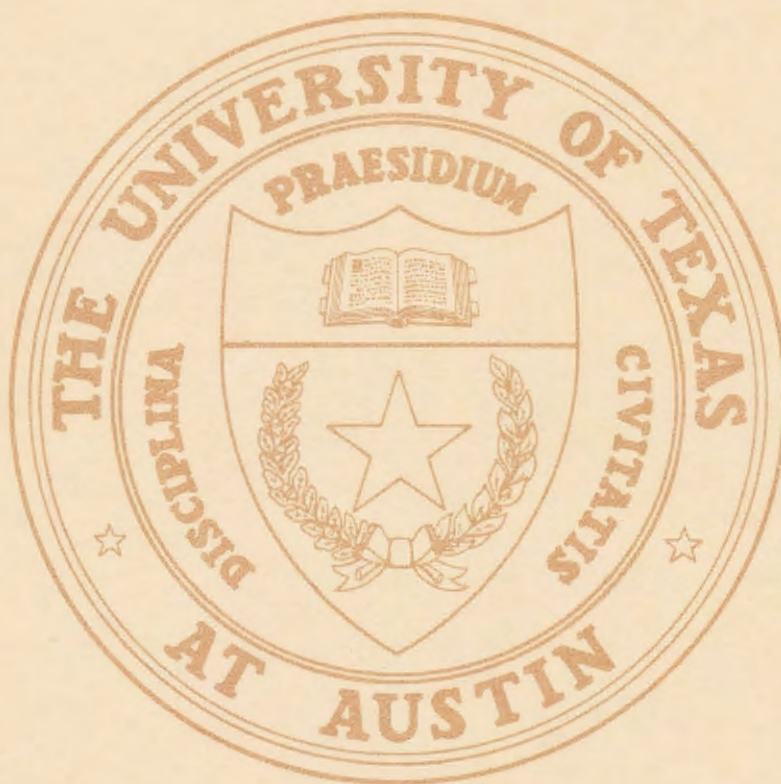


ANNUAL REPORT 1972



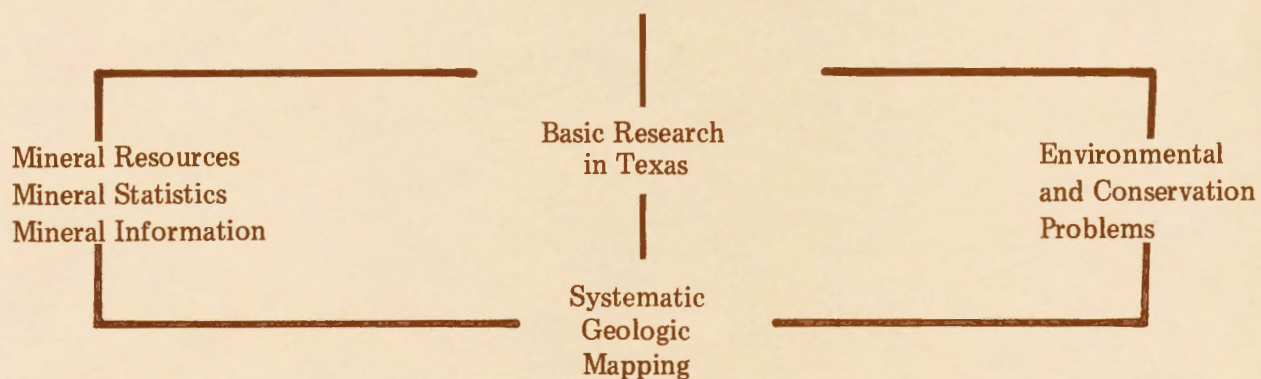
BUREAU OF ECONOMIC GEOLOGY

The University of Texas at Austin

W. L. Fisher, Director

BUREAU OF ECONOMIC GEOLOGY

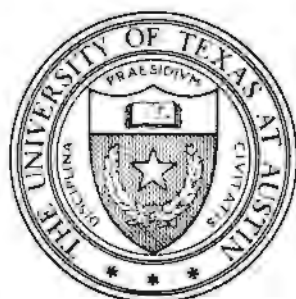
RESEARCH AND SERVICE IN GEOLOGY



BUREAU OF ECONOMIC GEOLOGY

The University of Texas at Austin

W. L. Fisher, Director



RESEARCH AND ADMINISTRATIVE OFFICES

Geology Building, Main Campus

LABORATORIES

Balcones Research Center

ANNUAL REPORT 1972

BUREAU OF ECONOMIC GEOLOGY

The Bureau of Economic Geology is a research bureau of The University of Texas at Austin; it also functions as a state agency. Established in 1909, it has for 63 years been recognized as the Texas State Geological Survey; its director fills the position of state geologist. The Bureau of Economic Geology also serves as a member agency of the State Interagency Council on Natural Resources and the Environment.

The Bureau is engaged in research and public service in Texas geology. It carries on basic research to further understanding of the geology of and the natural earth processes that operate in the state. 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 and special derivative maps at several scales for all those concerned with resources and land use in Texas. The Bureau participates in other University research efforts in the fields of resources and earth sciences including those of the Center for Research in Water Resources and the Marine Science Institute at Port Aransas. These two organizations, with the Bureau, constitute The University's Division of Natural Resources and Environment.

The Bureau publishes major reports in The University of Texas Publication Series and maintains its own series of Reports of Investigations, Atlases, Geologic Quadrangle Maps, Geological Circulars, Mineral Resource Circulars, and Special Publications. A complete list of publications is available on request.

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, The General Land Office, Interagency Natural Resources Council, and numerous other state departments, boards, conservation organizations, water districts, councils of government, 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 Survey, National Aeronautics and Space Administration, Environmental Protection Agency, 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 officials, private groups, corporations, and citizens through correspondence and conference.

PUBLICATIONS IN 1972

In its role as a public geologic research unit, the Bureau of Economic Geology disseminates the results of research programs and projects primarily through its own publication series. During the 63-year history of the Bureau, nearly 700 reports, bulletins, and maps have been published covering all major aspects of the geology and natural resources of Texas. To date, approximately 1 million publications have been distributed, primarily through direct sales. Distribution and publication inventory have steadily increased through the years.

Bureau publications are made available to interested persons at a price determined to recover printing costs. A list of publications of the Bureau of Economic Geology is available on request.

Environmental Geologic Atlas of the Texas Coastal Zone, Galveston-Houston Area, by W. L. Fisher, J. H. McGowen, L. F. Brown, Jr., and C. G. Groat. 91 pp., 22 figs., 9 pls., 7 tables (\$6.75).

This publication, the first of a series of seven atlases of the Texas Coastal Zone, presents an inventory of environments and resources of the Galveston-Houston area. Comprising all of Galveston County and portions of Brazoria, Chambers, Fort Bend, Harris, and Liberty counties, the study area extends from the 5-fathom line in the Gulf of Mexico to approximately 50 miles inland.

The Galveston-Houston Atlas contains 9 full-color maps, consisting of a basic environmental geologic map and 8 special-use environmental maps. The basic environmental geologic map—published at a scale of 1:125,000—shows resource and environmental units (geologic substrate and soils), biologic units, active and potentially active physical process units, and man-made units. The special-use environmental maps are prepared at a scale of 1:250,000. These maps include (1) physical properties, (2) environments and biologic assemblages, (3) current land use, (4) mineral and energy resources, (5) active processes, (6) man-made features and water systems, (7) rainfall, stream discharge, and surface salinity, and (8) topography and bathymetry. The Environmental Geologic Atlas is designed for use in regional planning for improved use of coastal resources. Additional sections of the atlas are scheduled for publication in the near future.

Report of Investigations No. 74. Edwards Group, Surface and Subsurface, Central Texas, by Peter R. Rosa. 198 pp., 35 figs., 19 pls., 2 tables (\$3.50).

The Edwards Group is an important stratigraphic unit in Texas in that it serves as the recharge and principal aquifer for the Edwards underground

water system. In addition, the Edwards is a significant producer of oil and gas throughout much of its subsurface extent.

This comprehensive study of the Edwards strata in Central Texas, including the area of the Edwards Recharge Zone, was written by Dr. Peter R. Rose, who is currently a geologist with Shell Oil Company in Denver. The report delineates the stratigraphic framework of the Edwards and associated rocks in the areas of the coastal plain and the eastern Edwards Plateau and relates this framework to comparable stratigraphic units to the northeast and southwest. The generalized paleogeography and depositional history of the Edwards and associated Cretaceous rocks are reconstructed along with a thorough outline and explanation of the several diagenetic processes that have affected these rocks.

Report of Investigations No. 75. Depositional Systems and Shelf-Slope Relationships in Upper Pennsylvanian Rocks, North-Central Texas, by William E. Galloway and L. F. Brown, Jr., 62 pp., 31 figs., 5 pls., 3 tables (\$2.00).

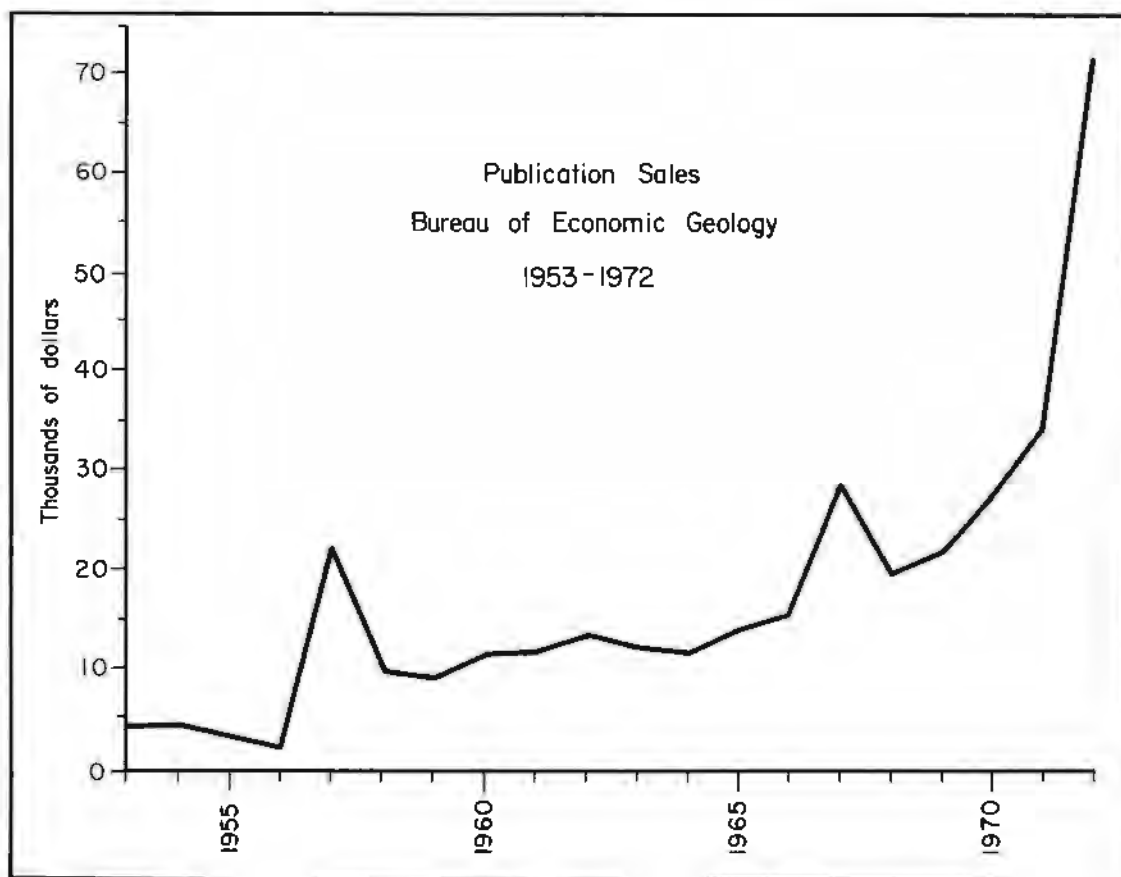
Three component depositional systems, the Cisco fluvial-deltaic system, the Sylvester shelf-edge bank system, and the Sweetwater slope system, that developed along the Eastern Shelf of the Midland Basin during Late Pennsylvanian and Early Permian time are the subject of this report. Detailed information is presented on the fluvial-deltaic systems that prograded across the Eastern Shelf, extending locally through the Sylvester shelf-edge bank system, and on the slope wedges or fans that accumulated as terrigenous sediments accumulated on the slope in the deeper basin areas. The detailed facies descriptions and geometry presented in this report should be of great utility in understanding the complex stratigraphic and structural controls that influenced the accumulation of petroleum in north-central Texas. The many maps, cross sections, and diagrams contribute significantly to the value of this report.

Report of Investigations No. 76. Presidio Bolson, Trans-Pecos Texas and Adjacent Mexico: Geology of a Desert Basin Aquifer system, by Charles G. Groat. 46 pp., 20 figs., 1 pl. (\$2.00).

Mountain-bounded desert basins or bolsons are the most important aquifer systems throughout most of southwestern and western United States and northern Mexico. This report, through a detailed stratigraphic analysis of a dissected bolson-fill sequence, provides a framework for understanding the relationships between the types and distribution of bolson-fill sediments and the occurrence of ground water in desert basins. Presidio Bolson is typical of most desert basins in that it formed by Tertiary faulting and was filled with sediments

shed from the surrounding mountains and deposited in alluvial fans and in lakes. This bolson is somewhat unique in that it has been dissected by the Rio Grande and its tributaries. The dissection provides both an opportunity to study the bolson fill and the geomorphic history of the Rio Grande, including the formation of the spectacular pediments that dominate the landscape. The mineralogy and composition of gravels, sands and clays in the basin are also discussed in some detail.

Report of Investigations No. 77. Fossil Vertebrates from the Late Pleistocene Ingleside Fauna, San Patricio County, Texas, by Ernest L. Lundelius, Jr. 74 pp., 59 figs., 1 pl., 52 tables (\$3.00).



