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OKLAHOMA GEOLOGY NOTES

NOAH FIELDS DRAKE

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Cover Picture

NOAH FIELDS DRAKE

With a massive and remarkable contribution to geologic knowledge of northeastern Oklahoma, N. F. Drake's single published study on Oklahoma geology opened up to geologists nearly a sixth of the area of the State. His map (a two-page spread) showed the geology of the Cherokee and Creek Nations and much of the Osage and Choctaw Nations. In particular he showed the Lower Carboniferous-Coal Measures (Mississippian-Pennsylvanian) contact with remarkable accuracy. His Permian-Upper Coal Measures contact is approximately the Missouri-Virgil contact. He noted the structure of the Ouachitas, the Ozarks, and the Osage homocline. He saw the Spavinaw Granite and was first to find it in place and to map it.

Drake described the Silurian (Ordovician) along the Illinois River and mapped the Silurian "marble" of Sequoyah County. His descriptions of sections of the Noel Shale and of Mississippian units are valid to this day. He observed and described Pennsylvanian rocks throughout the area and drew cross sections of these occurrences. He named the Oologah Limestone and described it, and named the Pawnee limestone, but the name was preoccupied.

Drake's fossil lists are intelligible and he named and described three new species. His notes on the coal beds are still invaluable. Drake's work in Indian Territory was for his doctoral dissertation, which was published by the American Philosophical Society in 1897 under the title *A Geological Reconnaissance of the Coal Fields of the Indian Territory*. His field work was, almost unbelievably, accomplished in six months during 1896. He had earlier worked for the Arkansas and Texas geological surveys and for the U. S. Coast and Geodetic Survey and the U. S. Geological Survey.

Drake was born near Summers, Arkansas, January 30, 1864. He took a civil engineering degree at the University of Arkansas in 1888, and bachelor's, master's, and doctor's degrees at Stanford (1894, 1895, 1897). He taught and did mining-company work in China from 1898 to 1911. He was professor of geology at the University of Arkansas and state geologist from 1911 to 1920 and was a successful consultant as well as a pillar of the Fayetteville community until his death in 1945.

Sources drawn upon for this article are a memorial by H. D. Miser, published in the Proceedings Volume of the Geological Society of America for 1947, from which the cover picture is reproduced, and a memorial by A. W. Giles, published in 1945 in the Bulletin of the American Association of Petroleum Geologists.

—C. C. B.

Caney River Arch,
a Pre-Seminole Uplift in Northeastern Oklahoma

Philip A. Chenoweth*

Present outcrop patterns and pre-Missourian subcrops in northeastern Oklahoma reveal the presence of a late Desmoinesian uplift which extended roughly east-west across parts of Osage, Tulsa, and Rogers Counties. Isopachs of certain Missourian limestone formations in this same area further suggest that the uplift, here designated the Caney River arch, exerted an influence upon carbonate sedimentation. Reeflike limestone banks of the Hogshooter and Dewey Formations, in particular, appear to have been restricted to the flanks of the former uplift, as though a slightly higher, probably submarine, topographic element existed during the time of their deposition. Quite possibly the character of sandstone and shale deposition in associated formations was also influenced by this feature.

The *Geologic Map of Oklahoma* (Miser, 1954) clearly shows an unconformity at the base of the Seminole Formation increasing in depth of erosion from the Kansas border southward to the vicinity of the Caney River (fig. 1). From about this latitude southward the unconformity appears to diminish in magnitude. Ries (1955) recognized no unconformity at this level in Okfuskee County, and Tanner (1956) found no conclusive evidence for one in Seminole County. In the vicinity of the Arbuckle Mountains, however, a prominent unconformity has been described at this horizon, and Ham (1955) showed the Missourian resting upon successively older strata down to the Ordovician Simpson Group.

Late Paleozoic orogeny in Oklahoma began in the Mississippian Period, reached several climaxes in Pennsylvanian time, and continued spasmodically but less strongly in Permian time. The three major uplifts of southern Oklahoma and adjacent states (Ouachita, Arbuckle, and Wichita uplifts) reached their maximum elevations at slightly different times during the Pennsylvanian Period; however, none of the mountain-making orogenies is dated as post-Desmoinesian pre-Missourian. Nevertheless, uplift continued spasmodically in all of the orogenic areas during this segment of time.

