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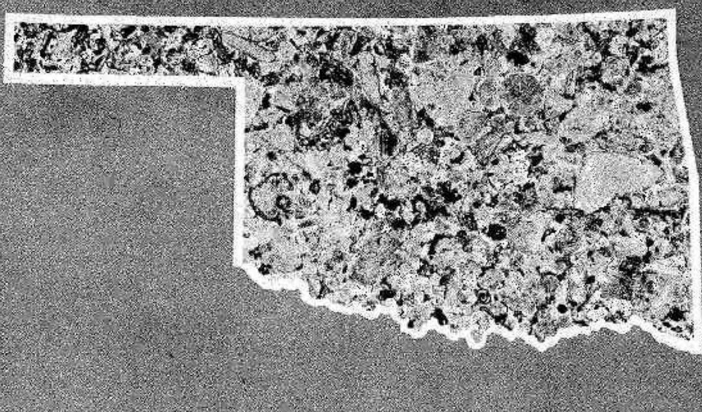
OKLAHOMA GEOLOGY NOTES



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Cover Picture

Diagenetic Fabrics

The cover photograph is a photomicrograph (x5) illustrating various fabrics produced by diagenetic modification of a crinoidal limestone (encrinite). The rock is a crinoidal calcarenite characterized by grainstone-packstone fabric. This Pennsylvanian rock occurs approximately 1,200 feet stratigraphically below the famous "Buckhorn" fossil beds along Dry Branch of Buckhorn Creek, sec. 26, T. 1 S., R. 3 E., Murray County, Oklahoma.

Pressure solution has occurred at the point contacts of many adjacent crinoid fragments. Solution has also preferentially dissolved crinoid material. Replacement calcite in the partially dissolved crinoid fragment is in all cases syntaxial spar. Some crinoid fragments also display a crystalline calcite mosaic that is nonsyntaxial between the crinoid single crystal and the syntaxial replacement spar. It is not clear whether this is the result of grain diminution or represents a later history of solution and replacement. Two types of syntaxial rims occur about the crinoid fragments. Syntaxial cement rims occur in areas in which crinoid fragments constitute almost all the particulate material and where there is no calcite mud matrix. The rim cement has been deposited syntaxially in open space surrounding the crinoid grains. Syntaxial replacement rims occur in areas of the rock that contain interstitial calcite mud and small fossil particles, although crinoid particles are still the principal grain material. Grain growth has altered much of the original calcite mud to an irregular and patchy, fine-crystalline mosaic. Grain diminution may be indicated by the presence of crinoid grains that are incompletely destroyed by the growth of a fine mosaic of nonsyntaxial calcite crystals.

—*Dwight E. Waddell*

The Mineral Industry of Oklahoma in 1965*

(Advance Summary of Final Figures)

Robert B. McDougal†

Mineral output in Oklahoma rose to a new record of $902 million in value in 1965, according to the Bartlesville, Oklahoma, office of the Bureau of Mines, U. S. Department of the Interior. All segments of the mineral industry gained except clays, sand and gravel, tripoli, and volcanic ash. The mineral fuels—paramount in the State's mineral-industry economy—accounted for almost 94 percent of the total mineral value in 1965, nonmetals more than 5 percent, and metals the remainder.

Strip mining of the Permian redbeds for copper ore in Jackson County began in late 1965. Silver was recovered as a byproduct from the milling and processing of the copper ore. Wildcat wells and field development wells totaled 4,490. The drilling activity was generally widespread across the State with two areas—the Anadarko and Arkoma basins—receiving considerable attention. In Latimer County's Wilburton Pool, Shell Oil Co. had an interesting discovery at its No. 1-4 Williams-Mabry, sec. 4, T. 4 N., R. 18 E., that struck gas on the upthrown block of the Choctaw fault, flowing 2 million cubic feet per day from the Spiro (Atokan) sand at 2,947 feet. The well is a 640-acre offset to 11,000-foot Spiro production to the north. Twenty-one oil and gas reservoirs in Garfield, Kingfisher, and Logan Counties were combined in April to form the huge Sooner Trend, the heart of which is the Dover-Hennessey field.

A new high in building activity was established in 1965 as the value of new construction (residential, nonresidential, and public works) reached $1.7 billion for an 8.1 percent gain above 1964.