This report describes the diverse fauna of Pleistocene fresh-water pond deposits from a portion of the Ingleside barrier-island complex. Among the numerous species of mammals, birds, reptiles, amphibians, and fish that lived in the area were camels (*Camelops*), mammoths (*Mammuthus*) horses (*Equus complicatus*), bison (*Bison antiquus*), and large tortoises (*Geochelone* and *Gopherus hexagonata*). Ingleside fauna is correlated with the Pamlico Terrace of the East Coast of the United States and a post-Sangamon interglacial age is suggested for these Texas vertebrate fossils. Information presented in this report represents a significant contribution to an understanding of the Pleistocene faunal sequence in the South Texas area.

Geological Circular 72-1. Mineral Deposits in the West Chinati Stock, Chinati Mountains, Presidio County, Texas, by William N. McNulty, Sr. 13 pp., 7 figs. (\$.75).

Potentially commercial deposits of fluorite (CaF_2) and of silver, lead, and zinc minerals—including galena (PbS), sphalerite (ZnS), argentite (Ag_2S), and cerargyrite (AgCl)—are described in the report. The minerals are found in fissure veins that cut through a huge mass of porphyritic hornblende granite—the West Chinati Stock—in the Chinati Mountains of Presidio County in West Texas. In addition, the report points out commercial, porphyry-type copper deposits possibly may be present in the masses of rhyolite and other igneous rocks that cut through the margins of the granite stock.

The report includes geologic and locality maps of mineral prospects and a summarized discussion of the geology of the area. It is based on a reconnaissance study made in 1969 by Dr. W. N. McNulty, Sr., currently professor of geology and graduate advisor at The University of Texas at El Paso.

Geological Circular 72-2. Cretaceous Paleogeography: Implications of Endemic Ammonite Faunas, by Keith Young. 13 pp., 4 figs., 3 tables (\$.50).

This report outlines the major features of Cretaceous (Commanchean) paleogeography in Texas and the Gulf Coast Basin based on the distribution of and variation in cosmopolitan and endemic ammonite faunas. Cosmopolitan-endemic cycles are defined and related to variations in paleogeography. The thirteen-page report includes four text figures outlining Cretaceous paleogeography, three tables showing correlation of principal stratigraphic units and faunas. A discussion of the implication of

endemism for biostratigraphic correlations is presented.

Geological Circular 72-3. Evaluation of Sanitary Landfill Sites, Texas Coastal Zone—Geologic and Engineering Criteria, by L. F. Brown, Jr., W. L. Fisher, and J. F. Malina, Jr. 18 pp., 3 figs., 4 tables (\$.50).

This circular describes the geologic and engineering criteria for the proper disposal of solid waste. Lands of the Texas Coastal Zone, including approximately 20,000 square miles, are graded and grouped into four main suitability groups. Of these groups only one is entirely suitable for waste disposal sites, two groups constitute very poor site areas, and one group can be utilized only locally and with proper engineering design. Based on detailed mapping and analysis completed as a part of this Bureau's *Environmental Geologic Atlas of the Texas Coastal Zone*, such features as soil and substrate permeability, position of ground water table, and surface slope and topography were considered in the land grading.

Of the approximately 100 in-ground waste disposal sites currently in operation in the Texas Coastal Zone, about 20% are in secure geological and hydrological locations, about 30% are in insecure sites and pose pollution threats, and the balance are in sites of marginal suitability.

Geological Circular 72-4. Depositional Systems and Oil-Gas Reservoirs in the Queen City Formation of Texas, by E. H. Guevara and Roberto Garcia. 22 pp., 18 figs., 2 tables (\$.75).

Large delta systems have been a major component of the eastern part of the Texas Gulf Coast Basin throughout much of its history, while areas to the south and west have been characterized by strike-fed barrier-island and lagoonal systems. This pattern is repeated in the Queen City Formation, where a high-constructive, lobate delta system is present in East Texas and a high-destructive delta system characterized by strandplain sands and lagoonal muds is present in South Texas. Facies in each system described are similar to those in the Wilcox and Jackson Groups of the Gulf Coast Basin. Petroleum production from the thin strike-oriented sands in South Texas has been considerable; the thick deltaic sands in East Texas have yielded only minor production. This report, reprinted from Transactions of the 22nd Annual Convention of the Gulf Coast Association of Geological Societies, provides detailed descriptions of the facies and their distribution, and shows the relationship of the occurrence of oil and gas to the facies.

Geologic Atlas of Texas. Abilene Sheet. Frederick Byron Plummer Memorial Edition, compiled by L. F. Brown, Jr., and J. L. Goodson, assisted by Peggy Harwood under the direction of V. E. Barnes; reviewed and edited by the Geologic Atlas Committees of the Abilene Geological Society, Fort Worth Geological Society, and Dallas Geological Society. Scale 1:250,000, in full color, topographic base (\$2.50).

Areal geologic map—with topography, roads, and culture—covering all or part of Bosque, Brown, Callahan, Coleman, Comanche, Eastland, Erath, Hamilton, Haskell, Hood, Jones, Palo Pinto, Parker, Runnels, Shackelford, Stephens, Stonewall, Taylor, Throckmorton, and Young counties within an area of 1° of latitude (32° 00' to 33° 00') by 2° of longitude (98° 00' to 100° 00'). The map is published as a memorial edition honoring the late Dr. Frederick Byron Plummer. A professor of petroleum engineering at The University of Texas at Austin and geologist at the Bureau of Economic Geology for many years until his death in 1947, Dr. Plummer was the author of numerous publications pertaining to Carboniferous stratigraphy and paleontology in Texas.

Geologic Atlas of Texas. Dallas Sheet. Gayle Scott Memorial Edition, compiled and field checked by J. H. McGowen, C. V. Proctor, Jr., W. T. Haenggi, and D. F. Reaser under the direction of V. E. Barnes; reviewed and edited by Geologic Atlas Committees of the Dallas Geological Society and the Fort Worth Geological Society. Scale 1:250,000, in full color, topographic base (\$2.50).

Areal geologic map—with topography, roads, and culture—covering all or part of Anderson, Bosque, Collins, Dallas, Denton, Ellis, Erath, Freestone, Johnson, Hamilton, Henderson, Hill, Hood, Hunt, Kaufman, Navarro, Parker, Rockwall, Somervell, Tarrant, Van Zandt, and Wise counties within an area of 1° of latitude (32° 00' to 33° 00') by 2° of longitude (96° 00' to 98° 00'). The map is published as a memorial edition honoring the late Dr. Gayle Scott. A professor of geology at Texas Christian University for many years until his death in 1948, Dr. Scott was the author of numerous publications pertaining to Texas paleontology and stratigraphy.

Geologic Quadrangle Map No. 40. Gravity, Magnetic, and Generalized Geologic Map of the Van Horn—Sierra Blanca Region, Trans-Pecos Texas, by Michael A. Wiley. Scale 1:125,000; 26-page text, 4 figs., 4 tables (\$2.00).

A geologic map and accompanying 26-page text present information about a portion of the Texas

lineament, which extends across the Van Horn—Sierra Blanca area of Culberson and Hudspeth counties in West Texas. The full-color map shows the surface geology and also gravity and magnetic data; the text includes a geologic interpretation of the gravity and magnetic anomalies and information about the stratigraphy and tectonic history of the area.

In addition to its geological and geophysical significance, the region covered by the report is important because of its mineral resources. The State's greatest production of copper came from mines in the area, and potentially important deposits of fluorspar are present. Geophysical gravity and magnetic data presented in the publication are a basic aid to exploration. The map and text were prepared by Dr. Michael A. Wiley, presently a geologist with Atlantic Richfield Company in Dallas.

Special Publication. Bibliography and Index of Texas Geology, 1951-1960, by Elizabeth T. Moore and Margaret D. Brown. 575 pp. (\$6.50).

This publication is the most recent compilation of references dealing with the geology of Texas. Two previous publications, The University of Texas Bulletin No. 3232 and The University of Texas Publication No. 5910, cover the geologic literature through 1950.

There are 2,340 papers cited in the bibliography. Detailed cross-indexing by subject, geologic system, and geographic localities occupies approximately three-fourths of this publication. An additional feature is a list of all theses and dissertations pertaining to Texas geology. The 923 graduate reports cited include the results of graduate study completed at universities throughout the United States.

Mineral Resource Circular No. 53. The Mineral Industry of Texas in 1970, by R. F. Zaffarano, Roselle Girard, and E. R. Slatick. 32 pp., 1 fig., 23 tables (free on request).

A preprint from the *Minerals Yearbook, 1970* of the U.S. Bureau of Mines, prepared through a cooperative arrangement between the U.S. Bureau of Mines and the Bureau of Economic Geology. Included are: a table showing value of mineral production in individual Texas counties during the year; a review of production of mineral fuels, industrial minerals (nonmetals), and metals in 1970, and a list of principal mineral producers in Texas. An annual issue of the Bureau.

PUBLICATIONS REPRINTED

The following publications were reprinted during 1972 and are again available for distribution.

Report of Investigations No. 42. Texas Gemstones, by Elbert A. King, Jr. 42 pp., 20 figs., 6 pls., 1961 (3rd printing; \$.50).

Geological Circular 71-1. Resource Capability Units—Their Utility in Land- and Water-Use Management with Examples from the Texas Coastal Zone, by L. F. Brown, Jr., W. L. Fisher, A. W. Erxleben, and J. H. McGowen. 22 pp., 4 figs., 3 tables, 1971 (2nd printing; \$.50).

Guidebook 6. Texas Rocks and Minerals, an Amateur's Guide, by Roselle M. Girard. Sketches by Bill M. Harris. 109 pp., 76 figs., 1964 (2nd printing; \$1.25).

Special Publication. Delta Systems in the Exploration for Oil and Gas, a Research Colloquium, by W. L. Fisher, L. F. Brown, Jr., A. J. Scott, and J. H. McGowen. 212 pp., 168 figs., 1969 (5th printing; \$5.00).

PUBLICATIONS IN PRESS

Environmental Geologic Atlas of the Texas Coastal Zone. Beaumont-Port Arthur Area, by W. L. Fisher, J. H. McGowen, L. F. Brown, Jr., and C. G. Groat.

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

Geological Circular 73-1. Asbestos in the Allamore Talc District, Hudspeth and Culberson Counties, Texas, by R. G. Rohrbacher.

Handbook No. 3. Flourspar in Texas, by W. N. McAnulty, Sr.

Guidebook No. 13. Geology of the Llano Region and Austin Area, Texas, by V. E. Barnes, W. C.

Bell, S. E. Clabaugh, P. E. Cloud, Jr., R. V. McGehee, P. U. Rodda, and K. P. Young. Field trip excursion, modified and expanded from the Bureau's Guidebook No. 5 (1963) and Shreveport Geological Society's Guidebook of 1971 Field Trip.

Special Publication. Toward a National Policy on Energy Resources and Mineral Plant Foods, Samuel P. Ellison, Jr., Editor. These papers were presented at the Forum on Energy Resources and Mineral Plant Foods, May 15-17, 1972, at the Joe C. Thompson Conference Center, The University of Texas at Austin, Austin, Texas. Joint sponsors of the Forum were the National Materials Policy Commission, Washington, D.C., and The University of Texas at Austin.

OPEN-FILE REPORTS

The Bureau of Economic Geology maintains an open file of reports, maps, and manuscripts obtained from various sources. Some are unpublished, and others are progress reports of projects that

ultimately will be published. These materials may be examined and copied, but publication rights are reserved. No new materials were placed on open file during 1972.

PAPERS BY BUREAU OF ECONOMIC GEOLOGY STAFF IN SCIENTIFIC JOURNALS

Barnes, V. E., 1971, Description and origin of large tektite from Thailand: *Chemie der Erde*, vol. 30, pp. 13-19.

_____, and Barnes, M. A., N.D., World-wide investigation of tektites continued: *Lapidary Journal*, vol. 26, April, pp. 18-48.

_____, and Eifler, G. K., Jr., 1969, Cartography of Quaternary deposits of Texas: *Etudes sur le Quaternaire dans le Monde*, Mireille Ters, ed., pp. 861-864, 8th INQUA Congress, Paris, 1969.

Brown, L. F., Jr., 1972, South Texas eolian system—a model of coastal eolian processes (abstract):

Gulf Coast Association of Geological Societies Transactions, vol. 22, p. 58.

Fisher, W. L., 1972, Depositional systems of the Carrizo—Upper Wilcox of Texas and their relation to the occurrence of oil and gas: *Bull. South Texas Geological Society*, vol. 13, no. 3, pp. 11-13

Garner, L. E., 1972, Environmental geology of the Austin, Texas area (abstract): *Geological Society of America, Abstracts with Programs*, 1972 Annual Meetings, vol. 4, no. 7, p. 515.

Girard, R. M. (with Zaffarano, R. F., and Slatick, E. R.), 1972, The mineral industry of Texas: *Minerals Yearbook 1970*, vol. III, Bureau of Mines, United States Department of the Interior.

Groat, C. G., and Brown, L. F., Jr., 1972, Environmental Geologic Atlas—basic data for Coastal Zone management: *Proceedings of the Conference on Tools for Coastal Zone Management*, Marine Technology Society, Washington, D.C., pp. 1-15.

McGowen, J. H., and Garner, L. E., 1972, Relation between Texas barrier islands and Late Pleistocene depositional history (abstract): *American Association of Petroleum Geologists Bulletin*, vol. 56, pp. 638-639.

———, ———, and Wilkinson, B. H., 1972, The sig-

nificance of changes in shoreline features along the Texas Gulf Coast (abstract): *Gulf Coast Association of Geological Societies Transactions*, vol. 22, p. 240.

Morton, R. A., 1972, Clay mineralogy of Holocene and Pleistocene sediments, Guadalupe delta of Texas: *Journal of Sedimentary Petrology*, vol. 42, pp. 85-88.

———, and Donaldson, A. C., 1972, Evolution of tidal deltas along a tide dominated shoreline (abstract): *Geological Society of America, Abstracts with Programs*, 1972 Annual Meetings, vol. 4, no. 7, p. 604.

