CHARLES J. MANKIN

OKLAHOMA GEOLOGY NOTES

$2.00 per year
.25 per copy

OKLAHOMA
GEOLOGICAL SURVEY
NORMAN, OKLAHOMA

VOLUME 22, NUMBER 3

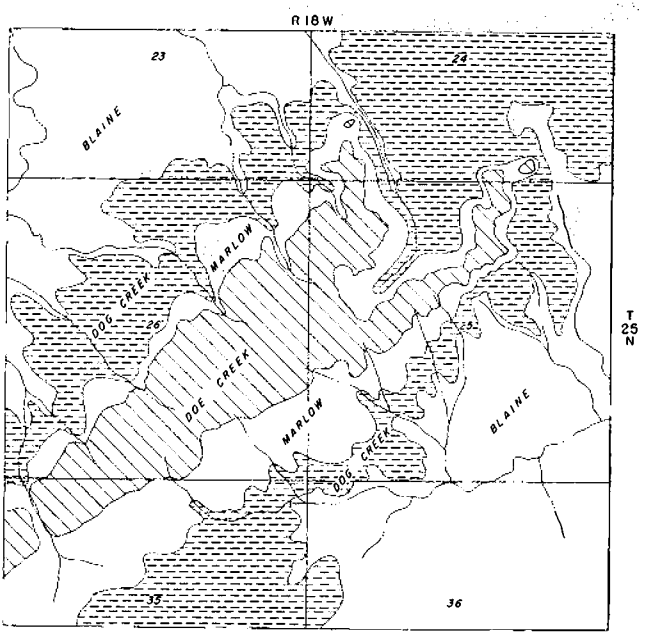
MARCH 1962

Doe Creek Limestone

The cover photograph is a vertical view of one of the larger outcrop areas of the sandy Doe Creek Limestone Member of the Marlow Formation in Woodward County. The Marlow is the basal member of the Whitehorse Group (Guadalupean). The area, two miles square, includes the southern half of sections 23 and 24, the whole of sections 25 and 26, and the northern half of sections 35 and 36, T. 25 N., R. 18 W. Within the area are outcrops of the Blaine Formation and overlying Dog Creek Shale of the El Reno Group (Guadalupean).

The northeastward-trending butte, which forms the drainage divide diagonally across the area, is capped by the resistant Doe Creek Limestone Member. The Doe Creek is unique in that it forms a discontinuous linear outcrop pattern normal to the regional strike. It has been mapped, by Alton O. Riley, from sec. 5, T. 22 N., R. 20 W. (Woodward County) to sec. 20, T. 28 N., R. 16 W. (Woods County). Beyond these points it is covered by the Rush Springs Sandstone (upper part of Whitehorse Group).

Although the Doe Creek Member does not resemble a limestone, it contains 65 percent or more calcium carbonate. The rock is composed of coarse- to fine-grained sand with marine fossile and oölites.



It is uniformly cross-bedded and erodes to a rough, vuggy surface. It has a distinctive orange-pink color and is a firm, resistant rock because of the lime cement. In cross section the deposit is characteristically channel-like and interfingers laterally with the normal Marlow sandstones. Because of this and because of its elongate linear trend and its composition, it is probable that the Doe Creek is a channel sediment that was deposited in a marine strait or a tidal outlet.

The gypsum members of the Blaine Formation (in ascending order: Medicine Lodge, Nescatunga, Shimer, and Haskew) appear as white bands in the escarpments flanking the valleys in the upper left and lower right parts of the picture. The Blaine is overlain by the Dog Creek Shale and the contact can be traced only by field observation. The Dog Creek is overlain by the Marlow Formation; the Marlow is a soft friable sandstone forming low rolling hills. Because of creep, it covers the Marlow-Dog Creek contact, which can be mapped in the field only where it is exposed by recent gullying.

A. J. M.

Oklahoma Section of National Association of Geology Teachers

The National Association of Geology Teachers (NAGT), a vigorous and rapidly growing organization, seeks, in the words of its constitution, "to foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the earth sciences, and to disseminate knowledge in this field to the general public." Although several other societies are also keenly interested in these objectives and likewise promote them in various ways, NAGT is the only organization devoted primarily to geological education. It welcomes into membership any person genuinely interested in any phase of its work.

From modest beginnings in 1937, the Association has grown to a present membership in excess of 700, distributed throughout ten regional sections representing nearly all of the 50 states, as well as the District of Columbia and British Columbia. The purposes of the Association are implemented primarily by the members through the framework of the various sections. The National Association is affiliated with the American Geological Institute, the American Academy of Arts and Sciences, and the Geological Society of America, and holds its national meetings with this latter organization. NAGT also publishes semi-annually the *Journal of Geological Education*, soon to be issued quarterly.

On December 15, 1961, a small group of interested people met in Stillwater, Oklahoma, in connection with the annual meetings of the Oklahoma Academy of Science, and decided upon the formation of an Oklahoma Section of the National Association of Geology Teachers.

A set of temporary by-laws was adopted, and Edward C. Stoever, Jr., of The University of Oklahoma, was elected acting president. Plans were made to organize formally the section during the fall, 1962, meetings of the Oklahoma Academy of Science, to be held in Stillwater. During the current year the Oklahoma membership will be expanded, and a program planned for the organizational meeting.

Under the membership rules many persons in addition to teachers qualify for membership by reason of their interest in, "disseminating geological information." Annual dues of $3.00, of which $0.50 is payable to the section with which a member is affiliated, include a subscription to both the *Journal of Geological Education* and to *GeoTimes,* the publication of the American Geological Institute. Interested parties are urged to get in touch with Edward C. Stoever, Jr., School of Geology, The University of Oklahoma, Norman, Oklahoma.

Reference

Fryxell, Fritiof, 1961, National Association of Geology Teachers: GeoTimes, July-August, vol. 6, no. 1, p. 17-23, 43, 8 illus., approx. 7 refs.

E. C. S., Jr.

New Survey Publications

In February 1962 the Oklahoma Geological Survey issued two circulars.

Circular 49, *Permian plant microfossils from the Flowerpot Formation, Greer County, Oklahoma,* was written by L. R. Wilson, professor of geology, The University of Oklahoma. The report is a description of a partial assemblage of spores and pollen taken from an olive-gray shale bed, approximately 12 inches thick, in a stratigraphic section that is otherwise unfossiliferous. The assemblage consists of 23 genera and 27 species of which 9 genera and 22 species are new. This circular has 50 pages, 2 figures, and 3 plates. The plates comprise 32 color illustrations of representatives of 20 genera. Price: $1.00 paper bound.

Circular 58, *Correlation of Paleozoic rocks from Coal County, Oklahoma, to Sebastian County, Arkansas,* was prepared by Sherwood E. Frezon, geologist for the U. S. Geological Survey, Denver, Colorado. The report presents data concerning the extent and lithology of the Paleozoic rock units in the subsurface in the western part of the Arkoma basin and the correlation of these rocks with formations in the Arbuckle Mountains and the Ozark uplift. In the pocket of this 53-page circular are two regional cross sections, one showing correlation of all Paleozoic rocks and the other showing correlation of only the pre-Woodfrd rocks. Lithologic and electric logs for 17 selected wells were used in making the cross sections, each of which has a vertical scale of 1 inch=200 feet and a horizontal scale of 1 inch=6 miles. Price: $2.00 cloth bound; $1.25 paper bound.

BIBLIOGRAPHY AND INDEX OF OKLAHOMA GEOLOGY 1961

Prepared by KENNETH S. JOHNSON

Bibliography—pages 57-69
Index—pages 69-78

BIBLIOGRAPHY

Amsden, T. W., 1961, Stratigraphy of the Frisco and Sallisaw Formations (Devonian) of Oklahoma: Okla. Geol. Survey, Bull. 90, 121 p., 26 figs., 13 pls. Surface study in Sequoyah County and Arbuckle Mountains region.

Arkansas Geological and Conservation Commission, *see* University of Oklahoma, School of Geology, and others.

Ash, S. R., 1961, Bibliography and index of conodonts, 1949-1958: Micropaleontology, vol. 7, p. 213-244, 1 fig., 1 table.

Atkins, R. L., 1961, Oklahoma, *in* International Oil and Gas Development; Year Book 1961 (review of 1960): Internat. Oil Scouts Assoc. and Soc. Petroleum Engineers AIME, vol. 31, pt. 1, p. 232-255. Discovery and exploratory well records.

Bado, J. T., 1961a, Geology of the Southwest Dover Field, Kingfisher County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 166-171, 3 figs., 1 table.

———— 1961b, North Okarche Field, Kingfisher County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 113-117, 2 figs., 1 table.

Bailey, O. F., and Graft, R. D., 1961, Soil survey of Jackson County, Oklahoma: U. S. Dept. Agriculture, Soil Conserv. Service, series 1958, no. 4, 67 p., 24 figs., 10 tables, 54 aerial photos.

Barby, B. E., 1961a, Panhandle gas hunt sets hot pace: Oil and Gas Jour., vol. 59, no. 22 (May 29), p. 210-217 incl. ads, 4 figs., 1 table.

———— 1961b, Reserves may spell success for the Panhandle: Oil and Gas Jour., vol. 59, no. 23 (June 5), p. 128-130, 2 figs.

Beghtel, F. W., *see* Furnish, W. M., and Beghtel, F. W.

Bell, R. J., 1961, Pre-Pennsylvanian subsurface geology of the East Lindsay area, Garvin County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 11, no. 7 (Mar.), p. 2-16, 11 figs.

Bell, Walton, 1961, Surface geology of the Muskogee area, Muskogee County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 12, no. 3 (Nov.), p. 2-21 incl. ads, 3 figs. Pennsylvanian stratigraphy and surface structure.

Berryhill, R. A., 1961, Subsurface geology of south-central Pawnee County, Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 12, no. 4 (Dec.), p. 2-18 incl. ads, 8 figs., 1 table.

Bike, P. B., 1961, Watchful waiting in Ouachitas may end—pending outcome of key test: Oil and Gas Jour., vol. 59, no. 14 (Apr. 3), p. 266-268, 3 figs. Pushmataha County.

Bowman, G. A., 1961, Some drilling programs and problems in the Arkoma basin, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 223-234, 6 figs.

Branan, C. B., Jr., 1961, Tectonics of the Ouachita Mountains of Oklahoma and Arkansas, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 3-28, 20 figs.

Branson, C. C., 1961a, Arkoma basin, a Middle Pennsylvanian geosyncline, *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma: Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 76-78, 3 figs.

———— 1961b, Code of stratigraphic nomenclature: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 317-322. Review of code published by American Commission on Stratigraphic Nomenclature.

———— 1961c, New records of the scyphomedusan *Conostichus*: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 130-138, 1 fig., 3 pls. Pennsylvanian jellyfish in Midcontinent region.

———— 1961d, Pennsylvanian System of the Arkoma basin and of the Midcontinent platform, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 177-194, 11 figs.

———— 1961e, Productoidea in Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 161-164. Review of Geol. Soc. America, Mem. 81, by Muir-Wood and Cooper.

———— 1961f, *Reticulatia* in the Belle City Limestone: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 128, 1 fig. Pennsylvanian productid from Seminole County.

———— 1961g, Trilobite from the Francis Shale near Ada: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 179-180, 2 figs. Pennsylvanian *Ameura sangamonensis* from Pontotoc County.

———— 1961h, Two new brachiopod genera from Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 232. *Gacina* from the Moorefield Formation (Mississippian), Cherokee County, and *Pakistania* from the Marlow Formation (Permian), Woods County.

Branson, C. C., and Jordan, Louise, 1961, Index to geologic mapping in Oklahoma: Okla. Geol. Survey. Map I, Surface Mapping, 1901-1960; Maps II-V, Subsurface Mapping, 1940-1960. Bibliography and index.

Brazelton, W. F., *see* Reeves, C. C., Jr., and Brazelton, W. F.

Burbridge, P. P., *see* Felix, C. J., and Burbridge, P. P.

Burwell, A. L., 1961, A somewhat different clay: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 189-190, 2 tables. Properties of clay in Batesville Sandstone (Mississippian), Ottawa County.

Busch, D. A., 1961, Make the most of those electrical logs if you want to find strat traps: Oil and Gas Jour., vol. 59; no. 28 (July 10), p. 162-163, 166-167, 4 figs. East-west cross section; T. 7 N., Rs. 6 to 15 E., Savanna Formation (Pennsylvanian) to Caney Shale (Mississippian).

