BUREAU OF ECONOMIC GEOLOGY

Annual Report 1969

BUREAU OF ECONOMIC GEOLOGY

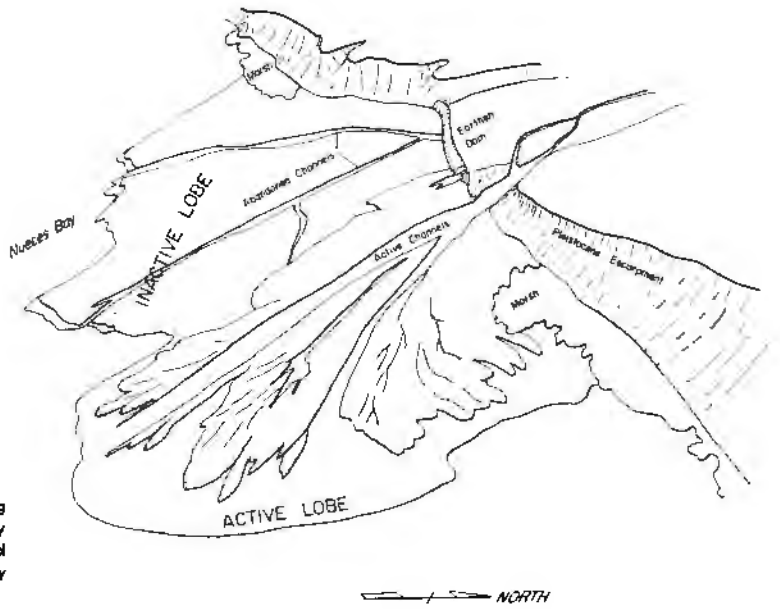
RESEARCH AND SERVICE IN GEOLOGY

Mineral Resources
Mineral Statistics
Mineral Information

Environmental and Conservation Problems

Basic Research in Texas

Systematic Geologic Mapping



Cover: Aerial view of Gum Hollow fan delta, Nueces Bay, looking west. This delta has developed during the past 30 years, due mainly from runoff of an artificial drainage system. Fan history, process, and sediments are described in a Bureau report recently completed by J. H. McGowen.

BUREAU OF ECONOMIC GEOLOGY
THE UNIVERSITY OF TEXAS AT AUSTIN
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Austin, Texas 78712

RESEARCH AND ADMINISTRATIVE OFFICES
GEOLOGY BUILDING, MAIN CAMPUS

LABORATORIES
BALCONES RESEARCH CENTER

The Bureau of Economic Geology is a research bureau of The University of Texas at Austin; it also functions as a State agency. Establisbed in 1909, it has for 61 years been recognized as the Texas State Geological Survey; its Director fills the position of State Geologist. The Bureau is engaged in research and public service in Texas geology. It carries on basie research to further understanding of the geologic architecture of the State and the natural earth processes that operate in Texas. The applied program is focused on earth resources, environmental and conservation problems, and engineering problems. The Bureau's efforts in systematic geologic mapping are designed to produce geologic maps at several scales for all those concerned with land use in Texas. The Bureau participates in other University research efforts in the fields of resonrces and earth sciences, such as the Center for Research in Water Resources. 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 reqnest.

The 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. The Texas Water Development Board, Texas Highway Department, Parks and Wildlife Department, Texas Industrial Commission, Railroad Commission, and nnmerons other State departments, boards, eonservation organizations, water districts, and chambers of commerce utilize Bureau publications and services on both a formal and informal basis through interagency contracts and staff conferences. The Bureau also cooperates with Federal agencies, such as the Geological Snrvey, 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 private groups, corporations, and citizens through correspondence and conference.

Publications in 1969

Special Publication. DELTA SYSTEMS IN THE EXPLORATION FOR OIL AND GAS, by W. L. Fisher, L. F. Brown, Jr., A. J. Scott, and J. H. McGowen. 212 pp., 168 figs., August 1969 ..... $5.00

A syllabus published in conjunction with a Research Colloquium of the Bureau of Economic Geology, August 27–29, 1969. It includes discussion notes, 168 maps and other text figures, and a list of 321 selected references pertaining to modern and ancient delta systems. The discussion notes are summarized as follows:

Delta Systems and Deltaic Deposition, by A. J. Scott and W. L. Fisher. Includes concepts of depositional systems; examination of principal depositional environments, processes, and specific facies of a spectrum of Holocene delta systems; stratigraphic classification of modern and ancient delta systems; considerations of basic kinds and patterns of delta facies and delta systems recognizable in ancient basin fills.

Gulf Coast Basin Tertiary Delta Systems, by W. L. Fisher. A consideration of ancient delta systems in the Lower Wilcox, Upper Wilcox, Yegua, and other units of the northwestern Gulf Coast Basin. Emphasis is placed on basic kinds of delta systems, constituent facies and bases for recognition, sand patterns and trends, lateral and vertical facies trends, E-log characteristics in facies recognition and evaluation, and structural association.

North Texas (Eastern Shelf) Pennsylvanian Delta Systems, by L. F. Brown, Jr. Includes consideration of ancient delta systems in the Cisco Group of North-central Texas Eastern Shelf with emphasis on facies patterns, channel sand distribution, relationship of shelf carbonates and slope and basinal systems to delta systems; compactional features of sand-shale sequences; a depositional model for the Eastern Shelf; and role of deltas in cyclothemic deposition.

Delta Systems and Oil and Gas Occurrence, by W. L. Fisher and L. F. Brown, Jr. Includes discussion of Gulf Coast Basin Lower Wilcox, Upper Wilcox, Yegua, and Jackson trends and Eastern Shelf Cisco trends with a consideration of oil and gas trends in ancient delta systems of these trends; the origin, migration, and entrapment of hydrocarbons in delta sediments; relationship of specific delta facies to regional and local structures; geometry of delta reservoirs; porosity and permeability of delta reservoirs; and use of a delta model in predicting reservoir conditions.

Delta Systems in Other Basins, by L. F. Brown, Jr., and W. L. Fisher. A consideration of delta systems in other oil and gas basins of North America including examples from Cretaceous of U. S. Western Interior and Alaska North Slope basins and Upper Paleozoic of U. S. Eastern Interior and Midcontinent basins.

Report of Investigations No. 64. PALYNOLOGY OF THE EDDLEMAN COAL (PENNSYLVANIAN) OF NORTH-CENTRAL TEXAS, by J. Fred Stone. 55 pp., 5 figs., 6 pls., December 1969 ..... $1.50

The Eddleman Coal is a bed in the Thrifty Formation of the Cisco Group occurring in Young, Jack, Brown, Eastland, Stephens, and Palo Pinto counties. The spore and pollen flora identified from samples collected in Young County is classified into 37 genera and 65 species, ten of which are regarded as new. The microfossil flora is in an excellent state of preservation. No previously published account is known of palynological investigations of rocks of this geological age in North-central Texas, and the flora substantiates the age of the Eddleman Coal as Pennsylvanian. Individual spore and pollen specimens collected are illustrated in the plates, and geologic sections of two Young County localities productive of the palynomorphs are among the other illustrations. A glossary and 68 references are included in the report.

Guidebook No. 8. THE GEOLOGIC STORY OF PALO DURO CANYON, by William H. Matthews III. 51 pp., 37 text figs., August 1969 ..... $1.00

Guidebook primarily concerned with the geologic history of Palo Duro Canyon but also containing a brief review of man's history in the area. Generalized geologic maps of Palo Duro Canyon State Park and of the Texas Panhandle are included. A generalized place map of the Canyon shows location of major points of interest, such as Coronado Lodge, Capitol Peak, Fortress Cliff, the Lighthouse, Sad Monkey railroad, Santana's Face. The wrap-around cover is an aerial photograph of the Canyon. The book contains a list of selected references as well as a glossary of geologic terms used in the text. One of a series of Bureau Guidebooks designed for popular use.

Guidebook No. 9. FIELD EXCURSION, EAST TEXAS—CLAY, GLAUCONITE, IRONSTONE DEPOSITS, by Thomas E. Brown, Leo E. Newland, Donald H. Campbell, and Arthur J. Ehlmann. 48 pp., 13 text figs., 3 tables, October 1969 ..... $1.00

Guidebook prepared for East Texas field trip made in conjunction with the Eighteenth National Clay Conference held in Arlington, Texas, October 19–22, 1969, and sponsored by the Clay Minerals Society. Included are a road log from Arlington to Kilgore and vicinity, with running description of main points of interest and descriptions of four stops of clay and glauconite localities.

Geologic Atlas of Texas. AMARILLO SHEET, Leroy Thompson Patton Memorial Edition, compiled by G. K. Eifler, Jr., under the direction of V. E. Barnes; reviewed and edited by the Geologic Atlas Project Committee of the Panhandle Geological Society. Scale 1:250,000, in color, topographic base, February 1969 ..... $2.50

Areal geologic map with topography, roads, and culture, covering all of Carson, Gray, and Wheeler counties, and por-

tions of Armstrong, Collingsworth, Donley, Hemphill, Hutchinson, Moore, Potter, Randall, and Roberts counties. Published as a memorial edition honoring the late L. T. Patton, who was long associated with Texas Technological College. Dr. Patton was the author of many geologic reports about western Texas and Oklahoma, including reports ou the geology of Potter Coanty and of Stonewall County, published as University of Texas Bulletins 2330 and 3027, respectively.

Geologic Quadrangle Map No. 25. GEOLOGY OF THE JOHNSON CITY QUADRANGLE, BLANCO COUNTY, TEXAS, by V. E. Barnes. Areal geologic map in color (scale 1:24,000) with 12-page accompanying text. Originally published in 1963; reprinted November 1969 ..... $1.50

Geological Circular GC 69–1. EDWARDS FORMATION (LOWER CRETACEOUS), TEXAS: DOLOMITIZATION IN A CARBONATE PLATFORM SYSTEM, by W. L. Fisher and Peter U. Rodda. Reprinted from American Association of Petroleum Geologists Bulletin, vol. 53, no. 1, pp. 55–72, 14 figs., January [March] 1969 ..... $0.75

Description of the regional stratigraphy of the Edwards Formation in terms of component facies. The Edwards Formation is an important aquifer and oil reservoir and is a major source of industrial limestone (crushed stoue, raw materials for lime and portland cement, chemical limestone, etc.). Facies recognized in outcrop and subsnrface sections of the Edwards Formation include three of primary limestone, which were deposited on an extensive shallow-water marine platform, and one of diagenetic dolomite, which was superimposed on parts of the primary facies. This paper describes possible origins of Edwards dolomite emphasizing that the processes of dolomitization were part of the original depositional system and that the type of dolomitization was controlled by specific depositional facies. Included in the report are maps, cross sections, diagrams, and a bibliography of 66 references.