———, Ayers, W. B., and Renton, J. J., 1972, Shale composition and sandstone properties used to interpret depositional environments of shallow-water deltas, in Pennsylvanian deltas in Ohio and northern West Virginia: *Field trip guidebook for American Association of Petroleum Geologists, Eastern Section*, 1st Annual Meeting, May 1972, pp. VI 1—VI 20.

Wermund, E. G., and True, Claudia, 1972, Determining the significant environmental geologic units in a thick carbonate terrain of southwest Texas (abstract): *Geological Society of America, Abstracts with Programs*, 1972 Annual Meetings, vol. 4, no. 7, p. 704.

DR. PETER T. FLAWN NAMED PRESIDENT OF U.T. SAN ANTONIO

Dr. Peter T. Flawn, director of the Bureau of Economic Geology from 1960 to 1970, has been named President of The University of Texas at San Antonio. Flawn became Vice President of Academic Affairs of U.T. Austin on leaving the Bureau in 1970 and later served as Executive Vice President before assuming the presidency of U.T. San Antonio in late 1972. For the past two years, Dr. Flawn was also Director of U.T. Austin's Division of Natural Resources and Environment.



NEW STAFF MEMBERS

Eight people joined the Bureau staff during 1972 as research scientists. Six were added to the regular staff; two joined the Bureau on one-year appointments.

Don G. Bebout



Dr. Don G. Bebout joined the Bureau of Economic Geology staff as a research scientist in October of 1972. He had previously spent 13 years as a research geologist with Esso Production Research Company in Houston. Bebout's principal interest and background is in the geology of carbonate and evaporite rocks. He has conducted carbonate studies in several areas of the United States as well as studies in North Africa, the Bahamas, the North Slope, Indonesia, Venezuela, Mexico, and Canada.

Dr. Bebout holds a B.S. degree in geology (1952) from Mount Union College and an M.S. degree (1954) from the University of Wisconsin at Madison. His doctorate in geology was obtained in 1961 from the University of Kansas. He is a member of the American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists.

Bebout will develop a research program in carbonate facies as a part of the Bureau's basin analysis program in Energy and Mineral Resources. He has initiated a study of the Deep Edwards trend in Texas.

Joseph L. Brewton



Joseph L. Brewton became a full-time research staff member on September 1 after previously working for the Bureau in a part-time capacity. Brewton received his B.S. (1967) and M.A. (1970) degrees from The University of Texas at Austin and is currently completing final requirements for the Ph.D. degree.

Presently, Brewton's research is in the South Texas Coastal Plain where he is mapping Pleistocene, Holocene, and Recent depositional facies and their relationship to the geologic history of the Texas Coastal Plain. He is also assisting in supervising the Environmental Geologic Atlas Project and serving as a staff member for the State Land Capability Map Project.

P. Jan Cannon



Dr. P. Jan Cannon received his B.S. (1965) and M.S. (1967) degrees from the University of Oklahoma. He received a Ph.D. degree in geology from the University of Arizona in 1972. Before joining the Bureau staff, Cannon worked for five years with the U.S. Geological Survey as an Apollo Landing Site mapper in Flagstaff, Arizona, and as a principal investigator for the Remote Sensing Studies program of the Regional Geophysics Branch in Denver.

Dr. Cannon's principal research interest is the application of remote sensing data to quantitative geomorphology. He has written or co-authored 15 scientific reports on geomorphology, lunar geology, and remote sensing. Cannon's primary responsibility at present is as a staff geologist on the Bureau's South Texas Environmental Geology project. In addition, he is developing research projects in the areas of fluvial landforms and processes, and in remote sensing.



Dwight E. Deal

Dr. Dwight E. Deal joined the Bureau staff in July 1972 on a one-year appointment. He is currently on leave from Sul Ross University, where he is an assistant professor in the Department of Geology. Deal holds a B.S. degree in geophysics from Rensselaer Polytechnic Institute (1959) and an M.S. degree in geology from the University of Wyoming (1963). His doctorate in geology is from the University of North Dakota and was received in 1970. Before joining the Sul Ross faculty, Deal worked as a geologist with the Pan American Petroleum Company and with the North Dakota Geological Survey.

Dr. Deal is a member of the Geological Society of America, the American Association of Petroleum Geologists, and the American Association for Quaternary Environment. He is currently on the board of directors of the National Speleological Society.

Deal is participating in the Bureau's South Texas Environmental Geology project with special emphasis on mapping and hydrogeology of carbonate terrains as applied to problems of land use and land capability.



Keene Ferguson

Dr. Keene Ferguson joined the Bureau of Economic Geology staff in September of 1972 on a one-year appointment. Ferguson holds a B.S. (1956) and M.A. (1958) in geology from The University of Texas at Austin. After graduation, he worked as a subsurface geologist for Humble Oil and Refining Company in their Abilene District Office.

Ferguson's doctorate is in history, received from The University of Texas at Austin in 1965. His dissertation was written under the supervision of Dr. William Goetzmann and was published by The University of Texas Press as "Geology and Politics in Frontier Texas, 1845-1909." It is a history of the geological surveys in Texas prior to the establishment of the Bureau of Economic Geology. With his background in both geology and history, Ferguson is currently writing the history of the Bureau of Economic Geology from its inception in 1909 through 1960, spanning the directorships of Phillips, Udden, Sellards, and Lonsdale.



William R. Kaiser

Dr. William R. Kaiser joined the Bureau of Economic Geology research staff in October of 1972. Previously, Kaiser worked for Humble Oil and Refining Company in South Texas and in Houston. He spent two years with the Ghana Geological Survey as a Peace Corps volunteer.

Kaiser holds a B.A. (1959) and an M.S. (1962) in geology from the University of Wisconsin at Madison. His doctorate in geology was received in 1972 from The Johns Hopkins University. Dr. Kaiser's research interest and background is deltaic sedimentation, sedimentary petrography, iron sedimentation, and carbonate chemistry. He is currently involved in the Bureau's updating survey of lignites in Texas.



Robert A. Morton

Dr. Robert A. Morton joined the Bureau of Economic Geology research staff in June of 1972. He received a B.A. degree in geology in 1965 from the University of Chattanooga and M.S. (1966) and Ph.D. (1972) degrees in geology from West Virginia University. His dissertation was a study of some ancient sediments of West Virginia compared to modern sediments of the Texas Coast. Dr. Morton previously has worked as a geologist with Chevron Oil Company in New Orleans.

Morton is a member of the American Association of Petroleum Geologists and the Society of Sigma Xi. His research interest is primarily study of modern coastal processes and sedimentation and the application of modern processes to the interpretation of ancient sediments. At present, Dr. Morton is participating in the Bureau's South Texas Environmental Geology project. He is also developing research projects in fluvial sedimentation and hydraulics.



Charles M. Woodruff, Jr.

Charles M. Woodruff, Jr., joined the Bureau of Economic Geology research staff in June of 1972. He received his B.A. (1966) degree and M.S. (1968) degree in geology from Vanderbilt University. From 1968 to 1970, Woodruff worked as a geologist for the Tennessee Division of Geology. He is currently completing final requirements for a Ph.D. in geology from The University of Texas at Austin. His dissertation is a study of the geology and its relation to land-use problems along Lake Travis in Central Texas.

Woodruff's main interest and background is environmental geology; he is one of the first products of the new environmental geology program of the U.T. Department of Geological Sciences. Currently, he is participating in the Bureau's South Texas Environmental Geology project and will direct an environmental and land capability study of the 10-county Capital Area Planning Council district.



Lori B. McVey

Lori McVey joined the Bureau staff in May 1972 as editor of the Bureau's publication series. She received her B.A. degree in English from the University of Iowa at Iowa City, Iowa, in 1968 and then worked at Look Magazine's Des Moines office as copy editor and in-house writer. In 1970, she came to The University of Texas at Austin on a fellowship from the National Institute of Mental Health and received her M.A. in communications in December 1971.

After graduation, she worked as centennial historical editor for the Lockhart Post-Register until she came to the Bureau. Her professional affiliations include the Association of Earth Science Editors, Sigma Delta Chi, the Austin Geological Society and the American Public Health Association.

JOSEPHINE CASEY RETIRES

After completing nearly 46 years of dedicated service, Miss Josephine Casey retired as editor at the Bureau of Economic Geology on May 31, 1972. As she served in various official capacities through the years, her name became widely known; many visiting geologists made a point to call on her when they came to Austin.

Miss Casey's career at the Bureau began in 1926 when Dr. E. H. Sellards was director, and it spanned the directorships of Dr. John Lonsdale and Dr. P. T. Flawn. She joined the staff as a stenographer, later became a secretary, and then an administrative secretary. In 1960, she was appointed administrative assistant. In 1967, she officially became editor—for many years prior to that time, however, Miss Casey had been editing Bureau publications in addition to her regular staff duties.

In her extensive career of service to the Bureau, Miss Casey is unique; she has undoubtedly read a larger portion of the Bureau's volume of publications than has any other person. Her meticulous care in manuscript editing is well known to the many authors who have worked with her.

On May 30, approximately 100 of her friends and colleagues attended a reception held in her honor at the Bureau offices in the Geology Building. Dr. Peter T. Flawn, President of U.T. San Antonio and one of the four Bureau directors under whom Miss Casey worked, commemorated her service to the Bureau in a letter which stated:

Few people are aware of the great contribution you made in holding the organization together during difficult days, when you not only carried executive responsibility for the office but also for the Bureau's lifeblood—its publications.

The publication series that you built and edited so very carefully were responsible for the Bureau's international reputation.



Dr. W. L. Fisher presented Miss Casey with a plaque carrying the following citation:

For your loyalty and devotion to the Bureau of Economic Geology, for your counsel and advice to Bureau directors and staff; for your administrative talents, for your editorship that has given Bureau publications a genuine mark of excellence and for your 45 years with us, the Bureau will forever be in your debt. We salute you and express our appreciation to you, not only as the longest tenured member in the history of the Bureau, but as our friend and colleague.

BUREAU BECOMES MEMBER OF INTERAGENCY COUNCIL ON NATURAL RESOURCES AND ENVIRONMENT

In July 1972, Governor Preston Smith designated the Bureau of Economic Geology as a regular voting member of the Interagency Council on Natural Resources and Environment. Organized in 1968, the Council consists of all State agencies concerned with natural resources and the environment of the State. The University of Texas at Austin and Texas A&M University are *ex officio* members of the Council.

The Director represents the Bureau on the Council. In addition, several Bureau staff members par-

ticipate in the work of important committees of the Council. Dr. L. F. Brown is a member of the Council's Land Management Advisory Committee, serving as chairman of the Land Use Information Subcommittee. Dr. E. G. Wermund of the Bureau staff is a member of the Council's Natural Resources Information System Committee.

Bureau participation on the Council is basic to its role as the State geological survey, a role in which it functions in addition to being a research bureau of The University of Texas at Austin. As an

important link between the University and State government, the Bureau of Economic Geology maintains close relationship with all State agencies concerned with the natural resources and environment of the State. This relationship ranges from the interchange of research data and information

to a variety of cooperative projects. Currently, the Bureau has cooperative programs through Inter-agency Cooperative Contracts with the General Land Office, the Texas Water Development Board, and the Division of Planning Coordination, Office of the Governor.

BUREAU OF ECONOMIC GEOLOGY RESEARCH PROGRAMS AND PROJECTS

Bureau research programs and projects are designed to embrace most of the major concerns of the State in areas of natural resources and environment. Through the years, an extensive program has been maintained in Mineral and Energy Resources. At no time in the past has research in the area of mineral and energy research been more critical than at present. Bureau of Economic Geology research projects in this area range from inventory and evaluation of the distribution, grade, and potential development of resources to regional and local studies aimed at fuller understanding of the State's resources and the development of concepts basic to exploration and conservation. Currently, programs include basin analysis of important oil and gas trends, research in the occurrence and potential utilization of deep-basin lignites, an inventory of the scope, type, and impact of surface mining, and investigation of a number of hard mineral resources.

In recent years, environmental concerns and resource conservation have become items of major

consideration. In anticipation of these concerns, the Bureau early developed a program in Environmental Geology and Land Capability, currently one of the most extensive programs of its kind in the U.S. Principal objective of this program is environmental inventory through mapping and analysis. The basic concept of land and water capability has been developed and utilized as a method to accommodate requisite resource use compatible with the environmental carrying capacity of the State's natural resources. Current programs in Environmental Geology and Land Capability are being conducted by the Bureau in two critical areas of the State: the Coastal Zone and metropolitan areas.

In addition to projects as a direct part of these two major programs, a variety of projects in basic geologic research, in systematic geologic mapping, and in resource statistics and information are maintained. Current research projects of the Bureau of Economic Geology include the following.

Environmental Geology and Land Capability Program

Statewide Land Classification and Land Capability Map.—R. S. Kier, L. F. Brown, L. E. Garner, and J. L. Brewton; assisted by Mary Bowers, Patricia Passmore, Alan Funk, and Dennis Bell.

This project, undertaken during 1972 with partial support from the Texas Water Development Board and the Division of Planning Coordination, Office of the Governor, is designed to provide a statewide classification of Texas lands and a 1:500,000 wall map showing distribution of these lands and their natural capacity to sustain various kinds of land use. This statewide analysis augments detailed environmental mapping programs of the Bureau of Economic Geology and provides a critically needed technical base to proper land and resource use and possible future land use management.