Castagno, J. L., *see* Johnston, K. H., and Castagno, J. L.
Chandler, P. P., 1961, Limestone-dolomite facies of the Upper Wolfcampian of north-central Oklahoma: Okla. Acad. Science, Proc., 1960, vol. 41, p. 108-109. Surface study in Noble, Payne, and Pawnee Counties.
Cobban, W. A., *see* Gill, J. R., and Cobban, W. A.
Cronoble, W. R., 1961, Wreford Limestone, Kay County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 255-259, 1 pl. Petrography of Permian limestone being mined to allow LPG storage.
Culp, C. K., Jr., 1961, Stratigraphic relations of the Sycamore Limestone (Mississippian) in southern Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 11, no. 10 (June), p. 7-18, 8 figs. Hollis basin and southern part of Anadarko basin.
Cunningham, B. J., 1961, Stratigraphy Oklahoma-Texas Panhandles, *in* Oil and gas fields of the Texas and Oklahoma Panhandles: Panhandle Geol. Soc., p. 45-60, 2 figs. Precambrian through Quaternary.
Curtis, N. M., Jr., 1961, Annotated bibliography and index of Oklahoma geology 1960: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 55-81.
Dahlgren, E. G., 1961, 10 'million-dollar' tests in Anadarko basin: Oil, vol. 21, no. 7 (July), p. 21.
Deaton, W. M., and Haynes, R. D., 1961, Helium production at the Bureau of Mines, Okla., plant: U. S. Bur. Mines, Info. Circ. 8018, 16 p., 9 figs., 4 tables. Keyes plant, Cimarron County.
Diggs, W. E., 1961, Structural framework of the Arkoma basin, *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma: Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 62-65, 3 figs.
Dodd, C. G., *see* Ham, W. E., Dodd, C. G., and Ray, Satyabrata.
Doerr, A. H., 1961, Coal mining and landscape modification in Oklahoma: Okla. Geol. Survey, Circ. 54, 48 p., 13 figs.
Dowds, J. P., 1961, Mathematical probability is an oil-search tool: World Oil, vol. 153, no. 4 (Sept.), p. 99-102, 105-106, 9 figs., 1 table. Fields in Beaver, Cimarron, and Harper Counties are used as examples.
Duane, D. B., 1961, Heavy-mineral segregation in Springer sandstones in Anadarko and Ardmore basins, Oklahoma: Amer. Assoc. Petroleum Geologists, Bull., vol. 45, p. 556-560, 3 figs. 1 table. A barrier confined topaz to the Anadarko basin and staurolite to the Ardmore basin during part of the Pennsylvanian Period.
Eddleman, M. W., 1961, Tectonics and geologic history of the Texas and Oklahoma Panhandles, *in* Oil and gas fields of the Texas and Oklahoma Panhandles: Panhandle Geol. Soc., p. 61-68, 2 figs.
Ellzey, R. T., Jr., 1961, Mississippian rocks on the western flank of the Oklahoma City uplift, Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 11, no. 8 (Apr.), p. 2-15, 9 figs.
England, R. L., 1961a, Subsurface study of the Hunton Group (Silurian-Devonian) in the Oklahoma portion of the Arkoma basin: Okla.

City Geol. Soc., Shale Shaker, vol. 12, no. 2 (Oct.), p. 2-20 incl. ads, 8 figs., 1 table.

———— 1961b, The Hunton Group of the Oklahoma portion of the Arkoma basin, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 79-100, 3 figs., 5 pls., 1 table. Subsurface study of Silurian-Devonian strata.

Enright, R. J., 1961, Marietta basin dazzles gas hunters: Oil and Gas Jour., vol. 59, no. 6 (Feb. 6), p. 82-84. Southeast Marietta Field, Love County.

Fay, R. O., 1961a, *Agmoblastus,* a new Pennsylvanian blastoid from Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 278-280, 1 pl. *A. dotti* from the Hogshooter Limestone, Washington County.

———— 1961b, Bibliography and index of conodonts, 1949-1958, a review: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 202-203. Conodonts in Oklahoma.

———— 1961c, Geologic map of Blaine County, Oklahoma. Advance publication of geologic map to accompany Okla. Geol. Survey, Bull. 89, in press.

Fay, R. O., *see* Reimann, I. G., and Fay, R. O.

Felix, C. J., and Burbridge, P. P., 1961, *Pteroretis,* a new Mississippian spore genus: Micropaleontology, vol. 7, p. 491-495, 4 figs., 1 pl., 1 table. *Acanthotriletes uncinatus* from the Chester, Beaver County.

Fischer, A. G., 1961, Stratigraphic record of transgressing seas in light of sedimentation on Atlantic Coast of New Jersey: Amer. Assoc. Petroleum Geologists, vol. 45, p. 1656-1666, 5 figs., 1 table. Compared with Cherokee (Pennsylvanian) cyclothems of northeastern Oklahoma.

Fort Smith Geol. Soc., *see* Tulsa Geol. Soc. and Fort Smith Geol. Soc.

Fraser, C. D., *see* Pirson, S. J., and Fraser, C. D.

Frezon, S. E., 1961, Correlation of pre-Des Moines rocks from the Arbuckle Mountains [Okla.] to western Arkansas, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 39-59, 3 figs. Stratigraphy of Oil Creek (Ordovician) through Atoka (Pennsylvanian) strata.

Frezon, S. E., and Schultz, L. G., 1961, Possible bentonite beds in the Atoka Formation in Arkansas and Oklahoma, *in* Geological Survey research 1961: U. S. Geol. Survey, Prof. Paper 424-C, p. 82-84, 1 fig., 3 tables.

Furnish, W. M., and Beghtel, F. W., 1961, A new Desmoinesian ammonoid genus from Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 289-293, 1 fig. Classification of *Gastrioceras venatum* Girty, 1911, as new genus *Wewokites* Furnish and Beghtel. Fossils from the Wewoka Formation.

Gill, J. R., and Cobban, W. A., 1961, Stratigraphy of lower and middle parts of the Pierre Shale, northern Great Plains, *in* Geological Survey research 1961: U. S. Geol. Survey, Prof. Paper 424-D, p. 185-191, 4 figs., 1 table. Includes paleogeographic maps showing pre-erosion distribution of lower and middle Pierre Shale equivalents (Late Cretaceous) in Oklahoma.

Graft, R. D., *see* Bailey, O. F., and Graft, R. D.
Grandone, Peter, *see* McDougal, R. B., and Grandone, Peter.
————, *see* McDougal, R. B., Grandone, Peter, and Ham, W. E.
Guerrero, E. T., and Stewart, F. M., 1961, How to find original oil in place by the volumetric method: Oil and Gas Jour., vol. 59, no. 7 (Feb. 13), p. 89-91, 3 figs., 4 tables. Example used is Northwest Triume Field, Tillman County.
Guest, M. E., *see* Wilson, L. R., and Guest, M. E.
Gutschick, R. C., Weiner, J. L., and Young, Leighton, 1961, Lower Mississippian arenaceous Foraminifera from Oklahoma, Texas, and Montana: Jour. Paleontology, vol. 35, p. 1193-1221, 5 figs., 4 pls., 1 table. Fossils from the Welden Limestone, Pontotoc County.
Ham, W. E., 1961a, Andesite tuff and dacite basement rocks of northeastern Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 139-149, 2 figs., 2 pls., 1 table. Petrography of pre-Upper Cambrian extrusive igneous rocks, Craig County.
———— 1961b, Correlation of pre-Stanley strata in the Arbuckle-Ouachita Mountain region: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 204-224, 1 fig., 1 table.
———— 1961c, New gypsum plant to open soon: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 193. Plant will quarry Cloud Chief gypsum (Permian) near Weatherford, Custer County.
———— 1960d, Oklahoma, *in* Gillson, J. L., and others, The carbonate rocks, *in* Industrial minerals and rocks: New York, Amer. Inst. Mining Metall. Engineers, p. 178-180, 1 fig. Industrial uses of limestone and dolomite in Oklahoma.
———— 1961e, Oklahoma Bryozoa under study: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 334. Bryozoans from the Oil Creek Formation (Ordovician) in the Arbuckle Mountains are being studied.
Ham, W. E., and Jordan, Louise, 1961, A Permian stratigraphic section in west-central Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 4-9, 1 fig. Composite section of Flowerpot Shale through Quartermaster Formation.
Ham, W. E., Dodd, C. G., and Ray, Satyabrata, 1961, Field trip to Wichita Mountain area, Oklahoma, *in* Clays and clay minerals: National conf. on clays and clay minerals, 8th, Proc., vol. 8, p. 1-10, 4 figs. Field descriptions and lab analyses of clays derived by alteration of igneous rocks.
Ham, W. E., Mankin, C. J., and Schleicher, J. A., 1961, Borate minerals in Permian gypsum of west-central Oklahoma: Okla. Geol. Survey, Bull. 92, 77 p., 20 figs., 3 pls., 8 tables. Probertite, ulexite, and priceite are replacement nodules in the Blaine and Cloud Chief Formations, Custer and Blaine Counties.
Ham, W. E., *see* McDougal, R. B., Grandone, Peter, and Ham, W. E.
Hamric, B. E., 1961, Hoffman gas area, Okmulgee and McIntosh Counties, Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 11, no. 9 (May), p. 2-15, 10 figs.
Hart, D. L., Jr., 1961a, Fluctuations of water levels in wells: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 41-47, 8 figs. Examples cited are in Oklahoma.

———— 1961b, Ground water in the alluvium of Beaver Creek basin, Oklahoma: U. S. Geol. Survey open-file report, 13 p., 1 fig.

Harvey, R. L., 1961, Subsurface geology of a portion of southern [central] Hughes County, Okla.: Okla. City Geol. Soc., Shale Shaker, vol. 11, no. 5 (Jan.), p. 2-18 incl. ads, 10 figs., 2 tables.

Haynes, R. D., *see* Deaton, W. M., and Haynes, R. D.

Hendricks, T. A., 1961, Abnormal bedding in the Savanna Sandstone and Boggy Shale in southeastern Oklahoma, *in* Geological Survey Research 1961: U. S. Geol. Survey, Prof. Paper 424-B, p. 114-117, 2 figs. Surface study of Pennsylvanian strata in Pittsburg County.

Herrmann, L. A., 1961, Structural geology of Cement-Chickasha area, Caddo and Grady Counties, Oklahoma: Amer. Assoc. Petroleum Geologists, Bull., vol. 45, p. 1971-1993, 17 figs., 3 tables.

Hills, J. M., 1961, Correlation of Permian formations of North America: Amer. Assoc. Petroleum Geologists, Bull., vol. 45, p. 1412-1414. Comments on correlations by Dunbar and others, 1960 (Geol. Soc. America, Bull., vol. 71, p. 1763-1806), including some reference to Oklahoma formations.

Hyden, H. J., 1961, Distribution of uranium and other metals in crude oils, *in* Uranium and other metals in crude oils, pt. B: U. S. Geol. Survey, Bull. 1100, p. 17-99, 39 figs., 3 pls., 8 tables. Includes 11 analyses of oil from northeastern and central Oklahoma.

Ireland, H. A., 1961, New phosphatic brachiopods from the Silurian of Oklahoma: Jour. Paleontology, vol. 35, p. 1137-1142. *Artiotreta parva* and *Acrotretella siluriana* from the Chimneyhill Limestone, Murray and Carter Counties.

Jenny, W. P., 1961, Many old, updated magnetic prospects prove to be valid: World Oil, vol. 153, no. 6 (Nov.), p. 124-127, 130, 9 figs. Includes magnetic survey map of the Cumberland Field, Marshall and Bryan Counties.

Joensuu, Oiva, *see* Marshall, R. R., and Joensuu, Oiva.

Johnston, K. H., and Castagno, J. L., 1961, Developments in waterflooding and pressure maintenance in Osage County, Oklahoma, oilfields, 1961: U. S. Bur. Mines, Info. Circ. 8038, 38 p., 17 figs., 5 tables. Statistics and several electric logs.

Jordan, Louise, 1961a, Helium from Keyes gas area, Cimarron County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 183-184. Statistics.

———— 1961b, LPG cavern in Wreford Limestone, Kay County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 250-255, 5 figs. Storage in Permian limestone; includes electric and lithologic logs.

———— 1961c, LPG storage in Flowerpot salt, Beaver County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 34-35, 1 fig. Includes gamma ray and lithologic logs of Flowerpot and Blaine Formations (Permian).

———— 1961d, Natural gas in Oklahoma, 1959: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 22. Statistics.

———— 1961e, Natural gas in Pushmataha County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 323-326, 1 fig. History of development.