MINERAL FUELS

Coal.—Less than 1 million tons of coal, valued at more than $5.5 million, was produced by 13 operators at 15 operations (3 underground, 1 auger, and 11 strip pits) in 6 counties. Haskell, Craig, and Rogers Counties led in quantity and value of output. The Kerr-McGee Corporation announced plans for developing a new multimillion-dollar coal-mining operation in Haskell County, the largest in the State. The company reported several factors favoring the venture, including faith in the coal reserves, the Arkansas River navigation project, and a 15-

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* This report, U. S. Bureau of Mines, Mineral Industry Surveys Area Report IV-199, has been prepared under a cooperative agreement between the Bureau of Mines, Department of the Interior, and the Oklahoma Geological Survey, Dr. William E. Ham, geologist, for collecting information on all minerals except fuels. The report was prepared July 11, 1966. Preliminary figures were published in Area Report IV-191, which appeared in the February 1966 issue of Oklahoma Geology Notes (p. 31-34).

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TABLE I.—MINERAL PRODUCTION IN OKLAHOMA[1]

MINERAL	1964 QUANTITY	1964 VALUE (THOUSANDS)	1965 QUANTITY	1965 VALUE (THOUSANDS)
Clays[2] (thousand short tons)	835	$ 854	794	$ 806
Coal (bituminous) (thousand short tons)	1,028	5,474	974	5,520
Gypsum (thousand short tons)	694	1,899	761	2,343
Helium (thousand cubic feet)	298,803[3]	8,591[3]	300,992	9,532
Lead (recoverable content of ores, etc.) (short tons)	2,781	729	2,813	878
Natural gas (million cubic feet)	1,323,390	166,747	1,385,400[4]	175,950[4]
Natural gas liquids:				
Natural gasoline and cycle products (thousand gallons)	554,053	34,011	570,129	34,561
LP gases (thousand gallons)	880,804	28,055	894,665	32,208
Petroleum (crude) (thousand 42-gallon barrels)	202,524	587,320	203,441	587,944
Salt (thousand short tons)	6	41	9	65
Sand and gravel (thousand short tons)	6,680	7,003	5,218	6,023
Stone (thousand short tons)	13,987	15,087	16,417	18,071
Zinc (recoverable content of ores, etc.) (short tons)	12,159	3,307	12,715	3,713
Value of items that cannot be disclosed: Bentonite, cement, copper, lime, silver, tripoli, and volcanic ash	----	22,670		23,953
Total	....	$881,788[3]	----	$901,567[4]

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes bentonite; included with "Value of items that cannot be disclosed."
[3] Revised.
[4] Preliminary.

percent depletion allowance authorized during the last session of the State legislature.

Natural gas.—Marketed natural gas increased 5 percent in volume and 6 percent in value from the previous year. Texas, Beaver, Garvin, Harper, and Stephens Counties, in descending order, led 65 counties in the output of natural gas. At yearend, the proved recoverable reserve of natural gas in Oklahoma was approximately 14.7 cubic feet of gas reserve for each cubic foot produced. Estimated proved recoverable natural-gas reserves increased 3 percent to 20,357 billion cubic feet at yearend. Exploratory drilling added 359 billion cubic feet to the gas reserves through new discoveries; extensions and revisions added another 1,540 billion cubic feet. Nine gas-storage fields in nine counties were used by the natural-gas industry.

Natural-gas liquids.—Seventy-three natural-gasoline plants and 4 cycling plants recovered nearly 1.5 billion gallons of natural-gas liquids. One new plant was completed, another was under construction, and operations were discontinued at three plants. Proved recoverable reserves of natural-gas liquids at yearend was estimated at 358.3 million 42-gallon barrels. Exploratory drilling added more than 5 million barrels to the recoverable reserve; extensions and revisions of existing pools added more than 42 million barrels. Yearend storage capacity for natural-gas liquids totaled 1.3 million barrels at eight underground sites.

Petroleum.—Crude-petroleum output totaled 203.4 million barrels from 80,947 oil wells, compared with nearly 203 million barrels from 80,511 oil wells in 1964. Daily average production of crude oil was about 6.9 barrels per well. Petroleum production was reported in 65 counties, of which Stephens, Osage, Carter, Garvin, and Creek Counties led in the order named. Proved reserves of recoverable petroleum declined for the tenth consecutive year in 1965, for no significant petroleum reserves were located to offset depletion. Estimated proved recoverable reserves of crude oil amounted to more than 1,715.5 million barrels at yearend, equivalent to 7.5 barrels of recoverable crude oil underground for each barrel of oil produced in 1965. Extensions and revisions added 131.5 million barrels to the proved reserves; 6.4 million barrels were added through new discoveries. Thirteen refineries had a total daily operating capacity of 416,430 barrels of crude oil and 154,657 barrels of cracked gasoline on January 1, 1965. Nearly 69 percent of the State's 1965 production was processed by these refineries.

