions can be made only through large numbers of radiocarbon dates coupled with archeological evidence.

Other series of samples were run for projects of The University of Texas Marine Science Institute at Port Aransas, the Texas Archeological Salvage Project, the Department of Geological Sciences of The University of Texas at Austin, and the Department of Geosciences at Texas Technological University. Technical advice was provided to staff members of the Universidad de El Salvador who are establishing a radiocarbon laboratory there.

As a result of recent building improvements, this Laboratory is now one of the best-housed C¹⁴ laboratories in the country. In 1968, the complete interior of the Laboratory's building at Balcones Research Center was renovated: a suspended ceiling was built, new lighting was installed, the interior was painted, and the laboratory was made dust-tight.

Public Service

The Bureau not only develops basic scientific data but also performs the important function of disseminating information about Texas geology and mineral production. In addition to publishing reports and maps, the Bureau provides direct assistance to many individuals and organizations as a public service.

During the year, geologists, engineers, students, teachers, industrialists, rock and fossil collectors, prospectors, realtors, and others, requested information by letter, telephone, or visits to the Bureau. All members of the Bureau research staff continued to provide such

information by conference and by correspondence. Two staff members who spent a large portion of their time in such direct public service are L. E. Garner, who examined rock and mineral specimens submitted to the Bureau for identification, and Roselle Girard, who replied to hundreds of inquiries for information about various aspects of Texas geology.

Other public services of the Bureau included preliminary testing and evaluation of industrial rocks and minerals at the Mineral Studies Laboratory under the supervision of D. A. Schofield, chemist-in-charge. Last

Spring, W. L. Fisher and Roselle Girard prepared a revised summary of Texas economic mineral deposits for the *Texas Almanac* of *The Dallas Morning News*. During the Fall, W. R. Stearns presented information to the Austin City Council about estimates of natural gas reserves and about the future availability of natural gas

for the City's thermal-electric generating plants. The Well Sample and Core Library provided facilities for the examination and study of subsurface materials from Texas wells, and the Vertebrate Paleontology Laboratory examined vertebrate fossil material submitted for identification.

Research Assistants at the Bureau of Economic Geology

The Bureau of Economic Geology regularly employs several students on a temporary full- or part-time basis. All hold at least undergraduate degrees in geology; some are currently finishing requirements for the Ph.D. in Geology. Students work in conjunction with and under the supervision of senior Bureau staff members on current Bureau research projects. Research assistants and associates during 1968 include:

Charles G. Groat (Research Scientist Associate III) is assisting J. H. McGowen and Alan J. Scott in the Bureau's investigation of the Van Horn Sandstone of West Texas. Groat plans to receive a Ph.D. in Geology from The University of Texas at Austin in June 1969; his dissertation subject is "Geology of Presidio Bolson, Presidio County, Texas and adjacent Mexico."

G. Lyman Dawe (Research Scientist Associate II) assisted W. L. Fisher in study of mineral resources of proposed reservoir sites, and P. U. Rodda in geology of Austin project. Dawe is completing a Ph.D. in Geology at The University of Texas at Austin and is presently with Pan Am Petroleum Corporation in Fort Worth, Texas.

Cleo V. Proctor, Jr. (Research Scientist Associate I) is assisting V. E. Barnes on the Texas Geologic Atlas project mainly in compiling and field checking the Waco Sheet. Proctor holds an M.S. in Geology from Baylor University and plans to work toward the Ph.D. in Geology at The University of Texas at Austin.

J. Stewart Nagle (Research Scientist Assistant III) is assisting W. L. Fisher in study of depositional systems in the Wilcox and Yegua-Jackson Groups of the Texas Gulf Coast. Nagle plans to complete requirements for a Ph.D. in Geology at The Uni-

versity of Texas at Austin in June 1969; subject of his dissertation is "Geology of Hood and Somervell Counties and the Paluxy Drainage in Erath County."

A. Richard Smith (Research Scientist Assistant III) is assisting L. F. Brown, Jr., in studies of Upper Pennsylvanian and Lower Permian depositional systems of North Texas. Smith is currently working toward a Ph.D. in Geology at The University of Texas at Austin. His dissertation subject is "Karst morphology and hydrology of Castile Gypsum in the Delaware Basin of Texas and New Mexico."

Peter H. Townsend (Research Scientist Assistant III) is assisting P. U. Rodda in the Bureau's Environmental Geology of Austin project. Townsend is currently enrolled in graduate school at The University of Texas at Austin working toward a Ph.D. in Geology; subject of his dissertation is "Environmental geology along the Balcones Fault Zone between Austin and San Antonio."

Ismael Ferrusquia-V (Research Scientist Assistant II) is employed at the Bureau's Vertebrate Paleontology Laboratory assisting John A. Wilson. Ferrusquia is currently working toward a Ph.D. in Geology with the subject of his dissertation "Geology and paleontology of the Huajuapán de León, Oaxaca, Mexico, Quadrangle, with emphasis on the continental Tertiary deposit."

William E. Galloway (Research Scientist Assistant II) assisted W. L. Fisher during the summer of 1968 on the Bureau's Yegua-Jackson project. Galloway recently completed the M.S. in Geology at The University of Texas at Austin and is presently working toward a Ph.D. in Geology; his disserta-

tion will concern Upper Pennsylvanian depositional systems in North-central Texas.

William Anderson (Research Scientist Assistant I) assists V. E. Barnes in tektite research. Anderson is presently working toward an M.A. in Geology at The University of Texas at Austin but will join the U.S. Navy in June 1969.

Jerilyn Collins (Research Scientist Assistant I) assists P. U. Rodda. Collins is currently completing requirements for an M.S. in Geology from Florida State University.

Christine R. Gever (Research Scientist Assistant I) assists Salvatore Valastro in preparation of samples for radiocarbon dating at the Bureau's Radio-

carbon Laboratory. Gever holds a B.A. in Geology from Rice University.

Peggy Harwood (Research Scientist Assistant I) is assisting V. E. Barnes on the Texas Geologic Atlas project, currently doing photogeology of the Brownwood Sheet. Harwood is completing requirements for an M.A. in Geology from The University of Texas at Austin with the subject of her thesis "Geomorphology of tidal flats of Texas Coast."

Carolyn Leach (Research Scientist Assistant I) is assisting P. T. Flawn in compiling locations of uranium deposits, and W. R. Stearns in study of mineral resources on Texas public lands. Leach has a geology degree from Texas Technological College in Lubbock.

BUREAU OF ECONOMIC GEOLOGY

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