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OKLAHOMA GEOLOGY NOTES

CHARLES WILLIAM HONESS

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Cover Picture

Charles William Honess

The core area of the Ouachita Mountains was geologically unknown before C. W. Honess mapped and described the geology of the southern Ouachita Mountains, a report published in 1923 as Oklahoma Geological Survey Bulletin 32. The work was accomplished while he was a geologist for the Survey from 1916 to 1923, and the report was used as a doctoral dissertation at Columbia University. Geologic mapping in the area was extremely difficult. It was only because the Federal Land Office had cleared section lines that it was possible to keep oriented and to traverse the forests without slow compass traverses. Honess' camp was twice burned out by natives who thought him a revenuer and he lost notes and specimens (in 1948 a fire in a building on the south campus destroyed his final collection of rock specimens.) Before the report was published the notorious Jack Walton vetoed the Survey's appropriation, but geologists raised money to print 6,500 copies. The book and maps remain the authoritative and detailed source of geologic data on the area to this day.

He was also author of reports on the Stanley Shale (1921), on field work in the Ouachitas (1921), on southern Le Flore and northwestern McCurtain Counties (1924), and on oil and gas in Pushmataha, McCurtain, Bryan, and Choctaw Counties (1927).

Honess was born in Berea, Ohio, on June 28, 1885. He was graduated from Oberlin College in 1912 and earned the Master of Arts degree at Cornell in 1913. His early field work was done in the summers of 1914 and 1915 for the Wisconsin Geological Survey.

After Honess' work in the Ouachitas he was a petroleum geologist for Empire Gas and Fuel Company and then (from 1927 to 1949) with Gulf Oil Company mostly in Oklahoma and Kansas, and with which he was district geologist. He died hours after an operation to remove a brain tumor on March 29, 1949.

He was a charter member of the American Association of Petroleum Geologists, Fellow of the Geological Society of America, Fellow of the American Association for the Advancement of Science, member of the Society of Economic Paleontologists and Mineralogists, of Sigma Xi, and of Sigma Gamma Epsilon.

D. R. Seely caused a mountain in Le Flore County to be named Honess Mountain and named a fault first mapped by Honess the Honess fault.

—C. C. B.

Highest Point in Oklahoma

Arthur J. Myers

On July 4, 1903, a party of geologists led by C. N. Gould climbed Black Mesa near Kenton, Cimarron County (then part of Beaver County), in the extreme northwestern part of the Oklahoma Panhandle. Realizing that this was undoubtedly the highest point in Oklahoma Territory, Gould estimated the elevation to be 4,800 feet, which he described as a "wild guess." It was not until twenty-five years later that a reliable elevation was established. Much of the effort to secure a true elevation during the intervening years is chronicled in a folder of correspondence on file at the Oklahoma Geological Survey.

Gould's estimate was published in an article appearing in the *Kansas City Star* and thus was brought to the attention of the U. S. Geological Survey, which, in a letter dated July 23, 1924, informed him that his estimated elevation would be adopted until a better value could be obtained.

In a letter to C. H. Birdseye of the U. S. G. S., dated September 2, 1926, Gould wrote that he and C. L. Cooper had carried some aneroid levels from Clayton, New Mexico, 40 miles away, and, after checking and allowing for errors, had determined the elevation to be 5,050 feet. However, he was sure that this was not correct and was writing to inquire whether a Major Muldrow, who was working in the area, could run a line of levels with plane table from Clayton to the top of the mesa. Birdseye replied that the Survey was unwilling to be credited with a permanent elevation established by plane table and that the determination should be made by a spirit-level line double run or checked back. However, it was late in the season and no survey was made.

On June 4, 1926, Gould wrote to Birdseye that he had heard that a government party was running levels in the Panhandle of Texas and he wondered whether they could determine the elevation of the mesa. W. H. Herron replied on June 11, 1926, that, if the Oklahoma Geological Survey would pay the expenses, the work could be done when the men had completed their present assignment.

However, it was not until 1928 that the elevation of the highest point in Oklahoma was established by F. W. Hughes, topographer of the U. S. G. S., and J. A. Stone of the Oklahoma Geological Survey. According to the U. S. G. S. files, the elevation is 4,977.354 feet (4th order, unadjusted); however a handwritten memorandum by Hughes in the files of the Oklahoma Geological Survey gives an elevation of 4,977.900. Hughes' work was based upon an elevation of 5,072 feet for de Maya triangulation station, which had been established by the U. S. Coast and Geodetic Survey in 1922 by vertical angles. The vertical-angle method is considered less accurate than the spirit-level method, and the elevation therefore may be in error by several feet.

A monument to mark the point was constructed of blocks of black volcanic lava laid in cement mortar. It was 5 feet high, 3 feet wide at the base, tapering to 18 inches at the top, and capped with an 18-inch cube of Wichita Mountains granite (fig. 1). On the east side of the granite cube was carved the elevation of the mesa.

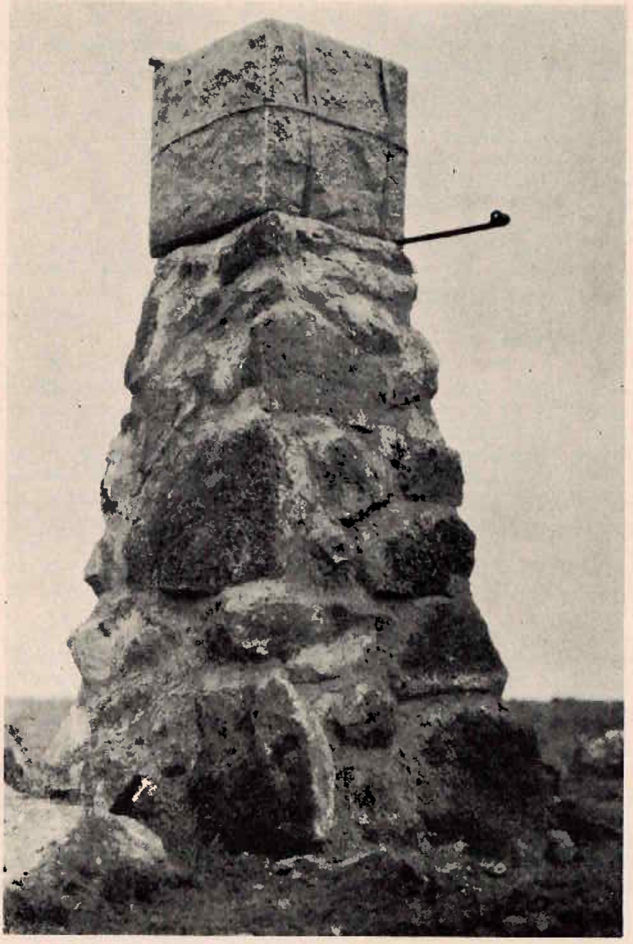

Figure 1. Monument erected in 1928 by the Oklahoma Geological Survey to mark the highest point in Oklahoma.
(Reproduced from Gould, 1929b)

A dedication of the highest point in Oklahoma was held July 4, 1928. A road had been constructed to the top of the mesa, but it was found to be too steep for some of the cars and so the dedication was held in Kenton.