HELIUM

The Federal Bureau of Mines helium plant at Keyes produced 300.9 million cubic feet of helium extracted from natural gas from the Keyes field. Helium sales totaled 256.7 million cubic feet, valued at $9 million; the remainder of the production was placed in underground storage as part of the national helium conservation program.

NONMETALS

The output of nine nonmetals was valued at more than $51 million and represented an over-all gain of about 7 percent in value. Cement, gypsum, and stone were the only principal nonmetals in which output increased in quantity and value.

Cement.- Output of cement at three plants was 10 percent greater and the value of shipments increased 5 percent in 1965.

Gypsum.—Production of gypsum increased 10 percent in volume and slightly more than 23 percent in value. Open-pit mines were operated by eight producers in Blaine, Caddo, Canadian, Comanche, Jackson, and Washita Counties to supply gypsum for wallboard and other building materials, in agriculture as a soil conditioner, and as a retarder in portland cement.

Sand and gravel.—Output of sand and gravel was 22 percent lower and the value 14 percent less than in 1964. Johnston, McClain, Oklahoma, Pushmataha, and Tulsa Counties supplied more than 50 percent of the sand and gravel produced in 37 counties in 1965. Sand was used mainly in building, paving, fill, and high-purity glass sand. Gravel was used for paving and building purposes.

Stone.—Production of stone increased more than 17 percent in quantity and 20 percent in value from the previous year. Stone was produced in 40 counties of which Comanche, McIntosh, Murray, Pontotoc, and Tulsa Counties supplied more than 50 percent. Limestone constituted 80 percent of the stone produced, sandstone 12 percent, and the remaining 8 percent was granite and chat.

METALS

Copper.—Copper was strip mined by The Eagle-Picher Company southeast of Creta in southwestern Jackson County from a deposit in the Flowerpot Shale in the Permian redbeds. A small mill was erected by the company to concentrate the ore, a combination of carbonates and sulfides of copper, for processing at a copper smelter in El Paso, Texas.

Lead.—Thirty-two producers reported output of lead ore from 61 operations. Recoverable lead output in Ottawa County increased 1 percent and value 20 percent above 1964.

Silver.—A small amount of silver associated with the copper mined near Creta was recovered from the copper concentrate.

Zinc.—Recoverable zinc output in Ottawa County increased nearly 5 percent in tonnage and more than 12 percent in value from 1964. Thirty-six producers reported zinc-ore output from 64 operations.

TRI-STATE DISTRICT

Tri-State mining activity was confined to the Kansas and Oklahoma sections, as mines in the district's southwest Missouri segment were inactive for the eighth consecutive year. Lead production increased 12 percent in quantity and 34 percent in value; zinc output rose 14 percent in quantity and 23 percent in value. Lead-concentrate output was up 16 percent from 1964; zinc concentrates increased 14 percent in the same period. Value of the concentrates increased 41 and 26 percent, respectively. Sixty-three percent of the district's lead concentrates and 66 percent of the zinc concentrates were produced from Oklahoma crude ore and the remainder was credited to mines in Kansas. Although the Lead-Zinc Mining Stabilization Program continued in effect throughout the year, no payments were made to miners in the district, as lead and zinc prices remained above the level at which payment is made under the program.

Primary Orthopyroxene-Spinel Intergrowths in Cambrian Cumulates, Wichita Mountains, Oklahoma[1]

W. L. Hiss* and H. E. Hunter†

Cambrian basic layered accumulative rocks crop out over an area of approximately 68 square miles in Kiowa and Comanche Counties, Oklahoma, in the core of the Wichita Mountains igneous complex (Tilton, Weatherill, and Davis, 1962). The rocks comprise anorthosite, feldspathic gabbro, olivine gabbro, and troctolite, and are unquestionably the result of accumulation through gravity settling of crystals from a cooling magma. This genesis has been recognized by several previous investigators (Chase, 1950; Huang and Merritt, 1952, 1954), and has been confirmed by the more recent work of Hiss (1960), Gilbert (1960), and Spencer (1961). Evidence in support of the accumulative character of the rocks includes rhythmic layering, igneous lamination resulting from planar orientation of minerals, and gravity stratification in which mafic zones grade upward into less mafic zones. The relatively simple mineralogy and textural relationships of primary and interprecipitate minerals in these rocks are features which characterize layered basic accumulative rocks in many parts of the world.