———— 1961f, 1960 statistics of Oklahoma's petroleum industry: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 198-201, 4 tables.
———— 1961g, Oil and gas in Kingfisher County, Oklahoma: Kansas-Oklahoma Oil Reporter, vol. 3, no. 10 (Jan.), p. 38-43 incl. ads, 4 figs. Development and geology.
———— 1961h, Salt in Wellington Formation, Grant County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 272-274, 2 figs. Permian formation contains salt in the subsurface.
———— 1961i, Underground LPG storage in Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 95-96, 2 tables. Statistics.
Jordan, Louise, *see* Branson, C. C., and Jordan, Louise.
————, *see* Ham, W. E., and Jordan, Louise.
Kornfeld, J. A., 1961, Deeper gas pays spur Arkoma basin activity: World Oil, vol. 153, no. 2 (Aug. 1), p. 94-96, 2 figs.
Lahoud, J. A., 1961, Cartersville gas field [Le Flore Co., Okla.], *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma: Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 51-53, 2 figs.
Laudon, R. B., 1961, Carboniferous stratigraphy of the Ouachita Mountains, *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma: Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 72-75, 2 figs.
Leonard, A. R., 1960, Ground water in Oklahoma: Oklahoma Water Resources Board, 12 p., 6 figs.
Leonard, A. R., *see* Ward, P. E., and Leonard, A. R.
Levinson, S. A., 1961, New species and genera of Bromide (Middle Ordovician) ostracodes of Oklahoma: Micropaleontology, vol. 7, p. 359-364, 1 pl., 1 table. Ostracodes from Carter County.
Lucas, E. L., 1961, Tourmaline in Pennsylvanian sediments of the Ardmore basin: Okla. Acad. Science, Proc. 1960, vol. 41, p. 118-121, 6 figs.
Mackey, F. L., 1961, Developments in Oklahoma in 1960: Amer. Assoc. Petroleum Geologists, Bull., vol. 45, p. 802-815, 4 figs., 13 tables. Statistics.
Madeley, H. M., *see* Pitt, W. D., Madeley, H. M., and Robertson, J. R.
Mairs, Tom, 1961, Subsurface study of the Fernvale-Viola in the Oklahoma portion of the Arkoma basin, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 67-77, 3 figs.
Malloy, J. M., 1961, Fifty-third annual report of mines and mining of Oklahoma: Dept. Chief Mine Inspector, 41 p. Statistics.
Mankin, C. J., *see* Ham, W. E., Mankin, C. J., and Schleicher, J. A.
————, *see* Young, L. M., and Mankin, C. J.
Marshall, R. R., and Joensuu, Oiva, 1961, Crystal habit and trace element content of some galenas: Economic Geology, vol. 56, p. 758-771, 2 figs., 3 tables. Includes analyses of galena collected in the Picher district, Ottawa County.
McClain, K. M., and Planalp, R. N., 1961, General geology of the Red Oak Gas Area, Latimer and Le Flore Counties, Oklahoma, *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma:

Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 45-50, 4 figs., 1 table.

McDaniel, Gary, 1961, Surface stratigraphy of the Hartshorne Formation, Le Flore, Latimer and Pittsburg Counties, Oklahoma, *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma: Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 66-71, 3 figs.

McDougal, R. B., and Grandone, Peter, 1961, The mineral industry of Oklahoma in 1960: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 282-285, 1 table. Production figures on metals, nonmetals, and mineral fuels.

McDougal, R. B., Grandone, Peter, and Ham, W. E., 1961, The mineral industry of Oklahoma: U. S. Bur. Mines, Minerals Yearbook 1960, p. 803-828, 3 figs., 21 tables. Production figures on metals, nonmetals, and mineral fuels.

McElroy, M. N., 1961, Isopach and lithofacies study of the Desmoinesian Series of north-central Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 12, no. 1 (Sept.), p. 2-22 incl. ads, 15 figs. Subsurface stratigraphy.

Meinders, H. C., and others, 1961, Soil survey of Texas County, Oklahoma: U. S. Dept. Agriculture, Soil Conserv. Service, ser. 1958, no. 6, 60 p., 21 figs., 11 tables, 120 aerial photos.

Moses, P. L., 1961, Geothermal gradients now known in greater detail: World Oil, vol. 152, no. 6 (May), p. 79-82, 1 fig., 1 table. Includes map of Oklahoma with contours in degrees per 100 feet.

Murphey, J. J., *see* Pate, C. O., Murphey, J. J., and Orth, R. P.

Myers, A. J., 1961, The Upper Room of Alabaster Cavern, Woodward County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 26-32, 6 figs. Cave in the Blaine Formation (Permian).

National Petroleum Bibliography, 1961a, Geological maps—Oklahoma, oil and gas: National Petroleum Bibliography, Amarillo, Texas, 329 p. Subsurface structure and isopach maps of oil and gas fields in Oklahoma submitted to the Oil and Gas Division, Oklahoma Corporation Commission (1955-1961 hearings).

National Petroleum Bibliography, 1961b, Hugoton embayment-Anadarko basin yearbook: National Petroleum Bibliography, Amarillo, Texas, 250 p. Maps and statistics of selected oil and gas fields in Panhandle and extreme western Oklahoma.

Nicholson, Alex., 1961, Chimney Rock, a Permian outcrop: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 2-3, 1 fig. Flowerpot Shale, Woodward County.

Norden, J. A. E., 1961, Intercontinental detection of underground nuclear explosions in Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 261-271, 3 figs. Description of Wichita Mountains Seismological Observatory, Comanche County.

Oakes, M. C., 1961, Geologic map of Okmulgee County, Oklahoma. Advance publication of geologic map to accompany Okla. Geol. Survey, Bull. 91, in press.

Oil and Gas Journal, 1961, Deep drilling marks Oklahoma's Anadarko: Oil and Gas Jour., vol. 59, no. 50 (Dec. 11), p. 135-136, 141, 1 fig.

Orth, R. P., *see* Pate, C. O., Murphey, J. J., and Orth, R. P.

Panhandle Geological Society, 1961, Oil and gas fields of the Texas and Oklahoma Panhandles: Panhandle Geol. Soc., 264 p. Papers on Panhandle geology. Includes maps and statistics of selected fields in Oklahoma Panhandle.

Pate, C. O., Murphey, J. J., and Orth, R. P., 1961, Chemical character of surface waters of Oklahoma 1956-1957: Okla. Water Resources Board, Bull. 18, 140 p. Chemical analyses from stations on rivers and creeks in Oklahoma.

Patterson, J. R., 1961, Ordovician stratigraphy and correlations in North America: Amer. Assoc. Petroleum Geologists, Bull., vol. 45, p. 1364-1377, 12 figs. Includes Ordovician strata in Oklahoma.

Pirson, S. J., and Fraser, C. D., 1961, Revised method interprets electric logs in oil-wet rocks: The Petroleum Engineer, vol. 33, no. 7 (July), p. B 32-37, 3 figs., 3 tables. Electric logs of Springer sands (Pennsylvanian) in southern Oklahoma used as examples.

Pitt, W. D., Madeley, H. M., and Robertson, J. R., 1961, Concretionary stream bar deposits: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 301-306, 1 fig., 1 pl., 1 table. Drainage area with high percentage of calcium favors formation of concretions around organic material in small stream in Cleveland County.

Planalp, R. N., 1961, High drilling costs, varied geology fail to slow Arkoma basin growth: Oil and Gas Jour., vol. 59, no. 1 (Jan. 2), p. 124-126, 128-129, 2 figs. Cross section of Morrow and Atoka Formations (Pennsylvanian).

Planalp, R. N., *see* McClain, K. M., and Planalp, R. N.

Pollack, J. M., 1961, Significance of compositional and textural properties of South Canadian River channel sands, New Mexico, Texas and Oklahoma: Jour. Sed. Petrology, vol. 31, p. 15-37, 15 figs., 6 tables.

Ray, Satyabrata, *see* Ham, W. E., Dodd, C. G., and Ray, Satyabrata.

Reeves, C. C., Jr., 1961a, Cross-sections show Marietta basin's Pennsylvanian strata: World Oil, vol. 153, no. 6 (Nov), p. 120-121, 3 figs. (Augments Reeves, C. C., Jr., 1961b.)

———— 1961b, Facies changes are key to Marietta basin's oil future: World Oil, vol. 153, no. 5 (Oct.), p. 137-143, 3 figs. (Augmented by Reeves, C. C., Jr., 1961a.)

Reeves, C. C., Jr., and Brazelton, W. F., 1961, The Stockton Field—key to the Marietta basin?: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 118-127, 7 figs. Field is in Love County.

Reimann, I. G., and Fay, R. O., 1961, *Polydeltoideus* a new Silurian blastoid from Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 86-89, 1 pl. Blastoid from Henryhouse Shale, Pontotoc County.

Robertson, J. R., *see* Pitt, W. D., Madeley, H. M., and Robertson, J. R.

Rogatz, Henry, 1961, Shallow oil and gas fields of the Texas Panhandle and Hugoton, *in* Oil and gas fields of the Texas and Oklahoma Panhandles: Panhandle Geol. Soc., p. 8-37, 6 figs.

Rogers, R. G., and Tinsley, J. D., 1961, Developments in Texas and

Oklahoma Panhandles in 1960: Amer. Assoc. Petroleum Geologists, Bull., vol. 45, p. 816-824, 1 fig., 4 tables. Statistics.

Rose, W. A., 1961, Significant fields and prolific recent discoveries in and near field trip area, *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma: Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 58-61, 1 fig., 2 tables.

Schleicher, J. A., *see* Ham, W. E., Mankin, C. J., and Schleicher, J. A.

Schreiber, J. F., Jr., 1961, Sedimentation survey of Lake Carl Blackwell, Payne and Noble Counties, Oklahoma: Okla. City Geol. Soc., Shale Shaker, vol. 11, no. 6 (Feb.), p. 11-17, 7 figs., 4 tables.

Schultz, L. G., *see* Frezon, S. E., and Schultz, L. G.

Scull, B. J., 1961, A comparison of Plio-Miocene sedimentation of the Gulf Coast with the Atoka sedimentation of the Arkoma basin, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 127-175, 14 figs.

Shreveport Geological Society, 1961, Cretaceous of southwest Arkansas and southeast Oklahoma: Guidebook, spring field trip, March 24-25, 1961, Shreveport, Louisiana.

Sohn, I. G., 1960 [1961], Paleozoic species of *Bairdia* and related genera: U. S. Geol. Survey, Prof. Paper 330-A, 119 p., 15 figs., 6 pls. Includes ostracodes from Oklahoma.

Sowers, D. L., and others, 1961, Oklahoma, *in* International Oil and Gas Development; Year Book 1961 (review of 1960): Internat. Oil Scouts Assoc. and Soc. Petroleum Engineers AIME, vol. 31, pt. 2, p. 311-360. Statistics.

Starke, J. M., Jr., 1961, Geology of northeastern Cherokee County, Oklahoma: Okla. Geol. Survey, Circ. 57, 62 p., 16 figs., 1 pl. Surface study of Cotter Formation (Ordovician) through Hindsville Formation (Mississippian).

Stehli, F. G., 1961, New genera of upper Paleozoic terebratuloids: Jour. Paleontology, vol. 35, p. 457-466, 8 figs., 1 pl. *Gacina moorefieldensis* from the Moorefield Formation (Mississippian), Cherokee County, and *Pakistania schucherti* from the Marlow Formation (Permian), Woods County.

Stewart, F. M., *see* Guerrero, E. T., and Stewart, F. M.

Strimple, H. L., 1961a, Additional notes concerning *Paragassizocrinus*: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 294-298, 1 pl. Pennsylvanian crinoid.

———— 1961b, An unusual *Agassizocrinus:* Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 158-161, 5 figs. Crinoid from the Goddard Formation (Mississippian), Johnston County.

———— 1961c, Late Desmoinesian crinoid faunule from Oklahoma: Okla. Geol. Survey, Bull. 93, 189 p., 23 figs., 19 pls. Crinoid crowns from the Holdenville Formation (Pennsylvanian), Okmulgee County.

———— 1961d, Morrowan *Hydriocrinus*: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 306-307. *H. rosei*: crinoid from the Hale Formation (Pennsylvanian), Muskogee County.

———— 1961e, New *Paradelocrinus* from Oklahoma: Okla. Geol.

Survey, Okla. Geology Notes, vol. 21, p. 225-229, 1 pl. Description of Pennsylvanian crinoids: *P. wapanucka* from the Wapanucka Limestone, Pontotoc County; *P. johnstonensis* from the Pumpkin Creek Limestone, Johnston County; and *P. atoka* from the Atoka Formation, Coal County.

———— 1961f, New species of *Bronaughocrinus* and *Stuartwellercrinus* from the Carboniferous of Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 186-189, 1 pl. Description of crinoids: *B. cherokeensis* from the Hindsville Formation (Mississippian), Cherokee County; and *S. praedecta* from the Wapanucka Formation (Pennsylvanian), Pontotoc County.

———— 1961g, Notes on two Chester crinoids: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 23-25, 3 figs. Mississippian crinoids, *Mantikosocrinus castus* and *Bronaughocrinus figuratus,* collected in the Cookson Hills.

———— 1961h, On *Myeinocystites* Strimple: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 184-185, 1 fig. *M. natus,* Ordovician carpoid from the Bromide Formation, Carter County.

Strimple, H. L., and Watkins, W. T., 1961, On *Synbathocrinus ? antiquus*: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 48-49, 2 figs. Silurian crinoid from the Henryhouse Shale, Pontotoc County.

Tasch, Paul, 1961a, Data on some new Leonardian conchostracans with observations on the taxonomy of the family Vertexiidae: Jour. Paleontology, vol. 35, p. 1121-1129, 2 pls., 3 tables. Including *Pemphicyclus laminatus* from the Wellington Shale (Permian), Noble County.

———— 1961b, Valve injury and repair in living and fossil Conchostracans: Kansas Acad. Sci., Trans., vol. 64, no. 2, p. 144-149, 5 figs. Including *Cyzicus (Lioestheria)* from the Wellington Shale (Permian), Noble County.