During each of the pulsations in the tectonically active areas harmonic effects were produced in all surrounding regions, although the magnitude of these effects differed from place to place for each orogeny. The earliest of the major uplifts, the Wichita orogeny, culminating at the close of the Morrowan Epoch, had perhaps the most widespread results. Arching, faulting, and epeiric uplift were felt as far from southern Oklahoma as western Colorado, New Mexico, and Nebraska. The orogeny which culminated in the rise of the Ouachita Mountains, early in the Desmoinesian Epoch, is correlated with a part of the vast and long-lasting Appalachian "revolution," which affected

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much of eastern North America. In contrast with these two earlier events, the Late Pennsylvanian Arbuckle uplift is generally regarded as having had less widespread effects. Results of this orogeny may, however, be concealed beneath the sediments of the coastal plain toward the southeast.

With almost every orogenic pulse in the mountain and foredeep areas in southern Oklahoma, a corresponding movement took place upon the shelf in northeastern Oklahoma. Except for the pronounced arching and faulting accompanying the Wichita orogeny, however, these were relatively minor fluctuations. A remarkable feature of these orogenic episodes is that, although locally the movement was strong and erosion deep, little or no folding occurred within a few miles of the strongest uplifts.

The plane which marks the close of the Desmoinesian period of deposition and the commencement of the Missourian is widely recognized in North America and in Europe. In parts of the Midcontinent it is a disconformity and everywhere it is represented by a distinctive change in the fossil flora and fauna. The fact that no apparent erosion accompanied the episode in central Oklahoma, so close to an uplift of major proportions, is, to say the least, unusual. Especially is this so when one recognizes that northward, farther from the uplift, a physical break of some magnitude does occur.

The contact of the Holdenville Shale and the Seminole Formation in Seminole and Okfuskee Counties is a paraconformity (Dunbar and Rodgers, 1957, p. 119). The upper surface of the Holdenville Shale must have remained a broad mud flat, probably beneath a shallow seaway, during a rather long period of time. It is difficult to conceive of conditions which permitted this surface to remain free of deposits and free of erosion for a long time while arching, exposure, and rather deep erosion occurred a short distance to the north and while strong uplift and deep erosion went on just to the south. That the time span involved was of considerable length is attested to by dramatic changes in fauna and flora between the Holdenville and the Seminole. The unconformity itself may be traced without interruption from the Appalachian coal fields of western Pennsylvania to the vicinity of Tulsa. The Caney River arch is a relatively minor flexure of that surface. The Okfuskee-Seminole paraconformable segment probably also represents a minor feature, albeit a puzzling one.

Desmoinesian strata in northeastern Oklahoma consist principally of silty sandstones and shales deposited on a broad, flat shelf. Shallow marine waters covered the shelf much of the time, but numerous coal beds and certain nonmarine aspects of the sandstone formations indicate periodic withdrawal of the sea. Several thin but widespread and extremely fossiliferous limestones resulted from brief periods of submergence, accompanied by a temporary diminution in mud and silt supply. The series is characterized as the result of frequent ebb and flood of a shallow sea; northeastern Oklahoma was alternately awash and exposed. Probably each retreat of the sea corresponded to a slight deepening of the basins to the south or to a slight upward tilt of the land area to the north. Some evidence indicates that the Ozark