The writers have examined 135 thin sections of troctolite and olivine-bearing gabbro in the course of preliminary petrographic work on basic intrusive rocks of the Wichita Mountains. Olivine crystals in 122 of the sections are surrounded by complete or partial coronas of apparently randomly oriented, anhedral grains of hypersthene, many of which contain complex vermicular intergrowths of spinel. Intergrowths of olivine and spinel showing identical textural relationships were observed in two specimens. The intergrowth texture illustrated herein (pl. I, figs. 1, 2; pl. II, fig. 1) is strikingly similar to quartz feldspar intergrowths in many micropegmatites.

Coronas range from thin shells less than 1 mm thick to aggregates of ophitic grains 2 cm in largest dimension. Larger mineral grains of the coronas enclose small laths of plagioclase, and smaller grains are molded between olivine and larger surrounding plagioclase grains. In some specimens of olivine gabbro the olivine and hypersthene grains are in turn surrounded by larger grains of clinopyroxene. Contacts between spinel and silcate minerals in the intergrowths are knife-sharp, as are the contacts of the coronas with the enclosed olivine and surrounding plagioclase.

Values of *d*, determined from X-ray diffractograms and measure-

[1] This paper is part of a general study of the layered basic igneous rocks of the Wichita Mountains, directed by H. E. Hunter and supported by the Oklahoma Geological Survey and the National Science Foundation.

* Water Resources Division, U. S. Geological Survey, Albuquerque, N. Mex.; research for this paper was completed prior to affiliation with the Survey.

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ments of optic angles, indicate that the olivine composition ranges from Fo_{65} to Fo_{75} (Yoder and Sahama, 1957). Composition of the orthorhombic pyroxene has not been accurately determined but direct measurement of 2V on twelve grains suggests a composition range of from En_{65} to En_{85}. The orthopyroxene is slightly pleochroic (x, pale pink; y, colorless; z, pale green) which suggests that the composition lies in the hypersthene range suggested by the 2V measurements. Spinel intergrown with hypersthene and olivine is opaque in thin section, black under reflected light, and has extreme magnetic susceptibility. The mineral is probably an iron-rich spinel close to magnetite in composition.

Textural relationships between olivine and plagioclase in the corona-bearing rocks described by Hiss (1960) show clearly that olivine originated as small, early-formed grains and accumulated with plagioclase laths to form a crystal mesh. Further crystallization from the pore fluid resulted in a strongly poikilitic texture in which numerous fine plagioclase laths are enclosed near the border of the olivine (pl. II, figs. 1, 2). Textural relationships of the larger hypersthene-spinel intergrowths and hypersthene grains are identical to those of the poikilitic olivine. Knife-sharp contacts of the corona minerals with olivine and plagioclase, the poikilitic texture of the larger grains, and the interstitial position of the smaller grains indicate rather conclusively that the coronas with hypersthene-spinel intergrowths are products of the original cooling of the magma, and represent the last interprecipitate minerals to form.

Huang and Merritt (1954) described coronas about olivine in troctolite from the Wichita Mountains. One type of corona is described as consisting of a shell of pinkish hypersthene passing outward into a second shell, the mineral constituents of which are too small for precise identification but having the properties of a diopside-spinel intergrowth. Formation of the corona was attributed to thermal metamorphism in accordance with the views of Shand (1945). Reference is also made to selective replacement of olivine by iron ores. The present writers have observed such coronas in few specimens; other evidence of alteration, such as serpentinization of olivine, uralitization of pyroxene, and development of white mica in plagioclase, is invariably present in such rocks. Replacement of olivine by iron ores is probably the result of serpentinization of the olivine with concurrent separation of iron oxide, and the iron ores so formed bear no relation to the spinel of the hypersthene-spinel intergrowths. Textures of the "diopside-spinel" intergrowths are similar to those of the hypersthene-spinel intergrowths