Governor Henry S. Johnston of Oklahoma invited representatives of the states of Kansas, Texas, Colorado, and New Mexico to attend. Willard Mayberry, editor of the *Tri-State News* of Elkhart, represented the governor of Kansas; Professor E. H. Wells, president of the New Mexico School of Mines at Socorro, represented the governor of New Mexico; and from Texas came Mrs. Olive K. Dixon, wife of Billy Dixon, the buffalo hunter who participated in the fight with the Indians at the battle of Adobe Walls. Colorado did not send a representative. An account of the dedication and a description of the geology of the area were published by Gould (1929a, 1929b); these were accompanied by transcripts of the addresses given on the occasion.

In 1953 Jenkin Lloyd Jones, editor and publisher of the *Tulsa Tribune*, climbed to the top of Black Mesa and found the stone set by the Oklahoma Geological Survey in 1928. The elevation marked on the stone was 4,778 feet, which Jones believed to be in error. He therefore asked Governor Murray to have the State Department of Highways make a survey to the top of the mesa from a U. S. C. G. S. bench mark in the valley near Kenton. Such a survey was made under the direction of W. N. McLaughlin between May 1 and May 9, 1954.

McLaughlin learned from ranchers in the area that an elevation of 4,978 feet had been marked on the original bronze disk monument set in natural stone by the Oklahoma Geological Survey. He found part of the stem still in place, but the disk had been destroyed. The stone cutter who had inscribed the existing granite monument had erroneously inscribed an elevation of 4,778 feet.

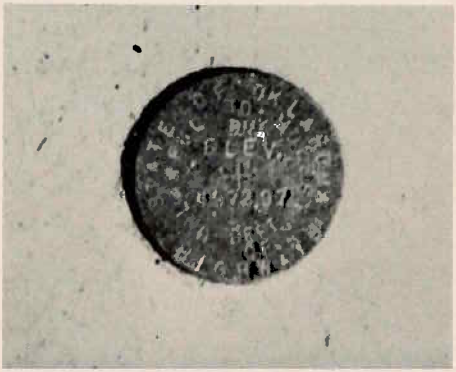

Figure 2. Bronze cap set by the Oklahoma Department of Highways stamped with the elevation of 4,972.97 feet.

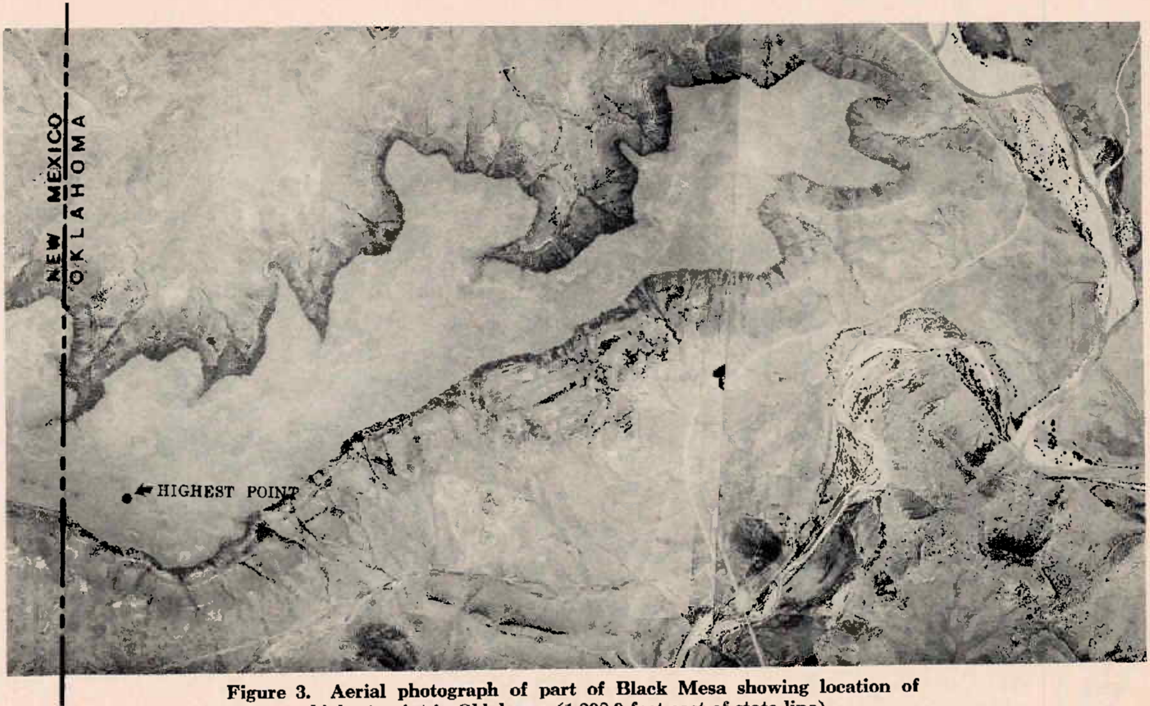

Figure 3. Aerial photograph of part of Black Mesa showing location of highest point in Oklahoma (1,298.9 feet east of state line).

Figure 4. Monument purchased by the Tulsa Tribune and erected in 1955 by the State Department of Highways. Photographs of north, south, and west sides are through the courtesy of the Tulsa Tribune.

Two separate level lines run by two separate parties started at U. S. C. G. S. bench mark B-81-1935, which is a standard bronze disk in the northwest corner of the Kenton garage, at an elevation of 4,350.283 feet. As a check, the level lines were run through U. S. C. G. S. bench mark K-12-1939 at the east end of Kenton, at an elevation of 4,353.088 feet. The lines were run north along the county road across the Cimarron River to the foot of Black Mesa, then in a northwesterly direction to the top of the mesa, and then west approximately 1.75 miles to the highest elevation. The two level lines checked to within 0.02 foot, and the elevation of the highest point in Oklahoma was established as 4,972.97 feet. Set in concrete is an Oklahoma Department of Highways standard monument, 3.25-inch-diameter bronze cap on a 30-inch-long, 2-inch-diameter stem, stamped with the elevation of 4,972.97 feet (fig. 2). Figure 3 is an aerial photograph of Black Mesa showing the location of the highest point.

In 1955 the highest point in Oklahoma was marked by an 11-foot, granite obelisk purchased by the *Tulsa Tribune* and erected by the State Department of Highways. Figure 4 is four views of the monument, which, in addition to the elevation, has the distances to the neighboring states inscribed upon it. Cimarron County, Oklahoma, is the only county in the United States which is bordered by four states.

The only passable road to the top of Black Mesa in Oklahoma is a private road from the Jack Wiggins ranch house (SE¼ NW¼ sec. 20, T. 6 N., R. 1 ECM.), which is north of Black Mesa off a county road. From the ranch house the road extends in a southwesterly direction approximately 6 miles to the top of the mesa, then southeasterly about 4 miles to the monument.

A lava cliff approximately 45 feet high rims most of the mesa (fig. 5). In places, however, slopes are more gentle and the top can be reached without too difficult a climb. Below the lava the valley slope, formed on Cretaceous and Jurassic sandstones, is approximately 30 degrees. This slope is littered with boulders of basalt up to several feet in diameter.

Black Mesa extends in an east-southeasterly direction from T. 33 S., R. 56 E., in Las Animas County in southeastern Colorado, across northeastern Union County, New Mexico, into Cimarron County of the Oklahoma Panhandle.