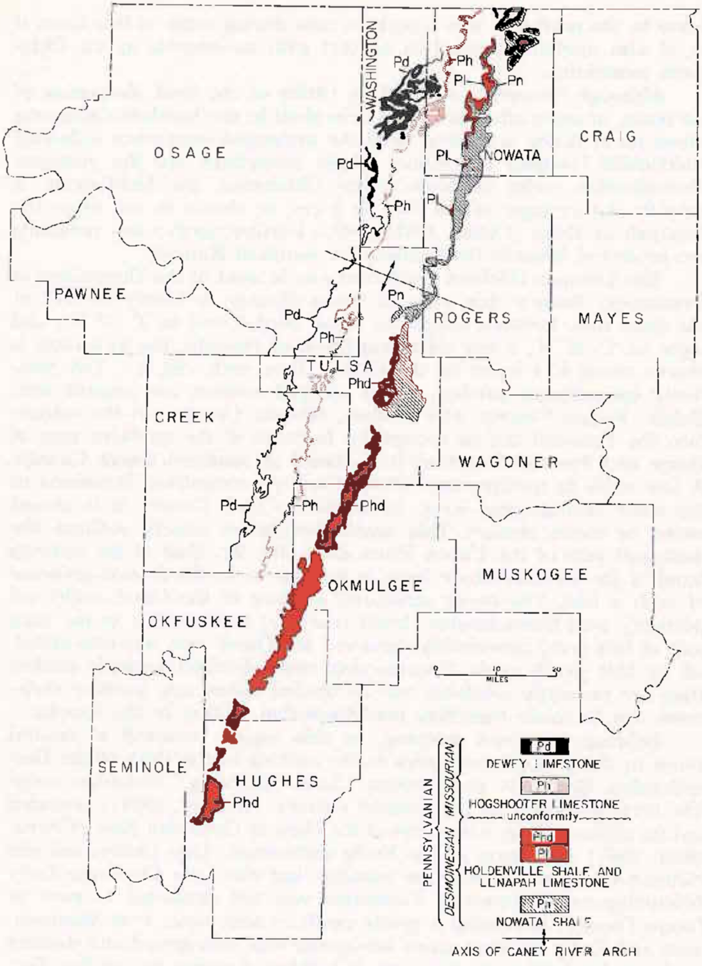

Figure 1. Geologic map of a part of northeastern Oklahoma showing outcrops of the Nowata, Lenapah, Holdenville, Hogshooter, and Dewey Formations. The area between the base of the Hogshooter and the Desmoinesian formations is occupied by the Seminole, Checkerboard, and Coffeyville Formations; a major unconformity is at the base of the Seminole, indicated by erosion of the Nowata, Lenapah, and Holdenville.

dome to the northeast was a positive area during some of this time; if so, it also probably reacted in concert with movements in the Oklahoma mountains.

Although frequently exposed by tilting of the land, deepening of the basin, or some other movement, the shelf in northeastern Oklahoma shows no evidence of folding until the prolonged emergence following Holdenville-Lenapah deposition. These formations are the youngest Desmoinesian rocks in northeastern Oklahoma; the Holdenville is actually the younger of the two, as it can be shown to rest upon the Lenapah in Tulsa (Oakes, 1952, p. 47). Farther north a few remnants are preserved beneath the Seminole in southern Kansas.

The Lenapah thickens northward (as do most of the Desmoinesian limestones) from a thin edge in Tulsa County to nearly 30 feet at the state line. Between exposures along Bird Creek in T. 20 N., and those in T. 25 N., a few miles southwest of Nowata, the formation is absent owing to erosion on the Caney River arch (fig. 1). Two relatively insignificant patches, which escaped erosion, are present near Talala, Rogers County, and Watova, Nowata County. In the subsurface the Lenapah can be recognized in much of the northern part of Osage and Pawnee Counties; it is absent in southern Osage County. A few wells in northwestern Creek County encountered limestone at the same stratigraphic level; in southern Creek County it is absent owing to facies change. This areal distribution clearly outlines the westward part of the Caney River arch (fig. 2). East of the outcrop band of the Nowata Shale there is no clue as to the former presence of such a fold. The major structural features of the Ozark uplift, all probably post-Desmoinesian, trend nearly at right angles to the long axis of this arch; presumably, however, the Ozark area was also affected by this gentle arch. Considerably more detailed geologic studies than are presently available will be needed before any positive statement can be made regarding pre-Missourian folding in the Ozarks.

Folding, or broad warping, in this region occurred at several times in the geologic past prior to the arching at the close of the Desmoinesian Epoch. A pre-Lamotte (Late Cambrian) mountain range has been described in the general vicinity (Ireland, 1955); repeated uplifts affected these mountains at the close of Cambrian time (Chenoweth, 1965) and again in the Early Ordovician. Late Ordovician and Silurian-Devonian records are missing, but the Late Devonian-Early Mississippian Chattanooga Formation was not deposited in most of Osage County, indicating a gentle uplift at that time. Post-Mississippian and Early Pennsylvanian emergence was widespread and distinct evidence for folding in this area is lacking. Arching during the Desmoinesian Epoch is suggested by a thinning of the Fort Scott outcrop band across the eastward projection of the axis of the Caney River arch.

Movement subsequent to the main episode of folding immediately prior to deposition of the Seminole Formation is shown by the pattern of limestone reef banks in at least two of the early Missourian units, the Hogshooter Limestone and the Dewey Limestone (figs. 3, 4). Figure 1 shows by breadth of outcrop that each of these formations