Geological Circular GC 69–2. SULFUR IN WEST TEXAS: ITS GEOLOGY AND ECONOMICS, by J. B. Zimmerman and Eagene Thomas. 35 pp., 9 figs., April 1969 ..... $0.75

A presentation of the geology of the West Texas sulfur deposits and a summary of the history of recent sulfur exploration and production in an area that includes Culberson, Pecos, and Tom Green counties. The anthors, who are with the University Lands Office at Midland, Texas, have drawn on geologic literature, personal knowledge, and data from individuals and companies working in West Texas for material contained in the report. Main sections of the report include: a review of sulfur production, demand, and economics; geology of the West Texas deposits; land and leasing; exploration methods, reserve calculations, and costs; water supply; and descriptions nf operations of several plants and experimental projects. Most of the sulfur companies in the area are using the Frasch mining method, althongh one plant is extracting sulfur from gypsum in Culberson County. The West Texas region contains proved reserves of native sulfar of about 100 million long tons in place.

Geological Circular GC 69–3. VIRGIL AND WOLFCAMP REPETITIVE ENVIRONMENTS AND THE DEPOSITIONAL MODEL, NORTH-CENTRAL TEXAS, by L. F. Brown, Jr. Reprinted from "Symposium on Cylic Sedimentation in the Permian Basin," West Texas Geological Society Publication No. 69–56, pp. 115–134, 8 figs., April [August] 1969 ..... $0.50

A discussion of the depositional systems in Upper Pennsylvanian and Lower Permian rocks of the Eastern Shelf of the West Texas Basin and presentation of a depositional model of the Cisco-Bowie complex. The rocks include deltaic and fluvial sandstones that are petroleum reservoirs, clays that are used in ceramic production, and coal facies of past and potential economic importance. Callahan, Eastland, Shackelford, and Stephens coanties are included in the area of study. Strata of Virgil and Lower Wolfcamp age (Cisco-Bowie rocks) on the Eastern Shelf in North-central Texas were deposited as parts of four depositional systems—deltaic, fluvial, interdeltaic, and open shelf. A dozen major repetitive sequences as well as numerous minor ones are recognized. By using a depositional model concept, this report attempts to explain the origin of the complex repetitive sequences. Control of deposition is considered in the light of numerous theories used to explain cyclic deposition in Upper Paleozoic rocks throughout the world. Included in the report are isolith maps showing areal distribution of several fluvial-deltaic sandstones, and vertical sections illustrating distribation of facies. A list of 63 references completes the publication.

Geological Circular GC 69–4. GEOMETRY AND DISTRIBUTION OF FLUVIAL AND DELTAIC SANDSTONES (PENNSYLVANIAN AND PERMIAN), NORTH-CENTRAL TEXAS, by L. F. Brown, Jr. Reprinted from Transactions, Gulf Coast Association of Geological Societies, Vol. XIX, pp. 23–47, 22 text figs., October 1969 ..... $0.75

Discussion of fluvial and deltaic sandstones of the Virgil and Wolfcamp Series (Upper Pennsylvanian and Lower Permian) in the Eastern Shelf. The area investigated comprises approximately 2,000 square miles in Callahan, Eastland, Shackelford, and Stephens counties of North-central Texas. The sandstones occar in elongate deposits and in sheet deposits. The sheet deposits are thin and difficult to map, but the more common elongate deposits can be mapped from their outcrop westward into the subsurface of the Eastern Shelf. The elongate deposits have been important targets for oil and gas exploration for many years. Some provide a local water supply. They also are potential conduits and reservoirs for storage of desalinated or imported water. The primary goal of this investigation was to develop knowledge of the external geometry of elongate deposits of sandstone and of the factors that controlled distribution of the deposits in upslope areas of the Eastern Shelf. The investigation involved (1) constrnction of a stratigraphic framework that included the spatial distribution of major sandstone systems; (2) interpretation of dominant source direction, paleoslope, and depositional model from stratigraphic aud sedimentary information; (3) development of a structural frame-

work using both conventional and residual mapping techniques; (4) comparison of stratigraphic and strnctural data in order to evalnate possible structural control of elongate sandstone patterns; and (5) approximation of paleosurface and subsidence trends using decompaction techniques. The report inclndes 22 figures and a list of 76 references.

Miscellaneous Chart. TEXAS MINING LAWS PERTAINING TO STATE PUBLIC LANDS, compiled by Carolyn Leach. 1 sheet, February 1969 ..... $0.50

This chart lists mining laws that pertain to fee lands (surface and mineral rights owned by the State) and relinquishment (mineral classified) lands. It includes information about royalty and rental payments on lands leased for production of oil and gas; sulfur, coal, lignite, and potash; uranium, thorium, and other fissionable material; gold, silver, platinum, and other metals and precious stones; nonmetallic indnstrial minerals snch as talc, barite, and gypsum; and sand and gravel, stone and sbell.

Mineral Resource Circular No. 51. THE MINERAL INDUSTRY OF TEXAS IN 1968, by F. N. Netzeband and Roselle Girard. Decemher 1969 ..... Free on reqnest

A preprint from the *Minerals Yearbook, 1968* of the U.S. Bureau of Mines, prepared under a conperative agreement between the U. S. Bureau of Mines and the Bureau of Economic Geology. Included are: a listing that shows value of mineral prodnction in individual Texas counties dnring the year; a review of production of mincral fuels, industrial minerals (nonmetals), and metals in 1968; and a list of principal mineral producers in Texas. An annual issue of the Bnrean.

Open-File Reports

The Bureau of Economic Geology maintains an open file of about 300 reports and manuscripts that are unpublished or are progress reports of projects that ultimately will be published. These reports may be examined and copied, but publication rights are reserved. Principal reports placed on open file during 1969 include:

Uranium in Texas. Prepared by Peter T. Flawn, W. L. Fisher, and Carolyn H. Leach, with contributions from D. L. Norton and D. Hoye Eargle, for Southern Interstate Nnclear Board. Published as part of a report on "Uranium in the Southern United States" by U. S. Atomic Energy Commission. Texas chapter includes: (a) brief history of activity, study, and current status; (b) geologic summary of Texas uranium deposits; (c) Texas law governing exploration and development of uranium deposits; (d) summary descriptions of mines and prospects in Texas; (e) prospects for future development and research recommendations; (f) reported uranium occurrences in Texas with accompanying index map; and (g) list of pertinent references.

Permian red-bed copper deposits in Kansas, Oklahoma, and Texas. Prepared by U. S. Bureau of Mines. Material pertinent to Texas in the report includes: (a) index map of copper-study areas in North Texas; (b) list of landowners in Texas copper district; (c) location maps of U. S. Bureau of Mines drill-hole sites and sample sites in the Buzzard Peak area of King, Knox, and Stonewall connties, in the Medicine Mound area of Hardeman County, and in the Truscott area of Knox County; (d) results of analysis of outcrop samples of copper-bearing strata; (e) logs of drill holes in Hardeman, King, Knox, and Stonewall counties; (f) list of significant red-bed copper mines and prospects in Oklahoma and Texas; and (g) correlation chart of Permian red beds in Texas, Oklahoma, and Kansas.

Publications in Press

Report of Investigations No. 65. Lower Cretaceous Stratigraphy, Northern Coahuila, Mexico, by Charles I. Smith.

Report of Investigations No. 66. Cambrian Trilobites, by Susan Burton Longacre. Reprint of Memoir 4, Journal of Paleontology.

Report of Investigations No. 67. Facies and Genesis of a Hurricane-Washover Fan, St. Joseph Island, Central Texas Coast, by Peter B. Andrews.

Report of Investigations No. 68. Pre-Chappel Conodonts of the Llano Region, Texas, by George Seddon.

Guidebook No. 10. Geologic and Historic Guide to the State Parks of Texas, by Ross A. Maxwell.

Geologic Quadrangle Map No. 37. Geology of Bofecillos Area, Trans-Pecos Texas, by John F. McKnight.

Geologic Quadrangle Map No. 38. Austin West, Travis County, Texas, by P. U. Rodda, L. E. Garner, and G. L. Dawe.

Geologic Quadrangle Map No. 39. Geology of Southern Quitman Mountains, Hudspeth County, Texas, by Bill R. Jones and Donald F. Reaser.

Papers by Bureau of Economic Geology Staff in Scientific Journals

Barnes, V. E. (1969) Petrology of moldavites (abstract): International Tektite Symposium, 3rd, Corning Museum of Glass and Smithsonian Institution, Corning, New York, p. 42.

Barnes, V. E. (1969) Petrology of moldavites: Geochemica et Cosmochimica Acta, vol. 33, pp. 1121–1134.

Barnes, V. E. (1969) Progress of tektite studies in China: American Geophysical Union, E⊕S, Transactions, vol. 50.

Barnes, V. E., and Eifler, G. K., Jr. (1969) Cartography of Quaternary deposits of Texas (abstract): International Union for Quaternary Research (INQUA), 8th International Congress, Paris, Abstracts, p. 325.

Barnes, V. E., and Smith, L. A. (1969) Age of South China Sea tektites (abstract): International Tektite Symposium, 3rd, Corning Museum of Glass and Smithsonian Institution, Corning, New York, p. 34.

Brown, L. F., Jr. (1969) Geometry and distribution of fluvial and deltaic sandstones (Pennsylvanian and Permian), North-central Texas: Gulf Coast Association of Geological Societies Transactions, vol. 19, pp. 23–47. (Reprinted as Bureau of Economic Geology Geological Circular GC 69–4.)

Brown, L. F., Jr. (1969) Late Pennsylvanian paralic sediments, *in* A guidebook to the Late Pennsylvanian shelf sediments, North-central Texas: Dallas Geological Society, pp. 21–33.

Brown, L. F., Jr. (1969) Virgil and Lower Wolfcamp repetitive environments and the depositional model, North-central Texas, *in* Symposium on cyclic sedimentation in the Permian Basin: West Texas Geological Society Publication No. 69–56, pp. 115–134. (Reprinted as Bureau of Economic Geology Geological Circular GC 69–3.)

Brown, L. F., Jr., Galloway, W. E., and Kessler, L. G., II (1969) Field trip, second day (discussion), *in* A guidebook to the Late Pennsylvanian shelf sediments, North-central Texas: Dallas Geological Society, pp. 52–68.

Brown, L. F., Jr., and Goodson, J. L. (1969) Sedimentary versus contemporaneous tectonic control of fluvial-deltaic deposition (abstract): Geological Society of America, Abstracts with Programs for 1969, Part 2, p. 4.

Fisher, W. L. (1969) Eocene depositional systems of the Gulf Coast Basin: their relation to oil and gas (abstract): Houston Geological Society Bulletin, vol. 12, no. 4.

Fisher, W. L. (1969) Facies characterization of Gulf Coast Basin delta systems, with some Holocene analogues: Gulf Coast Association of Geological Societies Transactions, vol. 19, pp. 239–261.

Fisher, W. L. (1969) Noumetallic industrial minerals —examples of diversity and quantity: American Mining Journal, vol. 56, no. 2, pp. 120–126, 6 figs.

Fisher, W. L., and McGowen, J. H. (1969) Depositional systems in the Wilcox Group (Eocene) of

Texas and their relationship to occurrence of oil and gas: American Association of Petroleum Geologists Bulletin, vol. 53, pp. 30–54, 12 figs.