Tinsley, J. D., *see* Rogers, R. G., and Tinsley, J. D.

Totten, R. B., 1961, Review of exploration and development of oil and gas for the Texas and Oklahoma Panhandle area, *in* Oil and gas fields of the Texas and Oklahoma Panhandles: Panhandle Geol. Soc., p. 69-74.

Tulsa Geological Society and Fort Smith Geological Society, 1961, Arkoma basin and north-central Ouachita Mountains of Oklahoma: Guidebook, Field Conf., Apr. 14-15, 1961, Tulsa, Oklahoma, 90 p.

United States Geological Survey, 1961a, Geological Survey research 1961: U. S. Geol. Survey, Prof. Paper 424-A, p. 22-23, 131. Abstracts of papers being presented in U. S. Geol. Survey, Prof. Papers 424-B, C, and D.

———— 1961b, Quality of surface waters of the United States, 1957. Parts 7-8. Lower Mississippi River basin and western Gulf of Mexico basins: U. S. Geol. Survey, Water-supply Paper 1522, 499 p., 1 fig. Chemical analyses from stations on rivers and creeks in Oklahoma.

———— 1960 [1961]c, Surface water supply of the United States,

1959. Part 7. Lower Mississippi River basin: U. S. Geol. Survey, Water-supply Paper 1631, 557 p., 2 figs. Statistics

———— 1960 [1961]d, Surface water supply of the United States, 1959. Part 8. Western Gulf of Mexico basins: U. S. Geol. Survey, Water-supply Paper 1632, 529 p., 2 figs. Statistics.

University of Oklahoma, Department of Business and Industrial Services, Extension Division, *see* University of Oklahoma, School of Geology, and others.

University of Oklahoma, School of Geology, and others, 1961, The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., 234 p.

Unklesbay, A. G., 1961, A large Pennsylvanian orthocone from Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 108-110, 1 fig. Description of cephalopod *(Mooreoceras normale)* from the Fort Scott Limestone, east of Tulsa.

Ward, P. E., 1961a, Salt springs in Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 82-85, 4 figs., 1 table.

———— 1961b, Shallow halite deposits in northern Woodward and southern Woods Counties, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 275-277, 2 figs. Removal of salt in the subsurface by ground water.

Ward, P. E., and Leonard, A. R., 1961, Hypothetical circulation of ground water around salt springs in western Oklahoma, Texas, and Kansas, *in* Geological Survey research 1961: U. S. Geol. Survey, Prof. Paper 424-D, p. 150-151, 2 figs.

Warren, J. W., 1961, The basicranial articulation of the Early Permian cotylosaur, *Captorhinus*: Jour. Paleontology, vol. 35, p. 561-563, 2 figs. *C.* sp. from Comanche County used as example.

Watkins, W. T., *see* Strimple, H. L., and Watkins, W. T.

Weiner, J. L., *see* Gutschick, R. C., Weiner, J. L., and Young, Leighton.

Westheimer, J. M., 1961, Notes on the Hartshorne Sandstone: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 50-51. Lithologic means of identifying the Hartshorne (Pennsylvanian) on the surface north of the Arbuckle Mountains, and in the subsurface in the Ardmore basin.

Wheeler, R. R., 1960, The structural map of the Midcontinent from Denver to the east Texas Gulf Coast: Robert R. Wheeler, Dallas, Texas. Scale: 1 inch=6 miles. Central Series (consisting of 3 Sheets) covers Oklahoma from T. 24 N., southward into north Texas: Eastern Sheet extends from Oklahoma-Arkansas state line to R. 7 W.; Center Sheet extends from R. 8 W. to R. 11 ECM.; Western Sheet includes T. 1 N., Rs. 1 to 10 ECM.

Wilson, L. R., 1961, Palynological fossil response to low-grade metamorphism in the Arkoma basin, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 195-210, 1 fig., 7 tables.

Wilson, L. R., and Guest, M. E., 1961, Travertine formation associated with mosses at Turner Falls and Prices Falls, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 310-316, 3 figs., 1 pl. Pleistocene deposits in Murray County.

Survey, Okla. Geology Notes, vol. 21, p. 225-229, 1 pl. Description of Pennsylvanian crinoids: *P. wapanucka* from the Wapanucka Limestone, Pontotoc County; *P. johnstonensis* from the Pumpkin Creek Limestone, Johnston County; and *P. atoka* from the Atoka Formation, Coal County.

———— 1961f, New species of *Bronaughocrinus* and *Stuartwellercrinus* from the Carboniferous of Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 186-189, 1 pl. Description of crinoids: *B. cherokeensis* from the Hindsville Formation (Mississippian), Cherokee County; and *S. praedecta* from the Wapanucka Formation (Pennsylvanian), Pontotoc County.

———— 1961g, Notes on two Chester crinoids: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 23-25, 3 figs. Mississippian crinoids, *Mantikosocrinus castus* and *Bronaughocrinus figuratus*, collected in the Cookson Hills.

———— 1961h, On *Myeinocystites* Strimple: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 184-185, 1 fig. *M. natus*, Ordovician carpoid from the Bromide Formation, Carter County.

Strimple, H. L., and Watkins, W. T., 1961, On *Synbathocrinus ? antiquus*: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 48-49, 2 figs. Silurian crinoid from the Henryhouse Shale, Pontotoc County.

Tasch, Paul, 1961a, Data on some new Leonardian conchostracans with observations on the taxonomy of the family Vertexiidae: Jour. Paleontology, vol. 35, p. 1121-1129, 2 pls., 3 tables. Including *Pemphicyclus laminatus* from the Wellington Shale (Permian), Noble County.

———— 1961b, Valve injury and repair in living and fossil Conchostracans: Kansas Acad. Sci., Trans., vol. 64, no. 2, p. 144-149, 5 figs. Including *Cyzicus (Lioestheria)* from the Wellington Shale (Permian), Noble County.

Tinsley, J. D., *see* Rogers, R. G., and Tinsley, J. D.

Totten, R. B., 1961, Review of exploration and development of oil and gas for the Texas and Oklahoma Panhandle area, *in* Oil and gas fields of the Texas and Oklahoma Panhandles: Panhandle Geol. Soc., p. 69-74.

Tulsa Geological Society and Fort Smith Geological Society, 1961, Arkoma basin and north-central Ouachita Mountains of Oklahoma: Guidebook, Field Conf., Apr. 14-15, 1961, Tulsa, Oklahoma, 90 p.

United States Geological Survey, 1961a, Geological Survey research 1961: U. S. Geol. Survey, Prof. Paper 424-A, p. 22-23, 131. Abstracts of papers being presented in U. S. Geol. Survey, Prof. Papers 424-B, C, and D.

———— 1961b, Quality of surface waters of the United States, 1957. Parts 7-8. Lower Mississippi River basin and western Gulf of Mexico basins: U. S. Geol. Survey, Water-supply Paper 1522, 499 p., 1 fig. Chemical analyses from stations on rivers and creeks in Oklahoma.

———— 1960 [1961]c, Surface water supply of the United States,

1959. Part 7. Lower Mississippi River basin: U. S. Geol. Survey, Water-supply Paper 1631, 557 p., 2 figs. Statistics

———— 1960 [1961]d, Surface water supply of the United States, 1959. Part 8. Western Gulf of Mexico basins: U. S. Geol. Survey, Water-supply Paper 1632, 529 p., 2 figs. Statistics.

University of Oklahoma, Department of Business and Industrial Services, Extension Division, *see* University of Oklahoma, School of Geology, and others.

University of Oklahoma, School of Geology, and others, 1961, The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., 234 p.

Unklesbay, A. G., 1961, A large Pennsylvanian orthocone from Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 108-110, 1 fig. Description of cephalopod *(Mooreoceras normale)* from the Fort Scott Limestone, east of Tulsa.

Ward, P. E., 1961a, Salt springs in Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 82-85, 4 figs., 1 table.

———— 1961b, Shallow halite deposits in northern Woodward and southern Woods Counties, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 275-277, 2 figs. Removal of salt in the subsurface by ground water.

Ward, P. E., and Leonard, A. R., 1961, Hypothetical circulation of ground water around salt springs in western Oklahoma, Texas, and Kansas, *in* Geological Survey research 1961: U. S. Geol. Survey, Prof. Paper 424-D, p. 150-151, 2 figs.

Warren, J. W., 1961, The basicranial articulation of the Early Permian cotylosaur, *Captorhinus*: Jour. Paleontology, vol. 35, p. 561-563, 2 figs. *C.* sp. from Comanche County used as example.

Watkins, W. T., *see* Strimple, H. L., and Watkins, W. T.

Weiner, J. L., *see* Gutschick, R. C., Weiner, J. L., and Young, Leighton.

Westheimer, J. M., 1961, Notes on the Hartshorne Sandstone: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 50-51. Lithologic means of identifying the Hartshorne (Pennsylvanian) on the surface north of the Arbuckle Mountains, and in the subsurface in the Ardmore basin.

Wheeler, R. R., 1960, The structural map of the Midcontinent from Denver to the east Texas Gulf Coast: Robert R. Wheeler, Dallas, Texas. Scale: 1 inch=6 miles. Central Series (consisting of 3 Sheets) covers Oklahoma from T. 24 N., southward into north Texas: Eastern Sheet extends from Oklahoma-Arkansas state line to R. 7 W.; Center Sheet extends from R. 8 W. to R. 11 ECM.; Western Sheet includes T. 1 N., Rs. 1 to 10 ECM.

Wilson, L. R., 1961, Palynological fossil response to low-grade metamorphism in the Arkoma basin, *in* The Arkoma basin: Okla., Univ., Bienn. Geol. Symposium, 7th, Proc., p. 195-210, 1 fig., 7 tables.

Wilson, L. R., and Guest, M. E., 1961, Travertine formation associated with mosses at Turner Falls and Prices Falls, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 310-316, 3 figs., 1 pl. Pleistocene deposits in Murray County.

Woncik, John, 1961a, Kingfisher County—hottest oil play in U. S.: World Oil, vol. 153, no. 5 (Oct.), p. 173-175, 177, 3 figs.
———— 1961b, The geology of the Kinta gas district [Haskell Co., Okla.], *in* Arkoma basin and north-central Ouachita Mountains of Oklahoma: Tulsa Geol. Soc. and Fort Smith Geol. Soc., Guidebook, Field Conf., Apr. 14-15, 1961, p. 55-57, 2 figs., 1 table.
Young, Leighton, *see* Gutschick, R. C., Weiner, J. L., and Young, Leighton.
Young, L. M., and Mankin, C. J., 1961, Dimensional grain-orientation studies of recent Canadian River sands: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 99-107, 4 figs. Stream deposits and sedimentary structures studied in Cleveland County.

INDEX

abnormal bedding, Savanna Sandstone and Boggy Shale, *Hendricks*
abstracts, research in 1961, *U. S. Geological Survey* (a)
Alabaster Cavern, Upper Room, *Myers*
ANADARKO BASIN:
  borate minerals, Permian, *Ham, Mankin, and Schleicher*
  Cement-Chickasha area, *Herrmann*
  deep wells, *Oil and Gas Journal*
  'million-dollar' test wells, *Dahlgren*
  Springer Formation, heavy-mineral segregation, *Duane*
  stratigraphy: Mississippian and Devonian, *Ellzey;* Permian, Flowerpot through Quartermaster, *Ham and Jordan;* Sycamore Limestone, *Culp*
  western part, oil and gas fields, maps, *National Petroleum Bibliography* (b)
ARBUCKLE MOUNTAINS:
  brachiopods, *Ireland*
  bryozoans under study, *Ham* (e)
  stratigraphy: Frisco and Sallisaw Formations, *Amsden;* pre-Des Moines, *Frezon;* pre-Stanley, *Ham* (b)
ARDMORE BASIN:
  Cumberland Field, *Jenny*
  Hartshorne Sandstone, lithologic identification, *Westheimer*
  Springer Formation, heavy-mineral segregation, *Duane*
  tourmaline in Pennsylvanian sediments, *Lucas*
ARKOMA BASIN:
  abnormal bedding, Savanna Sandstone and Boggy Shale, surface study, *Hendricks*
  Atoka Formation, sedimentation compared with Gulf Coast Plio-Miocene, *Scull*
  bentonite in Atoka Formation, *Frezon and Schultz*