The mesa is about 45 miles long. In Colorado, where it is known as Mesa de Maya, it is from 7 to 8 miles wide, and in New Mexico it narrows to about half a mile. It enters Oklahoma in sec. 6, T. 5 N., R. 1 ECM., and extends in an east-northeasterly direction for approximately 3 miles and is approximately one-third of a mile wide. The top of the mesa is essentially flat and slopes from an elevation of above 6,600 feet at the western end to 4,900 feet at the eastern end. Four mesas north of West Carrizo Creek in Colorado are capped by the same lava flow.

Schoff (1943, p. 118) stated that the lava is about 50 feet thick at the east end of Black Mesa and thickens to about 85 feet at the Oklahoma-New Mexico state line.

Rothrock and Noe (1925, p. 72-73) believed that the three spines of igneous rock known as the Piney Mountains were the source of the lava. The spines are the highest part of a circular hill approximately 5 miles in diameter, and the surface slopes away from them in all directions.

The writer was unable to find the location of Piney Mountain, but on the Mesa de Maya and Mt. Carrizo topographic maps an east-west line of lava-capped hills called Black Buttes is centered at about 103° 30′ W longitude and 27° 06′ 12″ N latitude. The land slopes away from the buttes, and the hill is about 5 miles in diameter. To the west-northwest and separated by a saddle is the highest point of Mesa de Maya. The elevation is above 6,875 feet (25-foot contour interval) and is located at approximately 103° 40′ W longitude and 37° 07′ 40″ N latitude.

As the lava welled up, it spread over the flats in Colorado and covered a rather extensive area, some of it flowing into valleys. The

Figure 5. Lava cliff along rim of Black Mesa.

lava capping Black Mesa in New Mexico and Oklahoma had flowed down a valley which was probably a predecessor of the present Cimarron Valley. Subsequently streams have cut down into the bordering, less resistant rocks, leaving the flows as mesas. The upper surfaces are smooth and grassed over. The basalt cliffs represent only the lower part because the upper, broken, and more porous basalt has been weathered and leveled.

Scoff (1943, p. 119) stated that the age of the basalt flow is post-middle Pliocene and pre-early Pleistocene. Baldwin and Muehlberger (1959, p. 79) placed the Raton basalts at the base of the Pleistocene; however they stated that this is questionable and that it might be Pliocene.

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Recycled Hystrichosphaerids in Pleistocene Sediments in Central Oklahoma*

T. A. Bond

INTRODUCTION

During the preparation of samples of Pleistocene clays from oxbow lake deposits along the Washita River in central Oklahoma, supplied by Paul B. Allen of the Soil and Water Conservation Research Division, at Chickasha, Oklahoma, several specimens of hystrichosphaerids were found. The forms were identified as *Cannosphaeropsis, Hystrichosphaeridium,* and *Baltisphaeridium,* common Cretaceous-Tertiary genera. Unquestionably these fossils have been recycled from Cretaceous strata in western Oklahoma, southwestern Kansas, the Texas Panhandle, and eastern Colorado. This recycling was a result of the extensive erosion during the Wisconsinan Stage of the Pleistocene Epoch.

The order Hystrichosphaerida (O. Wetzel, 1933) comprises a group of microscopic organisms with characteristics suggesting a close phylogenetic affinity to the Protozoa. Recent studies by Evitt (1961, 1963a, 1963b) have presented additional evidence that many post-Paleozoic hystrichosphaerids are dinoflagellate cysts.

Hystrichosphaerids are found predominantly in shales and argillaceous or arenaceous limestones. The nature of the rock types, as well as associated organisms (Foraminifera, Ostracoda, and other microscopic forms), strongly suggests that most hystrichosphaerids are restricted to brackish and/or marine waters. The group as a whole has a long geologic range from Precambrian to Recent (Wilson and Hoffmeister, 1955).

* Study supported by National Science Foundation Grant G19593.

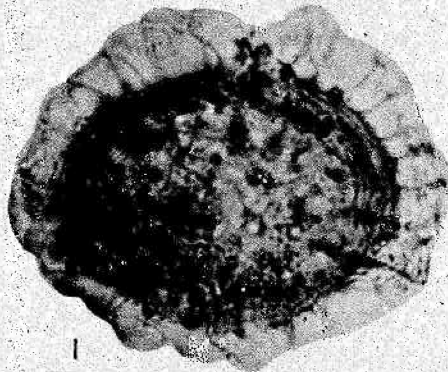
Explanation of Plate I

Figure 1. Cannosphaeropsis **sp. OPC 1004 F-2-1. Lorica diameter 32 microns by 25 microns; processes tubular, 3 to 5 microns long, 1 to 1.5 microns wide at base, tapering toward apex which is bifurcated forming anchorlike tips, 5 to 7 microns across the top; lorica enclosed within smooth membrane attached at the apex of the processes, walls of processes smooth, annular thickenings present where processes join lorica. Over-all diameter 37 microns by 32 microns.**

Figure 2. Baltisphaeridium **sp. OPC 1004 A-2-5. Locica diameter 61 microns, surface covered with numerous small hairlike processes, 1 micron long and approximately 0.5 micron wide at the base tapering to a point, smooth, pilome 40 microns in diameter.**

Figure 3. Hystrichosphaeridium **sp. OPC 1004 L-3-4. Lorica diameter 50 microns by 35 microns; processes tubular, 10 microns long, 5 microns wide at the base, processes bifurcate at tip, walls of processes smooth.**

Plate I



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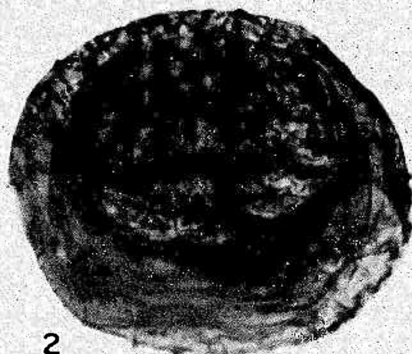

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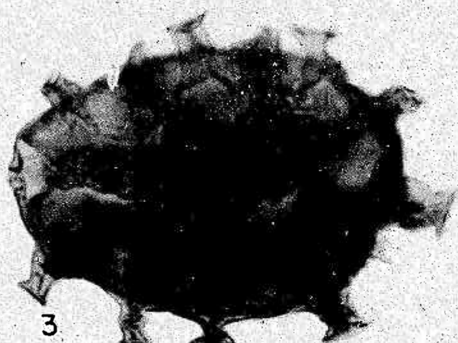

3

Phylum PROTOZOA Goldfuss, 1818
Order HYSTRICHOSPHAERIDA O. Wetzel, 1933

Family HYSTRICHOSPHAERIDAE O. Wetzel, 1933

Genus *Cannosphaeropsis* (O. Wetzel, 1933)
emend. Deflandre, 1947
Cannoshaeropsis sp.
Plate I, figure 1

Specimen OPC 1004 F-2-1

Lorica, ellipsoidal to nearly spherical, smooth, 32 microns by 25 microns; processes, tubular, numerous, 3 to 5 microns long, 1 to 1.5 microns wide at base, tapering toward apex which is bifurcated, forming anchorlike tips, 5 to 7 microns across the top; lorica enclosed within a smooth membrane attached at the apex of the processes, walls of processes smooth, annular thickenings present where processes join lorica. Over-all diameter 37 microns by 32 microns.