Fisher, W. L., and McGowen, J. H. (1969) Lower Eocene lagoonal systems in the Texas Gulf Coast Basin: Memoirs, UNESCO Simposio Internacional Lagunas Costeras, Mexico, D. F., 15 pp.

Fisher, W. L., and Rodda, P. U. (1969) Edwards Formation (Lower Cretaceous), Texas—dolomitization in a carbonate platform system: American Association of Petroleum Geologists Bulletin, vol. 53, pp. 55–72, 14 figs., 1 table. (Reprinted as Bureau of Economic Geology Geological Circular GC 69–1.)

Flawn, P. T., Fisher, W. L., and Brown, L. F., Jr. (1969) Environmental geology and the coast—rationale for land-use planning (abstract): Geological Society of America, Abstracts with Programs for 1969, Part 7, p. 67.

Henderson, E. P., and Barnes, V. E. (1969) Restudy of Nordheim ataxite, DeWitt County, Texas (abstract): American Geophysical Union, E⊕S, Transactions, vol. 50, p. 222.

McGowen, J. H., and Garner, L. E. (1969) Comparison of recent and ancient coarse-grained point bars (abstract): American Association of Petroleum Geologists Bulletin, vol. 53, no. 3, pp. 731–732.

Rodda, P. U., and Fisher, W. L. (1969) Geological influence of an ancient carbonate lagoon, Lower Cretaceous, Texas: Mem., UNESCO Simposio Internacional Lagunas Costeras, Mexico, D. F., 13 pp.

Rodda, P. U., Murphy, M. A., and Morton, D. M. (1969) Geology of the Ono quadrangle, Shasta and Tehama counties, California: California Division of Mines and Geology, Bull. 192.

Scott, A. J., Hoover, R. A., and McGowen, J. H. (1959) Effects of Hurricane Beulah, 1967, on Texas coastal lagoons and barriers: Mem., UNESCO Simposio Internacional Lagunas Costeras, Mexico, D. F., 14 pp.

Brown Wins Best Paper Award

Dr. L. F. Brown, Jr., of the Bureau staff, won a Best Paper Award for a presentation made at the Annual Meeting of the Gulf Coast Association of Geological Societies at Miami Beach, Florida in October. Title of Brown's paper, which placed third out of approximately 70 papers presented at the meeting, was "Geometry and distribution of fluvial and deltaic sandstones (Pennsylvanian and Permian), North-Central Texas." The paper was published in the Meeting's Transactions and has been reprinted as a Bureau Geological Circular. Brown's paper describes a variety of facies in the Upper Paleozoic of the Eastern Shelf and considers these facies in terms of an overall depositional model. Particular emphasis is given to sandstone body geometry and its relationship to structural and compactional features. The paper is an outgrowth of a long-term Bureau project directed by Brown in North-Central Texas Paleozoics.

Well Sample Library Receives Large Collection

In August 1969 Cities Service Oil Company donated an extensive collection of well records to the Bureau of Economic Geology Well Sample and Core Library. Included in the collection are geological and production information on 120,000 individual wells from 107 Texas counties, chiefly in the West Texas area, and also about 20,000 well records from southeastern New Mexico. In addition to well records the collection also includes approximately 1,500 electric logs. The material is on open file and available for use and study at the Bureau's Well Sample and Core Library, housed at The University of Texas Balcones Research Center.

During October 1969, the Permian Basin Sample Laboratory, Midland, Texas, donated an extensive collection of well cuttings to the Bureau of Economic Geology Well Sample and Core Library. Making up the collection are approximately 1,250,000 iudividual samples from 1,600 wildcat wells from 52 West Texas counties. This collection augments existing samples and cores from about 30,000 Texas wells at the Library.

Participants in Bureau's Delta Colloquium view exhibits

Bureau Presents Delta Colloquium

The first in a series of Research Colloquia designed to present results of work conducted by the Bureau of Economic Geology, UT Austin, was held August 27–29 in the Geology Building. The theme of this first Colloquium, "Delta Systems in the Exploration for Oil and Gas," was developed in five half-day lectures and one evening session, devoted to informal discussion and exhibits of maps, sections, photographs, electric logs, cores and outcrop samples. Colloquium leaders were W. L. Fisher, L. F. Brown, Jr., and J. H. McGowen, of the Bureau staff, and Alan J. Scott, of the Department of Geological Sciences. A 212-page syllabus on delta systems in oil and gas exploration was distributed to registrants. Additional copies of the syllabus have been printed and are available from the Bureau of Economic Geology, UT Austin.

Attending the Colloquium were 200 geologists including representatives of major and independent oil companies, independent geologists, State and Federal Survey geologists, and geology faculty and students from universities in Texas and elsewhere. One-third of the registrants were from out of State, including geologists from Alaska, Arkansas, California, Colorado, Kansas, Louisiana, Missouri, New Mexico, Ohio, Oklahoma, Pennsylvania, Wyoming, Brazil, and Mexico. More than half of the geologists were from the Gulf Coast region.

Delta deposits are of interest and importance because they make up large parts of the fill of ancient basins and because certain deltaic sediments and fans form significant reservoirs and source beds for oil and gas. The Colloquium stressed principles of delta formation, the nature of the component facies of delta systems and how they can be recognized in ancient deposits, and relationships to the occurrence of oil and gas. Data were drawn mainly from long-term Bureau research project in established oil and gas-producing areas, such as the Gulf Coast Basin and the North Texas Eastern Shelf of the Midland Basin, and also from studies of the modern Texas Gulf Coast. The great amount of subsurface information available in these areas permits three-dimensional reconstruction of sedimentary rock bodies and comparison with similar modern features, such as the deltas of the Mississippi, Rhone, and Nile rivers. Deltaic deposits are also reservoirs for oil and

gas in much of the U. S. Western Interior and Eastern Interior basins and for the very large, recently discovered fields of the Alaska North Slope. These basins were discussed briefly during the Colloquium, emphasizing features common to Texas oil and gas basins. Models of deposition derived from studies of modern and ancient delta systems aid not only in understanding reservoir characteristics of producing fields but also are effective tools for predicting extensions of producing trends.

A. J. Scott and W. L. Fisher opened the Colloquium with an introduction to delta systems and deltaic deposition including an examination of principal depositional processes, environments, and facies of modern delta systems, the classification of deltas, and the recognition of ancient delta systems.

Gulf Coast Tertiary delta systems were the first to be considered in detail. Fisher described ancient delta systems of the Wilcox, Yegua, and Frio of the northwestern Gulf Coast basin and emphasized basic kinds of delta systems, constituent facies, criteria for recognition, and association with other depositional systems.

L. F. Brown described ancient delta systems in the Cisco Group of the North Texas Eastern Shelf, with emphasis on facies patterns, sand distribution, and the relationship of shelf, slope, and basin deposits to delta systems.

One session was devoted to oil and gas occurrence in ancient delta systems of the Gulf Coast Wilcox, Yegua, Jackson, and North Texas Cisco trends. Fisher and Brown discussed the origin, migration, and entrapment of hydrocarbons in delta sediments, the characteristics of delta reservoirs, and the use of delta models to predict reservoir trends.

In the final session of the Colloquium, Fisher and Brown described other oil and gas-bearing delta systems from known and undeveloped basins: Cretaceous of Alaska North Slope and U. S. Western Interior, Upper Paleozoic of U. S. Eastern Interior and Mid-Continent, and Triassic of Germany. To conclude the Colloquium, Scott summarized and reviewed criteria for the recognition of delta facies and delta systems.

Five rooms of delta displays were organized by J. H. McGowen. These included outcrop and subsurface maps, lithic and electric log cross sections, core, outcrop slabs, and outcrop photographs of modern, Gulf Coast Basin Tertiary, and North-central Texas Pennsylvanian delta systems.

A principal aim of the Research Colloquia series is to present results of Bureau research prior to publication and to stimulate exchange of ideas among those interested in Texas geology and mineral resources. Future Colloquia will be designed to present results of other Bureau investigations.

Groat Joins Bureau Staff

Mr. C. G. Groat joined the staff of the Bureau of Economic Geology on September 1, 1969, after working for a year on the Bureau's Van Horn Heavy Metals Project. Mr. Groat received an A.B. from the University of Rochester in 1962 and an M.S. from the University of Massachusetts in 1967; he will receive a Ph.D. in geology from The University of Texas at Austin in June 1970. His previous geological activities have included mapping in northwestern Montana, ground-water and geomorphic investigations of desert basins in the Mojave Desert of California, and a study of the Presidio Bolson and the Rio Grande. His research interests are centered in Trans-Pecos Texas and include desert geomorphology, ground water, and regional stratigraphy and tectonics.

C. G. Groat

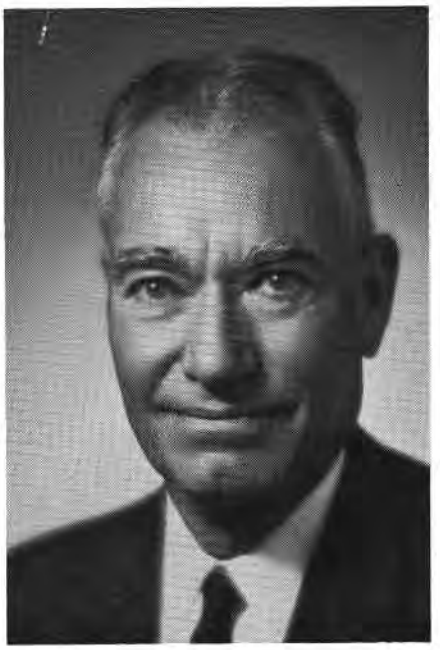
Ross Maxwell Retires

Dr. Ross A. Maxwell, for the past 17 years a Research Geologist at the Bureau of Economic Geology of The University of Texas at Austin, retired from the Bureau's staff on August 31.

He is noted for his studies of West Texas geology—especially the geology of the Big Bend country of Brewster County—and for his geological investigations of State and National parks. Dr. Maxwell has made fundamental contributions to the understanding of Texas geology in his studies of the Trans-Pecos region, particularly the Big Bend area. He has made a great effort to make geology meaningful to the public through his guidebooks to National and State parks.

Dr. Maxwell is a native Oklahoman and is a graduate of the University of Oklahoma. He obtained his Ph.D. degree from Northwestern University in 1936. That same year, he joined the National Park Service and in 1940 was appointed Regional Geologist, directing geological research in National Park Service areas in Arizona, Arkansas, Colorado, New Mexico, Nevada, Oklahoma, Texas, and Utah. In 1944, Dr. Maxwell became the first Superintendent of the Big Bend National Park, a position he held until joining the Bureau of Economic Geology staff in 1952.

He is author of numerous geological reports, including Bureau of Economic Geology Report of Investigations 43, "Mineral Resources of South Texas," and the popular Guidebook 7, "The Big Bend of the Rio Grande"; he is senior author of University of Texas Publication 6711, "Geology of Big Bend National Park, Brewster County, Texas." Now in press is his "Geologic and Historic Guide to the State Parks of Texas" and under review is his "Correlation of the Tertiary Volcanic Rocks in West Texas."