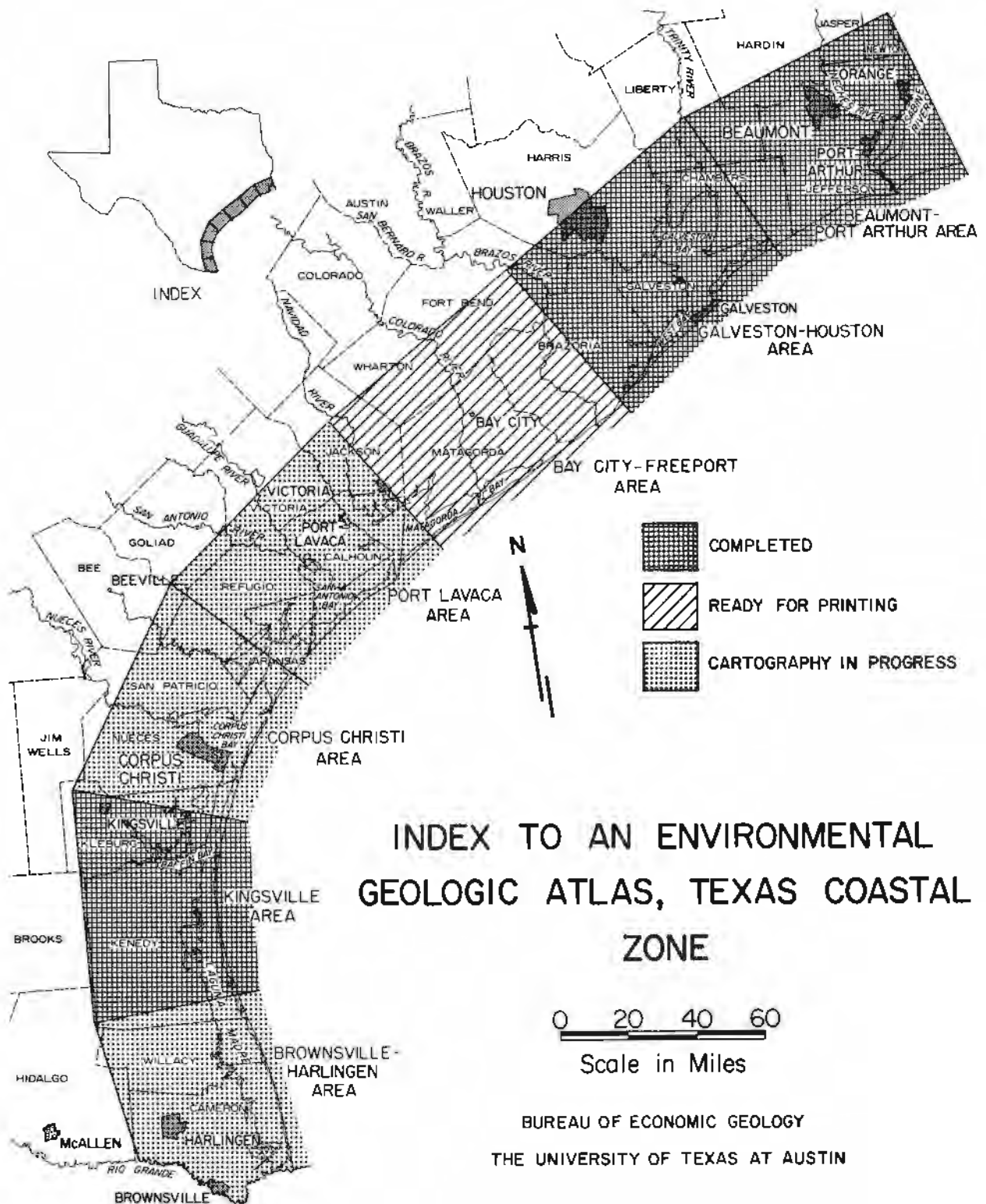
The classification includes approximately 75 land capability units broadly classed as (1) hydrologic units; (2) geologic (substrate) and soils units; (3) physical properties units; (4) geomorphic-structural units; (5) active process units; (6) biologic units; (7) subaqueous coastal units; and (8)

man-made units. Each of the 75 capability units is delineated by a unique color and symbol on 1:500,000 U.S. Geological Survey topographic, physical, and cultural base. A legend—including color inset maps depicting such features as regional physiography, generalized soils distribution, climate, and major drainage basins—and a descriptive text will accompany the map.

Color separation for the first quadrant of the four-part map is currently underway and completion of the entire map is scheduled during 1973.

Environmental Geologic Atlas of the Texas Coastal Zone.—L. F. Brown, Jr. (project coordinator), W. L. Fisher, J. H. McGowen, C. G. Groat, C. V. Proctor, Jr., J. L. Brewton, and several research assistants.

The Environmental Geologic Atlas of the Texas Coastal Zone, consisting of seven separate folios, is nearing completion. During 1972, the Galveston-Houston Atlas was published and the Beaumont-Port Arthur and Kingsville Atlases were in press. Subsequent sheets will be issued at approximately



three-month intervals. Each folio consists of a basic Environmental Geologic Map, at a scale of 1:125,000, and a series of eight Special-Use Maps, at a scale of 1:250,000. All are in full color and on a specially constructed base. Each folio will be accompanied by a descriptive text.

The Environmental Geologic Atlas of the Coastal Zone is the product of an extensive study of the Coastal Zone conducted by the Bureau of Economic Geology during the past three years. The Atlas set covers approximately 20,000 square miles of the Texas Coastal Zone within an area extending from about the 5-fathom line offshore to 50 miles inland. Mapping was accomplished by the use of detailed photographic mosaics, topographic maps, and existing maps of many types. Photo-mapping was supplemented by many hours of low-level aerial reconnaissance and selected field studies. The Special-Use Maps were derived from basic mapping and from compilation of diverse existing data. The Environmental Geologic Atlas is designed to provide a thorough inventory of natural and man-made resources of the Coastal Zone and to serve as a basic document in planning, development, and conservation of the Texas Coast.

The Atlas consists of the following seven folios, listed in the order of scheduled publication (see index map): Galveston-Houston Sheet; Beaumont-Port Arthur Sheet; Kingsville Sheet; Bay City-Freeport Sheet; Port Lavaca Sheet; Corpus Christi Sheet; and Brownsville-Harlingen Sheet. Each folio includes the following complement of maps:

Basic Environmental Geologic Map: Prepared at a scale of 1:24,000 and published at a scale of 1:125,000. A total of 130 separate resource units is shown on these maps, including physical units (geologic substrate and soils), biologic units, active and potentially active physical-process units, and man-made units.

Special-Use Environmental Maps: A series of eight special-use maps, derived from the Basic Environmental Geologic Map and supplemented by compilation of data from diverse sources. These maps are at scale of 1:250,000.

Physical Properties Map: Characteristics of substrate, soils, and landforms for specific physical uses such as engineering, construction, and waste disposal. Coastal lands are graded in 15 separate categories according to physical properties and appropriate physical use. Zones of active and potentially active faults are indicated. Existing pits, quarries, sludge pits, sewage disposal sites, solid-waste disposal sites, and shallow piercement salt domes are plotted.

Mineral and Energy Resources Map: Shows occur-

rence and distribution of major mineral resources, including oil and gas fields, sulfur, salt shell reefs, constructional fill. Also indicated are pits and quarries, LPG storage sites, salt, and sulfur mines, cement and lime plants, power generating plants, utility lines, pipelines, and offshore production platforms.

Environments and Biologic Assemblages Map: Occurrence and distribution of 45 natural environments and biologic assemblages. These include on-land vegetational zones and benthonic assemblages of bays, estuaries, and offshore areas.

Man-Made Features and Water Systems Map: Delineation of natural water bodies by type, artificial water bodies (reservoirs and drainage, irrigation, and transportation canals), and principal features constructed or altered by man.

Active Processes Map: Characterization of bay and open-gulf shorelines as erosional, depositional, or stabilized (both natural and man-made stabilization); high-energy subaqueous zones; areas of rapid deposition in bays, estuaries, and open gulf; sites of active or potential hurricane wash-overs; and areas inundated by hurricane storm surges and aftermath flooding.

Current Land Use Map: Delineation of 25 major types of land use within such major categories as agricultural lands, range-pasture, woodland-timber, swamp-timber, wetlands (salt, brackish, and freshwater marsh), residential-urban areas, recreational areas, and industrial areas. Also indicated are sulfur and brine production sites, pits and quarries, sludge pits, sewage-disposal sites, solid-waste disposal sites, pipelines, airfields, and artificial surface reservoirs.

Rainfall, Stream Discharge, and Surface Salinity Map: Monitoring stations, rainfall, discharge, and surface salinity graphs; and contours of bay salinities for humid, drought, and normal seasons.

Topography and Bathymetry Map: Shaded relief map of landforms shown at 5-foot contour intervals derived from detailed 7.5-minute topographic base maps; shaded bathymetry of bays, estuaries, and offshore areas at 1-fathom intervals.

Preliminary data from the Environmental Geologic Atlas have been utilized by numerous State and Federal agencies, local governmental groups and authorities, as well as several university and private groups. Basic data from the Coastal Zone study have been used to establish resource capability units in development of operational guidelines for Coastal Zone management. Such a program will

provide adequate inventory of the kind, grade, and distribution of land and water resources and their capability for various levels of use.

Inventory and delineation of the State's resources is basic to the development of prudent and fair land use policies and to a logical management of natural resources that will permit needed development consistent with desirable environmental quality. Comparable environmental inventories are being completed for several other critical areas of the State.

Criteria for Coastal Zone Management.—During 1971 an interdisciplinary team of coastal scientists, engineers, and economists was formed at The University of Texas at Austin under the auspices of the Division of Natural Resources and Environment. The research team, charged with establishing and outlining criteria for land and water management of the Texas Coastal Zone, began initial work under funding from the Coastal Resources Management Program of the Division of Planning Coordination, Office of the Governor. An interim report was prepared by the research team and published by the Office of the Governor in early 1972. Beginning in June of 1972, the research team continued work under a two-year grant from the RANN Program of the National Science Foundation, augmented by funds from the Office of the Governor. The grant is administered through the Division of Natural Resources and Environment.

Participating in the interdisciplinary research team are: W. L. Fisher and Robert S. Kier (Bureau of Economic Geology); E. Gus Fruh (Project Director), J. F. Malina, Jr., and Frank D. Masch (Department of Civil Engineering and Environmental Health Engineering Laboratories); Carl H. Oppenheimer (Marine Science Institute); and Jared E. Hazleton and Kingsley E. Haynes (LBJ School of Public Affairs).

During the past year, the team has concentrated their efforts in the Corpus Christi Bay area. The Bureau's principal input consists of (1) delineating the land-resource capability units in terms of their natural ability to withstand various uses, and construction of maps depicting the areal distribution of these units; (2) accumulating data that will allow quantification of the physical parameters of the capability units and permit determination of ground water levels, seasonal fluctuations, and direction and rate of movement; (3) ascertaining the three-dimensional configuration of the major land capability units where other than surface use is involved; and (4) documenting the kinds and rates of natural and man-induced changes in the dynamic units along the coastline.

Assisting in the Bureau's work on the project are research assistants Albert Erxleben, Michael Dildine, and James Woodman.

Matagorda Bay and Environs—A Pilot Study.—A cooperative program between the Bureau of Economic Geology and the General Land Office; coordinated by J. H. McGowen of the Bureau of Economic Geology and Wayne Oliver of the General Land Office. Bureau assistants include B. H. Wilkinson, J. L. Brewton, R. W. Nordquist, J. R. Byrne, and C. R. Lewis; Land Office participants include Doran Williams, Lee McKibben, Scooter Cheatham, Harry Garner, and Robert Clark. This comprehensive program, initiated in 1970, is in its second year.

Initial phase of this study involved detailed mapping of geologic boundaries that are coextensive with legal boundaries between State and private lands through a series of vintage photographs. Historical change and rate of change of these dynamic boundaries has been defined. A report is being prepared at present which will discuss and demonstrate geologic changes; this report will also include a review of the legal aspects of Texas shorelines and will develop a geologic-legal basis for distinction of private and State-owned coastal lands and waters.

Currently, detailed studies of the bay bottom and configuration are underway—including sediment analyses, molluscan composition, content of organic carbon, and distribution and amount of heavy metals. Heavy metal determinations are being completed by Charles Holmes, U.S. Geological Survey in Corpus Christi. The U.S. Army Corps of Engineers, Galveston District, are providing core data.

Processes on the Texas Gulf Shoreline.—J. H. McGowen. Detailed mapping and monitoring of the Texas Gulf shoreline to define erosional, depositional, or equilibrium state and rate and amount of change. Dynamic changes of the shoreline through natural processes significantly interact with man's activities along the coast. Through mapping of a series of vintage photographs of the Texas shoreline and construction of a large number of profiles across the barrier islands and the beaches, three kinds of shorelines have been defined. For certain segments, the shoreline is eroding rapidly, up to a maximum of forty feet per year. Other segments of the shoreline are in equilibrium, being neither erosional nor depositional; equilibrium can result from natural or artificial stabilization or where sediment supply and beach processes are equal. Certain reaches of the shoreline are depositional—that is, showing seaward accretion over a short period of time.

This project deals with the underlying causes of erosion, equilibrium or accretion. Volume of sand stored in the barriers is considered. The present erosional rates of headlands, erosion of the inner continental shelf, and volume of sediment

delivered to the Gulf by the Brazos, Colorado, and Rio Grande are being considered to determine the role each plays in barrier development and maintenance.

From correlation of the distribution of beach processes and the distribution of potential sediment sources as previously mapped by the Bureau of Economic Geology, a very simple rule is apparent. Beaches that are composed dominantly of shell fragments are generally erosive to highly erosive; those composed of sand and little shell are generally in equilibrium or are depositional.

Environmental Analysis and Mapping of the Nueces, San Antonio, Guadalupe, and Lavaca River Basins.—E. G. Wermund, Jr. (project coordinator), P. J. Cannon, D. E. Deal, L. E. Garner, R. A. Morton, and C. M. Woodruff, assisted by Claudia True, Judy Russell, Nancy Smith, David Walz, and Russell Shepard. This long-term project, initiated in June 1972, under contract with the Texas Water Development Board, is a comprehensive environmental geologic analysis of approximately 33,000 square miles of the Nueces, San Antonio, Guadalupe, and Lavaca River Basins of South Texas. Objectives of the project call for preparation of the following maps as a part of the environmental inventory: basic environmental geology map (scale 1:125,000), slope map (scale 1:125,000), physical properties map (scale 1:250,000), active process map (scale 1:250,000), biologic assemblages map (scale 1:250,000), current land use map (scale 1:250,000), man-made features map (scale 1:250,000), and mineral and energy resources map (scale 1:250,000).