Cannosphaeropsis is the more numerous of the hystrichosphaerids observed and the specimens are well preserved. The Oklahoma fossils do not conform to any previously described species of *Cannosphaeropsis,* but, because they were not found "in situ," a new specific name is not designated.

Genus *Baltisphaeridium* Eisenack, 1958
Baltisphaeridium sp.
Plate I, figure 2

Specimen OPC 1004 A-2-5

Lorica spherical to slightly elliptical, 61 microns in diameter; surface covered with numerous small hairlike processes, 1 micron long and approximately 0.5 micron wide at the base tapering to a point, smooth; pilome 40 microns in diameter,

A single specimen of this form was observed. The form is poorly preserved and many of the spines are broken and blunted. Abrasion during recycling may have been responsible for the condition of the spines.

Genus *Hystrichosphaeridium* (Deflandre, 1937)
emend. Eisenack, 1958
Hystrichosphaeridium sp.
Plate I, figure 3

Specimen OPC 1004 L-3-4

A single specimen of this form was observed and is similar to *Hystrichosphaeridium choanophorum* Deflandre and Cookson, 1955, a species described as post-Upper Miocene. The Oklahoma specimen differs only in the size of the lorica and the length of the processes. *H. choanophorum* is 54 microns by 63 microns and the processes are

15 to 17 microns long, whereas the lorica of the Oklahoma specimen is 50 by 35 microns and the processes are 10 microns.

DISCUSSION

Recently recycling has been stressed in connection with palynological studies by Wilson (1964), who has shown that it is a common phenomenon in many rock formations. Cushing (1964) has also reported recycling of Cretaceous hystrichosphaerids from late Wisconsinan sediments in east-central Minnesota.

The occurrence of Cretaceous-Tertiary hystrichosphaerids in Pleistocene sediments of Oklahoma presents an interesting problem concerning late Wisconsinan drainage and physiography. The only Cretaceous-Tertiary marine rocks in western Oklahoma are small outliers and sinkhole fillings of Cretaceous age in Beckham, Roger Mills, Washita, Woodward, and Harper Counties. These deposits are remnants of more extensive Cretaceous deposits, some of which may have been the source for the hystrichosphaerids.

Work by Myers (1962) in northwestern Oklahoma established the presence of a middle Pleistocene stream channel which flowed approximately parallel to the present North Canadian and Cimarron Rivers. It is also Myers' opinion (oral communication) that the North Canadian River is much older than the Cimarron River. Because the present Washita River flows in the same direction as the two previously mentioned rivers, it seems probable that none of the rivers was connected in such a manner as to allow material eroded from southwestern Kansas or eastern Colorado to enter the Washita River. The present drainage basin of the Washita River includes much of the Texas Panhandle region. Therefore it is probable that the source area for these forms was the Texas Panhandle area or the area of former extensive Cretaceous-Tertiary deposits in northwestern Oklahoma now drained by the Washita River.

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Stained Mounting Medium for Palynological Fossils*

L. R. Wilson

Palynological fossils are commonly stained in order to make their morphographic structures more distinct and to aid in making photomicrographs of them, but among many Paleozoic assemblages the fossils appear to resist all staining attempts. Many of these fossils are colorless and nearly transparent, a condition which hampers study and results in poor photomicrographs.

Recent experiments with translucent stain-resisting fossils have resulted in the development of a technique for staining the mounting medium instead of the fossils. The resulting preparations improve the definition of the fossils and commonly differentially stain certain structures; also the quality of photomicrographs is markedly improved. One disadvantage of stained mounting media is that, if the preparation has an abundance of finely dispersed particles, the particles may take stain and may adhere to some of the fossils and give them an exine pattern difficult to interpret.

Staining of glycerine jelly used as a mounting medium has been noted eariler by Wodehouse (1959, p. 106-109) and by Wilson and Hedlund (1960). The technique described here utilizes Clearcol (Wilson, 1959), a water-miscible mountant widely used in palynological laboratories. Of several stains investigated, malachite green appears to be the most satisfactory. The stock solution is approximately 1 gram of stain crystals to 50 cc of distilled water. The procedure for staining is as follows:

* One study supported by National Science Foundation Grant GB-1850.

(1) Concentrate the fossils in a watch glass containing approximately 3 to 5 cc of distilled water.
(2) Add a drop of stock stain solution to the fossil preparation in the watch glass.
(3) Stir or swirl the preparation and if desirable add additional stain until the solution has a uniform blue-green color; allow the mixture to rest a few minutes to allow the stain to react with the particles.
(4) Prepare a smear of Clearcol mounting medium on a microscope-slide cover slip (for detailed directions see Wilson and Goodman, 1964).
(5) Rotate the watch glass until the particles are concentrated in the vortex created by the rotation; then with a finely tapered eye-dropper extract a quantity of the particles and transfer them to the Clearcol smear.
(6) Uniformly mix and spread the Clearcol and stained fossil-bearing liquid over the cover slip leaving approximately ⅛ inch of glass margin around the edge.
(7) Place the cover slip on a labeled microscope slide and transfer both to a warming plate which is no hotter than 40°C.
(8) After the preparation has dried to a hard film, invert and mount the cover slip in Canada balsam or other similar medium.
(9) Return slide to the warming plate until it is ready for microscopic study.

When viewed through the microscope the mounting medium is only slightly green, but the color is generally intense enough to secure desired results. If a darker medium is required, additional stain should be added to the aqueous solution before it is transferred to the Clearcol smear. In some cases tissues will bleed the green stain, but, if the bleeding is not too great, the contrast caused by the darker stain around the periphery of the tissues yields better photomicrographs. Generally greater contrast between the fossils and the mounting medium is achieved by focusing on their peripheries until a narrow Becke line appears. If photomicrographs can be taken at that focal plane, the resulting pictures have sharper outlines and can be trimmed more accurately. Spores and pollen with different morphological structures, or of different geological ages in the same preparation, may be differentially stained. These color differences can be a valuable aid in morphographic, taxonomic, and stratigraphic studies.

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Sponge Borings or Snail Borings

Carl C. Branson

Two Oklahoma occurrences of borings in Pennsylvanian crinoid plates have been recently described (Branson, 1964a, 1964b). Sieverts-Doreck has kindly sent reprints of her articles, among which is an article (1963) on almost identical borings on plates of a Devonian crinoid. The Oklahoma borings were doubtfully attributed to sponges; the ones from Germany assigned to snails. The Devonian examples are, as are the Pennsylvanian examples, cut into by round-bottomed pits, with thickened shell material around them. They are arranged in irregular rows radial upon the calyx plates in one specimen, upon the brachial plates in the other.

Termier and Termier (1950, p. 240, pl. 228, fig. 15) illustrated a similar type of boring in a crinoid column from the upper Visé of Morocco. The borings are mainly along a linear band on the columnal. They were mistaken for insertions of cirri, and their probable true nature was recognized by Sieverts-Doreck.