R. A. Maxwell

Dr. Maxwell is a member of the American Association of Petroleum Geologists, American Institute of Professional Geologists, Austin Geological Society, Geological Society of America, Sigma Gamma Epsilon, Sigma Xi, and West Texas Geological Society.

Bureau of Economic Geology Projects

Basic Geology

Gulf Coast Basin

Depositional Systems in the Wilcox Group of Texas. W. L. Fisher, J. H. McGowen. Delineation and description of 13 depositional systems in the Lower and Upper Wilcox of Texas have 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 and about 65 stratigraphic dip and strike cross sections have been prepared.

Basic approach in study of the Texas Wilcox has heen 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-hay systems, delta flank systems, and shelf and embayment systems. Component facies of certain of these systems show distinct relationships to the occurrence, distrihution, and quality of mineral deposits, including oil and gas (subsurface), fresh water (suhcrop), and lignite, ceramic clay, and industrial sand (outcrop).

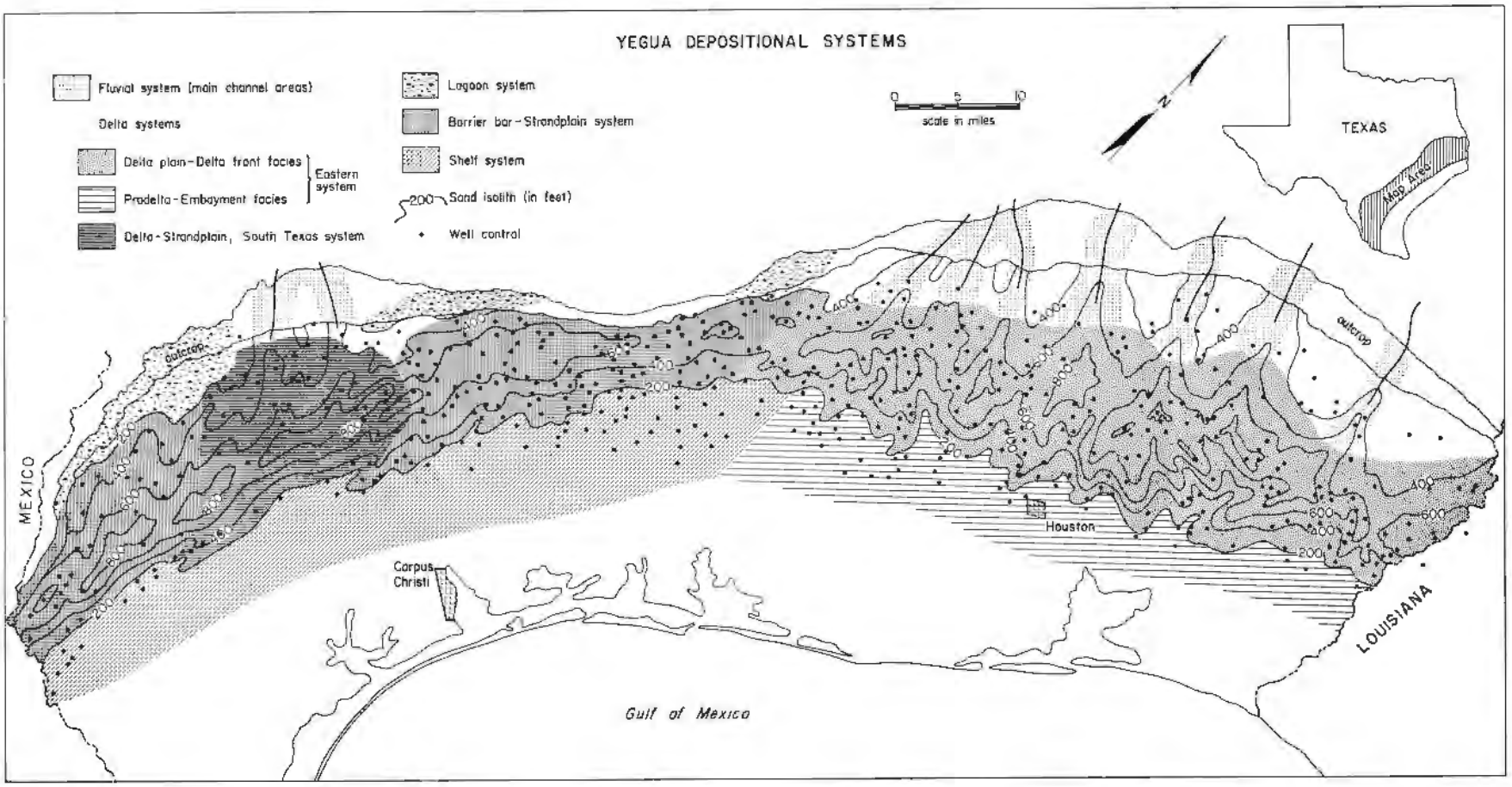
Preliminary results of project have been published in volumes 17, 18, and 19 of the Gulf Coast Association of Geological Societies Transactions, in volume 53, no. 1, of the Bulletin of the American Association of Petroleum Geologists, and in Geological Circular 67–4 and Special Publication "Delta Systems in the Exploration for Oil aud Gas" of the Bureau of Economic Geology. A comprehensive report is being prepared for Bureau publication. Maps, cross sections, and logs are available on an open-file basis prior to publication of the final report.

Depositional Systems in the Jackson-Yegua Groups of Texas. W. L. Fisher, J. S. Nagle, and W. E. Galloway. A regional investigation of the main depositional units in the Jackson Group and Yegua Formation in Texas. The project ineludes outcrop and subsurface study throughout the Texas Gulf Coast Basin. Investigation has been under way for about eight 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.

Preliminary maps and results were published in Bureau of Economic Geology Special Publication "Delta Systems in the Exploration for Oil and Gas" (*see* p. 3 of this Report). Maps, cross sections, and logs are available on an open-file basis prior to final publication.

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. A brief consideration of land use is inclnded. Manuscript is complete and is being edited for pnblication.

Depositional Facies of Colorado River System. L. E. Garner. A study of the sediment dispersal pattern as related to specific fluvial depositional


YEGUA DEPOSITIONAL SYSTEMS
Fluvial system (main channel areas)
Delta systems
Delta plain-Delta front facies
Prodelta-Embayment facies
Eastern system
Delta-Strandplain, South Texas system
Lagoon system
Barrier bar-Strandplain system
Shelf system
200 Sand isolith (in feet)
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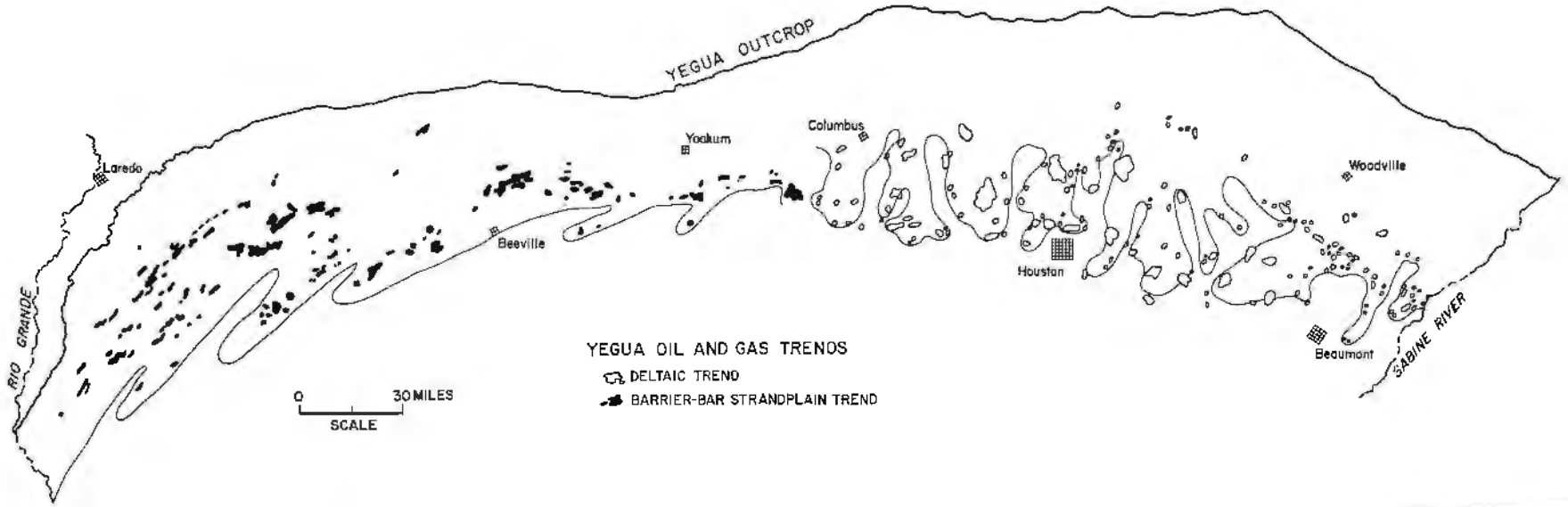
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Laredo
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Beeville
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YEGUA OIL AND GAS TRENDS
DELTAIC TREND
BARRIER-BAR STRANDPLAIN TREND

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. Reconnaissance work is completed and detailed studies of specific areas are in progress. The project was initiated in January 1969.

Physiographic Features and Stratification Types of Coarse-Grained Point Bars: Modern and Ancient Examples. J. H. McGowen and L. E. Garner. A study of the relationships between fluvial processes, physiographic features, stratification, and textural types of two modern streams—the Amite River of Louisiana and the Colorado River of Texas. These streams are characterized by a high ratio of bed load to suspension load and by a short duration of peak discharge. Data obtained from the study of these modern streams aided in recognition of ancient fluvial deposits of similar origin in the Tertiary and Pleistocene sediments of Texas. This study emphasized the lack of preservation of a complete vertical sequence of stratification types in ancient coarse-grained point-bar deposits. Recognition of basic fluvial types of deposition is important in river management, in exploration and development of fluvial sand and gravel deposits, and in predicating downdip associated sand trends in ancient deposits. The study was initiated in the summer of 1968; the manuscript is completed and currently under review.