The first phase of the project, scheduled for completion in August 1973, includes the southern Edwards Plateau to south of U.S. Highway 90 and east of U.S. Highway 81. This region is of prime environmental significance as it is the primary recharge area for the subsurface Edwards limestone aquifer which supplies water to nearly one million people in metropolitan San Antonio, San Marcos, New Braunfels, Hondo, and Uvalde. This important aquifer supplies irrigation water for about 3,700 square miles of croplands. Mapping is being completed on 1:24,000 topographic sheets and controlled aerial photographic prints of the same scale. It is augmented by 1:40,000 stereo pairs of black-and-white aerial photographs. Interpretations are checked both on the ground and by means of low-level aerial surveys. The metropolitan San Antonio area is being treated as a detailed urban study within the context of the larger project.

Subsequent phases of the study will involve environmental inventory southward through the drainage basins to the Texas Coastal Zone, including the recharge areas of the important Carrizo-

Wilcox aquifer. Completion of the entire project is scheduled for 1975.

Environmental Geologic Atlas of the Houston Area Test Site.—C. V. Proctor, Jr., assisted by Charan Achalabhuti and Douglas Hall. Preparation of an environmental geologic atlas of the 18-county area adjacent to Houston and Harris County, Texas. The project was launched under contract with the National Aeronautics and Space Administration in Houston. An extension of the Bureau's Environmental Geologic Atlas of the Texas Coastal Zone, the study involves the preparation of (1) a basic environmental map, (2) active processes and biologic assemblages, (3) man-made features and surface water systems, and (4) mineral and energy resources. A special land capability classification is being derived, evaluating environmental carrying capacity of mapped lands and environmental units with existing and potential land uses.

Included in the project are the following counties: Burleson, Brazos, Grimes, Walker, San Jacinto, Montgomery, Waller, Washington, Austin, Colorado, Wharton, Fort Bend, Harris, Liberty, Chambers, Galveston, Brazoria, and Matagorda. Mapping for the atlas utilizes NASA black-and-white photomosaics at scale of 1:125,000 and color and color-infrared aerial photographs at an approximate scale of 1:120,000. Photo interpretation is being augmented by low-level aerial reconnaissance and on-site field checking. The project was initiated in 1972 and is scheduled for completion in 1973.

Environmental Geology and Geologic History of the Texas Inner Coastal Plain.—Cleo V. Proctor, Jr., Charan Achalabhuti, and Joseph L. Brewton. This project, initiated in 1971, is an inland extension of the Bureau's Environmental Geologic Atlas of the Texas Coastal Zone. The area embraced extends from the Sabine River to the Rio Grande, including a belt from approximately 45 miles to 100 miles inland of the Texas Coast. The project involves detailed mapping of geologic facies, environmental units, and land capability. Mapping has been completed for approximately 15,000 square miles of the project area and is currently in manuscript form. The project is scheduled for completion during 1973.

Environmental Geology of the Austin Area, Texas—An Aid for Urban Planning.—L. E. Garner. A study of the geology and physical properties of rock units of the Austin area. The project is designed to provide data for planners, engineers, and other interested persons. Field mapping by L. E. Garner, P. U. Rodda, and K. P. Young is complete. Basic data have been compiled as a geologic map at

a scale of one inch to a mile. Engineering data were obtained from State and Municipal agencies and private firms.

Basic map and special-purpose maps of the entire Austin area are in cartographic preparation and will accompany the final report. Included are maps showing engineering properties (slope stability, permeability, excavation potential, shrink-swell potential, corrosion potential), slope intensity, current land use, and surficial deposits. Report is scheduled for completion in 1973.

Land-Use and Geology, Lake Travis and Vicinity, Travis and Burnet Counties, Texas.—Charles M. Woodruff, Jr. Initiated in March 1971, this project

is a study of the relationship of geology to problems of residential development along Lake Travis. The major land-use problem in the area is disposal of domestic wastes by means of septic tanks. A study of physical properties of the underlying earth materials points up the threat of pollution from this method of waste disposal. Factors germane to this problem are areal geology, soils, fracture-intensity, slope, ground water, and current land use. During 1972, a geologic map was completed, data pertaining to soils and ground water were compiled, a slope map was constructed, and a preliminary investigation of ground-water quality was begun. Scheduled completion date for the project is June 1973.

Energy and Mineral Resources Program

Surface Mining in Texas: Inventory and Environmental Effects.—C. G. Groat, assisted by W. B. Anderson, S. D. Etter, and M. G. Munson. Legislation to regulate surface mining has been proposed at both the Federal and State level. In order to insure that comprehensive, unbiased information will be available about mining in Texas, the Bureau of Economic Geology undertook a broad study of mining in Texas in October 1971. This information is basic to those involved in evaluating regulations that deal with reclamation.

Data has been gathered from topographic maps, aerial photographs, and extensive field investigations. Compilation of this information is in final stages. The results of this study will be available in two forms: (1) as an open-file collection of county maps showing the location of surface mines, supplemented by detailed maps of the mines and descriptive information—including surface area affected, mine dimensions, commodity produced, and present reclamation programs; and (2) a formal, summary report to be published as a Report of Investigations. The open-file materials will be available early in 1973, the summary report in late in 1973.

This project has been partially funded by the Division of Natural Resources and Environment of The University of Texas at Austin. The General Land Office provided much support, including the part-time services of Tom Blanton.

Texas Lignites: Conventional and Deep-Basin Energy Sources.—W. L. Fisher, C. G. Groat, and W. R. Kaiser, assisted by C. L. Burton. Solid fossil fuels are receiving significant attention because they provide a significant alternative energy source during the current energy crisis. Coals and lignites are being mined at increasing rates for use in fueling power plants throughout the United States. Extensive near-surface reserves are supplemented

by huge concentrations of deeper supplies that can be tapped for *in situ* processing for the production of gas.

Texas has vast reserves of lignite at minable depths and in deeper parts of the Gulf Basin. Near-surface deposits are presently being mined at three locations and two additional installations have been announced. The deep-basin reserves hold great promise for future utilization as technology in this area advances at a rapid pace. This study is an extension and expansion of an earlier survey of Texas lignites (Report of Investigations No. 50, now out of print), and stresses the gathering of detailed stratigraphic information relating to the deep-basin lignite occurrence. Precise and detailed geological information of this type will be needed for the planning of *in situ* utilization of the lignites.

The final report will contain a review of current technology in lignite utilization and an analysis of the potential for utilization of Texas lignites as *in situ* technology becomes available on a production scale. Completion is scheduled for 1973.

Depositional Systems in the Texas Gulf Coast Basin.—W. L. Fisher, J. H. McGowen, and C. V. Proctor, Jr. A long-term program in basin analysis through reconstruction and genetic interpretation of principal facies of major stratigraphic units of the Texas Gulf Coast Basin. To date, preliminary reports have been published on several stratigraphic units. Comprehensive publications, illustrated with primary map and cross-section data, are currently being prepared for the Lower Wilcox, Upper Wilcox, Yegua, and Jackson. Studies of Texas Upper Cretaceous sands, completed in East Texas, are presently being extended to South Texas. Principal goals of the projects are to relate genetic depositional facies and systems to the distribution and occurrence of oil and gas, and in some units, deep-basin lignites.

Carbonate Environments and Diagenetic History—Deep Edwards Reef Trend, South Texas.—D. G. Bebout. The location of the Deep Edwards Reef Trend has been well established during the past 30 years both by drilling and careful examination of seismic profiles by petroleum companies. However, wells in this trend have been noncommercial because of spar cementation of original primary porosity and lack of leaching to develop secondary porosity. The objective of this project is to study in detail select cores from the Deep Edwards Trend in order to interpret the depositional environments and, more important, to determine the history of the diagenetic changes which have taken place since deposition and variations in these changes across major regional structures. Cores obtained thus far for this study are from the Humble No. 1 Dilworth, McMullen County; Tenneco No. 1 Alamo Lumber Company, Live Oak County; and Tenneco No. 1 Schulz, Live Oak County. This project was initiated in December 1972.

Virgil-Wolfcamp Facies, Eastern Shelf, North-Central Texas.—L. F. Brown, Jr., assisted during 1972 by Roberto García and Arthur Cleaves. Regional surface and subsurface study of a 30-county area of North-Central Texas, involving the examination of approximately 10,000 well logs. Goal of the project is mapping and recognition of fluvial, deltaic, and related marine depositional systems and their component facies. The resulting regional picture of Late Pennsylvanian and Early Permian depositional features will serve as a guide in the search for oil, water, clay, and other resources in the study area and in similar depositional systems elsewhere.

Comparison with modern analogs is a significant part of this study. The project was initiated in 1968 and has progressed to the point that maps and cross sections are in advanced stages of preparation. One of the publications resulting from this project—Bureau of Economic Geology Report of Investigations No. 75, "Depositional Systems and Shelf-Slope Relationships in Upper Pennsylvanian Rocks, North-Central Texas," by W. E. Galloway and L. F. Brown, Jr.—was issued in 1972. Preparation for additional publications will continue during 1973.

Upper Pennsylvanian and Middle Permian Limestones of the Central Basin Platform in Texas.—E. G. Wermund, assisted by Edgar H. Guevara and Charles A. Caughey. A study, initiated in November 1971, of subsurface carbonate environments in a major oil- and gas-producing province. The initial phase of the project is a pilot study for computer data processing by the Bureau of Economic Geology.

During 1972, electrical logs of wells drilled in the Central Basin Platform in Ector and Winkler counties of West Texas were correlated for the stratigraphic section of interest. In addition, a code for putting lithologic descriptions of core and ditch samples onto punch cards was developed. At year's end, cores and samples were being described, and a description of the encoding procedure was being written for publication in 1973.

Zeolites in Texas.—C. G. Groat, assisted by G. L. Bartz and J. C. Reid. Natural zeolites are extensively utilized in Japan as soil conditioners, in gas drying, as fillers in the paper industry, as additives in pozzolanic cements, and for other purposes. The capacity for ion exchange exhibited by zeolites provides great potential for use in waste-water treatment and in the removal of certain radioactive wastes from nuclear reactor waters. Utilization of zeolites in the United States is very limited at the present time, but the presence of large reserves and growing recognition of their value indicate a significant potential for future use of zeolites.

Texas has large reserves of zeolites, chiefly clinoptilolite, in Tertiary rocks of the Coastal Plain and in volcanic tuffs in Trans-Pecos Texas. The present study will provide maps and descriptive information useful in evaluating and developing Texas zeolites. Field and laboratory work have been completed; publication of results is anticipated for late 1973.

Copper Deposits of North Texas.—Gary E. Smith. An investigation of the Permian "red-bed" copper deposits of North Texas that follows, in a more comprehensive way, the work on the copper deposits begun by W. E. Galloway and L. F. Brown, Jr. The current investigation, initiated in June 1972, is a geology thesis supported in part by the Bureau of Economic Geology. It includes geochemical studies and the mapping of surface and subsurface Permian stratigraphic units of the San Angelo and other formations in the area to determine the depositional history of sand and mud facies in which the copper occurs. Distribution of copper mineralization and depositional controls are being defined.

Talc Deposits of the Allamore District, Texas.—R. G. Rohrbacher. A study of the occurrence, origin, and distribution of talc deposits in Precambrian rocks of the Allamore area, Culberson and Hudspeth counties, Texas. Includes detailed mapping, petrography, and geochemistry of the talc deposits and associated rocks. (Doctoral dissertation partly supported by the Bureau of Economic Geology.)

Regional Geologic and Geochemical Study of Trans-Pecos Texas with Emphasis on the Occurrence of Mineral Deposits.—C. G. Groat, assisted by graduate students. The project involves an extensive compilation of existing geological information to be used in a synthesis relating the occurrence of mineral deposits to regional structural, stratigraphic, igneous, and geochemical controls. Initial geochemical sampling has been completed, with concentration in the Chinati, Quitman, and Wylie Mountains and nearby areas. One of the chief aims of the project is to develop a model that will aid prospecting in the area.

Texas Public Lands—Estimate of Future Oil and Gas Production from Established Fields of Texas Gulf Coast, Offshore, Bays, and Estuaries.—W. R. Stearns. An investigation of oil and gas reserves of State-owned lands in the Gulf Coast and offshore areas. Necessary oil and gas data have been acquired and processed. The portion of this study pertaining to the lower Gulf Coast was completed during 1972, and investigation of the upper Texas coast and offshore areas is continuing. The study is one phase of a long-term project, initiated in 1969, for the purpose of surveying and evaluating the mineral resources of all lands owned by the State of Texas.

Mineral Atlas of Texas.—R. M. Girard, C. G. Groat, and W. R. Stearns, assisted by graduate students.

Geologic Atlas and Quadrangle Mapping

Geologic Atlas of Texas.—V. E. Barnes, G. K. Eifler, and others. The preparation of a geologic map of the State to be issued as a series of 37 separate 1° x 2° sheets at a scale of 1:250,000. Fourteen sheets of the Atlas have been published; two, the Dallas and Abilene Sheets, were issued in 1972.

Geologists of the Bureau have completed field checking the Emory Peak-Presidio and San Angelo Sheets and portions of the Fort Stockton, Big Spring, and Wichita Falls-Lawton Sheets. The San Antonio Sheet has been scribed, and is scheduled for publication early in 1973.

Geologists who worked on the Atlas during the

The preparation of a series of maps of the State showing locations of (1) mines, quarries, and prospects; (2) occurrences of metals, nonmetals, asphalt, and coals; (3) oil and gas fields; (4) principal power and transportation facilities; (5) mineral processing and manufacturing facilities, including smelters, and cement, ceramic, and lime plants. The project was initiated June 1, 1971.

Mineral Production in Texas.—R. M. Girard, in cooperation with the staff of the U.S. Bureau of Mines. Annual compilation of Texas mineral production data and other mineral information. During 1972, a report on 1971 production of industrial minerals in Texas was prepared for inclusion in the Texas chapter of the U.S. Bureau of Mines *Minerals Yearbook, 1971*. A preprint of the chapter will be issued during 1973 as Bureau of Economic Geology Mineral Resource Circular No. 54, "The Mineral Industry of Texas in 1971." Compilation of Texas mineral production data is a continuing cooperative program between the Bureau of Economic Geology and the U.S. Bureau of Mines.