The idea that snails made the borings is here rejected. Snails bore shells in order to get to and to eat the flesh of clams, other snails, and brachiopods. The fact that the borings under consideration are all shallow pits and in no case penetrate the hard parts indicates that snails were not the organisms that made the pits. Furthermore snails bore mainly by use of secreted acids and use the radula for extraction of flesh. The borings were made slowly, as shown by the fact that the crinoid built up shell material around the margins of the pits. A hungry snail bores rapidly and there would not be time for the crinoid to react effectively. Penetrating bore holes attributed to gastropods occur in shells of Ordovician to Recent age. Sponges bore into shell material in order to make depressions which serve for protection.

The record of borings which appear to be those of sponges now includes borings of crinoid plates of Devonian to Pennsylvanian age and borings in oyster shells of Cretaceous to Recent age.

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Ordovician Conodonts of the Leningrad Region

Carl C. Branson

Two papers on conodonts from near Leningrad have appeared in the last year and another is expected. The papers are by Sergeeva (1963a, 1963b), and in these papers she described 13 new species belonging to eight genera. The forms came from the Volkhov beds, from the Kunda beds, and from the Tallin beds, all supposed to be Lower Ordovician. The formations were named by Raymond (1916), who correlated the Kunda with the Beekmantown. The type section is at the town of Kunda, Esthonia. The Kunda is overlain in the Leningrad region by the Tallin beds, and underlain by the Volkhov beds (Walchow formation of Raymond).

Sergeeva's latest paper (1963b) described the new genus *Lenodus* from the Kunda beds. The genus has the appearance of *Zygognathus* Branson, Mehl, and Branson, 1951, originally described from Upper Ordovician rocks of Indiana and Kentucky. Sweet and others (1959) later referred forms from the Eden and from Middle Ordovician rocks to the genus.

Sergeeva's paper was translated by Ronald D. Grigsby, then a graduate student in chemistry at The University of Oklahoma, and the translation was checked by M. K. Elias. The abridged translation follows:

A New Early Ordovician Conodont Genus of the Family Prioniodinidae

S. P. SERGEEVA

By dissolving in acetic acid rocks from the Lower Ordovician limestone of the Leningrad region, we obtained numerous well-preserved conodonts representing many genera and species. Among them were found uniquely complex conodonts, easily distinguished from the others and belonging to the new genus *Lenodus*.

The description of the taxonomic features characteristic of the conodonts is given in an article by S. P. Sergeeva (1963a).

Family PRIONIODINIDAE

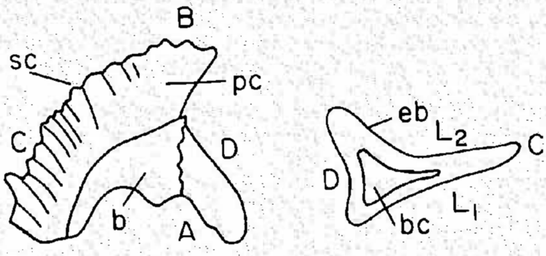
Genus *Lenodus* Sergeeva, gen. nov.

Type species—*L. clarus* sp. nov.; Lower Ordovician; Leningrad region.[1]

Diagnosis—Conodonts are slightly curved with a low, flat, principal denticle; with a short base, strongly arched from the side L_1 to D; and with small projections along the edge of the base. The secondary denticles are more or less prominent, blunt or sharp, and closely adjacent to each other, similar in form to a crest on the side C of the conodont. On the sides B and D of the base is located a smooth or slightly notched keel.

[1] The generic name was coined from the first syllable of Leningrad.

a b c d



e f

Figure 1. Lenodus clarus, **sp. nov.**

a. Specimen 8370/166 (x55), side L_1.
b. Holotype 8370/164 (x55), Popovka River, Kunda Horizon, side L_2.
c. Holotype, side L_1.
d. Specimen 8370/167 (x55), Volkhov River, Kunda Horizon, side L_1.
e. Holotype (x70), side L_2; b—base, pc—primary cusp, sc—secondary cusps.
f. Holotype (x70), side A; eb—edge of base, bc—basal cup.

Species composition—Two species—*L. clarus,* sp. nov., and *L. falodiformis,* sp. nov.—from the Lower Ordovician of the Leningrad region are known.

Remarks—The described genus is unique and includes the features characteristic to some extent of conodonts with a simple main denticle, sharp like a spear, with barlike base, small secondary denticles on the side C, less numerous on side D, and flat projections border the edge of the base of the conodont. This genus in all probability represents a transition from one taxonomic group to another.

(End of translation, specific descriptions omitted.)

It should be obvious that, although the Volkhov beds are Early Ordovician in age, the Kunda beds are Middle Ordovician. They contain *Scolopodus, Tetraprioniodus, Falodus, Ambalodus, Amorphognathus,* and *Zygognathus* (*Lenodus*). Of these genera one occurs only in the Upper Ordovician, two in Middle to Upper Ordovician, and three range upwards from the Early Ordovician. The Kunda beds are here considered to be of late Middle Ordovician age.

The Kunda conodont fauna is closely similar to that of the Middle Ordovician of Ringerike, Norway (Hamar, 1964), and of that of the Middle Ordovician of Wales (Bergström, 1964).

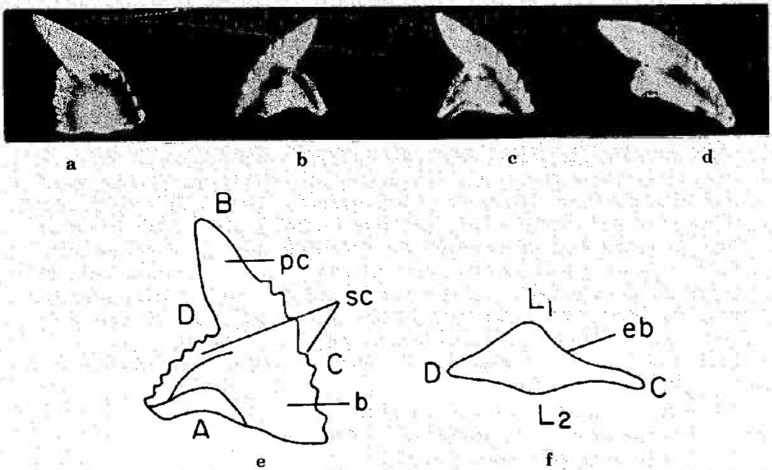


Figure 2. Lenodus falodiformis, **sp. nov.**

a. Specimen 8370/163 (x55), Popovka River, Volkhov Horizon, side L_1.
b. Holotype 8370/160 (x55), Volkhov River, Volkhov Horizon, side L_2.
c. Holotype, side L_1.
d. Specimen 8370/161 (x55), Popovka River, Kunda Horizon, side L_1.
e,f. Holotype (x80), side L_1 [and another view]; symbols are same as in figure 1.

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Field-Trip Guidebooks of Oklahoma Geology

Carl C. Branson

Geologic guidebooks are of more than casual value to geologists. They present material earlier than do formal reports, the writers are freer to advance ideas, and the books give directions to important localities. Garland Watts (1955) compiled a list of 72 such guidebooks on Oklahoma geology and logs of many other trips recorded only in typed form. From 1924 through 1964, 103 organized geologic field trips were held in Oklahoma. Of these, 32 are recorded only in typed or dittoed form, not generally available. For 70 trips mimeographed, offset, or printed guidebooks were issued, most of them now out of print. The following list is arranged chronologically.