North-Central Texas

Deposition of Upper Pennsylvanian—Lower Permian Rocks of North-central Texas. L. F. Brown, Jr. This project, aimed at defining the depositional model (including the significance of vertical sequences, sandstone distribution, and facies relationships), has been combined with detailed mapping studies in cooperation with J. H. McGowen, T. H. Waller, J. R. Ray, and Mary Seals. Deltaic, fluvial, interdeltaic, and shelf facies are being mapped and interpreted within 1,500 feet of section and within 1,200 square miles of outcrop in the Cisco area of North-central Texas. This project combines detailed areal mapping and stratigraphic studies with a concurrent study of the depositional nature of predominantly terrigenous facies. Additional field checking and local mapping are necessary; part of the manuscript is complete. This investigation has resulted in several publications. They include "Virgil and Wolfcamp Repetitive Environments and the Depositional Model, North-central Texas," issued as Bureau of Economic Geology Geological Circular GC 69–3, 1969, reprinted from West Texas Geological Society Publication 69–56, "Symposium on Cyclic Deposition in the Permian Basin," 1969; "North Texas (Eastern Shelf) Pennsylvanian Delta Systems," *in* Bureau of Economic Geology Special Publication "Delta Systems in the Exploration for Oil and Gas," 1969; and "Late Pennsylvanian Paralic Sediments," *in* "A Guidebook to the Late Pennsylvanian Shelf Sediments, North-central Texas," issued by the Dallas Geological Society in 1969. The project was initiated in 1967 and is expected to be completed during 1971. Progress during 1969 consisted mainly of outcrop studies of specific terrigenous depositional facies—delta front, channel-mouth bars, crevasse splays, prodelta facies, and braided and point-bar facies.

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 and Permian sandstone bodies of North-central Texas. Initiated in 1966; completed and published in 1969 (Gulf Coast Association of Geological Societies Transactions, vol. 19; reprinted as Bureau of Economic Geology Geological Circular GC 69–4).

Virgil-Wolfcamp Facies, Eastern Shelf, North-central Texas. L. F. Brown, Jr. Assisted to date by A. R. Smith (1968–1969) and Robert Merrill (1969–1970). A regional project that includes surface and subsurface studies of depositional systems within approximately 30 counties in North-central Texas. Recognition of regional distribution of deltaic, fluvial, interdeltaic, shelf, and slope-basin facies involves the comparison of faunal, sedi-

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Principal depositional systems and oil and gas trends of Yegua Formation (Eocene) of the Texas Gulf Coast Basin. From Bureau of Economic Geology Special Publication "Delta Systems in the Exploration for Oil and Gas."

mentary, and geometric data with modern analogs. Principal goal of the investigation is the construction of a regional picture of the Late Pennsylvanian and Early Permian depositional sequences in North-central and West-central Texas that will serve as a guide in locating coal, petroleum, ground water, clay, and other geologic resources. The project was begun in 1968 and is expected to be finished by 1971 or 1972.

Central and West Texas

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 Formations of Central Texas. V. E. Barnes, A. J. Boucot, P. E. Cloud, Jr., Helen Duncan, R. H. Flower, Mackenzie Gordon, R. H. Miller, A. R. Palmer, and George Seddon. A comprehensive investigation of the rocks and fossils in formations that make up the sequence from the top of the Ellenburger to the base of the Marble Falls. A study by George Seddon of "Pre-Chappel Conodonts of the Llano Region, Texas," a portion of this project, is in press as a Bureau publicatiou. A unit of this project previously published was a paper by V. E. Barnes, A. J. Boucot, P. E. Cloud, Jr., R. H. Miller, and A. R. Palmer, "Silurian of Central Texas: A First Record for the Region," published in *Science,* vol. 154, pp. 1007–1008, 1966.

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 tributaries. 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 heing 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.)

Volcanic Rocks of Trans-Pecos Texas. R. A. Maxwell and J. W. Dietrich. A stndy of outcropping Tertiary volcanic rocks primarily in Brewster, Presidio, and Jeff Davis counties. Emphasis on correlation and subdivision of main volcanic units. Manuscript is complete and prcsently 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 rocks in Texas. Principal investigation during 1969 concerned the stratigraphy of the Edwards Formation and associated rocks in the Balcones fault zone, in the western Edwards Plateau, and Stockton Plateau. A paper resulting from this study, "Edwards Formation (Lower Cretaceous), Texas: Dolomitization in a Carbonate Platform System," was published in the American Association of Petroleum Geologists Bulletin, vol. 53, no. 1, pp. 55–72, January 1969, and reprinted as Bureau of Economic Geology Geological Circular GC 69–1.

Tektites

Tektites. V. E. Barnes. Long-term, continuous research on world tektites. During 1969, Durvis Roberts, using activation analysis, continued analyzing southeast Asian tektites for tin. Petrographic study of moldavites from Czechoslovakia was completed, and results were presented at the Third International Tektite Symposium held in Corning, New York. Also presented at this Symposium was a paper by Lee A. Smith and Dr. Barnes on "Age of South China Sea Tektites," as determined hy the study of nannofossils in a carbonate coating on a specimen dredged from the bottom of the sea.

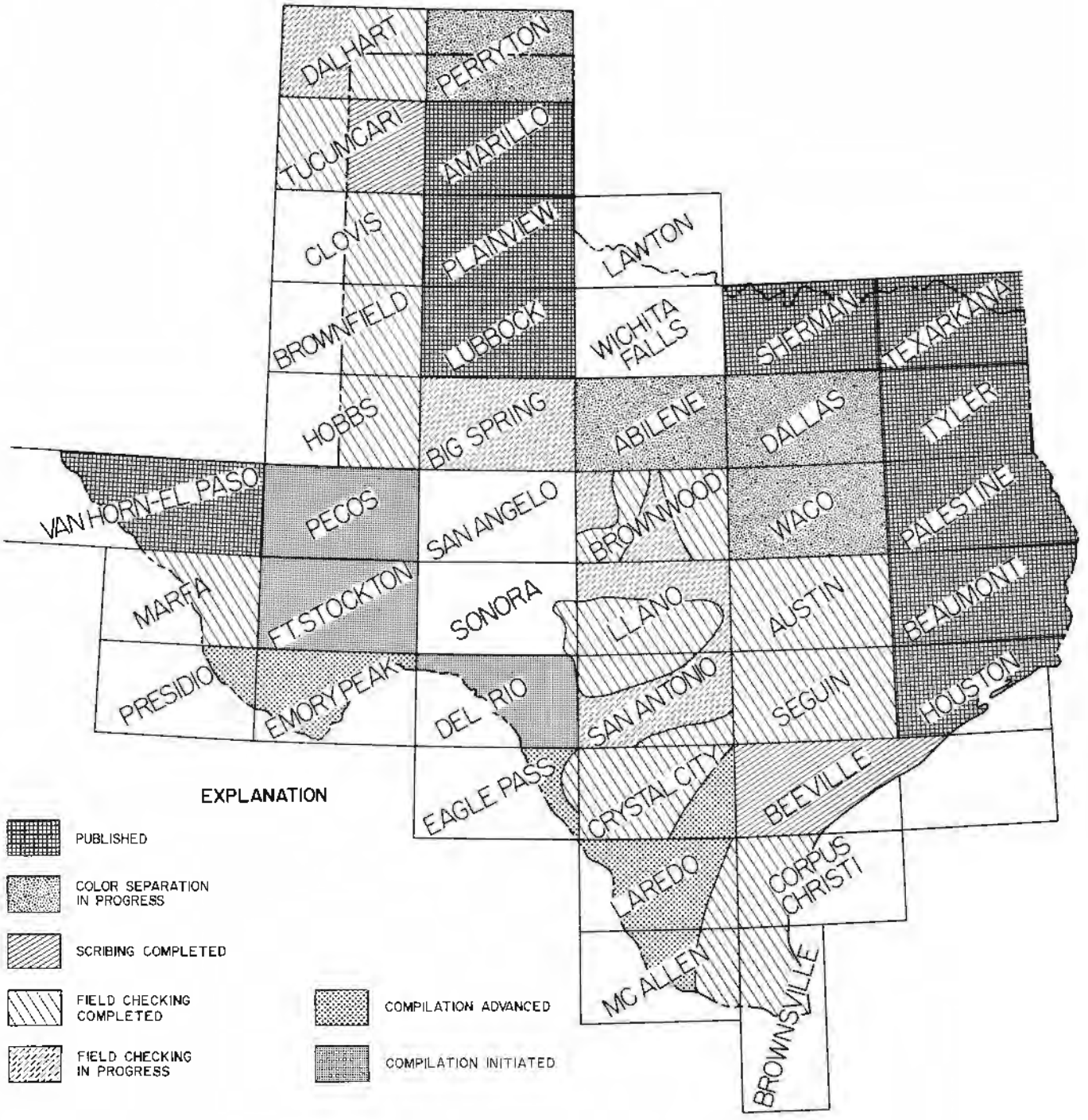
The following paper, a product of an investigation in Peru of glass originally thonght to be tektite, is in press: "Macusanite Occurrence, Age, and Composition, Macusani, Peru," by V. E. Barnes, George Edwards, W. A. McLaughlin, Irving Friedman, and Oiva Joensuu, *in* Bulletin of the Geological Society of America.

Following tbe Third International Tektite Symposium in Corning, New York, Professor George

Konta, Charles University, Prague, Czechoslovakia, and Professor J. F. Lovering, University of Melbourne, Victoria, Australia, joined a group from The University of Texas at Austin and a group from Houston in examination of a portion of the bediasite strewn field in Lee County, Texas. Dr. Alvin Van Valkenburg, Program Director for Geochemistry, Earth Sciences Section, National Science Foundation, Washington, D. C., visited the tektite project during April.

Geologic Mapping

Geologic Atlas Project. V. E. Barnes and others. The Texas Geologic Atlas project is a long-term Bureau



Current status of Geologic Atlas of Texas

project involving geologic mapping of the State on 1° x 2° sheets at a scale of 1:250,000. Since initiation of the project in 1962, 10 sheets have been published. The Amarillo Sheet was published during 1969. Color separation is in progress for the Perryton, Abilene, Dallas, and Waco Sheets. Field checking, in addition to that reported last year, has been completed for the Texas portion of the Hobbs Sheet, is nearing completion for the Anstin and Seguin Sheets, and is well advanced for the Marfa, Brownwood, and Crystal City—Eagle Pass Sheets.

At the 8th International Congress of INQUA held in Paris August–September 1969, a paper with Dr. G. K. Eifler, Jr., entitled "Cartography of Quaternary Deposits of Texas," was presented by Dr. Barnes who described the Texas Geologic Atlas project with emphasis on the compilation of Quaternary units. Also, the Plainview and Beaumont Sheets of the Atlas were exhibted at the Congress alongside an exhibit by the University of Wisconsin, the only other university of the United States with a wall exhibit.

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. (various sheets in common with Oklahoma and New Mexico—Perryton, Tucumcari, Clovis, Brownfield, and Hobbs Sheets); Mr. C. V. Proctor, Jr. (Dallas, Waco, Austin, and Seguin Sheets); Dr. L. F. Brown, Jr. (Abilene and Dallas Sheets); Mrs. Peggy Harwood (Brownwood Sheet); Dr. J. H. McGowen (Dallas Sheet); and Mr. Noel Waechter (Austin and Seguin Sheets). Other personnel working on the project included Dr. T. E. Brown of Stephen F. Austin State University (pre-Jackson and post-Cretaceous portion of Crystal City—Eagle Pass Sheet); Dr. Page Twiss of Kansas State University (Marfa Sheet); Dr. Saul Aronow of Lamar State College of Technology (Quaternary deposits of the Laredo-Corpns Christi Sheet and the McAllen portion of the McAllen-Brownsville Sheet); and Dr. R. O. Fay of the Oklahoma Geological Survey (Oklahoma portion of the Perryton Sheet).