Addendum to Index to Well Samples, 1963-1971.—M. L. Morrow. Compilation of data on well cuttings and cores received in 1970 and 1971 at the Bureau's Well Sample and Core Library is continuing. Publication is scheduled for 1973.

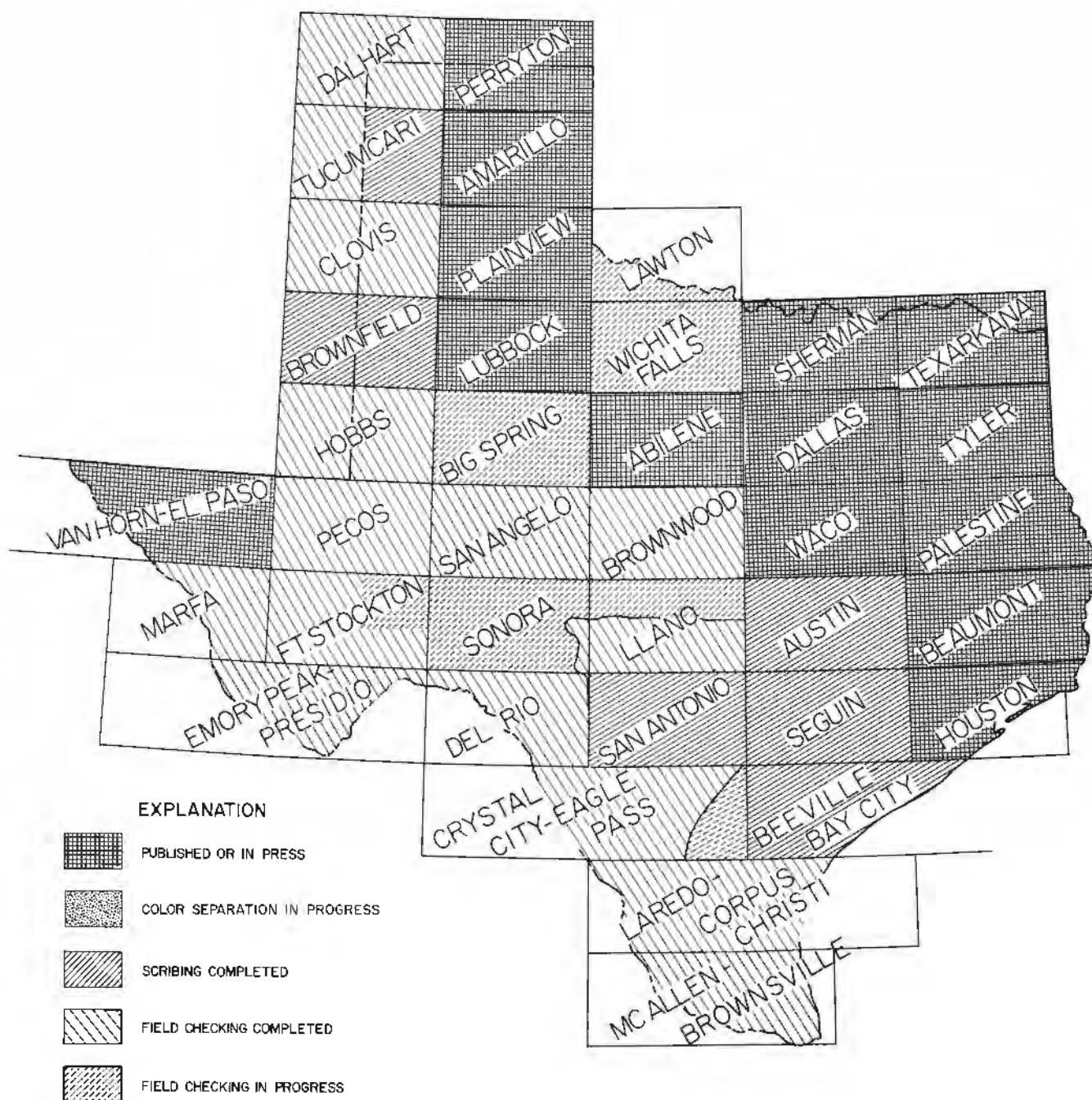
year include V. E. Barnes, project director; G. K. Eifler, Jr.; L. F. Brown, Jr.; R. S. Kier; J. B. Brown; John Gries; and A. W. Cleaves. The Geologic Atlas of Texas project is in part supported through an interagency contract with the Texas Water Development Board.

Geologic Quadrangle Mapping in Llano Region of Central Texas.—V. E. Barnes and R. V. McGehee. The preparation of geologic maps, with accompanying texts, of areas in Blanco, Burnet, and Llano counties. Scribing is in various stages of completion for Cap Mountain, Click, Dunman Mountain, and Kingsland quadrangles.

Other Research Projects

Depositional Environments of the Marble Falls Formation, Central Texas.—R. S. Kier and R. L. Zachry. A delineation of the carbonate facies and depositional patterns present in the exposed part of the lower Marble Falls Formation. Project includes the integration of previous studies by Kier

and Zachry in eastern San Saba County and western Lampasas County. Additional data pertaining to the Lampasas inlier in central Lampasas County will be gathered. This phase of a long-term study of the Lower Pennsylvanian of Central Texas is scheduled for completion in mid-1973.



Current status of Texas Geologic Atlas

Depositional Models, Lower Pennsylvanian of Central Texas.—R. S. Kier. The development of a regional depositional model for Lower Pennsylvanian strata of Central Texas. Previous studies in eastern San Saba County and western Lampasas County will be augmented by data derived from additional field and subsurface studies of Lower Pennsylvanian strata in the area south of the Callahan Divide (west-central Texas). The project, which is part of a long-term study, was initiated in 1968 and is scheduled for completion in 1973.

The Moore Hollow Group of Central Texas.—V. E. Barnes and W. C. Bell. Manuscript concerning these Cambrian and lowermost Ordovician rocks is being prepared for publication.

Relict Paleozoic Formations of Central Texas.—V. E. Barnes, with A. J. Boucot and others. Results of this investigation of the rocks and fossils of the geologic formations constituting the sequence from the top of the Ellenburger Group to the base of the Marble Falls Limestone have been published from time to time as a series of separate papers. Currently, A. J. Boucot is completing a manuscript on brachiopods collected from these formations. With the publication of his report, this long-term project will be completed.

Tektites.—V. E. Barnes, director of tektite research at The University of Texas at Austin, travelled to Egypt for a month during January and February as the recipient of a Smithsonian Foreign Currency Program Research Field Trip Award. He was invited by the Egyptian Geological Survey and Mining Authority to join in an investigation of Libyan Desert glass.

In August, Barnes and James R. Underwood, Jr., of West Texas State University, gave a paper entitled "Expedition to Area of Libyan Desert Glass, 1971," at the International Association of Planetary Geology Symposium held in conjunction with the 24th International Geological Congress in Montreal. Dr. Barnes joined field trips both before and after the Congress. The pre-Congress field trip included visits to various cryptovolcanic structures and to the Brent, Wanapeitei Lake, and Sudbury astroblemes. At the Brent astrobleme observation platform, Dr. Barnes unveiled a plaque in a ceremony commemorating the discovery of the astrobleme. The two-day field trip after the Congress visited the Charlevoix astrobleme along St. Lawrence River northeast of Quebec City.

The manuscript for a book on tektites with M. A. Barnes as coauthor was submitted to Dowden, Hutchinson & Ross for publication in their Bench Mark series of reference books in geology.

Hydrologic Characteristics of Coastal Plain Streams.—R. A. Morton and A. C. Donaldson. A

previously established classification of streams is being extended to include rivers of the Texas Coastal Plain. Hydrologic data collected for the Guadalupe River, Coeto Creek (a tributary of the Guadalupe), San Antonio River, and Gum Hollow Channel are being utilized. Basic data include discharge, sinuosity, gradient, channel bottom profiles, and sediment analysis. Project was initiated in 1971 and is expected to be completed in early 1973.

Evolution of the Nueces Drainage System, South-Central Texas.—P. J. Cannon. Quantitative data pertaining to the Nueces River and its environment are being gathered to determine the manner in which the drainage basin is changing and has changed as indicated by its system of channelways and component basins. The data include lengths of streams, number of stream segments, areas of basins, and gradients of channelways. The study will be used to determine possible flood hazards along the Nueces River. The study was started in 1972 and will continue through 1973.

Radar and Infrared Imagery in Quantitative Geomorphology.—P. J. Cannon. An evaluation of remote sensing techniques for use in obtaining quantitative data. By the use of radar and infrared imagery, lengths of streams and areas of drainage basins are determined. Radar utilized can be to cover large areas in any kind of weather and at night; infrared imagery provides high detail of small areas and can be obtained at night as well as in daylight. These methods provide an added tool in determining geomorphology of areas that are difficult to photograph.

Paleoflow Characteristics of Ancient and Modern River Deposits.—R. A. Morton and A. C. Donaldson. Derived paleoflow characteristics of the fluvial Grafton Sandstone (Pennsylvanian of northern West Virginia) have been compared with hydrologic characteristics of the Guadalupe River of Texas. Results of this comparison indicate that the ancient Grafton fluvial system closely resembled some of the Texas Coastal Plain rivers. The depositional model constructed from facies of the Guadalupe Delta, a model used for interpreting shallow-water deltaic sedimentation in the Appalachian Basin, can now be expanded to include the fluvial part of the depositional system. Project was initiated in 1971 and completed in late 1972.

Computer Processing of Geologic Data.—E. G. Wermund, R. A. Morton, P. J. Cannon, and L. E. Garner. During 1972, the Bureau of Economic Geology initiated computer analysis of geological and environmental data for several ongoing projects. Of particular significance to state planners will be a

program to overlay data of the Environmental Geologic Atlas of the Texas Coastal Zone. These data will include surface geology, physical properties of land units, soils, physical processes, biologic assemblages, topography, land use, mineral and energy resources, water systems, and climatic data. Digitizing basic or primary data of 1:24,000 work maps is being initiated. The first programs will simply display the data points and next overlay two different sets of data to display a new subset. Principal objective is to develop a data bank from which a variety of answers can be drawn. Data in these forms will extend the kind of basic information depicted on environmental maps.

As another example, a large amount of lineament or fracture data related to jointing and faulting has been gathered in surface mapping of the southern Edwards Plateau. These data are easily digitized and analyzed by machine. Display of both density of fracturing and azimuthal diversity of fracturing will contribute importantly to analysis of recharge zones for the Edwards Underground Aquifer.

One ongoing project is the investigation of late Paleozoic limestones on the Central Basin Platform of the Midland Basin—a major oil and gas province. A format has been designed that allows the lithologic description of samples, cores, and cuttings in

a numerical code. This coding is scheduled for publication in 1973.

In the Surface Mining of Texas project, the present inventory of open pits is designed for data processing storage. These data will be maintained on punched cards and magnetic tape, with plans for annual updating. Data pertinent to mineral production in Texas will be processed similarly.

History of the Bureau of Economic Geology (1909-1960).—W. K. Ferguson. The history of the Bureau of Economic Geology from its inception in 1909 through the directorships of W. B. Phillips, J. A. Udden, E. H. Sellards, and J. T. Lonsdale is being assembled through analysis of official correspondence, publications of the Bureau, and through interviews with numerous individuals aware of the workings of the Bureau during its earlier years. The history is a study of the whole concept of public geologic research and the goals of that research, as well as the story of the Bureau of Economic Geology and the role of its contributions to the knowledge of the geology and resources of Texas. The 1909 to 1960 history is a sequel to Ferguson's earlier history entitled *Geology and Politics in Frontier Texas, 1845-1909*, published by The University of Texas Press.

CONTINUING EDUCATION AND UNIVERSITY TEACHING

The results of Bureau research are incorporated in several aspects of Continuing Education as well as regularly scheduled teaching by certain members of the Bureau staff. In 1969, the Bureau initiated a series of Research Colloquia. The first in that series was "Delta Systems in the Exploration for Oil and Gas." Since original presentation in Austin, the Delta Colloquium has been presented as a Continuing Education program to most of the professional geological societies in Texas and to several societies outside the State. Leaders in this program include W. L. Fisher, L. F. Brown, Jr., and J. H. McGowen of the Bureau staff and A. J. Scott of the Department of Geological Sciences. During 1972, the Colloquium was presented to the South Texas Geological Society (San Antonio), the Houston Geological Society, and the Corpus Christi Geological Society. The syllabus prepared for the Delta Colloquium is now in its sixth printing.

The Bureau's program in Environmental Geology and Land Capability has been presented as a part of several conferences and short courses. A principal presentation this year was as a part of the Texas Coastal Zone Conference, sponsored by the University's Division of Natural Resources and

Environment. A workshop on Environmental Geology of the Texas Coastal Zone in cooperation with the Houston-Galveston Council of Government is currently being scheduled.

During 1972, W. L. Fisher participated in Continuing Education programs of the Permian Basin Graduate Center (Midland) and the American Association of Petroleum Geologists.

Five Bureau staff members hold joint appointments with the Department of Geological Sciences, and four members teach regularly scheduled courses in the Department. L. F. Brown, Jr., and W. L. Fisher participate in Geology 383 (Terrigenous Depositional Systems), C. G. Groat teaches Geology 326K (Mineral Resources), and J. H. McGowen participates in Geology 392C (Coastal Geology).

Bureau staff members also present numerous invited lectures during the year to professional societies, university groups, private groups, and State, Federal, and local governmental entities. These lectures—along with Continuing Education short courses and regular teaching—provide a mechanism for the dissemination of the results of Bureau research in addition to formal publication.