1924. Oklahoma Geological Survey. First Geologic Field Conference.
The Anadarko basin.
Jan. 5-7, 1924. 4-day trip. Attendance 8.
Conference of C. N. Gould and 7 other geologists.
One-page typed itinerary on file.

1925. Oklahoma Geological Survey. Second Geologic Field Conference.
Trip was entirely in Texas.
Oct. 19-23, 1925. Attendance 27.

1925. Oklahoma Geological Survey. Third Geologic Field Conference.
Sulphur, Duncan, Hobart, and Dozier.
Arbuckle Mountains and Permian sediments on the south side of the Anadarko basin.
Nov. 30-Dec. 4, 1925. Attendance 39.
Leader: C. N. Gould.
Résumé, 2 pages (mimeographed).

1926. Oklahoma Geological Survey. Fourth Geologic Field Conference.
Ada to Atoka. Northeast side of the Arbuckle Mountains and the western margin of the Ouachita Mountains.
Feb. 22-24, 1926. Attendance 45.
Leader: C. N. Gould.
Two pages and 2-page road log by John Fitts (mimeographed).

1926. Oklahoma Geological Survey. Fifth Geologic Field Conference.
Ponca City, Enid, and Guthrie. The Enid Formation.
March 8-10, 1926. Attendance 16.
Leader: Fritz Aurin.
Two pages (mimeographed).

1926. Oklahoma Geological Survey. Sixth Geologic Field Conference.
Muskogee to Tahlequah. Pre-Chattanooga formations in the Ozark Mountains.
June 18-20, 1926. Attendance 13.
Leaders: C. N. Gould and Dave Logan.
Résumé, 1 page (mimeographed).

1926. Oklahoma Geological Survey. Seventh Geologic Field Conference.
Hugo, Broken Bow, and Talihina. Ouachita Mountains.

Oct. 11-13, 1926. Attendance 19.
Conference of 19 geologists.
Résumé, 2 pages (mimeographed). Published in Amer. Assoc. Petroleum Geologists, Bull., vol. 10, p. 1306-1308.

1926. Oklahoma Geological Survey. Eighth Geologic Field Conference.
Western Oklahoma, Panhandle of Texas, and northeastern New Mexico.
Leaders: C. N. Gould and others.
Nov. 9-20, 1926. Attendance 36.
Four pages (mimeographed).

1927. Oklahoma Geological Survey. Ninth Geological Field Conference.
Ada, Atoka, and Seminole. Arbuckle Mountains and Pennsylvanian strata.
Feb. 21-23, 1927. Attendance 45.
Leader: John Fitts.
Résumé, 2 pages (mimeographed).

1927. Oklahoma Geological Survey. Tenth Geological Field Conference.
Western end of Arbuckle Mountains and Ardmore basin.
March 28-29, 1927. Attendance 81.
Geologic map and itinerary, 2 pages (mimeographed).

1927. Oklahoma Geological Survey. Eleventh Geological Field Conference.
Cretaceous and adjacent formations in northwest Oklahoma and southern Kansas.
May 24-30, 1927. Attendance 33.
Résumé, 2 pages (mimeographed).

1927. Oklahoma Geological Survey. Twelfth Geological Field Conference.
Johns Valley, Pushmataha, erratic boulders in the Caney shale.
June 24-25, 1927. Attendance 12.
One-page typed résumé on file.

1928. Oklahoma Geological Survey. Thirteenth Geological Field Conference (titled as Thirteenth [Third Ada] Field Conference).
McAlester, Antlers, Atoka, Ada, Ouachita and Arbuckle Mountains.
Feb. 18-23, 1928.
Leader: John Fitts.
Three-page résumé, 2-page itinerary (mimeographed).

1928. Oklahoma Geological Survey. Fourteenth Geological Field Conference (joint conference with Kansas Geological Society).
Northwestern Oklahoma and southern Kansas.
April 13-15, 1928. Attendance 37.
Leader: L. W. Kesler.
Three-page résumé (mimeographed).

1928. Shreveport Geological Society. Sixth Annual Field Trip.
Northeast Texas and southeast Oklahoma.
June 9-10, 1928.
Road log, 4 typed pages.

1929. Oklahoma Geological Survey. Fifteenth Geological Field Conference (titled as Fifteenth [Fourth Ada] Field Conference).
Type localities in Arbuckle Mountains.
April 11-14, 1929. Attendance 46.
Twenty-one-page road log and résumé (mimeographed).
Sponsored by Oklahoma Geological Survey and civic clubs of Ada.

1929. Association of American State Geologists. Field Meeting.
Oklahoma Geological Survey and Texas Bureau of Economic Geology.
Oct. 4-8, 1929.
Leaders: C. N. Gould and E. H. Sellards.
Nine-page road log (mimeographed), two maps.

1929. Oklahoma Geological Survey. Sixteenth Geological Field Conference.
Permian beds at southeast end of Anadarko basin.
Nov. 22-24, 1929. Attendance 18.
Leaders: Roger Sawyer and Clyde Becker.
One-page typed résumé on file.

1930. Oklahoma Geological Survey. Seventeenth Geological Field Conference.
Type localities of Permian redbeds.
April 11-13, 1930. Attendance 51.
Leaders: H. L. Griley and C. N. Gould.
Five-page itinerary, 9-page résumé (mimeographed).

1930. Oklahoma City Geological Society. First Field Trip.
North-central Oklahoma.
June 1, 1930.
Leaders: Fritz Aurin and J. V. Howell.
Road log and columnar section, 5 pages (mimeographed).

1930. Oklahoma Geological Survey. Eighteenth Geological Field Conference.
The Simpson formation of the Arbuckle Mountains.
June 12-14, 1930. Attendance 89.
Leaders: C. E. Decker, Rex McGehee, and E. O. Ulrich.
Six-page road log, 5 blue-line columnar sections, map.

1930. Oklahoma Geological Survey. Mineral Resources Field Trip.
Wichita Mountains Field Conference.
June 20-22, 1930. Attendance 46.
Three-page résumé (mimeographed).

1930. Oklahoma Geological Survey. Twentieth Geological Field Conference.
Arbuckle Mountains.
Sept. 26-28, 1930. Attendance 14.
Leaders: Clyde Becker and J. V. Howell.
Two-page résumé (mimeographed).

1930. Oklahoma City Geological Society. Second Field Conference.
Ponca City to Pawhuska, Oklahoma.
Oct. 12, 1930.
Leader: Robert Roth.
Road log and columnar section, 5 pages (mimeographed).

1930. Oklahoma Geological Survey. Nineteenth Geological Field Conference.
Fall field meeting of the Society of Economic Paleontologists and Mineralogists.
Arbuckle Mountains.
Oct. 24-26, 1930.
Leaders: C. W. Tomlinson and John Fitts.
Road log, 14 pages (mimeographed), maps.

1930. Oklahoma City Geological Society.
Western Oklahoma.
Dec. 13-14, 1930.
Leader: Noel Evans.
Two pages (mimeographed), map, and columnar section.

1931. Kansas Geological Society. Fifth Annual Field Conference.
Wichita, Arbuckle, and Ouachita Mountains.
Aug. 30-Sept. 5, 1931.
Leaders: C. E. Decker, John Fitts, Frank Gouin, C. W. Honess, H. D. Miser, C. W. Tomlinson, G. C. Branner, and K. K. Landes.
Ninety-seven pages (offset), map.