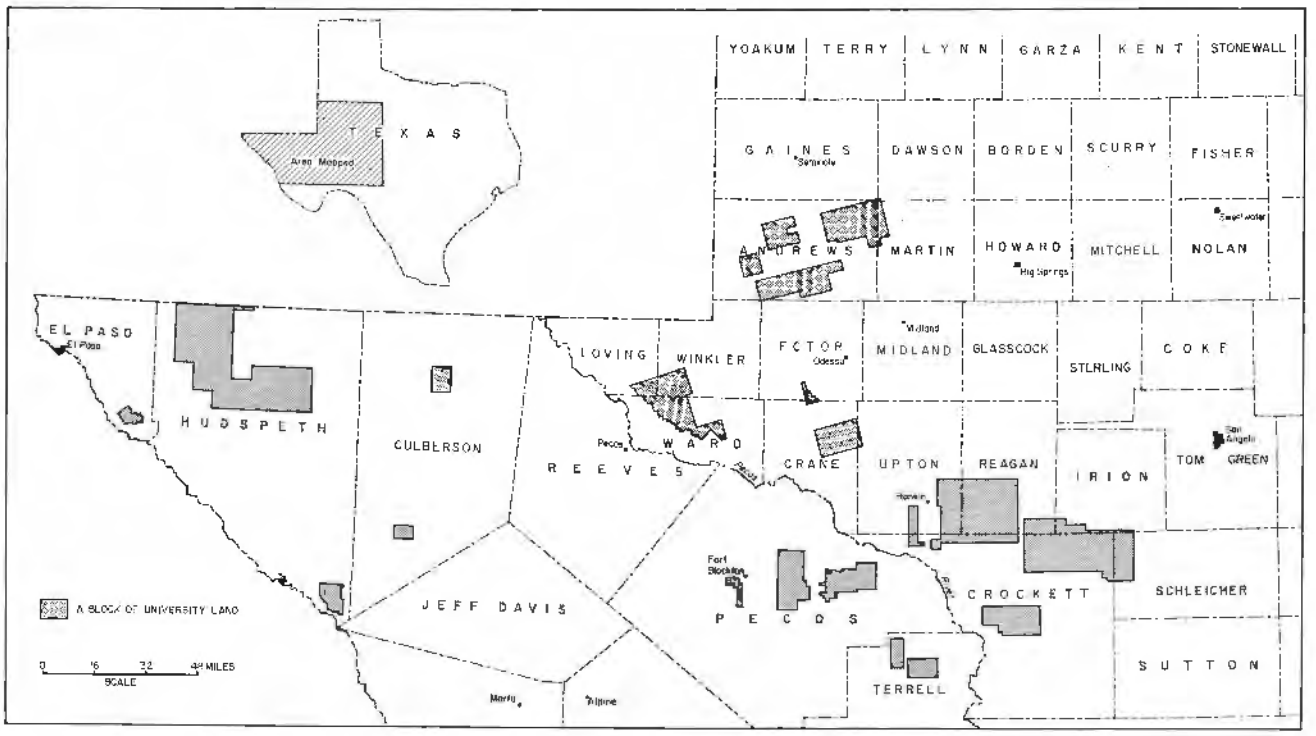
Geologic Quadrangle Maps and Reports, Blanco County, Texas. V. E. Barnes. Preliminary copies of U. S. Geological Survey 7.5-minute topographic quadrangles covering areas mapped geologically by Barnes have been received. As soon as base material becomes available, the geology will be scribed for the Howell Mountain, Round Mountain, Spicewood, Pedernales Falls, and Hammetts Crossing quadrangles. Texts for the Howell Mountain and Round Mountain quadrangles are completed, and texts for the other three quadrangles are in progress.

Precambrian Rocks, Southeastern Llano County, Texas, R. V. McGehee. Geologic mapping of Precambrian rocks in a 4-quadrangle area by McGehee and numerous UT Austin graduate students has been compiled by McGehee, and a text describing these rocks has been prepared. Although this project was completed by the first of the year, publication is being delayed to permit use of topographic bases that now are in preparation by the U. S. Geological Survey. Mapping of Paleozoic rocks within these quadrangles which was originally started by P. E. Cloud, Jr., and V. E. Barnes, and which in part is published (University of Texas Publication 4621), will be completed by Dr. Barnes.

Mineral Resources and Mineral Statistics

Mineral Resources of University Lands. W. L. Fisher, coordinator, L. F. Brown, Jr., P. T. Flawn, L. E. Garner, C. G. Groat, P. U. Rodda, and W. R. Stearns, in cooperation with J. B. Zimmerman, Geologist-in-Charge, University Lands, Geology.

Evaluation of mineral resources, exclusive of oil and gas, of lands owned by The University of Texas System. Project was initiated during the fall of 1969 and scheduled for completion in the fall of 1970. Study is designed to develop information on water, metallic and nonmetallic industrial mineral resources, and geologic data useful in planning for land use. Investigation consists of (1) compilation of all existing published and unpublished data including records from oil and gas wells, water wells, and other borings; (2) field examination of each tract with preparation of a geologic map (at scale of 1:24,000) and sampling of mineral deposits; (3) analysis and testing of samples; and (4) further field and laboratory evaluation of deposits that appear to he significant. Commodities being inventoried are: clays (common clays, ceramic clays, and bentonites), construction materials (aggregates, terrazzo materials and decorative aggregates, dimension stone), evaporites (gypsum, salt, potash salts,



University of Texas Lands of West Texas

sodium and magnesium brines), industrial sands, limestone and caliche, metals (copper, lead, molybdenum, silver, tin, titanium, tungsten, zinc), sulfur, volcanic ash and pozzolans, uranium, miscellaneous nonmetallics (barite, diatomite, dolomite, feldspar, fluorite, nepheline, perlite), and ground water.

Mineral Production in Texas. R. M. Girard, in cooperation with the U.S. Bureau of Mines. Annual compilation of Texas mineral production statistics and other mineral information. In progress as a continuing project. During 1969, a report on 1968 production of nonmetals in Texas was prepared for inclusion in the Texas Chapter of the U. S. Bureau of Mines *Minerals Yearbook, 1968*. A preprint of the chapter also was issued as Bureau of Economic Geology Mineral Resource Circular No. 51.

Van Horn Sandstone, Culberson and Hudspeth counties, Texas. J. H. McGowen and C. G. Groat. A stratigraphic, sedimentologic, and mineral resource study of the Van Horn Sandstone (Precambrian) of Trans-Pecos Texas. Several fluvial facies of this thick conglomerate-sandstone wedge were determined by field studies of texture and sequences of primary sedimentary structures. From north to south these facies are: (1) conglomerate, representing cuvette deposition; (2) mixed sandstone and conglomerate, resulting from sediment accumulation in an area near the distal cuvette; (3) sandstone, deposited from braided streams and characterized by a dominance of trough-fill and foreset cross-strata; and (4) sandstone with a dominance of trough-fill cross-strata (the most distally preserved facies of the Van Horn Sandstone), also laid down by braided streams. A petrographic study of the component facies indicated that concentrations of heavy minerals were most commonly associated with the distal sand facies. The project was initiated in November 1968 under contract with the U. S. Geological Survey; field work was completed in the summer of 1969; laboratory work was completed in the fall of 1969. Preparation of manuscript is in progress.

Uranium in Texas. P. T. Flawn, W. L. Fisher, and Carolyn Leach. Compilation of published and unpublished known occurrence of uranium deposits in Texas with description and locality map. Consideration of history and potential of uranium development, status of knowledge, and description of known

and potential uranium-bearing units in Texas. Project conducted in cooperation with Southern Interstate Nuclear Board. Included as part of SINB report "Uranium in the Southern United States," published by U. S. Atomic Energy Commission. Texas chapter on open file at Bureau of Economic Geology.

Talc Deposits of the Allamoore District, Texas. 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.)

Texas Public Lands—Estimate of Future Oil and Gas Production from Established Fields: Texas Gulf Coast, Offshore, Bays, and Estuaries. W. R. Stearns. This investigation, initiated in February 1969, is the first phase of a long-term Bureau project to survey and evaluate the resources of State-owned lands. Until now, no estimate of remaining reserves of presently producing wells has been made. Basic data used in this investigation are obtained from the files of the Railroad Commission of Texas and from published field papers. These data include reservoir information such as porosity, permeability, connate water content, PVT, gas-oil ratio, gravities of the oil and gas, and other parameters useful in determining reserves. Individual lease production data are being compiled and plotted graphically to determine production-decline rates. Subsurface structure contour maps are being either prepared or adapted from those on file at the Railroad Commission. Now in preparation is a preliminary report, "Estimated Future Oil and Gas Production, Railroad Commission District 4, Offshore, Bays, and Estuaries." Carolyn Leach is assisting in this investigation, which is expected to be completed during 1971.