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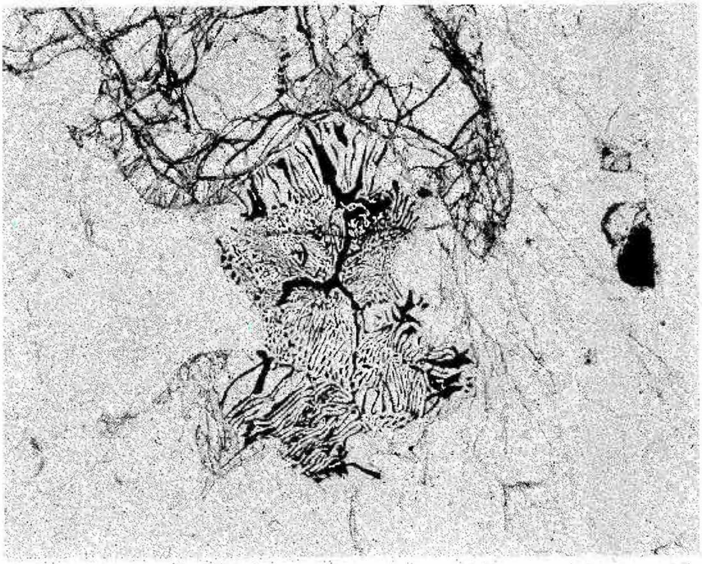
Explanation of Plate I

Figure 1. Hypersthene-spinel intergrowth in juxtaposition with olivine and surrounded by plagioclase. Ordinary light, x30. Thin section 156-2; SW cor. NW¼ NW¼ NE¼ SE¼ sec. 8, T. 4 N., R. 17 W., Kiowa County.

Figure 2. Enlarged view of the lower portion of the intergrowth shown in figure 1, above. Crossed nicols, x100.



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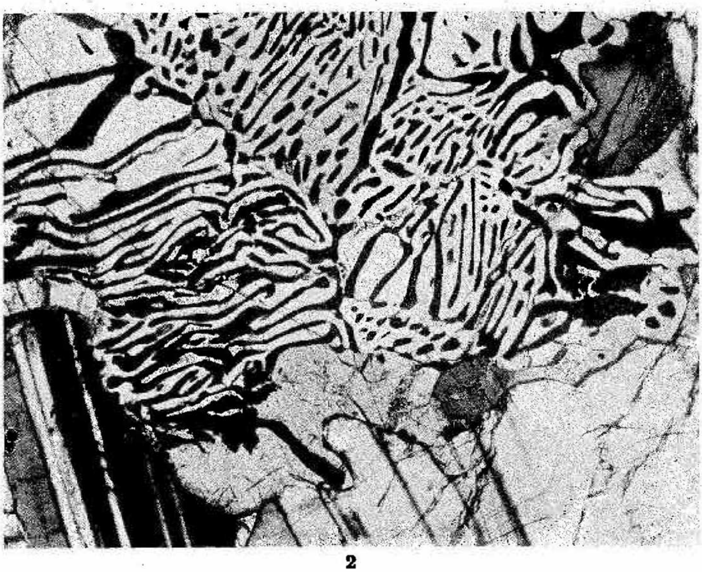

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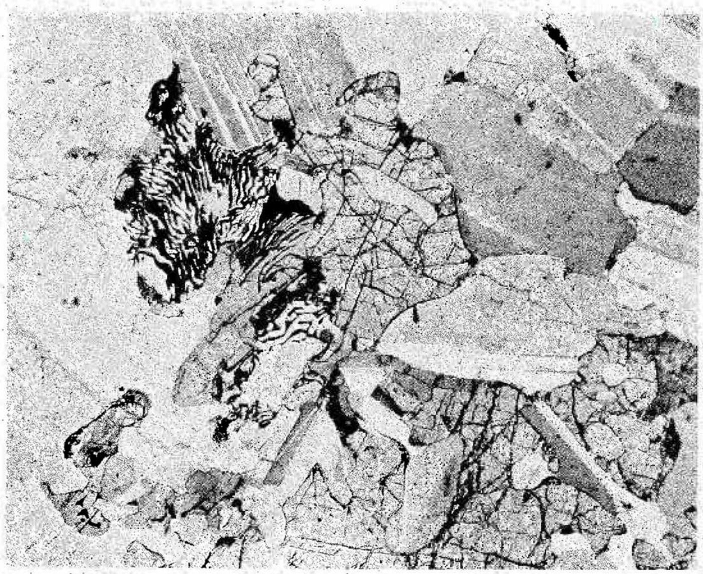
Plate II