Cartersville Field, *Lahoud*
drilling: costs, geology, *Planalp;* deep, for gas, *Kornfeld;* programs and problems, *Bowman*
field trip, *Tulsa Geological Society and Fort Smith Geological Society*
fossil response to low-grade metamorphism, *Wilson*
geosyncline, *Branson* (a)
Kinta gas district, *Woncik* (b)
oil and gas fields and recent discoveries, *Rose*
Red Oak gas area, *McClain and Planalp*
stratigraphy: Fernvale-Viola Limestones, *Mairs;* Hartshorne Sandstone, *McDaniel;* Hunton Group, *England* (a) (b); Pennsylvanian, *Branson* (d); pre-Des Moines, *Frezon*
symposium, *University of Oklahoma, School of Geology, and others*
tectonics, *Diggs*
Atoka Formation: bentonite, *Frezon and Schultz;* sedimentation, *Scull*
basement rocks, petrography, Craig County, *Ham* (a)
bentonite, Atoka Formation, Arkoma basin, *Frezon and Schultz*
bibliography: conodonts, *Ash, Fay* (b); geologic mapping in Oklahoma, 1901-1960, *Branson and Jordan;* Oklahoma geology, 1960, *Curtis*
Blaine Formation, *Jordan* (c)
Boggy Shale, *Hendricks*
Canadian River: channel sands, composition and texture, *Pollack;* stream deposits and sedimentary structures, *Young and Mankin*
carbonates: facies, *Chandler;* industrial uses, *Ham* (d)
Carboniferous: crinoids, *Strimple* (f); stratigraphy, Ouachita Mountains, *Laudon*
cave, Upper Room of Alabaster Cavern, *Myers*
Cherokee Group, cyclothems, compared with Atlantic Coast sedimentation, *Fischer*
Chimney Rock, Woodward County, *Nicholson*
clays, petrography: Ottawa County, *Burwell;* Wichita Mountains, *Ham, Dodd, and Ray*
coal mining, landscape modification, *Doerr*
code of stratigraphic nomenclature, review, *Branson* (b)
COUNTIES:
Beaver: LPG storage, Flowerpot salt, *Jordan* (c); new spore genus, *Felix and Burbridge*
Blaine: borate minerals, *Ham, Mankin, and Schleicher;* geologic map, *Fay* (c)
Bryan, Cumberland Field, *Jenny*
Caddo, Cement-Chickasha area, *Herrmann*
Carter: brachiopods, *Ireland;* carpoid, *Strimple* (h); ostracodes, *Levinson*
Cherokee: brachiopods, *Branson* (h), *Stehli;* crinoid, *Strimple* (f); northeastern, surface geology, *Starke*
Cimarron: helium, Keyes area, *Jordan* (a); helium plant, Keyes, *Deaton and Haynes*
Cleveland: stream bar deposits, concretions, *Pitt, Madeley, and*

Robertson; stream deposits and sedimentary structures, Canadian River, *Young and Mankin*
Coal, crinoid, *Strimple* (e)
Comanche: cotylosaur, *Warren;* Wichita Mountains Seismological Observatory, *Norden*
Craig, igneous basement rocks, petrography, *Ham* (a)
Custer: borate minerals, *Ham, Mankin, and Schleicher;* gypsum plant, *Ham* (c)
Garvin, East Lindsay area, *Bell, R. J.*
Grady, Cement-Chickasha area, *Herrmann*
Grant, Wellington Formation, salt, *Jordan* (h)
Haskell, Kinta gas district, *Woncik* (b)
Hughes, central, subsurface geology, *Harvey*
Jackson, soil survey, *Bailey and Graft*
Johnston, crinoid, *Strimple* (b) (e)
Kay: LPG storage in Wreford Limestone, *Jordan* (b); Wreford Limestone, petrography, *Cronoble*
Kingfisher: North Okarche Field, *Bado* (b); oil and gas, *Jordan* (g); recent drilling activity, *Woncik* (a); Southwest Dover Field, *Bado* (a)
Latimer, Red Oak gas area, *McClain and Planalp*
Le Flore: Cartersville Field, *Lahoud;* Red Oak gas area, *McClain and Planalp*
Love: Southeast Marietta Field, *Enright;* Stockton Field, *Reeves and Brazelton*
Marshall, Cumberland Field, *Jenny*
McIntosh, Hoffman gas area, *Hamric*
Murray: brachiopods, *Ireland;* travertine and mosses, *Wilson and Guest*
Muskogee: crinoid, *Strimple* (d); Muskogee area, surface geology, *Bell, Walton*
Noble: conchostracans, *Tasch* (a) (b); Lake Carl Blackwell, sedimentation survey, *Schreiber;* Upper Wolfcampian carbonate facies, surface geology, *Chandler*
Okmulgee: crinoids, *Strimple* (c); geologic map, *Oakes;* Hoffman gas area, *Hamric*
Osage, waterflood and pressure maintenance, oil fields, *Johnston and Castagno*
Ottawa: clay, properties, *Burwell;* galena, analyses, *Marshall and Joensuu*
Pawnee: south-central, subsurface geology, *Berryhill;* Upper Wolfcampian carbonate facies, surface geology, *Chandler*
Payne: Lake Carl Blackwell, sedimentation survey, *Schreiber;* Upper Wolfcampian carbonate facies, surface geology, *Chandler*
Pittsburg, abnormal bedding, Savanna Sandstone and Boggy Shale, *Hendricks*
Pontotoc: blastoid, *Reimann and Fay;* crinoids, *Strimple* (e) (f), *Strimple and Watkins;* Foraminifera, *Gutschick, Weiner, and Young;* trilobite, *Branson* (g)

Pushmataha: key test well, *Bike;* natural gas, *Jordan* (e)
Seminole, brachiopod, *Branson* (f)
Sequoyah, Frisco and Sallisaw Formations, stratigraphy, *Amsden*
Texas: Guymon-Hugoton gas area, *Rogatz;* soil survey, *Meinders and others*
Tillman, Northwest Triume Field, original oil in place, *Guerrero and Stewart*
Washington, blastoid, *Fay* (a)
Woods: brachiopods, *Branson* (h), *Stehli;* salt, removal by ground water, *Ward* (b)
Woodward: Alabaster Cavern, Upper Room, *Myers;* Chimney Rock, *Nicholson;* salt, removal by ground water, *Ward* (b)
CRETACEOUS:
Late, paleogeographic map of distribution, *Gill and Cobban*
southeast Oklahoma, field trip, *Shreveport Geological Society*
Des Moines, pre-, stratigraphy, *Frezon*
Desmoinesian, *McElroy*
DEVONIAN:
Anadarko basin, *Ellzey*
stratigraphy, Frisco and Sallisaw Formations, *Amsden*
ECONOMIC GEOLOGY:
clay, Ottawa County, *Burwell*
coal mining and landscape modification, *Doerr*
drilling costs, Arkoma basin, *Planalp*
drilling programs and problems, Arkoma basin, *Bowman*
gypsum plant, *Ham* (c)
helium, Keyes area, *Jordan* (a)
helium plant, Keyes, *Deaton and Haynes*
limestone and dolomite, industrial uses, *Ham* (d)
LPG storage, *Jordan* (i)
mineral industries, statistics, *McDougal and Grandone, McDougal, Grandone, and Ham*
mines and mining, statistics, *Malloy*
original oil in place, calculation of, *Guerrero and Stewart*
Picher district, galena, analyses, *Marshall and Joensuu*
waterflood and pressure maintenance, Osage County, *Johnston and Castagno*
electric log interpretation, oil-wet rocks, Springer sands, *Pirson and Fraser*
Fernvale-Viola Limestones, *Mairs*
field trips: Arkoma basin and Ouachita Mountains, *Tulsa Geological Society and Fort Smith Geological Society;* southeast Oklahoma, Cretaceous, *Shreveport Geological Society;* Wichita Mountains, clay petrography, *Ham, Dodd, and Ray*
Flowerpot Shale, *Jordan* (c)
Frisco and Sallisaw Formations, *Amsden*
geomorphology: cave, *Myers;* Chimney Rock, *Nicholson;* landscape modification, coal mining, *Doerr*
geophysics: magnetic prospecting, Cumberland Field, *Jenny;* Wichita Mountains Seismological Observatory, *Norden*

geosyncline, Arkoma basin, *Branson* (a)
geothermal gradients, *Moses*
gypsum, new plant, *Ham* (c)
Hartshorne Sandstone, *McDaniel, Westheimer*
helium, Keyes area, *Jordan* (a)
helium plant, Keyes, *Deaton and Haynes*
Hollis basin, stratigraphy, Sycamore Limestone, *Culp*
Hunton Group, stratigraphy, Arkoma basin, *England* (a) (b)
HYDROLOGY:
cave development, *Myers*
ground water: *Leonard, Hart* (b); removal of salt by, *Ward* (b), *Ward and Leonard*
salt-springs, western Oklahoma, *Ward* (a)
surface waters, chemical analyses, *Pate, Murphey, and Orth, U. S. Geological Survey* (b)
surface water, supply, statistics, *U. S. Geological Survey* (c) (d)
water-level fluctuations, *Hart* (a)
Lake Carl Blackwell, sedimentation survey, *Schreiber*
magnetic prospecting for oil, Cumberland Field, *Jenny*
maps: Blaine County, geologic, *Fay* (c); geologic mapping in Oklahoma, bibliography and index, *Branson and Jordan;* oil and gas fields, *National Petroleum Bibliography* (a) (b), *Panhandle Geological Society;* Oklahoma, tectonic, *Wheeler;* Okmulgee County, geologic, *Oakes*
MARIETTA BASIN:
Southeast Marietta Field, *Enright*
Stockton Field, *Reeves and Brazelton*
stratigraphy, Pennsylvanian, *Reeves* (a) (b)
mathematical probability, an oil search tool, examples in Beaver, Cimarron, and Harper Counties, *Dowds*
metamorphism, low-grade, fossil response to, *Wilson*
MINERAL/MINERALOGY:
andesite tuff and dacite, Craig County, *Ham* (a)
bentonite, Atoka Formation, Arkoma basin, *Frezon and Schultz*
borates, in gypsum, *Ham, Mankin, and Schleicher*
channel sands, composition and texture, Canadian River, *Pollack*
clay: Ottawa County, *Burwell;* Wichita Mountains, *Ham, Dodd, and Ray*
galena, trace elements and crystal habit, *Marshall and Joensuu*
heavy-mineral segregation, Springer Formation, *Duane*
tourmaline in Pennsylvanian sediments, Ardmore basin, *Lucas*
travertine, associated with mosses, *Wilson and Guest*
Wreford Limestone, Kay County, *Cronoble*
mineral industries, statistics, *McDougal and Grandone, McDougal, Grandone, and Ham*
mines and mining, statistics, *Malloy*
MISSISSIPPIAN:
brachiopods, *Branson* (h), *Stehli*
clay, Ottawa County, *Burwell*
crinoids, *Strimple* (b) (g)

Foraminifera, *Gutschick, Weiner, and Young*
spore genus, *Felix and Burbridge*
stratigraphy: Anadarko basin, *Ellzey;* Sycamore Limestone, *Culp*
ORDOVICIAN:
bryozoans under study, *Ham* (e)
carpoid, *Strimple* (h)
ostracodes, *Levinson*
stratigraphy: Fernvale-Viola Limestones, *Mairs;* North American, *Patterson*
OUACHITA MOUNTAINS:
field trip, *Tulsa Geological Society and Fort Smith Geological Society*
key test well, *Bike*
natural gas, Pushmataha County, *Jordan* (e)
oil and gas fields and recent discoveries, *Rose*
stratigraphy: Carboniferous, *Laudon;* pre-Stanley, *Ham* (b)
tectonics, *Branan*
PALEOBOTANY:
Acanthotriletes uncinatus, Felix and Burbridge
fossil response to low-grade metamorphism, *Wilson*
mosses, associated with travertine, *Wilson and Guest*
PALEONTOLOGY:
Acrotretella siluriana, Ireland
Agassizocrinus, Strimple (b)
Agmoblastus dotti, Fay (a)
Ameura sangamonensis, Branson (g)
ammonoid, *Furnish and Beghtel*
Artiotreta parva, Ireland
Bairdia, Sohn
blastoids, *Fay* (a), *Reimann and Fay*
brachiopods, *Branson* (e) (f) (h), *Ireland, Stehli*
Bronaughocrinus cherokeensis, Strimple (f)
B. figuratus, Strimple (g)
bryozoans, under study, *Ham* (e)
Captorhinus, Warren
carpoid, *Strimple* (h)
cephalopod, *Unklesbay*
conchostracans, *Tasch* (a) (b)
conodonts, bibliography and index, *Ash, Fay* (b)
Conostichus, Branson (c)
cotylosaur, *Warren*
crinoids, *Strimple* (a) (b) (c) (d) (e) (f) (g), *Strimple and Watkins*
Cyzicus (Lioestheria), Tasch (b)
Foraminifera, arenaceous, *Gutschick, Weiner, and Young*
Gacina moorefieldensis, Branson (h), *Stehli*
Gastrioceras venatum, Furnish and Beghtel
Hydriocrinus rosei, Strimple (d)
Mantikosocrinus castus, Strimple (g)
Mooreoceras normale, Unklesbay

Myeinocystites natus, Strimple (h)
ostracodes, *Levinson, Sohn*
Pakistania schucherti, Branson (h), *Stehli*
Paradelocrinus, Strimple (e)
Paragassizocrinus, Strimple (a)
Pemphicyclus laminatus, Tasch (a)
Polydeltoideus, Reimann and Fay
Productoidea, review, *Branson* (e)
Reticulatia, Branson (f)
scyphomedusan, *Branson* (c)
Stuartwellercrinus praedecta, Strimple (f)
Synbathocrinus ? antiquus, Strimple and Watkins
trilobite, *Branson* (g)
Wewokites, Furnish and Beghtel