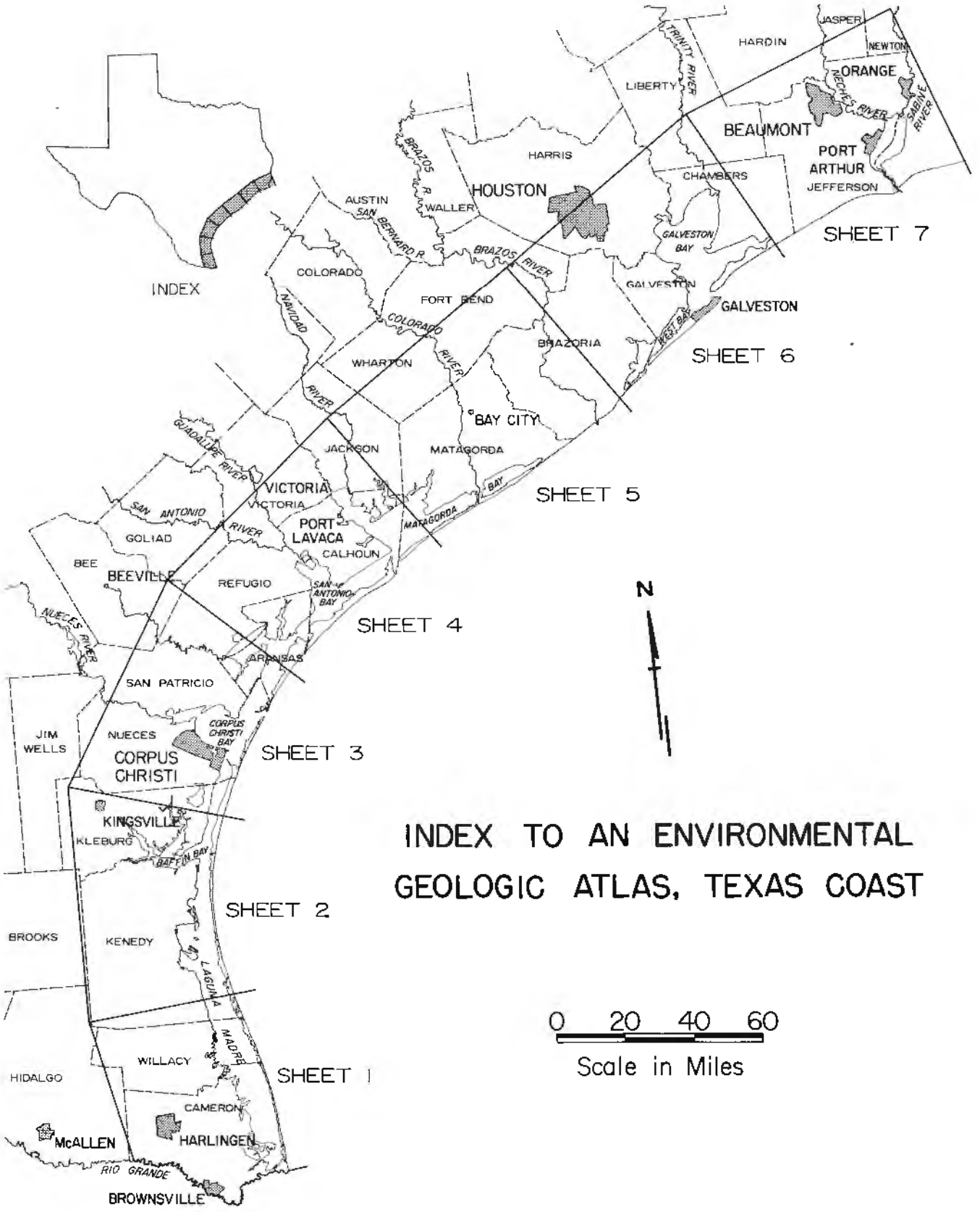
Environmental Geology

Environmental Geologic Atlas of the Texas Gulf Coast. L. F. Brown, Jr., W. L. Fisher, C. G. Groat, J. H. McGowen, and A. J. Scott. Preparation of an environmental geologic atlas of the Texas coastal area. Area covered parallels present coast extending from outer limit of present shoreface zone inland approximately 50 miles. About 150 individual depositional units and landforms are being mapped within the Holocene or modern coastal zone and inland within the Late Pleistocene. Atlas consists of seven separate sheets at scale of 1:125,000, with base constructed from 7.5-minute topographic sheets and Tobin controlled mosaics. Aerial photographs, low-level aerial reconnaissance, and on-the-ground field checking are being utilized in map preparation. Accompanying text to the atlas will include brief description of main depositional systems of the Texas coast, and specific map units in terms of active and originally active processes, composition, facies geometry, facies tracts, and engineering, land use, and resource potential. Atlas is designed for two main purposes: (1) for planning and land use in the populous and industrial coastal area of the State and (2) for use as a basic geologic document.

Geologic Criteria for Sanitary Land Fills in Texas. P. T. Flawn, L. J. Turk, and Carolyn Leach. A project to aid municipalities in selecting secure sites for solid waste disposal. Recent legislation has directed the State Health Department to set standards for municipal sanitary land fills. Geologic factors that influence site selection are the permeability of the earth materials, depth to water table, and topography. The study was started in June 1969 and is expected to be completed during 1970.

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. Basic data will be a series of 12 separately issued geologic maps compiled on 7.5-minute topographic quadrangle bases. Field mapping has been completed for nine quadrangles; mapping has been initiated for the remaining three. Engineering data such as moisture content, plasticity index, shrink-swell, and compressive strength have been obtained from State aud Municipal agencies and private laboratories. Final report will focus on environmental and engineering geology and will provide data for planners, engineers, and others. Several derivative land-use maps and mineral-resource maps will accompany the final report. Publication of the first four geologic maps will begin early in 1970. Publication of the additional maps will await new topographic base maps to be issued by the U. S. Geological Survey. Completion of final report is projected for 1970.

Environmental Geology of the Area Between Austin and San Antonio Along the Balcones Fault Zone. P. H. Townsend. A study of the geology along the Balcones fault zoue and of the relationship between the


INDEX
SHEET 7
SHEET 6
SHEET 5
SHEET 4
SHEET 3
SHEET 2
SHEET 1
N
JASPER
NEWTON
HARDIN
ORANGE
LIBERTY
TRINITY RIVER
NECHES RIVER
SABINE RIVER
BEAUMONT
PORT ARTHUR
JEFFERSON
CHAMBERS
HARRIS
HOUSTON
WALLER
AUSTIN
SAN BERNARD R.
BRAZOS R.
BRAZOS RIVER
GALVESTON BAY
GALVESTON
WEST BAY
COLORADO
FORT BEND
NAVIDAD RIVER
COLORADO RIVER
BRAZORIA
WHARTON
BAY CITY
JACKSON
MATAGORDA
MATAGORDA BAY
GUADALUPE RIVER
VICTORIA
SAN ANTONIO RIVER
PORT LAVACA
CALHOUN
GOLIAD
BEE
BEEVILLE
REFUGIO
SAN ANTONIO BAY
ARANSAS
NUECES RIVER
SAN PATRICIO
JIM WELLS
NUECES
CORPUS CHRISTI BAY
CORPUS CHRISTI
KINGSVILLE
KLEBURG
BAFFIN BAY
BROOKS
KENEDY
LAGUNA MADRE
WILLACY
HIDALGO
CAMERON
McALLEN
HARLINGEN
RIO GRANDE
BROWNSVILLE
INDEX TO AN ENVIRONMENTAL GEOLOGIC ATLAS, TEXAS COAST
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Scale in Miles

geology and the settlement, population distribution, and development of the Austin-San Antonio region. The project includes the compilation of an areal geologic map by means of field checking and synthesis of existing maps and by mapping in detail some portions of the fault zone. Derivative maps and a summary of information about specific important aspects of the geology for use by engineers and planners will be prepared. A study will be made of possible future environmental problems related to the geology of the region and of practical solutions of the problems. The project was begun in September 1968 under the direction of P. T. Flawn. Geologic mapping and synthesis of present geologic knowledge of the area are expected to be completed in early 1970, when work on specific environmental aspects will begin.

Bibliographies and Catalogs

Bibliography and Index of Texas Geology, 1951–1960. M. D. Brown and E. T. Moore. Manuscript completed for bibliographic listing, with index, of publications pertaining to Texas geology; editing nearing completion. 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.

Staff Activities

Meetings Attended

Staff members represented the Bureau of Economic Geology at numerous scientific and professional meetings in 1969. Principal meetings attended during the year include:

Abilene Geological Society, Meeting, Abilene, Texas—W. R. Stearns

American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Dallas, Texas—V. E. Barnes, L. F. Brown, Jr., W. L. Fisher, P. T. Flawn, L. E. Garner, C. G. Groat, P. Harwood, J. H. McGowen, W. R. Stearns

American Association of Petroleum Geologists, Southwest Section, Annual Meeting, Lubbock, Texas—W. R. Stearns

American Geological Institute, Board of Directors Meeting, Atlantic City, New Jersey; Dallas, Texas; Washington, D. C.—P. T. Flawn

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

American Geophysical Uuion, Western Meeting, San Francisco, California—V. E. Barnes

American Institute of Mining, Metallurgical, and Petroleum Engineers, National Affairs Committee Meeting, Washington, D. C.—P. T. Flawn

American Institute of Mining, Metallurgical, and Petroleum Engineers, Society of Petroleum Engineering, Southwest Texas Section, Spring Symposium, Corpus Christi, Texas—W. L. Fisher

American Institute of Professional Geologists, Texas Section, Annual Meeting, Midland, Texas—P. T. Flawn

American Institute of Professional Geologists, Committee on Man and His Geologic Environment, Meeting, Dallas, Texas—P. T. Flawn.

Association of American State Geologists, Annual Meeting, Tucson, Arizona—P. T. Flawn

Association of Engineering Geologists, Annual Meeting, San Francisco, California—P. T. Flawn

Conference on Texas Marine Resources and the Sea Grant Program, Texas A&M University, College Station, Texas—P. T. Flawn

Federal Water Pollution Control Administration, Marine Pollution Ecology Course, Orange, Texas—C. G. Groat

Geological Society of America and Affiliated Societies, Annual Meeting, Atlantic City, New Jersey—L. F. Brown, Jr., P. T. Flawn

Geological Society of America, South-Central Section, Meeting, Lawrence, Kansas—L. F. Brown, Jr., W. L. Fisher

Gulf Coast Association of Geological Societies, Annual Meeting, Miami Beach, Florida—L. F. Brown, Jr., W. L. Fisher

International Tektite Symposium, 3rd, Corning, New York—V. E. Barnes

International Union for Quaternary Research (INQUA), 8th International Congress, Paris, France—V. E. Barnes

Interstate Oil Compact Commission, Meeting, Casper, Wyoming—W. R. Stearns

Meteoritical Society, Annual Meeting, Houston, Texas—V. E. Barnes

New Mexico Geological Society, Annual Field Trip, Northern Chihuahua, Mexico—C. G. Groat

Philosophical Society of Texas, Meeting, Salado, Texas—P. T. Flawn

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

Southern Interstate Nuclear Board, Meetings, Atlanta, Georgia—W. L. Fisher

Texas Academy of Science, Meeting, Arlington, Texas—C. G. Groat

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

Texas Industrial Commission, Economic Development Conference, Colorado City, Texas—G. K. Eifler, Jr.

Texas Industrial Commission, Economic Development Conference, Luling, Texas—W. R. Stearns

Texas Industrial Commission, Economic Development Conference, Van Horn, Texas—G. K. Eifler, Jr., P. T. Flawn

Lectures and Public Addresses

V. E. Barnes—

Age of South China Sea tektites: International Tektite Symposium, 3rd, Corning, New York

Cartography of Quaternary deposits of Texas (with G. K. Eifler, Jr.): International Union for Quaternary Research, 8th International Congress, Paris, France

Petrology of moldavites: International Tektite Symposium, 3rd, Corning, New York

Tektites: National Science Foundation Secondary-School Students, Texas A&M University, College Station, Texas; *and* Brazos Valley Mineral Club, College Station, Texas

L. F. Brown, Jr.—

Depositional model for Upper Pennsylvanian and Lower Permian strata in North-central Texas: Texas Christian University Geology Club, Fort Worth, Texas

Geometry and distribution of fluvial and deltaic sandstones (Pennsylvanian and Permian), North-central Texas: Gulf Coast Association of Geological Societies, Annual Meeting, Miami, Florida

Sedimentary versus contemporaneous tectonic control of fluvial-deltaic deposition: Geological Society of America, South-central Section, Meeting, Lawrence, Kansas

G. K. Eifler, Jr.—

Mineral resources of the Colorado City area: Texas Industrial Commission, Economic Development Conference, Colorado City, Texas

W. L. Fisher—

Eocene depositional systems of the Gulf Coast Basin: their relation to oil and gas: Houston Geological Society, Houston, Texas

Mineral exploration in South Texas: American Institute of Mining, Metallurgical, and Petroleum Engineers, Society of Petroleum Engineers, Balcones Section, Austin, Texas

Mineral industries of South Texas—status and outlook: American Institute of Mining, Metallurgical, and Petroleum Engineers, Society of Petroleum Engineers, Southwest Texas Section, Spring Symposium, Corpus Christi, Texas

Infilling of the Gulf Coast Basin: Department of Geological Sciences Technical Sessions, The University of Texas at Austin, Austin, Texas

Tertiary delta systems of the Gulf Coast Basin and their relation to oil and gas occurrence: Society of Economic Paleontologists and Mineralogists, Permian Basin Section, Midland, Texas

P. T. Flawn—

Environmental geology: The University of Texas at El Paso, El Paso, Texas

Environmental geology and the coast—rationale for land-use planning: Geological Society of America and Affiliated Societies, Annual Meeting, National Association of Geology Teachers Symposium, Atlantic City, New Jersey

Geología ambiental: Universidad de Coahuila, Escuela de Mineria, Nueva Rosita, Coahuila, Mexico

Geology, 1969: Engineering for Executives Program of the College of Engineering, The University of Texas at Austin, Lakeway, Texas

Mineral and geologic resources of the Van Horn area, Texas: Texas Industrial Commission, Economic Development Conference, Van Horn, Texas

Mineral resources and multiple land use: Association of Engineering Geologists, Annual Meeting, San Francisco, California

Testimony to U.S. House of Representatives Committee on Interior and Insular Affairs in support of S.B. 719 to establish a National Mining and Minerals Policy: Washington, D. C.