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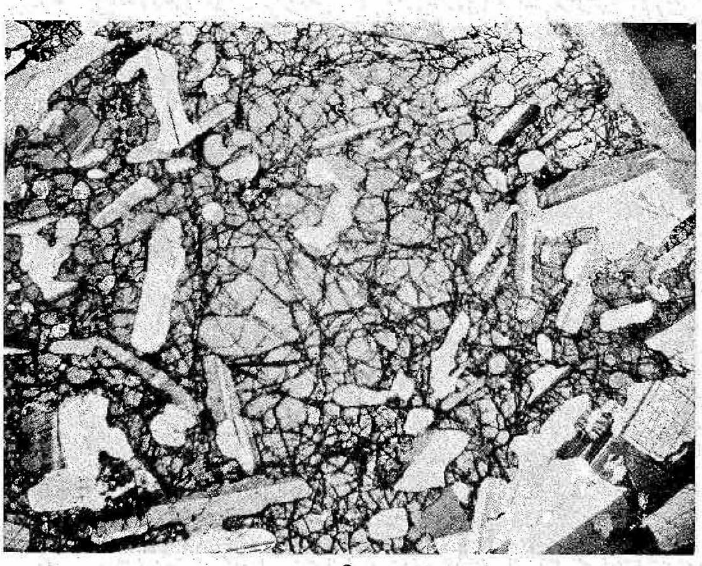

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described in this paper, except that the spinel has a feathery contact with the enclosing silicate minerals. Optical properties of the silicate minerals of these intergrowths are generally similar to those of uralitic amphibole developed elsewhere in the sections. It is highly probable that the intergrowths are amphibole-spinel, which formed by hydrothermal metamorphism of previous hypersthene-spinel intergrowths. Hunter (1958) has shown that knife-sharp magnetite-pyroxene contacts in unaltered gabbro become feathery when the pyroxene is hydrothermally altered to uralitic amphibole. The writers therefore postulate that the hypersthene-spinel coronas in troctolites of the Wichita Mountains were originally formed as primary magmatic products and that subsequently some of the coronas were altered to amphibole-spinel symplektites.

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Explanation of Plate II

Figure 1. Olivine grain with plagioclase enclosed in poikilitic texture. Poikilitic olivine and orthopyroxene-spinel intergrowth are surrounded by large plagioclase laths. Crossed nicols, x30. Thin section 173; NW¼ SE¼ NE¼ sec. 33, T. 4 N., R. 16 W., Kiowa County.

Figure 2. Olivine enclosing plagioclase in strongly poikilitic texture. Crossed nicols, x100.

Sole Marks in Atoka Rocks of Platform Facies

Carl C. Branson

Molds and impressions of segmented organisms occur in certain Atoka siltstones of Sequoyah, Cherokee, and Muskogee Counties, Oklahoma. These occur widely as molds in sandstones and siltstones and less abundantly as impressions with a dark pattern or carbonaceous film. A similar genus, *Scalarituba*, was described by Weller (1899, p. 12, pl. 6, fig. 1) upon the basis of *S. missouriensis* from the Northview Sandstone (Early Mississippian) of southwestern Missouri. The specimen figured by E. B. Branson (1938, pl. 20, fig. 28) is typical, as is that figured by Häntzschel (1962, fig. 133-4). *S. welleri* E. B. Branson, 1938, is not here believed to be a trace fossil of the same genus.

Scalarituba? atoka, new species
Figures 1, 2

Uniformly segmented tubular traces of a bottom-living organism. Segments hemispherical, concave at one end, separated by narrow interspaces. The tubes are probably feeding burrows of an annelid. The organism must have moved through bottom silts, passing the sediment through its digestive tract and removing nutrients. The segmentation is thought to be a pattern formed by regular forward expansions and contractions in the direction of the curved side of the segment.

Our specimens are from slabs used to face the upstream side of the dam of Tenkiller Ferry Reservior in Sequoyah County (collected by Dr. L. R. Wilson) and one slab (fig. 2) was collected by J. G. Blythe in SW¼ sec. 2, T. 15 N., R. 23 E., Cherokee County. They occur in siltstone of the middle part of the Atoka Formation.