Paleozoic, ostracodes, *Sohn*

PANHANDLE:
helium, Keyes area, *Jordan* (a)
helium plant, Keyes, *Deaton and Haynes*
petroleum: exploration and development, *Totten;* gas hunt, *Barby* (a); Guymon-Hugoton gas area, *Rogatz;* maps, statistics, oil and gas fields, *National Petroleum Bibliography* (b), *Panhandle Geological Society;* mathematical probability aids exploration, examples in Panhandle, *Dowds;* reserves, *Barby* (b); statistics, *Rogers and Tinsley*
stratigraphy, Precambrian through Quaternary, *Cunningham*
tectonics, *Eddleman*

PENNSYLVANIAN:
abnormal bedding, Savanna Sandstone and Boggy Shale, *Hendricks*
ammonoid, *Furnish and Beghtel*
Atoka Formation, sedimentation compared with Gulf Coast Plio-Miocene, *Scull*
bentonite beds, Atoka Formation, Arkoma basin, *Frezon and Schultz*
blastoid, *Fay* (a)
brachiopod, *Branson* (f)
cephalopod, *Unklesbay*
Cherokee Group, cyclothems compared with Atlantic Coast sedimentation, *Fischer*
crinoids, *Strimple* (a) (c) (d) (e)
geosyncline, Arkoma basin, *Branson* (a)
Hartshorne Sandstone, lithologic identification, *Westheimer*
scyphomedusan, *Branson* (c)
Springer Formation, heavy-mineral segregation, *Duane*
Springer sands, electric log interpretation, *Pirson and Fraser*
stratigraphy: Arkoma basin, *Branson* (d); Des Moines, *McElroy;* Hartshorne Sandstone, *McDaniel;* Marietta basin, *Reeves* (a) (b); Muskogee area, surface geology, *Bell, Walton*
tourmaline in Ardmore basin, *Lucas*
trilobite, *Branson* (g)

PERMIAN:
Blaine Formation, gamma ray and lithologic logs, *Jordan* (c)
borate minerals, *Ham, Mankin, and Schleicher*
brachiopod, *Branson* (h), *Stehli*
conchostracans, *Tasch* (a) (b)
correlation, *Hills*
cotylosaur, *Warren*
Flowerpot Shale, gamma ray and lithologic logs, *Jordan* (c)
stratigraphy, Flowerpot through Quartermaster, *Ham and Jordan*
Upper Wolfcampian carbonate facies, surface geology, *Chandler*
Wellington Formation, salt, *Jordan* (h)
Wreford Limestone: electric and lithologic logs, *Jordan* (b); petrography, *Cronoble*
PETROLEUM:
Cartersville Field, *Lahoud*
Cement-Chickasha area, *Herrmann*
Cumberland Field, magnetic prospect, *Jenny*
deep wells: Anadarko basin, *Oil and Gas Journal;* Arkoma basin, *Kornfeld*
drilling costs, geology, Arkoma basin, *Planalp*
drilling programs and problems, Arkoma basin, *Bowman*
East Lindsay area, *Bell, R. J.*
exploration and development, Panhandle, *Totten*
facies changes, Marietta basin, *Reeves* (a) (b)
fields and recent discoveries, Arkoma basin and Ouachita Mountains, *Rose*
gas hunt, Panhandle, *Barby* (a)
geothermal gradients, *Moses*
Guymon-Hugoton gas area, *Rogatz*
Hoffman gas area, *Hamric*
Hughes County, central, *Harvey*
Kingfisher County, *Jordan* (g), *Woncik* (a)
Kinta gas district, *Woncik* (b)
LPG storage: Wreford Limestone, Osage County, *Jordan* (b); Flowerpot salt, Beaver County, *Jordan* (c); statistics, *Jordan* (i)
maps: geologic mapping in Oklahoma, bibliography and index, *Branson and Jordan;* oil and gas fields, *National Petroleum Bibliography* (a) (b), *Panhandle Geological Society*
mathematical probability aids exploration, examples in Beaver, Cimarron, and Harper Counties, *Dowds*
'million-dollar' test wells, Anadarko basin, *Dahlgren*
North Okarche Field, *Bado* (b)
oil-wet rocks, electric log interpretation, Springer sands, *Pirson and Fraser*
Oklahoma City uplift, western flank, Mississippian and Devonian stratigraphy, *Ellzey*
original oil in place, calculation of, Northwest Triume Field, *Guerrero and Stewart*
Panhandle, *Barby* (a) (b)

Pawnee County, south-central, *Berryhill*
Pushmataha County: key test well, *Bike;* natural gas, *Jordan* (e)
Red Oak gas area, *McClain and Planalp*
reserves, Panhandle, *Barby* (b)
Southeast Marietta Field, *Enright*
Southwest Dover Field, *Bado* (a)
statistics: oil and gas, *Atkins, Mackey, Jordan* (f), *Sowers and others;* Panhandle, *National Petroleum Bibliography* (b), *Panhandle Geological Society, Rogers and Tinsley;* natural gas, *Jordan* (d)
Stockton Field, *Reeves and Brazelton*
stratigraphic traps, *Busch*
uranium, in crude oil, *Hyden*
waterflood and pressure maintenance, Osage County, *Johnston and Castagno*
PETROLOGY:
andesite tuff and dacite, Craig County, *Ham* (a)
carbonate facies, *Chandler*
channel sands, composition and texture, Canadian River, *Pollack*
clay: Ottawa County, *Burwell;* Wichita Mountains, *Ham, Dodd, and Ray*
Hartshorne Sandstone, lithologic identification, *Westheimer*
heavy-mineral segregation, Springer Sandstone, *Duane*
stream deposits and sedimentary structures, Canadian River, *Young and Mankin*
tourmaline in Pennsylvanian sediments, *Lucas*
Wreford Limestone, Kay County, *Cronoble*
Picher district, Ottawa County, galena, *Marshall and Joensuu*
Pleistocene, travertine and mosses, *Wilson and Guest*
Prices Falls, travertine and mosses, *Wilson and Guest*
research, 1961, abstracts, *U. S. Geological Survey* (a)
Sallisaw and Frisco Formations, *Amsden*
salt: LPG storage, Beaver County, *Jordan* (c); removal by ground water, *Ward* (b), *Ward and Leonard;* springs, western Oklahoma, *Ward* (a); Wellington Formation, Grant County, *Jordan* (h)
Savanna Sandstone, *Hendricks*
SEDIMENTATION:
Atoka Formation, compared with Gulf Coast Plio-Miocene, *Scull*
channel sands, composition and texture, Canadian River, *Pollack*
concretions, stream bar deposits, *Pitt, Madeley, and Robertson*
cyclothems, Cherokee Group, compared with present Atlantic Coast, *Fischer*
grain-orientation and sedimentary structures, Canadian River, *Young and Mankin*
incrustment of travertine on mosses, *Wilson and Guest*
Lake Carl Blackwell, *Schreiber*
Seismological Observatory, Wichita Mountains, *Norden*
SILURIAN:
blastoid, *Reimann and Fay*
brachiopods, *Ireland*

crinoid, *Strimple and Watkins*
soil survey: Jackson County, *Bailey and Graft;* Texas County, *Meinders and others*
Springer Formation, *Duane*
Stanley, pre-, stratigraphy, *Ham* (b)
stratigraphic traps, use of electric logs in finding, *Busch*
STRATIGRAPHY:
Atoka Formation, sedimentation compared with Gulf Coast Plio-Miocene, *Scull*
Carboniferous, Ouachita Mountains, *Laudon*
Cherokee County, northeastern, surface geology, *Starke*
Cherokee Group, cyclothems, compared with Atlantic Coast sedimentation, *Fischer*
code of nomenclature, review, *Branson* (b)
correlation of Permian, *Hills*
Des Moines, north-central Oklahoma, isopach and lithofacies, *McElroy*
Devonian, Anadarko basin, *Ellzey*
Fernvale-Viola Limestones, Arkoma basin, *Mairs*
Frisco and Sallisaw Formations, Sequoyah County and Arbuckle Mountains, *Amsden*
Hartshorne Sandstone: Arkoma basin, *McDaniel;* lithologic identification, *Westheimer*
Hunton Group, Arkoma basin, *England* (a) (b)
Mississippian, Anadarko basin, *Ellzey*
Muskogee area, surface geology, *Bell, Walton*
Ordovician, North America, *Patterson*
Ordovician through Mississippian, East Lindsay area, *Bell, R. J.*
Ordovician through Pennsylvanian: Hoffman gas area, *Hamric;* Hughes County, *Harvey*
Ordovician through Permian, Pawnee County, *Berryhill*
Pennsylvanian: Arkoma basin, *Branson* (d); Marietta basin, *Reeves* (a) (b)
Permian, Flowerpot through Quartermaster, *Ham and Jordan*
Precambrian through Quaternary, Panhandle, *Cunningham*
pre-Des Moines, Arkoma basin and Arbuckle Mountains, *Frezon*
pre-Stanley, Arbuckle-Ouachita Mountains region, *Ham* (b)
Sycamore Limestone, southern Oklahoma, *Culp*
Sycamore Limestone, *Culp*
tectonics: Arkoma basin, *Diggs;* Oklahoma, map, *Wheeler;* Ouachita Mountains, *Branan;* Panhandle, *Eddleman*
Turner Falls, travertine associated with mosses, *Wilson and Guest*
uranium, in crude oil, *Hyden*
Viola and Fernvale Limestones, *Mairs*
waterflood, Osage County, *Johnston and Castagno*
Wellington Formation, *Jordan* (h)
WICHITA MOUNTAINS:
clay petrography, *Ham, Dodd, and Ray*
Seismological Observatory, *Norden*
Wreford Limestone, *Cronoble, Jordan* (b)

The Mineral Industry of Oklahoma in 1961* (Preliminary)

Robert B. McDougal**

In 1961, the mineral industry of Oklahoma produced 19 minerals and mineral fuels valued at an estimated $791.2 million, according to the Bartlesville, Oklahoma, office of the Bureau of Mines, U. S. Department of the Interior. The 1960 value was $780.9 million. Gains were reported in total production value of helium, natural gas, natural-gas liquids, cement, clays, lime, pumice, salt, sand and gravel, and stone; decreases were reported in total value of coal, petroleum, asphalt, bentonite, gypsum, tripoli, lead, and zinc. Mineral fuels accounted for 94 percent of the 1961 total value, nonmetals for almost 6 percent, and metals less than 1 percent.

Mineral Fuels

Coal.—Output of coal in Oklahoma continued to decline in 1961. Closed in August 1960, Lone Star Coal Co. reopened its Carbon No. 5 mine in Pittsburg County in June. New type mining equipment—used in some British coal mines—was being installed at the mine.

Natural gas.—Marketed production of natural gas from 65 counties in 1961 increased 6 percent from the 1960 production. Value of the 1961 volume increased about 7 percent from 1960. New gas pools discovered during the year were added to the gas reserves.

Roger Mills County became the 66th county to report natural gas production when an abandoned well was deepened and opened in November. The reworked well was located 23 miles north of the Southwest Mayfield Pool in Beckham County.

Helium was extracted from natural gas at the Federal Bureau of Mines' Keyes plant.

Natural-gas liquids.—Natural-gas liquids, recovered by 69 natural-gasoline plants and 4 cycling plants, reached a new record of 1,331 million gallons, an increase of nearly 3 percent above 1960. The natural-gasoline and cycle-products component decreased slightly and the LP-gas component gained 5 percent.

Underground storage capacity for LP gas, nearly doubled by completion of Continental Oil Co.'s 300,000-barrel storage facility at Ponca City in April, will be further increased as the company had a 150,000-barrel facility under construction in a Grant County salt layer. Gulf Oil Corp. also was constructing an LPG storage unit of undisclosed capacity in a salt formation at Warren Petroleum's gas plant in Beaver County.

---

*This report, U. S. Bureau of Mines, Mineral Industry Surveys Area Report IV-135, has been prepared under a cooperative agreement for the collection of mineral data, except mineral fuels, between the Bureau of Mines and the Oklahoma Geological Survey, Dr. William E. Ham, Geologist.

**Geologist, U. S. Bureau of Mines, Division of Mineral Resources, Region IV.

Three new natural-gasoline plants were completed or under construction in 1961. Continental Oil Co. placed on stream its new absorption and refrigeration type natural-gas-liquids plant at Medford. At Hennessey, the Company built a $1.75 million natural-gas-products plant having daily input capacity of 30 million cubic feet. In the same area, Humble Oil & Refining Co. was also building a gas processing plant. This plant, with an ultimate capacity of 77 million cubic feet per day, will serve some 275 wells in the Dover-Hennessey area connected by an 85-mile gathering system.