BROWN COMPLETES AAPG DISTINGUISHED LECTURE TOUR

During 1972, Dr. L. F. Brown, Jr., Bureau Associate Director for Research, was named a Distinguished Lecturer for the American Association of Petroleum Geologists, the world's largest professional geological society. He lectured throughout North America, speaking to 60 professional societies and universities. Brown was one of the first lecturers in AAPG history selected to lec-

ture on two topics: "Environmental Geology" and "Depositional Systems in Cratonic Basins." Both subjects were based on Bureau research programs conducted and directed by Brown. Dr. Brown is the second Bureau staff member in the past two years to be designated as a Distinguished Lecturer of the AAPG. A similar lecture tour was completed by Dr. W. L. Fisher, Bureau Director, during 1971.

CONTRACTS AND GRANT SUPPORT

The Bureau of Economic Geology maintains formal and informal cooperative arrangements with several State and Federal agencies. A part of the Bureau research program is supported by contracts and grants with State agencies, local units of government, and Federal agencies. Contracts and grants in effect during 1972 include:

Environmental Mapping, Inventory and Analysis of South Texas, Including the Edwards and Carrizo-Wilcox Recharge Areas.—Texas Water Development Board.

Matagorda Bay and Environs Pilot Study.—Texas General Land Office.

Criteria for Coastal Zone Management.—National Science Foundation (RANN), through The

University of Texas at Austin Division of Natural Resources and Environment.

Environmental and Land Capability Mapping, 18-County Houston Area Test Site.—National Aeronautics and Space Administration.

State-Wide Land Capability Mapping and Land Classification.—Partial support from Texas Water Development Board and Division of Planning Coordination, Office of the Governor.

Environmental and Land Capability Analysis, CAPCO.—Partial support from Capital Area Planning Council.

Geologic Atlas of Texas.—Partial support from Texas Water Development Board.

PUBLIC SERVICE

The Bureau of Economic Geology provides numerous services to the public. One such service is to disseminate information about mineral resources, environmental geology, and other aspects of the geology of Texas to individuals, companies, and governmental agencies. Much of the geologic data developed through Bureau research projects is available as published maps and reports. In addition, the Bureau serves as a public inquiries office. Each year the Bureau responds to individual requests for information, received both by letter and telephone and from visitors. During 1972, many members of the Bureau staff provided such direct assistance—by conference and by correspondence—to geologists, engineers, students, tourists, realtors, industrialists, prospectors, rock and mineral collectors, and many others. Staff members who spend a large part of their time in such public service are L. E. Garner, who examines rock and mineral specimens submitted to the

Bureau for identification, and Roselle Girard, who replies to hundreds of requests for information about Texas geology and mineral resources.

Other public services of the Bureau include preliminary testing and evaluation of selected industrial rocks and minerals at the Mineral Studies Laboratory under the supervision of D. A. Schofield, Chemist-in-Charge. Also, the Bureau's Well Sample and Core Library continues to provide facilities for geologists and others to examine and study subsurface materials from Texas wells.

The Bureau provides a public Reading Room that contains publications pertaining to Texas geology and natural resources. Located on the fifth floor of the Geology Building on the Main Campus of The University of Texas at Austin, the Reading Room is open to the public Monday through Friday from 8:00 a.m. to 5:00 p.m. In addition, work maps, sections, and data developed in ongoing research projects are available for examination at the Bureau's main office.

WELL SAMPLE AND CORE LIBRARY

The Well Sample and Core Library is a depository for rock cuttings and cores obtained from the drilling of oil and gas wells, dry holes, engineering test borings, and water wells. Rock materials from every county in Texas are included in the collections. The Library currently has on file cuttings from 61,000 wells and cores from 1,445 wells—these materials were presented to The University of Texas at Austin by companies, government agencies, and individuals.

The Library's collections were augmented by several significant contributions during 1972. Mobil Oil Company donated 863 boxes of cores from three wells in Caldwell, Guadalupe, and Wichita counties; Shell Oil Company presented cores from four wells in Val Verde County; Sun Oil Company gave 4,672 boxes of cores from 269 wells drilled in various Texas counties; and the

United States Geological Survey contributed rock cuttings from 175 uranium-test wells drilled in Duval, Gonzales, Jim Hogg, Karnes, Live Oak, and McMullen counties.

The cuttings and cores are sources of basic information about the composition and structure of the subsurface rocks of Texas. Geologists study them in the exploration for oil, gas, uranium, and other economic mineral deposits. They also use them in environmental land-use studies, including the determination of potential waste-disposal and construction sites.

The Library, located in Building 18-B, is open for public use Monday through Friday from 8:00 a.m. to 5:00 p.m. Mr. W. R. Stearns is Supervisory Geologist; Mr. Marce L. Morrow is Administrative Clerk-in-Charge; and Mr. Harry J. Madsen is Technical Staff Assistant at the Library.

MINERAL STUDIES LABORATORY

The Mineral Studies Laboratory's chief function is the performance of chemical analysis, spectrographic analysis, and physical testing of Texas rocks and minerals. Most of the activities are in support of research studies of the Bureau of Economic Geology. A variety of materials, ranging from sulfide ores to Libyan Desert glass and sand, were analyzed or tested for Bureau projects during 1972.

The Laboratory also performed work for other divisions of The University of Texas at Austin. Services included analyses, consultations, testing, and sample preparation for faculty or staff members of the Departments of Anthropology, Art, Astronomy, and Chemical Engineering; the School

of Pharmacy; and the Texas Memorial Museum. One of the various services was the testing of ceramic pottery glazes in order to help the Department of Anthropology determine the antiquity of very old fragments of Greek pottery.

In addition, the Laboratory tested, analyzed, and evaluated samples submitted by Texas residents. Such work included the determination of humic acid and trace elements in lignites and the performance of preliminary ceramic tests on samples of Texas clays.

Mr. Daniel A. Schofield is Chemist-in-Charge, and Mr. Jim Tom Etheredge is Chemist at the Mineral Studies Laboratory. Mr. Robert M. Patton is Laboratory Assistant.

STAFF ACTIVITIES

Meetings Attended

Staff members represented the Bureau of Economic Geology at numerous scientific and professional meetings in 1972. Principal meetings attended during the year include:

American Association of Petroleum Geologists, Annual Meeting, Denver, Colorado—V. E. Barnes, L. F. Brown, Jr., C. G. Groat, J. H. McGowen, R. L. Shipman

American Association of Petroleum Geologists, Southwest Section, Annual Meeting, Midland, Texas—R. L. Shipman, W. R. Stearns, E. G. Wermund

American Commission on Stratigraphic Nomenclature, Meeting, Minneapolis, Minnesota—V. E. Barnes

American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Colorado Plateau Section, 16th Annual Mineral Symposium, Grand Junction, Colorado—C. G. Groat

American Society of Photogrammetry, Conference on Aerial Inventory and Land Planning, Cornell University, Ithaca, New York—C. G. Groat

Association of American State Geologists, Annual Meeting, Moab, Utah—W. L. Fisher, C. G. Groat

Association of Earth Science Editors, 6th Annual Meeting, Boulder, Colorado—L. J. McVey

Conference on Land Resource Management, Division of Planning Coordination, Office of the Governor, San Antonio, Texas—W. L. Fisher, R. L. Shipman

Conference on the Texas Coastal Zone, Division of Natural Resources and Environment, The University of Texas at Austin, Austin, Texas—L. F. Brown, Jr., W. L. Fisher, R. L. Shipman

Environmental Protection Agency Symposium on Information Systems, Cincinnati, Ohio—E. G. Wermund (Official representative of The University of Texas at Austin)

Forum on Energy Resources and Mineral Plant Foods, sponsored by The National Materials Policy Commission, Washington, D. C., and The University of Texas at Austin, Joe C. Thompson Conference Center, Austin, Texas—L. F. Brown, Jr., W. L. Fisher, R. L. Shipman

Geological Society of America, Annual Meeting, Minneapolis, Minnesota—V. E. Barnes, D. E. Deal, W. L. Fisher, L. E. Garner, C. G. Groat, R. A. Morton, R. L. Shipman, E. G. Wermund

Geological Society of America, Southeast Section, Annual Meeting, Tuscaloosa, Alabama—W. L. Fisher

Governor's Workshop on Intergovernmental Relations and Regional Planning, San Antonio, Texas—R. L. Shipman

Gulf Coast Association of Geological Societies, Annual Meeting, Corpus Christi, Texas—L. F. Brown, Jr., L. E. Garner, J. W. Macon, J. H. McGowen, R. L. Shipman

International Conference on Remote Sensing in Arid Lands, Annual Meeting, Tucson, Arizona—P. J. Cannon

International Geological Congress, 24th, Montreal, Canada—V. E. Barnes

Interstate Oil Compact Commission, Annual Meeting, Houston, Texas—W. L. Fisher, W. R. Stearns; and Midyear Meeting, Hot Springs, Arkansas—W. R. Stearns

Marine Technology Society, Conference on Tools for Coastal Zone Management, Washington, D. C.—C. G. Groat

Meteoritical Society, Annual Meeting, University of Chicago, Chicago, Illinois—V. E. Barnes

National Association of Geology Teachers and AGI Earth Science Teacher Preparation Project, Minneapolis, Minnesota—D. E. Deal

National Speleological Society, Annual Meeting, White Salmon, Washington—D. E. Deal

Oklahoma Environmental Institute, Oklahoma State University, Stillwater, Oklahoma—L. F. Brown, Jr.

Pipeliners Club, Meeting, Houston, Texas—W. L. Fisher

Secretary of State's Advisory Subcommittee on the 1972 United Nations Conference on the Human Environment, Hearing, Houston, Texas—W. L. Fisher, R. L. Shipman

SKYLAB Earth Resources Experiment Package (EREP) Principal Investigators Conference, sponsored by NASA, Manned Spacecraft Center, Houston, Texas—P. J. Cannon

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

Southern Interstate Nuclear Board, Annual Meeting, Austin, Texas—W. L. Fisher

Southern Plains Region CLOUDTAP Conference, sponsored by Texas Water Development Board, Oklahoma State Department of Agriculture, and Texas Water Conservation Association, Dallas, Texas—P. J. Cannon, R. L. Shipman

Southwest Center for Urban Research, Meeting, Houston, Texas—R. L. Shipman (representing the Bureau of Economic Geology)

Texas Academy of Science, Annual Meeting, Southwest Texas State University, San Marcos, Texas—L. F. Brown, Jr., R. S. Kier

Texas Advisory Committee on Conservation Education, Meetings, Austin, Texas—W. L. Fisher; Rusk, Texas—W. L. Fisher, C. G. Groat

Texas Surveyors Association, Annual Meeting, Houston, Texas—W. L. Fisher

University of Houston Beach Law Conference, Galveston, Texas—R. L. Shipman

Water, Inc., Annual Meeting, Plainview, Texas—R. L. Shipman

Lectures and Public Addresses

A measure of the interest in Bureau of Economic Geology research programs and their results is shown by the number of public lectures presented each year. These are given both within the State and throughout North America, and nearly all are presented by invitation. During the past two years Bureau staff members have given 185 such public lectures, not including lectures given by staff members as a part of regular teaching duties at UT Austin. More than half of the lectures were presented within the State and the remainder given throughout the U.S. and Canada. In addition, a few invited lectures are given each year outside of North America. Lectures are given to a wide audience, including professional societies, universities, and Federal, State, and local units of government.

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

Following are lectures given by Bureau staff members during 1972:

L. F. Brown, Jr.—Delta systems in the exploration for oil and gas: Bureau of Economic Geology Continuing Education Short Course, Corpus Christi Geological Society, Corpus Christi, Texas; Houston Geological Society, Houston, Texas; and South Texas Geological Society, San Antonio, Texas.

—Environmental geology; Depositional systems in cratonic basins [American Association of Petroleum Geologists Distinguished Lectures]: Abilene Geological Society, Abilene, Texas; Alaska Geological Society, Anchorage, Alaska; Alberta Society of Petroleum Geologists, Calgary, Alberta, Canada; Amherst College (4-college series), Amherst, Massachusetts; Arizona State University, Tempe, Arizona; Coast Geological Society, Oxnard, California; Colorado State University, Ft. Collins, Colorado; Corpus Christi Geological Society, Corpus Christi, Texas; Dallas Geological Society, Dallas, Texas; Duke University, Durham, North Carolina; Edmonton Geological Society, Edmonton, Alberta, Canada; Four Corners Geological Society, Durango, Colorado; Grand Valley State College, Allendale, Michigan; Houston Geological Society, Houston, Texas; Iowa State University, Ames, Iowa; Kansas Geological Society, Wichita, Kansas; Liberal Geological Society, Liberal, Kansas; Los Angeles Basin Geological Society, Los Angeles, California; McMaster University, Hamilton, Ontario, Canada; Memphis State University, Memphis, Tennessee; Michigan Basin Geological Society, East Lansing, Michigan; Mississippi Geological Society,

Jackson, Mississippi; Montana Geological Society, Billings, Montana; North Carolina State University, Raleigh, North Carolina; Northern Arizona University, Flagstaff, Arizona; Northern California Geological Society, San Francisco, California; Northern Illinois University, DeKalb, Illinois; Northern Ohio Geological Society, Cleveland, Ohio; Northwest Geological Society, Seattle, Washington; Oklahoma City Geological Society, Oklahoma City, Oklahoma; Panhandle Geological Society, Amarillo, Texas; Pennsylvania State University, University Park, Pennsylvania; Philadelphia Geological Society, Philadelphia, Pennsylvania; Rocky Mountain Association of Geologists, Denver, Colorado; Roswell Geological Society, Roswell, New Mexico; Shreveport Geological Society, Shreveport, Louisiana; South Texas Geological Society, San Antonio, Texas; State University of New York, Binghamton, New York; University of Alabama, University, Alabama; University of British Columbia, Vancouver, British Columbia, Canada; University of Cincinnati, Cincinnati, Ohio; University of Illinois, Urbana, Illinois; University of Iowa, Iowa City, Iowa; University of Kansas, Lawrence, Kansas; University of Michigan, Ann Arbor, Michigan; University of Nebraska, Lincoln, Nebraska; University of Notre Dame, South Bend, Indiana; University of Rochester, Rochester, New York; University of Tennessee, Knoxville, Tennessee; Utah Geological Association, Salt Lake City, Utah; Wayne State University, Detroit, Michigan; West Texas Geological Society, Midland, Texas; West Virginia University, Morgantown, West Virginia; and Wyoming Geological Society, Casper, Wyoming.