At many places surfaces of Atoka sandstones and siltstones display development of other sole marks. These have been called *Spirophyton,*

Figure 1. Scalarituba? atoka, **holotype OU 5795, x1.5. Atoka Formation, Sequoyah County. Small dark bodies may be excreta. Collected by L. R. Wilson.**
(Photograph by L. R. Wilson)

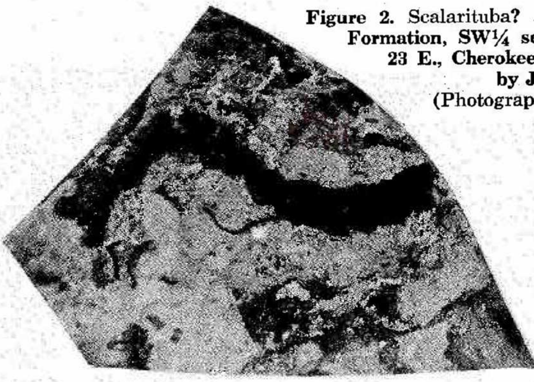

Figure 2. Scalarituba? atoka, **x1.5. Atoka Formation, SW¼ sec. 2, T. 15 N., R. 23 E., Cherokee County. Collected by J. G. Blythe.** (Photograph by L. R. Wilson)

Taonurus, rooster-tail marks, and are classified as *Zoophycos* by Häntzschel (1962, p. 220; 1965, p. 98). The range of the form genus is supposedly Devonian to Eocene and the type species is Eocene. Carboniferous forms certainly do not belong in reality to Tertiary groups, but it seems unwise to add to the list of names for these trace fossils (Häntzschel listed 16 synonyms). Not all specimens are truly organic; some seem to be swash marks.

In Oklahoma rooster-tail marks have been recorded in the Dirty Creek Sandstone Member of the Atoka Formation in Muskogee County as "markings like *Taonurus caudagalli*" (Newell, 1937, p. 29), from the Webbers Falls Member of the Atoka Formation in Muskogee County as "more regular type of boring classed as *Taonurus*" (Newell, 1937, p. 31), in the Blackjack School Member of the Atoka Formation in Muskogee County as "*Taonurus* like *caudagalli*" (Newell, 1937, p. 33), and in the basal sandstone of the Hartshorne Formation (erroneously called Blackjack (?) Sandstone Member of the Atoka Formation) by Newell (1937, p. 184) as *Taonurus* in SE cor. sec. 23, T. 25 N., R. 20 E., Craig County. Blythe (1959, p. 45) discussed "*Taonurus*" and gave localities in the Georges Fork-Dirty Creek section in Mayes County (p. 63, 64, 65). A locality on Beaver Mountain in sec. 30, T. 14 N., R. 24 E., in a sandstone 168 feet above the base of the Atoka was noted by Huffman (1958, p. 167).

Although the lithofacies in which "*Taonurus*" occurs is most common in the Atoka (fig. 3), these markings also occur locally in the Hartshorne of Craig and Mayes Counties and in the Savanna of Rogers County. The markings are a facies indicator, have no definite time range, and some may have no relationship to organisms.

Formal taxonomic treatment of these structures seems inadvisable. Trace fossils assigned to *Zoophycos* are recorded from rocks of Devonian to Miocene age and I have seen like structures in the Bighorn Dolomite (Ordovician) of Wyoming. Vanuxem first noted the occurrence of these sedimentary structures as cauda-galli (1842, p. 127). He figured two specimens (wood-cut 30, figs. 1, 2, p. 128) from the