Petroleum.—Production of an estimated 191 million barrels of crude petroleum was reported in 1961, a decline for the third consecutive year. Under the Interstate Oil Compact, the allowable production was adjusted to maintain a balance with demand. The allowable of 515,000 barrels per day for January was increased to 535,000 barrels for March—highest in 13 months—then was reduced to 505,000 barrels for July through October and raised to 525,000 barrels for December.

The State Corporation Commission approved a new formula for allocating oil production; first application was in December. The depth-acreage formula will be subjected to a monthly demand factor; all wells will be allowed to produce only a fixed percentage of the basic allowable.

Activity in 1961 was centered primarily in development-well drilling. The Oil and Gas Journal reported that a total of 5,290 exploratory and development wells were drilled in the first 11 months of 1961 compared with 4,348 wells for the same period in 1960. This represents an increase of 30 percent in development drilling and a decline of 14 percent in test-well drilling from the corresponding period in 1960.

As of January 1, 1961, Oklahoma had 15 refineries operating, according to the Oil and Gas Journal. These had a total capacity of 409,680 barrels of crude oil daily, a gain of 2 percent over 1960. In October, the Kerr-McGee Oil Industries, Inc., Cushing refinery began a cutback in manufacture of gasoline and fuel oils to concentrate on manufacture of high-quality lubricating oils. Bell Oil and Gas Co. revamped the Ben Franklin refinery at Ardmore. Crude petroleum formerly handled at Bell's Grandfield plant will now be processed at Ardmore; Grandfield will be converted into a terminal for asphalt and other products.

D-X Sunray Oil Co., at its West Tulsa refinery, placed a new 85,000 barrel per day crude-oil distillation unit on stream. The unit replaced five units having a combined capacity of 75,000 barrels per day. Champlin Oil & Refining Co. placed on stream a new delayed-coking unit at its Enid refinery. The unit will produce 100 tons of coke, 1,000 barrels of gasoline, and 300 barrels of burning oil per day.

NONMETALS

The estimated value of nonmetals (native asphalt, cement, clays, gypsum, lime, pumice, salt, sand and gravel, stone, and tripoli) produced in Oklahoma during 1961 totaled $47.0 million, 19 percent more than in 1960.

Dewey Portland Cement Co., Division of American-Marietta Corp.,

dedicated its $12-million cement plant east of Tulsa; the plant has an annual capacity of 1.25 million barrels. Oklahoma Cement Co. was planning to increase its facilities. Dewey Portland Cement Co. halted production at its Dewey plant in October to bring production in line with shipments; there was no indication when production would resume.

Construction by the U. S. Army Corps of Engineers (Tulsa District) continued at three dams: Oolagah dam on the Verdigris River, Eufaula dam on the Canadian River, and Keystone dam on the Arkansas River. The multipurpose structures will provide flood control, municipal and industrial water supply, and hydroelectric power. On October 18, Public Service Company of Oklahoma dedicated its 170,000-kilowatt electric generating station southeast of Oolagah.

METALS

Mine production in terms of recoverable lead and zinc, all from Ottawa County, declined 51 percent in 1961. Concentrates recovered during 1961 amounted to 600 tons of recoverable lead and 1,000 tons of recoverable zinc.

TABLE I.—MINERAL PRODUCTION IN OKLAHOMA[1]

MINERAL	1960 QUANTITY	1960 VALUE (THOUSANDS)	1961 (PRELIMINARY) QUANTITY	1961 (PRELIMINARY) VALUE (THOUSANDS)
Clays[2] (thousand short tons)	734	$ 739	902	$ 940
Coal (thousand short tons)	1,342	9,113	1,040	[3]
Helium (thousand cubic feet)	289,069	4,691	307,626	5,637
Lead (recoverable content of ores, etc.) (short tons)	936	219	600	128
Natural gas (million cubic feet)	824,266	98,088	874,000	104,900
Natural gas liquids:				
Natural gasoline and cycle products (thousand gallons)	531,995	33,074	529,200	33,300
LP gases (thousand gallons)	762,258	32,409	801,900	34,500
Petroleum (crude—thousand 42-gallon barrels)	192,913	563,306	191,220	558,362
Salt (common) (thousand short tons)	3	16	3	21
Sand and gravel (thousand short tons)	6,424	7,468	6,700	8,000
Stone (thousand short tons)	14,054[4]	16,098[4]	15,498	17,994
Zinc (recoverable content of ores, etc.) (short tons)	2,332	602	1,000	230
Value of items that cannot be disclosed: Asphalt (native, 1960), bentonite, cement, gem stones (1960), gypsum, lime, pumice, stone (crushed granite, 1960), and tripoli	...	16,756	...	29,754
Total Oklahoma[5]	...	$780,941[6]	...	$791,163

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producer).
[2]Excludes bentonite; included with "Value of items that cannot be disclosed."
[3]Included with "Value of items that cannot be disclosed."
[4]Excludes crushed granite; included with "Value of items that cannot be disclosed."
[5]Total adjusted to eliminate duplicating value of clays and stone.
[6]Revised figure.

Smelters.—Three horizontal-retort zinc plants were operated throughout 1961: American Metal Climax, Inc., at Blackwell; National Zinc Co., at Bartlesville; and The Eagle-Picher Co., at Henryetta.

Tri-State district.—Depressed lead-zinc markets, which led to the general shut down in mid-1958 of all major mining operations in the Tri-State district, continued throughout 1961. Legislation, designed to assist small producers of lead and zinc by providing subsidies to the operators, was authorized by the President. At yearend, funds were not yet available for approved payments to producers. Producers began reconditioning long-closed mines and mill operators were preparing their equipment in anticipation of the increased activity.

First Production in Roger Mills County, Oklahoma

Louise Jordan

Roger Mills, a western county of Oklahoma bordering the Texas Panhandle, has become the seventy-second county in Oklahoma in which oil or gas production has been discovered. The area is underlain by south-dipping rocks on the north limb of the Anadarko syncline. The westward-trending axis of the syncline is shown in part by the outcrop pattern of Permian rocks at the surface and it passes through the southern townships of the county (Arbenz, 1956). However, the axis of the basin as revealed by older sedimentary rocks lies 10 to 15 miles to the south. Thus the discovery of gas in Roger Mills County is in the deep, but not the deepest, part of the Anadarko basin, and at a total depth of 17,558 feet the hole did not test the entire rock sequence of Pennsylvanian age.

The wildcat discovery, No. 1 Hartley (NE¼ NE ¼ NW¼ sec. 34, T. 14 N., R. 26 W.) * was drilled originally to 12,384 feet and abandoned in 1953 by the Carter Oil Company. Shows of gas were obtained at that time at approximately 9,250 and 10,900 feet. In 1961, Gulf Oil Corporation re-entered and deepened the hole to 17,558 feet. Perforations were made first between 17,127 and 17,435 feet in "Lower Morrow" sandstones. A possible new producing-depth record for the State seemed possible when gas flowed at a rate of 2.25 million cubic feet daily through a ½-inch choke, but the gas flow died. The hole was plugged back to 15,148 feet, perforations were made from 14,960 to 14,980 feet in an "Upper Morrow" sandstone, and the hole was treated to flow 4 million cubic feet of gas daily through ½-inch choke, with 3 barrels of condensate per million. Both sandstones tested are considered to be of Morrowan age by company geologists. The well contains probably the deepest commercial production yet discovered in rocks of this age in the State. However, deeper production in Morrow rocks may be expected because the Gulf No. 1 Tabor (sec. 24, T. 8 N., R. 15 W., Washita County), recently plugged, had an excellent show of gas at 16,660 to 16,704 feet.

*Now officially designated as the West Reydon Field.

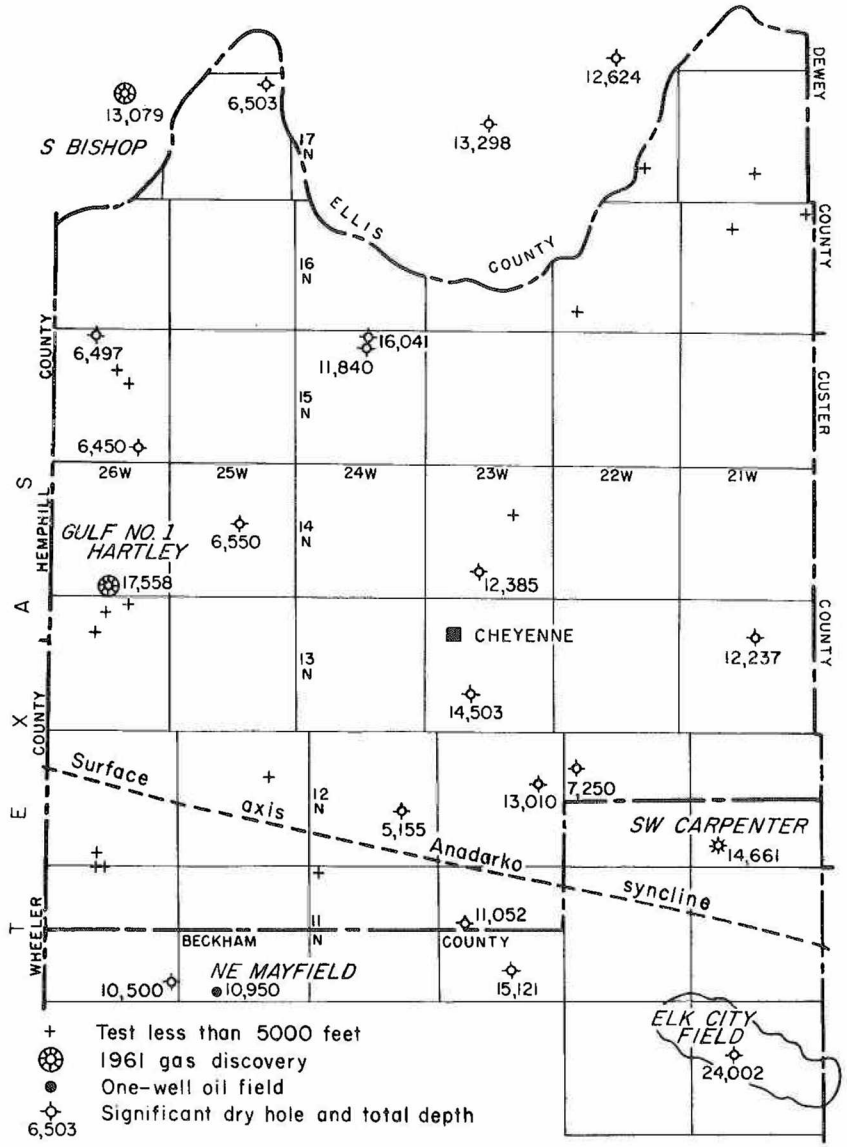


Figure 1. Map showing location of Gulf Oil Corporation No. 1 Hartley, first commercial gas discovery in Roger Mills County, location of dry holes, and of gas and oil fields in the vicinity.

At the well site of the No. 1 Hartley (elevation: 2,447 feet) the Pliocene Ogallala Formation crops out at the surface and is probably less than 200 feet thick. Underlying Permian rocks were penetrated to a depth of 6,078 feet. The base of the redbed-evaporite sequence, which contains salt in the Flowerpot Shale and in the section above and below the Cimarron anhydrite, and anhydrite in the Blaine and Wellington Formations, is reached at 4,420 feet. In most of the county, the thickness of the base-Blaine to base-Wellington section changes relatively little, ranging from 3,350 to 3,450 feet. The lower third of the Permian sequence (Wolfcampian) is mainly dolomite and limestone with minor thicknesses of shale. This section has been penetrated by all the wells (fig. 1) which went to depths of 6,000 to 7,000 feet.

Rocks of Virgilian, Missourian, Desmoinesian, Atokan, and Morrowan age, consisting of shale, sandstone, and some limestone, were penetrated in the Hartley well to its total depth of 17,558 feet, giving a thickness of more than 11,510 feet for rocks of Pennsylvanian age. Geologists estimate that the total thickness is approximately 12,000 feet at this site with an estimated subsea datum of 15,750 at the top of the Chester limestone. The depths below surface of Pennsylvanian subdivisions are reported as follows: Virgil, 6,078 feet; Missouri, 8,923 feet; Des Moines (tentative), 10,110 feet; Atoka (tentative), 13,850 feet; Morrow (tentative), 14,552 feet.

Only eight tests in the county have penetrated an appreciable thickness of Pennsylvanian rocks. One of these, Mobil Oil Company No. 1 Young (sec. 3, T. 15 N., R. 24 W.), completed as a dry hole in 1960, reached the top of the Chester limestone of definite Mississippian age at a depth of 15,622 (—13,297) feet having drilled through 9,870 feet of Pennsylvanian rocks. South of the Hartley well, the only test to have penetrated the top of the Mississippian is the deep Shell Oil Company test, No. 5 Rumberger in the Elk City Field, Beckham County, (fig. 1), which reached definite Mississippian rocks at a depth of 22,948 (—20,929) feet having drilled through a Pennsylvanian thickness of 16,468 feet (Jordan, 1960, p. 89). Between the Mobil No. 1 Young in north-central Roger Mills County and the Shell No. 5 Rumberger in the Elk City Field, Pennsylvanian rocks increase about 6,600 feet in thickness or at an approximate rate of 175 feet per mile. The base of the Pennsylvanian dips from a subsea datum of 13,296 feet at the north to 20,929 feet at the south or at a rate of about 200 feet per mile.