Texas marine mineral resources: Conference on Texas Marine Resources and the Sea Grant Program, Texas A&M University, College Station, Texas

The Texas professional geologist in the seventies (keynote address): American Institute of Professional Geologists, Texas Section, Annual Meeting, Midland, Texas

L. E. Garner—

Comparison of recent and ancient coarse-grained point bars (with J. H. McGowen): American As-

sociation of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Annual Meeting, Dallas, Texas

Operation and uses of the portable refraction seismograph: Department of Geological Sciences Classes in Engineering Geology and Hydrogeology, The University of Texas at Austin, Austin, Texas

Rocks and minerals of Texas: Brentwood School, Austin, Texas

C. G. Groat—

Effects of ground water on geomorphology, lower Mojave Valley, California: Texas Academy of Science, Meeting, Arlington, Texas

J. W. Macon—

Preparation of minimum-cost drawings: Association of Earth Science Editors, Meeting, Illustrations Panel, Houston, Texas

P. U. Rodda—

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

W. R. Stearns—

Future oil production and its economic impact on the Luling area: Texas Industrial Commission, Economic Development Conference, Luling, Texas

Project Gasbuggy, nuclear stimulation of oil and gas reservoirs: Austin Desk and Derrick Club, Austin, Texas

Committee Service and Offices

V. E. Barnes—

Austin Geological Society: Affiliations Committee, Chairman, 1969–1970; Nominations Committee, 1968–1969

G. K. Eifler, Jr.—

Austin Geological Society: President, 1969–1970; Executive Committee, 1969–1970; Public Relations Committee, Chairman, 1968–1969

W. L. Fisher—

Society of Economic Paleontologists and Mineralogists, Gulf Coast Chapter: Business Representative

Forum on Geology of Industrial Minerals: Steering Committee

P. T. Flawn—

American Association of Petroleum Geologists: State and Federal Agencies Advisory Committee

American Geological Institute: Board of Directors

American Institute of Mining, Metallurgical, and Petroleum Engineers: National Affairs Committee

American Institute of Professional Geologists: Committee on Man and His Geologic Environment; Executive Committee, Texas Section

Association of American State Geologists: President, 1969–1970

Geological Society of America: Joint Cooperative Committee, American Association of Petroleum Geologists—Geological Society of America

Gulf Universities Research Corporation: Advisory Board

Interagency Natural Resources Council for Texas: Chairman

Texas Advisory Committee on Conservation Education

Texas Mapping Advisory Committee

The University of Texas at Austin: Center for Research in Water Resources, Advisory Committee; Joint Council on University-State Relations; Latin-American Institute, Advisory Committee, Chairman; representing The University of Texas on the Interagency Natural Resources Council for Texas

L. E. Garner—

Austin Geological Society: Publications Committee, 1969–1970

R. M. Girard—

Austin Geological Society: Publications Committee, 1968–1969

R. A. Maxwell—

American Institute of Professional Geologists, Texas Section: State Parks Advisory Committee, Chairman (until August 1969)

Austin Geological Society: Vice-President, 1968–1969; Executive Committee, 1968–1969

Natural Science Association of the City of Austin: Executive Board (until August 1969)

Parks and Recreation Advisory Board of the City of Austin: Member (until May 1969)

W. R. Stearns—

Anstin Geological Society: Finance Committee, 1969–1970

Other Professional Responsibilities

L. F. Brown, Jr.—

American Association of Petroleum Geologists, Annual Meeting: Co-leader of pre-convention field trip, "Late Pennsylvanian Shelf Sediments, North-central Texas," sponsored by Dallas Geological Society and American Association of Petroleum Geologists

Dallas Geological Society publication, "A Guidebook to the Late Pennsylvanian Shelf Sediments of North-central Texas," 69 pp.: Co-editor (with E. G. Wermund)

Society of Economic Paleontologists and Mineralogists, Annual Meeting, Dallas, Texas: Co-chairman of Symposinm on Shelf Sediments in the Rock Record

L. E. Garner—

Austin Science Center: Conducted seminar on rock and mineral identification for elementary-school teachers

P. U. Rodda—

Conservation Education Workshops at East Texas State University, Commerce, Texas; Stephen F. Anstin State University, Nacogdoches, Texas; and Texas A & I University, Kingsville, Texas: Special consultant on mineral resources

Teaching Duties of Bureau Staff

Five Bureau staff members have joint appointments with the Department of Geological Sciences at The University of Texas at Anstin. These are V. E. Barnes, W. L. Fisher, and P. T. Flawn (Professors), P. U. Rodda (Associate Professor), and L. F. Brown, Jr. (Lecturer). Regularly scheduled courses are taught by P. T. Flawn (Geology 341: Mineral Resources); L. F. Brown and W. L. Fisher (with A. J. Scott) (Geology 383K: Terrigenous Depositional Systems); and P. U. Rodda (Geology 314K: Invertebrate Paleontology). In addition certain Bureau staff members supervise graduate theses and dissertations and serve on graduate student committees in the Department of Geological Sciences and as outside committee members in other departments and universities. During the 1969 Spring Semester, W. L. Fisher and A. J. Scott taught Geology 391.1 (Depositional Systems) as a UT extension course iu the Permian Basin Graduate Center, Midland, Texas. Various staff members gave specific lectures or participated in departmental field trips during the year.

Mineral Studies Laboratory

The Bureau of Economic Geology's Mineral Studies Laboratory continues to test, analyze, and evaluate possible commercial uses of samples of Texas rocks and minerals in support of various activities of the Bureau, the Department of Geological Sciences, and other departments of The University of Texas at Austin, as well as samples submitted by private individuals. Other activities of the staff of this Laboratory include improving and expanding the services offered as well as giving advice on methods and equipment used in the Laboratory.

Bureau projects to which the Laboratory has contributed include the Van Horn Heavy Metals Study, Colorado River Project, University Lands Project, and Parks and Wildlife Department Project.

Examiuation of samples from other departments of The University varied from chemical analysis of magnetic minerals to spectrographic analysis of minute deposits on arrowheads. Some samples called for qualitative spectrographic analysis of rare earth-bearing minerals and concentrates.

Samples of rocks submitted to the Bureau's administrative offices by Texas residents are further examined in the Mineral Studies Laboratory if they require mineral separation, physical testing, chemical or spectrographic analysis, and evaluation of commercial value. If possible commercial value is indicated as a result of tests performed in the Laboratory, further testing in specialized private testing and research laboratories is recommended. During 1969, samples received included a wide variety of materials: minerals for possible presence of precious metals, rare earths, antimony, copper, chromium, titanium, tungsten, etc.; clays for possible use as refractory, drilling mud, lightweight concrete aggregate; natural zeolites for possible use in water softening.

The technique of atomic absorption made possible the determination of less than part-per-million of gold in rock samples of the Van Horn Heavy Metals Project. A Jarrell-Ash dual purpose atomic absorption and flame emission spectrophotometer Model 82–526 SP was used for these analyses. This use is only one of many for which this instrument has been indispensable.

The spectrograph remains the most useful instrument when one or all (up to 70) elements in a mineral or rock need to he studied. An amount as small as one milligram of the powdered rock or mineral without further preparation can produce a spectrogram which is a permanent record of the elements present and their relative amounts. A comparator-densitometer is essential in interpreting a spectrogram. A Baird-Atomic, Inc. Model RC-2 microphotometer (densitometer) comparator is on order and represents the first and most important step in unit-by-unit replacement of the twenty-seven-year old spectrographic facilities available in the Mineral Studies Laboratory.

Well Sample and Core Library

The Well Sample and Core Library of the Bureau of Economic Geology is a permanent repository for Texas subsurface materials. The collections now contain rock cuttings and cores from more than 60,000 oil, gas, and water wells and exploratory boreholes drilled in the State. Also on file are drillers' logs, electric logs, and sample logs. All of these materials may be examined by geologists and others at the Library, where facilities for study, including microscopes, are available.

During 1969, the Library's holdings were substantially increased by gifts of cores, samples, and other data. Cities Service Oil Company donated a complete set of records of wells drilled iu West Texas counties through 1968. These are cataloged and filed in 1,134 ring binders.

Ernest K. Lehmann and Associates, Consulting Mining Geologists, of Minneapolis, Minnesota, presented 11,000 feet of cores obtained from boreholes drilled into Cambrian rocks in Blanco and Burnet counties. The Permian Basin Sample Laboratory, of Midland, Texas, donated well cuttings from 1,600 exploratory wells drilled in 52 West Texas counties during 1965 through September 1969.

Tenneco Oil Company, Houston, preseuted 172 boxes of cores from four wells in Gray County, and Zinn Petroleum Company, Houston, gave 80 feet of

cores from wells drilled into Buda Limestone in Frio and Pearsall connties.

The Well Sample and Core Library occupies office and storage space in Building 18-B of The University's Balcones Research Center located at the northwest edge of Austin. Mr. W. R. Stearns is chairman of the committee that supervises the operation of the Library. Mr. Marce L. Morrow is Administrative Clerk-in-Charge.

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. The Well Sample and Core Library provides facilities for the examiuation and study of subsurface materials from Texas wells.

Vertebrate Paleontology and Radiocarbon Laboratories Transferred

Since 1967 the Bureau of Economic Geology has assumed administrative responsibility for the Vertebrate Paleontology Laboratory and the Radiocarbon Laboratory housed at the Balcones Research Center. Effective in September 1969, administration of these laboratories was transferred to the Texas Memorial Museum.

Bureau of Economic Geology

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