—Environmental geology and genetic mapping: Technical Session, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas.

—Environmental geology program at the Bureau of Economic Geology: Association of Engineering Geologists, Arlington, Texas; Conference on the Texas Coastal Zone, Division of Natural Resources and Environment, The University of Texas at Austin, Austin, Texas; National Science Foundation Short Course on Environmental Geology, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas; Oklahoma Environmental Institute, Oklahoma State University, Stillwater, Oklahoma; Organization for the Preservation of Unblemished Shorelines (OPUS), Corpus Christi, Texas; and Texas Academy of Science, Symposium on Environmental Geology, Southwest Texas State University, San Marcos, Texas.

—Land use and the geologist: Austin Geological Society, October Meeting, Austin, Texas.

—Sedimentary structures in Pennsylvanian fluvial-deltaic systems, north-central Texas: Society



Places of Lectures: Bureau Staff, 1971-72.

of Economic Paleontologists and Mineralogists, Coastal Group, Denver, Colorado.

P. J. Cannon—Applications of radar and infrared imagery to quantitative geomorphology: International Conference on Remote Sensing in Arid Lands, Tucson, Arizona.

—Special problems in quantitative geomorphology: Geomorphology Class, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas.

—The application of quantitative geomorphology to geologic investigations: Advanced Class in Geomorphology and Photogeology, The University of Oklahoma, Norman, Oklahoma.

—The applications of radar imagery to geologic investigations: Seminar on Remote Sensing, Department of Geography, The University of Texas at Austin, Austin, Texas.

D. E. Deal—Complexities of limestone solution in the Black Hills: Departmental Seminar, Department of Earth and Planetary Sciences, University of Pittsburgh, Pittsburgh, Pennsylvania.

Glacial soils: Short course in Ocean Engineering, "Selected Topics in the Design of Fixed Offshore Platforms," College of Engineering, The University of Texas at Austin, Austin, Texas.

—Hydrology and cave development in mountainous regions of Mexico: Pittsburgh Grotto, National Speleological Society, University of Pittsburgh, Pittsburgh, Pennsylvania.

—Problems in Mid-Continent Quaternary stratigraphy: Technical Session, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas.

W. L. Fisher—Ancient and modern delta systems in the Gulf Coast Basin: University of Arizona, Tucson, Arizona.

—Approaches to land resource inventory and management: Conference on Land Resource Management, Division of Planning Coordination, Office of the Governor, San Antonio, Texas.

—Beach and shoreline processes in the Texas Coastal Zone—their relationship to land use and park planning: Report to the Texas Senate Interim Committee on the Coastal Zone, Port Aransas, Texas.

—Bureau of Economic Geology—Organization and Coastal Zone programs: Report to the Texas House of Representatives Interim Committee on Coastal and Marine Resources, Austin, Texas.

—Delta systems in the exploration for oil and gas: Bureau of Economic Geology Continuing Education Short Course, Corpus Christi Geological Society, Corpus Christi, Texas; Houston Geological Society, Houston, Texas; and South Texas Geological Society, San Antonio, Texas.

—Deltaic sedimentation: Sociedade Brasileira de Geologia, Salvador, Bahia, Brazil.

—Depositional systems in the Carrizo—Upper Wilcox of Texas and their relation to occurrence of oil and gas: South Texas Geological Society, San Antonio, Texas; and Corpus Christi Geological Society.

—Environmental geology of the Texas Coastal Zone: Conference on the Texas Coastal Zone, Division of Natural Resources and Environment, The University of Texas at Austin, Austin, Texas.

—Environmental mapping and analysis: Texas Water Development Board, Austin, Texas.

—Environmental mapping and resource management, Texas Coastal Zone: Pipeliners Club, Houston, Texas.

—Fluvial and deltaic depositional systems: Seminar, The University of Texas at Dallas, Dallas, Texas.

—Genetic approaches to facies analyses—establishing new frontiers in mature oil and gas basins: Interstate Oil Compact Commission, Annual Meeting, Houston, Texas.

—Geologic criteria in solid-waste disposal: Report to the Texas House of Representatives Solid-Waste Study Committee, Austin, Texas.

—Resource capability—the technical base for land management: Report to the Texas House of Representatives Land Use Management Committee, Houston, Texas.

—Geologic research in Texas: The University of Texas at El Paso, El Paso, Texas.

—Resource capability and environmental quality—the role of geologic monitoring: Report to the Secretary of State's Advisory Subcommittee on the 1972 United Nations Conference on the Human Environment, Houston, Texas.

—Resource use and environmental quality—toward a rational policy: Environmental Education Workshop, sponsored by Dallas Metropolitan Schools and Texas Mid-Continent Oil and Gas Association, Dallas, Texas.

—Terrigenous clastic depositional systems—genetic approach to facies analysis in mineral exploration: American Association of Petroleum Geologists, Continuing Education Short Course, Los Angeles Basin Geological Society, Los Angeles, California; and The University of Texas at Austin Extension Course, Permian Basin Graduate Center, Midland, Texas.

—The environmental trail—a geologic imperative: Geological Society of America, Southeast Section, Annual Meeting, Banquet Address, Tuscaloosa, Alabama.

—The technical base to land-use planning: American Association of Civil Engineers, Fort Worth, Texas.

—Traditions and departures in geologic and related mapping: Texas Surveyors Association,

Annual Meeting and Short Course, Houston, Texas.

—Uranium production, development, and potential in Texas: Southern Interstate Nuclear Board, Annual Meeting, Austin, Texas.

L. E. Garner—Environmental geology of the Austin, Texas, area: Geological Society of America, Annual Meeting, Minneapolis, Minnesota.

—Geology of Texas: Seventh-Grade Class, Fulmore Junior High School, Austin, Texas.

—Mineral resources of Texas: Environmental Education Workshop sponsored by the Texas Education Agency and participating universities and colleges, at Sam Houston State University, Huntsville, Texas; and East Texas State University, Commerce, Texas.

—Plans and progress of the Bureau of Economic Geology: Soil Survey Technical Work-Planning Conference, Texas A&M University, College Station, Texas.

—Rocks and minerals of Texas: Fifth-Grade Class, Hill Elementary School, Austin, Texas.

C. G. Groat—Environmental Atlas of the Texas Coastal Zone: American Society of Photogrammetry, Conference on Aerial Inventory and Land Planning, Cornell University, Ithaca, New York.

—Environmental Geologic Atlas of the Texas Coast—basic data for coastal zone management: Marine Technology Society, Conference on Tools for Coastal Zone Management, Washington, D. C.

—Mineral resources of Texas: Conservation Education Workshop, sponsored by the Texas Education Agency and participating universities, at West Texas State University, Canyon, Texas; and The University of Texas at El Paso, El Paso, Texas.

—Texas minerals—production, trends, and potential: American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Corpus Christi Mineral Subsection of Texas Coast Mining and Metals Section, Kenedy, Texas.

—The mineral industries and environmental management—levels of accommodation: American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), Colorado Plateau Section, 16th Annual Mineral Symposium, Grand Junction, Colorado.

—Van Horn Sandstone, West Texas—an Early Paleozoic alluvial-fan system: American Association of Petroleum Geologists, Annual Meeting, Denver, Colorado.

R. S. Kier—Stratigraphic interrelationships and the depositional history of the upper Marble Falls Formation, the Smithwick Formation, and the Strawn Formation: Texas Academy of Science, Stratigraphic and Structural Section, Southwest Texas State University, San Marcos, Texas.

J. H. McGowen—Delta systems in the exploration for oil and gas: Bureau of Economic Geology Continuing Education Short Course, Corpus Christi Geological Society, Corpus Christi, Texas; and South Texas Geological Society, San Antonio, Texas.

—Relation between Texas barrier islands and Late Pleistocene depositional history: American Association of Petroleum Geologists, Annual Meeting, Denver, Colorado.

—The significance of changes in shoreline features along the Texas Gulf Coast: Gulf Coast Association of Geological Societies, Annual Meeting, Corpus Christi, Texas.

R. A. Morton—Evolution of tidal deltas along a tide dominated shoreline: Geological Society of America, Annual Meeting, Minneapolis, Minnesota.

R. L. Shipman—The potentials of nuclear and thermonuclear energy: Panel Discussion on Nuclear, Thermonuclear, Thermal, and Solar Energy of the Forum on Energy Resources and Mineral Plant Foods, sponsored by The National Materials Policy Commission, Washington, D.C., and The University of Texas at Austin, Joe C. Thompson Conference Center, Austin, Texas.

—The University of Texas land use research: Conference on Land Resource Management, Division of Planning Coordination, Office of the Governor, San Antonio, Texas.

E. G. Wermund—Determining the significant environmental geologic units in a thick carbonate terrain of southwest Texas: Geological Society of America, Annual Meeting, Minneapolis, Minnesota.

Legislative Committee Hearings

Texas Senate Interim Coastal Zone Study Committee, Senator A. R. Schwartz, Chairman: Port Aransas—W. L. Fisher (testimony given), R. L. Shipman; Galveston—R. L. Shipman; Austin—R. L. Shipman (testimony given).

Texas Interim Committee on Environmental Matters, Senator Murray Watson, Chairman: Austin—W. L. Fisher (testimony given), R. L. Shipman.

Texas House of Representatives Interim Committee on Coastal and Marine Resources, Representative Ray Lemmon, Chairman: Austin—W. L. Fisher (testimony given); Houston—R. L. Shipman.

Texas House of Representatives Interim Land Use Management Committee, Representative Bill Clayton, Chairman: Houston—W. L. Fisher (testimony given); Austin—R. L. Shipman (testimony given).

Texas House of Representatives Interim Study Committee on Natural Resources, Representative John Allen, Chairman: Plainview—R. L. Shipman.

Texas House of Representatives Interim Solid Waste Study Committee, Representative Vernon Stewart, Chairman: Austin—W. L. Fisher (testimony given).

Committee Service and Offices

V. E. Barnes—American Commission on Stratigraphic Nomenclature: Member representing Association of American State Geologists.

—Austin Geological Society: Delegate to House of Delegates, American Association of Petroleum Geologists.

L. F. Brown, Jr.—Interagency Council on Natural Resources and the Environment: Land Resource Management Advisory Committee; Chairman, Subcommittee on Land Use Information.

—The University of Texas at Austin: Committee on Evaluation of Environmental Curriculum of the Department of Geological Sciences.

D. E. Deal—National Speleological Society: Board of Directors.

G. K. Eifler, Jr.—Austin Geological Society: Technical Programs Committee, 1971-1972.

W. L. Fisher—American Institute of Professional Geologists, Texas Section; Environmental Geology Committee, Chairman.

—Association of American State Geologists: Environmental Geology Committee; Governmental Liaison Committee; Offshore Drilling Committee.

—Austin Geological Society: Program Chairman, 1972-1973.

—Geological Society of America, Committee on Environment and Public Policy.

—Interagency Council on Natural Resources and the Environment.

—Society of Engineering Geologists: Engineering Map Committee.

—Texas Advisory Committee on Conservation Education, Chairman.

—Texas Mapping Advisory Committee.

—The University of Kansas: Advisory Board of Geology Associates.

—The University of Texas at Austin: Center for Research in Water Resources, Advisory Committee; Council for Advanced Transportation Studies, Executive Committee; Geology Foundation, Executive Committee; Publications Committee, Chairman; Sponsored Research Policy, ad hoc Committee; Energy Research Group.

L. E. Garner—Austin Geological Society, Public Relations Committee, 1972-1973.

R. M. Girard—Austin Geological Society: Publications Committee, 1971-1972; 1972-1973.

C. G. Groat—Austin Geological Society: Entertainment Committee, 1972-1973.

—The University of Texas at Austin: Department of Geological Sciences, Awards Committee.

L. J. McVey—Association of Earth Science Editors: Committee on Reference Citations.

R. L. Shipman—American Institute of Professional Geologists, Texas Section: Executive Committee, 1972-1973; Screening Committee, 1972; Legislative and Governmental Committee, Chairman, 1973.

E. G. Wermund—Interagency Council on Natural Resources and the Environment, Natural Resources Information System Committee.

Other Professional Responsibilities

L. F. Brown, Jr.—American Association of Petroleum Geologists Distinguished Lecturer for 1972.

—Interviewee on television program; topic was "Environmental Geologic Atlas of the Texas Coastal Zone": Station KLRN, Southwest Texas Educational Television Council, Austin, Texas.

—Panelist at Panel Discussion on Coal, Forum on Energy Resources and Mineral Plant Foods, sponsored by The National Materials Policy Commission, Washington, D. C., and The University of Texas at Austin, Joe C. Thompson Conference Center, Austin, Texas.

W. L. Fisher—Co-convenor, Forum on Energy Resources and Mineral Plant Foods, sponsored by The National Materials Policy Commission, Washington, D. C., and The University of Texas at Austin, Joe C. Thompson Conference Center, Austin, Texas.

—Lecturer, American Association of Petroleum Geologists Continuing Education Program.

J. H. McGowen—Program Chairman, "Detrital Sedimentation and Diagenesis," at American Association of Petroleum Geologists, Annual Meeting, Denver, Colorado.

—Participated in Eco-Conference, "Environmental Action Now," sponsored by Capital Area Planning Council, Concordia College, Huston-Tillotson College, and St. Edward's University, Austin, Texas.

R. L. Shipman—Chairman, Conference on the Texas Coastal Zone, Division of Natural Resources and Environment, The University of Texas at Austin, Austin, Texas.

—Panel Member, 16th Conference of the United States National Commission for UNESCO, "The Environment: Man on Trial," Houston, Texas.

E. G. Wermund—Represented Bureau of Economic Geology on the Water Quality Advisory Board for the Housing and Urban Development (HUD) San Antonio New Town environmental impact statement.

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