1932. American Association of Petroleum Geologists. Oklahoma City Field Trip.
March 25, 1932.
Two pages (mimeographed), map.

1932. Oklahoma City Geological Society. Contribution to the 17th Annual Convention of the American Association of Petroleum Geologists.
Highway geology of Oklahoma.
Sixty-seven pages.

1933. Kansas Geological Society. Seventh Annual Field Conference.
Southern Missouri, northern Arkansas, northeastern Oklahoma.
Sept. 3-7, 1933 (Oklahoma part, Sept. 7).
Leader of Oklahoma part: Ira H. Cram.
Fifty-two pages (offset), 2 pages (mimeographed).

1933. International Geological Congress. Sixteenth.
Tulsa to Cushing to Oklahoma City to Ardmore.
Leaders: W. E. Wrather, T. E. Weirich, H. H. Charles, and C. W. Tomlinson.
Ninety-one pages, 13 plates, 28 figures.

1934. Ardmore Group, not organized as a society. Ardmore, Ada Field Trip.
June 13-17, 1934.
Leaders: Robert M. Whiteside and R. E. Shutt.
Twenty-six pages, discussion, 2 plates. Road log, 12 pages (typed).

1934. Kansas Geological Society. Eighth Annual Field Conference.
Southwestern Kansas, southeastern Colorado, northeastern New Mexico, Panhandle of Texas, northwestern Oklahoma.
Sept. 1-4, 1934.
Leaders: R. L. Heaton, Ben Parker, H. W. Oborne, and A. C. Tester.

Seventy-one pages (offset).

1935. Oklahoma City Geological Society. Second Annual Outing. Sulphur-Ada.
Leaders: John Fitts, Hubert E. Bale, and J. T. Richards.
Date unknown, 1935.
Road log, 3 pages (typed).

1935. Shreveport Geological Society.
Ouachita Mountains, Oklahoma.
Oct. 5-6, 1935.
Leader: H. D. Miser.
Three pages (dittoed).

1936. Ardmore Geological Society.
The Pennsylvanian of the Ardmore basin north and south of Ardmore, Oklahoma.
March 14, 1936.
Leaders: Linn M. Farish and O. A. Seager.
Thirty-eight pages (mimeographed).

1936. Probably Tulsa Geological Society. Trip prepared for Twenty-first Annual Meeting of the American Association of Petroleum Geologists. Party stopped at Ada to dedicate memorial fossil tree to David White.
Tulsa to Sulphur (modified from Oklahoma City Geological Society, Highway geology of Oklahoma, 1932) and Sulphur towards Turner Falls.
March 19-21, 1936.
Leaders: Darsie A. Green (Tulsa-Sulphur) and C. E. Decker (Sulphur-Turner Falls).
Six pages (mimeographed).

1936. Ardmore Geological Society.
The pre-Pennsylvanian of the Ardmore area.
April 4, 1936.
Leaders: O. A. Seager, Linn M. Farish, and C. W. Tomlinson.
Twenty-two pages (mimeographed) and blue-line illustrations.

1936. Ardmore Geological Society.
Ardmore to the Wichita Mountains.
April 18, 1936.
Leaders: Frank Gouin, O. A. Seager, and Frank Worrell.
Twenty-seven pages, charts, maps.

1936. Ardmore Geological Society.
Ardmore to the Ouachita Mountains.
June 6, 1936.
Leaders: H. L. Griley, W. L. Russell, and E. W. Morgan.
Twenty-one pages (offset), maps, cross section, plate.

1936. Oklahoma City Geological Society.
A study of the Simpson formation. Secs. 24, 25, T. 2 S., R 1 W.
Oct. 17, 1936.
Leader: C. E. Decker.
Eight pages of maps and columnar sections.

1936. Oklahoma City Geological Society.
Study of the Simpson formation. Secs. 5, 8, 17, T. 2 S., R. 1 W.

Nov. 21, 1936.
Leaders: C. E. Decker and R. W. Harris (microscopic fossils).
Eight pages of maps and columnar sections.

1937. Oklahoma City Geological Society.
A study of the Simpson formation. Secs. 2-12, T. 1 N., R. 6 E.
March 5-6, 1937.
Leader: C. E. Decker.
Five pages, 3 illustrations.

1937. Ardmore Geological Society.
The Hoxbar and upper Deese formations south of Ardmore.
March 13, 1937.
Leader: C. W. Tomlinson.
Six pages (offset), map.

1937. Ardmore Geological Society.
Structure of the Criner Hills.
May 15, 1937.
Leader: C. W. Tomlinson.
Seven pages (offset), map.

1937. Kansas Geological Society. Eleventh Annual Field Conference.
Southeastern Kansas and northeastern Oklahoma.
Sept. 3-6, 1937.
Leaders: R. H. Dott, J. M. Jewett, G. E. Abernathy, and J. L. Borden.
One hundred eight pages (offset), geologic map, correlation charts.

1938. Shawnee Geological Society and Oklahoma Geological Survey.
A study of surface rocks from Calvin sandstone to Permian through T. 6 N. to T. 10 N., Hughes, Seminole, and Pottawatomie Counties.
April 2, 1938.
Leader: R. H. Dott.
Twelve pages (typed).

1938. Ardmore Geological Society.
The Lower Pennsylvanian of the Berwyn and Baum areas.
April 23, 1938.
Leaders: W. M. Guthrey and C. W. Tomlinson.
Eight pages.

1938. Shawnee Geological Society.
A study of surface rocks from McAlester shale to Thurman sandstone, Pittsburg County.
June 18, 1938.
Leader: T. A. Hendricks.
Twelve pages (mimeographed).

1939. American Association of Petroleum Geologists. Twenty-fourth Annual Meeting. Anadarko Basin Field Trip.
March 19-20, 1939.
Leaders: D. A. Green, N. W. Bass, A. Wedel, O. E. Brown, and R. P. Lehman.
Forty-two pages (offset), 14 illustrations, map, 13 columnar sections.

1940. Oklahoma City Geological Society.
Structural and stratigraphic features of the Wichita Mountains.
March 15-16, 1940.
Leader: C. E. Decker.
Thirty-three pages (offset), 2 plates.

1940. Ardmore Geological Society.
Washita Valley fault system and adjacent structures.
May 4-5, 1940.
Leader: C. W. Tomlinson.
Ten pages (offset), 4 maps.

1941. Sigma Gamma Epsilon.
Muskogee area.
April 26-27, 1941.
Seven pages (dittoed).

1941. Oklahoma City Geological Society.
The Mesozoic rocks of the Oklahoma Panhandle.
May 29-31, June 1, 1941.
Leaders: J. W. Stovall, Edward Bloesch, and S. L. Schoff.
Thirty-three pages (offset), 16 illustrations.

1941. Tulsa Geological Society.
Tulsa to Chouteau and Grand River area and return.
Oct. 18, 1941.
Leaders: R. A. Brant and L. E. Fitts.
Nine pages (mimeographed), map, geologic column, cross section.

1941. Tulsa Geological Society.
Pennsylvanian stratigraphy of Tulsa County.
Nov. 22, 1941.
Leader: M. C. Oakes.
Eight pages (mimeographed), columnar section.