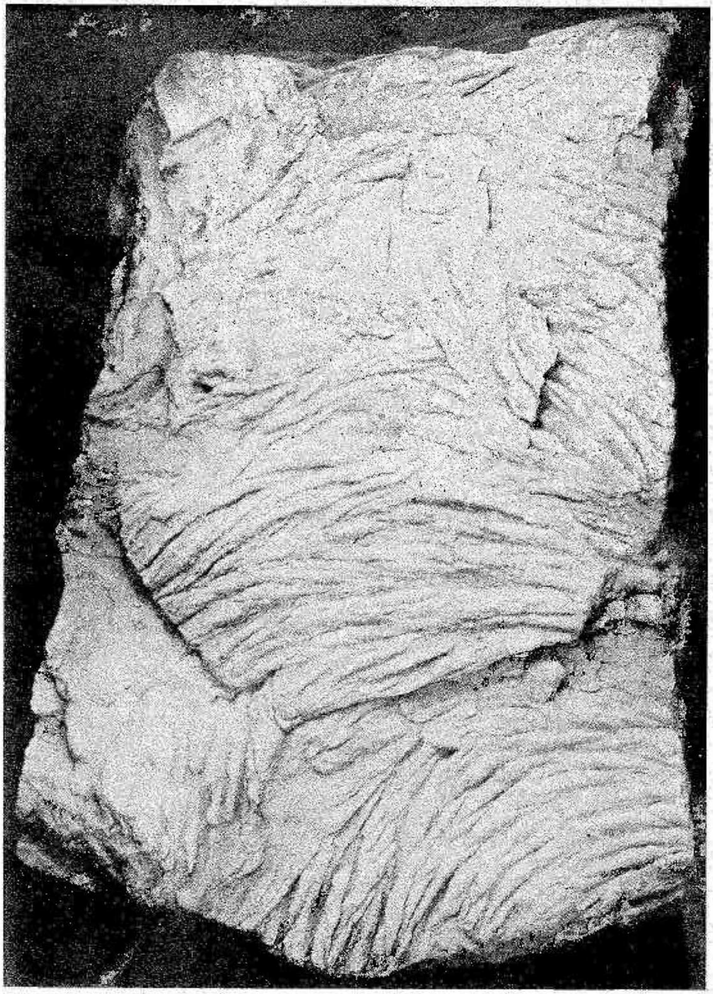

Figure 3. Caudagalli structure, x1. Atoka Formation, Blackjack School Siltstone, NE¼ sec. 24, T. 20 N., R. 18 E., Mayes County.
(Photograph by Mart P. Schemel)

Esopus grit (Onondagan) of New York. He figured another specimen from the Hamilton near Solsville, New York (wood-cut 39, p. 160), referred to specimens in the "Ithaca group" as "Cauda-galli fucoids," named *Fucoides velum* from the Waverly sandstone of Ohio (p. 176) and figured the "Retort fucoid" from Madison County (wood-cut 47, p. 177) in the Portage group.

Hall (1863, p. 78) erected the new genus *Spirophyton* to include *Fucoides cauda-galli* of Vanuxem (although Vanuxem did not use that combination). The type species is *S. typum* Hall (p. 80, pl. 2, figs. 1-3), a form of completely indeterminate affinity. *Spirophyton* is a name not applicable to caudagalli structures. It is here contended that caudagalli are sedimentary structures with no more organic relationship than the sole marks called prod marks and they should not be referred to by binary nomenclature.

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New Theses Added to O. U. Geology Library

The following Master of Science thesis was added to The University of Oklahoma Geology Library in August 1966:

Mineralogy and chemistry of chlorite from the Anderson talc deposit, Saline County, Arkansas, by Dah Cheng Wu.

Ardmore Basin Field Conference

A field conference on the Pennsylvanian of the Ardmore basin, sponsored by the Ardmore Geological Society, is scheduled for October 27-29, 1966. Field trips by buses will be conducted through the area south of Ardmore on Friday, October 28, and through the area north of Ardmore on Saturday, October 29.

The trips, under the leadership of Everett C. Parker and Robert C. Lang, are designed to provide a comprehensive survey of the Pennsylvanian rocks of the Ardmore basin, with emphasis upon new ideas, new mapping, and surface-to-subsurface correlations. Palynological dating of critical exposures will be discussed by L. R. Wilson and the geological framework of southern Oklahoma will be presented in a talk by Robert H. Dott.

Headquarters for the field conference will be at Lake Murray Lodge, 7 miles south of Ardmore, with registration from 1:00 P.M. to 6:00 P.M. on Thursday, October 27. A pre-registration fee of $20.00 ($22.50 if paid upon arrival) includes guidebook, transportation, box lunches, a social hour (Thursday night) and a dinner (Friday night). For registration forms and further information write to E. W. Wakeland, c/o Jake L. Hamon, 618 Little Building, Ardmore, Oklahoma 73401.

NOTE

In the article "Developments in the Oklahoma Portion of the Arkoma Basin, 1960-1965" (Oklahoma Geology Notes, vol. 26, no. 7, July 1966, p. 187-192), figure 1 shows a field labeled "new" in T. 10 N., R. 26 E. This field has now been named **Paw Paw** by the Nomenclature Committee of the Kansas-Oklahoma Division of the Mid-Continent Oil & Gas Association.

Natural-gas production is in secs. 11 and 12 from basal Atoka and Cromwell sands. The field is defined on the east by a dry hole. A well drilled in sec. 14 is currently being completed.

—J. F. R.

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