Figure 1 shows the location of fourteen significant tests with a total drilled footage of 146,682 feet. Other tests indicated by a plus sign are less than 4,500 feet deep, and for the most part were not drilled through the Permian redbed-evaporite section and thus furnish little geological information relative to hydrocarbon productive strata.

References Cited

Arbenz, J. K., 1956, Tectonic map of Oklahoma: Okla. Geol. Survey, Map GM-3.

Jordan, Louise, 1959, Second deepest hole in the world in Elk City Field, Beckham County: Okla. Geol. Survey, Okla. Geology Notes, vol. 19, p. 88-89.

TYPE SPECIES OF *Pleuroschisma*, A DEVONIAN BLASTOID FROM NEW YORK

ROBERT O. FAY

The type species of *Pleuroschisma* Reimann, 1945, is *Pentremites lycorias* Hall, 1862. This genus is a Devonian fissiculate blastoid with four anal deltoid plates (a superdeltoid, two cryptodeltoids, a hypodeltoid); ten hydrospire fields, with six to eight hydrospire slits in each field, not reduced in number on the anal side; moderately obconical form; lancet covered by side plates; narrow, steep, linear ambulacra that extend aborally; and moderately long radial processes on the radial lips. The three described species of this genus may be distinguished on form and on the relative height of deltoids. *P. hibbardi* Reimann, 1945, is narrow, with vault/width ratio 1.3, and low deltoid crests. *P. ontario* Reimann, 1945, is wide, with vault/width ratio 1.0, and low deltoid crests. *P. lycorias* (Hall), 1862, is wide, with vault/width ratio 0.7, and moderately high deltoid crests. The three species occur in

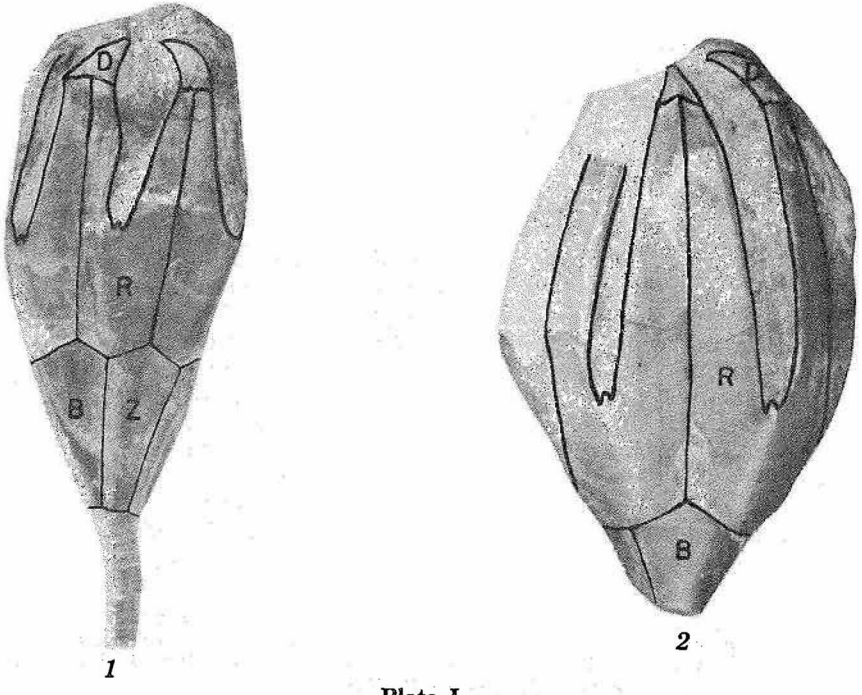


Plate I

Pleuroschisma lycorias (Hall), 1862. Lectoparatypes, E 11,800 (fig. 1) and E 16,305 (fig. 2), Buffalo Society of Natural Sciences Museum. Kashong Shale Member of Moscow Shale, West Alden, New York.

Figure 1. "B" ambulacral view of a specimen in rock, x4.1.

Figure 2. "A-B" interambulacral view of a damaged specimen, x3.5.

B—basal plate
D—deltoid plate
R—radial plate
Z—azygous basal plate

the Devonian Hamilton Group: *P. hibbardi* from the Centerfield horizon, near East Alexander, New York; *P. ontario* from the Coral zone of the Hungry Hollow Formation, near Thedford, Ontario; and *P. lycorias* from the Kashong Member of the Moscow Shale, near West Alden, New York, and from the Tichenor Limestone, near Springbrook, New York. The type specimen was described by Hall (1862), as coming from Hamilton shales, western New York. The type was never illustrated, and could not be located in Albany, New York City, or Chicago. Presumably the type is lost and a lectotype must be selected. The neotype is here designated: neotype, or new holotype, E 15,700; and two hypotypes, E 11,800 and E 16,305, from Kashong Shale Member of Moscow Shale, West Alden, New York, on deposit at the Buffalo Society of Natural Sciences Museum.

Pleuroschisma lycorias (Hall), 1862

Plate I, figures 1, 2; plate II, figures 1-4

Pentremites lycorias Hall, 1862, p. 151.

Pleuroschisma lycorias (Hall), Reimann, 1945, p. 24-25, pl. 5, figs. 10-13.

The neotype is approximately 13.5 mm long by 6.5 mm wide, slightly crushed and damaged, with ambulacra mostly filled with brachiolar plates, composed of dark crystalline calcite. Theca obconical, periphery at radial lips above mid-height, with vault 6.0 mm long, pelvis 7.5 mm long, and pelvic angle almost 43 degrees. Basalia steeply conical, 4 mm long by 4 mm wide, composed of 3 normally disposed basals, with basiradial sutures just below mid-height of pelvis. Radials 5, each 9 mm long by 3.5 mm wide, elongate, subpentagonal, with deep, narrow sinus 5 mm long by 2 mm wide, with hydrospire slits along margins of all ambulacra. At the radial lip of each ambulacrum, an elongate projection is prominent along the midline of each ambulacrum. The radial limbs extend to the summit, meeting at a point in a moderately high coronal process, overlapping the deltoids and almost completely concealing them in side view.

Deltoids four, wedge-shaped, short, 2 mm long by 1 mm wide, extending into moderately high coronal process, with approximately five or more (eight?) hydrospire slits on each side of an ambulacrum, extending to the adjacent radial limbs. On the anal side, the specimen is damaged, but apparently there were four anal deltoid plates: a superdeltoid adjacent to the mouth (present), two cryptodeltoids aborally resting upon the superdeltoid, presumably overlapped by a hypodeltoid (missing). The hypodeltoid would abut against the adjacent radial

---

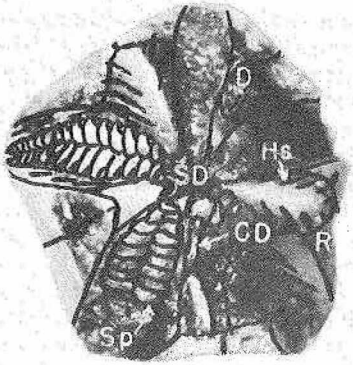
Plate II

Pleuroschisma lycorias (Hall), 1862. Lectotype (new holotype), E 15,700, Buffalo Society of Natural Sciences Museum. Kashong Shale Member of Moscow Shale, West Alden, Livingston County, New York.

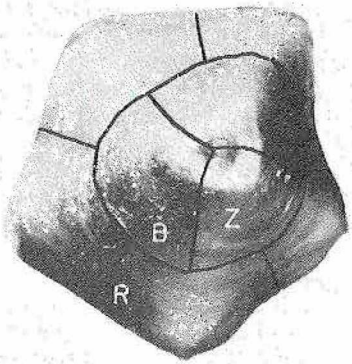
Figure 1. Oral view, x6.5.
Figure 2. Aboral view, x6.5.
Figure 3. "D" ambulacral view, x6.5.
Figure 4. "D" ambulacral view, x10.4.

B—basal plate
CD—cryptodeltoid plate
D—deltoid plate
Hs—hydrospire slit
R—radial plate
Sp—side plate
SD—superdeltoid plate
Z—azygous basal plate

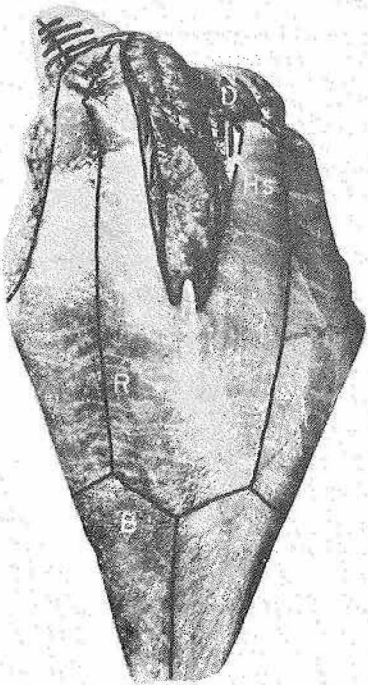
limbs, and the radial limbs would slightly overlap the cryptodeltoids. The hydrospire slits on the anal side are excavated in the cryptodeltoids. On the right side ("C" ambulacral side) of the anus, there are apparently four to five hydrospire slits excavated in the cryptodeltoid on that side, and presumably the same number on the left side. Thus there are ten exposed hydrospire fields, with possible reduction



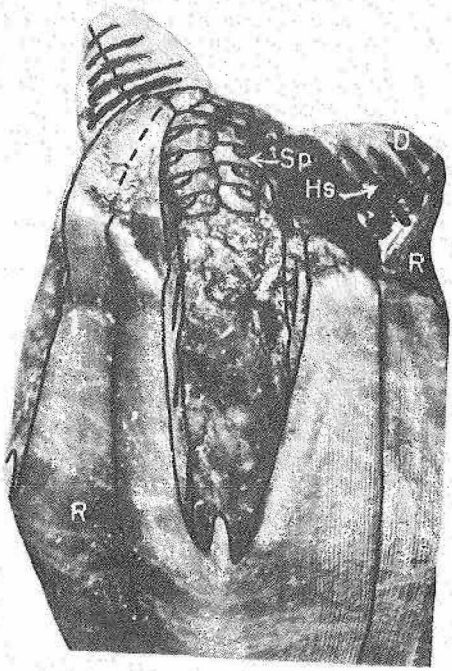
1



2



3



4

in number of hydrospire slits on the anal side, and four anal deltoid plates.

Ambulacra five, linear, each 6.5 mm long by 1.0 mm wide, with lancet covered by side plates, and 24 side plates in 10 mm length of an ambulacrum. Side plates large, subquadrangular, with outer side plates normally disposed on the adoral-abmedial bevelled corner of each primary side plate. Brachioles biserial, with each brachiolar semi-elliptical, about 0.5 mm long by 0.125 mm wide, arranged alternately, forming a zig-zag suture pattern, with small oral food groove. The brachiolar facets on the side plates are arranged in a manner that suggests that one of the first pair of brachiolars was attached to a secondary (or outer) side plate, and the other to the adjacent (aborally directed) primary side-plate handle. The surfaces of the calyx plates are ornamented with fine growth lines subparallel to plate margins.

Types and occurrence.—Hall's (1862) original types are presumably lost. Neotype, new holotype (herein selected), E 15,700; hypotypes, E 11,800 and E 16,305. Kashong Shale Member of Moscow Shale, West Alden, Livingston County, New York; in Buffalo Society of Natural Sciences Museum, Buffalo, New York. Another specimen with brachioles (a hypotype), E 15,987, is from a locality near the salt shaft, Wadsworth, Livingston County, New York, from the Kashong Shale Member.

References Cited

Hall, James, 1862, Contributions to palaeontology; comprising descriptions of new species of fossils from the Upper Helderberg, Hamilton and Chemung groups; Preliminary notice of some of the species of Crinoidea known in the Upper Helderberg and Hamilton groups of New York: New York State Cabinet Nat. History, Ann. Rept. 15, p. 115-153, 11 pls., 2 figs.

Reimann, I. G., 1945, New Devonian blastoids: Buffalo Society Natural Sciences, Bull., vol. 19, no. 2, p. 22-42, pls. 5-9.

OKLAHOMA GEOLOGY NOTES

Volume 22 March 1962 Number 3

IN THIS ISSUE

Page

Bibliography and Index of Oklahoma Geology 1961
KENNETH S. JOHNSON 57

The Mineral Industry of Oklahoma in 1961 (Preliminary)
ROBERT B. MCDOUGAL 79

First Production in Roger Mills County, Oklahoma
LOUISE JORDAN 82

Type Species of Pleuroschisma, *a Devonian Blastoid from New York*
ROBERT O. FAY 85

Doe Creek Limestone 54
Oklahoma Section of National Association of Geology Teachers 55
New Survey Publications 56