1945. Oklahoma Geological Survey. Mineral Resources Field Trip.
Ada district.
Nov. 30, 1945.
Leader: W. E. Ham.
Eighteen pages (mimeographed).

1946. Tulsa Geological Society.
Pennsylvanian and Mississippian rocks of eastern Oklahoma.
May 11, 1946.
Leaders: L. E. Fitts, Jr., and R. A. Brant.
Seventeen pages (mimeographed), 2 maps, columnar sections.

1946. Panhandle Geological Society.
Dry Cimarron Valley, Panhandle of Oklahoma and adjoining area.
May 16-18, 1946.
Leaders: W. F. Earl, D. B. Gould, and C. S. Lovington.
Eighteen pages (mimeographed), 4 maps, cross section.

1946. Oklahoma Geological Survey. Mineral Resources Field Trip.
Wichita Mountains district.
May 21, 1946.
Leader: W. E. Ham.
Fourteen pages (mimeographed), map.

1946. Ardmore Geological Society.
A structural and stratigraphic consideration of the Arbuckle Mountains and the Criner Hills.
June 28-29, 1946.
Leaders: W. E. Ham and C. W. Tomlinson.
Twenty pages (offset), 2 maps, columnar section, air photograph.

1946. Oklahoma Geological Survey. Mineral Resources Field Trip.
Ada district.
Nov. 8-9, 1946.
Leader: W. E. Ham.
Nineteen pages (mimeographed).

1946. Oklahoma City Geological Society.
The Lower Permian and Upper Pennsylvanian of north-central Oklahoma.
Nov. 14-15, 1946.
Leaders: E. C. Parker, A. N. Murray, and M. C. Oakes.
Seventeen pages (offset), maps, and sections.

1947. Sigma Gamma Epsilon.
Criner Hills.
April 19, 1947.
Leaders: J. W. Branson, H. A. Gerass, E. V. Harrison, Joseph Lintz, Jr., W. D. Rogers, and W. W. Stevens.
Eight pages (mimeographed), maps, and diagrams.

1947. Oklahoma Academy of Science.
Ozark area.
May 3, 1947.
Leader: C. A. Moore.
Seven pages (mimeographed), road log, and columnar section.

1947. Oklahoma Academy of Science.
Muskogee to Prague.
May 4, 1947.
Leader: M. C. Oakes.
Road log, 7 pages (mimeographed).

1947. Tulsa Geological Society.
Western part of the Ouachita Mountains in Oklahoma.
May 8-10, 1947.
Leader: T. A. Hendricks.
Fifty-six pages, 16 illustrations, cross section.

1947. North Texas Geological Society.
Cambrian and Ordovician rocks of the Wichita Mountains.
May 24, 1947.
Leaders: W. E. Ham and E. A. Frederickson.
Ten pages (mimeographed), map.

1947. Oklahoma Geological Survey. Industrial Tour.
Tulsa and Sand Springs.
Nov. 18, 1947.
Leader: M. C. Oakes.
Nine pages (mimeographed).

1948. Ardmore Geological Society.
Study of Pennsylvanian formations, Ardmore area.

June 18-19, 1948.
Leaders: C. W. Tomlinson and J. M. Westheimer.
Nine pages (offset), 7 maps and cross sections.

1949. Oklahoma City Geological Society.
The Pre-Cambrian and Ordovician rocks of the Wichita Mountains area.
Oct. 22-23, 1949.
Leaders: W. E. Ham, G. W. Chase, and E. A. Frederickson.
Sixteen pages, 8 illustrations.

1950. Oklahoma Academy of Science.
Camp Gruber area.
May 6, 1950.
Leader: G. G. Huffman.
Two pages (dittoed).

1950. Ardmore Geological Society.
Study of structure and stratigraphy in Arbuckle Mountains and related structures in Carter, Murray, and Johnston Counties.
May 26-27, 1950.
Leaders: C. W. Tomlinson, H. T. Weichbrodt, W. E. Ham, and Rolf Engleman.
Eleven pages (offset), 11 plates.

1950. Oklahoma Geological Survey (for Industrial Minerals Division of American Institute of Mining and Metallurgical Engineers).
Arbuckle Mountains.
Oct. 19-20, 1950.
Leader: W. E. Ham.
Thirty pages (mimeographed).

1950. Oklahoma City Geological Society.
Eastern part of the Ouachita Mountains in Oklahoma.
Nov. 4-5, 1950.
Leader: H. D. Miser.
Thirty-nine pages (offset), 2 maps.

1950. Tulsa Geological Society. Field Guide, 1950-1951 Season.
(1) Tri-State field trip to Eagle Picher Mining and Smelting Company's mines and mills.
Oct. 28, 1950.
Leader: H. E. Enlows.
Pages 5-7.
(2) Coody's Bluff to Burbank.
Dec. 9, 1950.
Leaders: M. J. Wells, T. E. Weirich, M. C. Oakes, L. E. Fitts, Jr., and A. N. Murray.
Pages 8-17.
(3) Tulsa to Spavinaw.
April 7, 1951.
Leaders: J. H. Gatchell and L. E. Fitts, Jr.
Pages 19-24.
(4) Kansas, Oklahoma, to Marble City, Oklahoma.
May 12, 1951.
Leaders: R. J. Lantz and L. E. Fitts, Jr.

Pages 27-35.

1951. Panhandle Geological Society.
Dry Cimarron Valley and the lower Front Range of the Rocky Mountains.
May 17-19, 1951.
Leaders: W. D. Neiler, D. B. Gould, and H. W. Oborne.
Twenty-three pages (offset), map.

1952. Ardmore Geological Society.
Study of Paleozoic structure and stratigraphy of the Arbuckle and Ouachita Mountains in Johnston and Atoka Counties.
April 25-26, 1952. Attendance 329.
Leaders: C. W. Tomlinson, T. A. Hendricks, and Rolf Engleman.
Seven pages, map, illustrations.

1952. Oklahoma Academy of Science and Sigma Gamma Epsilon.
Eastern part of Ouachita Mountains.
April 26-27, 1952.
Leader: H. D. Miser.
Nine pages (mimeographed), maps.

1953. Oklahoma Geological Survey (with Oklahoma City Geological Society). Guide Book I.
Pre-Atoka rocks in western part of the Ozark uplift, northeast Oklahoma.
April 24-25, 1953.
Leader: G. G. Huffman.
Forty-one pages (offset).

1953. Oklahoma Academy of Science.
Boiling Springs State Park, Woodward, Oklahoma.
May 2, 1953.
Leader: R. L. Clifton.
Seven pages (mimeographed), correlation chart.

1953. Sigma Gamma Epsilon.
Part I. Cambrian stratigraphy of the Wichita Mountains.
Part II. Stratigraphy and structure of the Criner Hills.
Dec. 12-13, 1953.
Leaders: E. A. Frederickson and K. Arbenz.
Twenty-one pages (hectographed).

1954. Oklahoma Geological Survey (with Oklahoma City Geological Society). Guide Book II.
Desmoinesian rocks of northeastern Oklahoma.
May 14-15, 1954.
Leader: C. C. Branson.
Forty-one pages (offset).

1954. Tulsa Geological Society.
Tulsa-Woolaroc-Bartlesville.
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