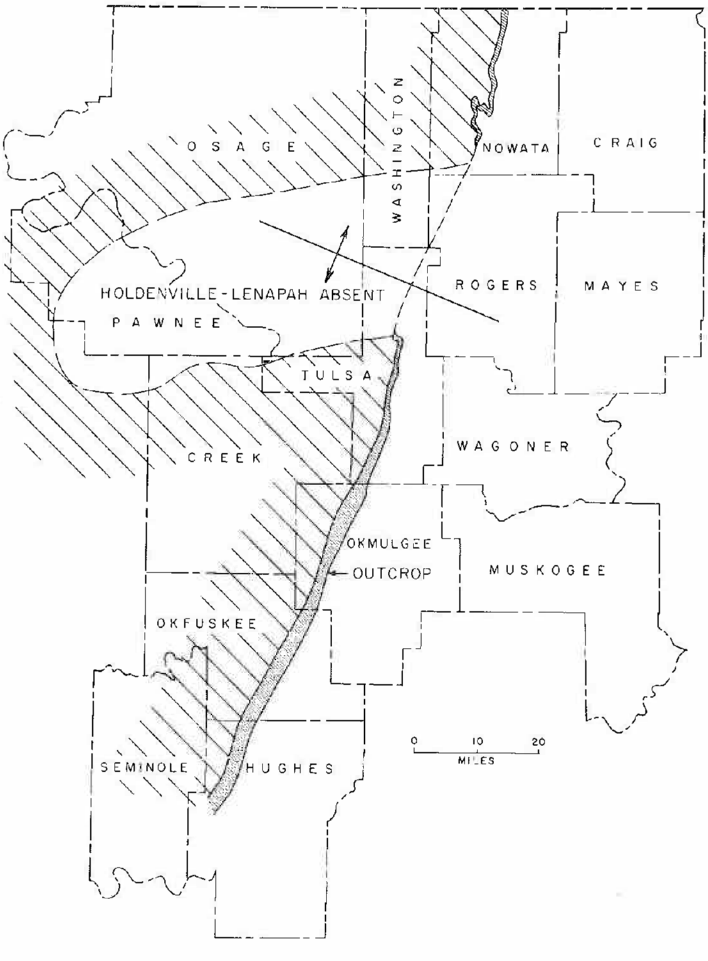

Figure 2. Subcrop map at the base of the Seminole Formation. Pre-Missourian erosion has removed the Lenapah and Holdenville Formations from a large oval area in Osage and Pawnee Counties; their outcrop is indicated from the Kansas border to southern Nowata County and from Tulsa County to Hughes County.

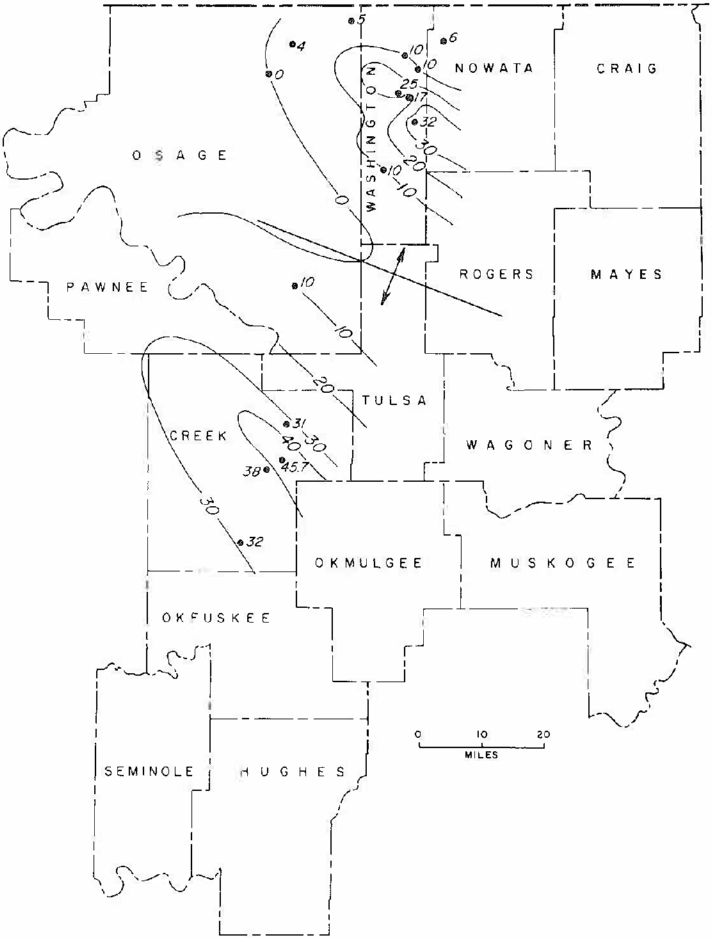

Figure 3. Thickness map, Dewey Limestone. Both measured outcrop sections and well logs have been utilized in construction of this map and that of the Hogshooter Limestone (fig. 4). The formation thins to less than a few feet across the axis of the Caney River arch. Thickened portions in Washington and Creek Counties probably are the result of reefing in these areas.

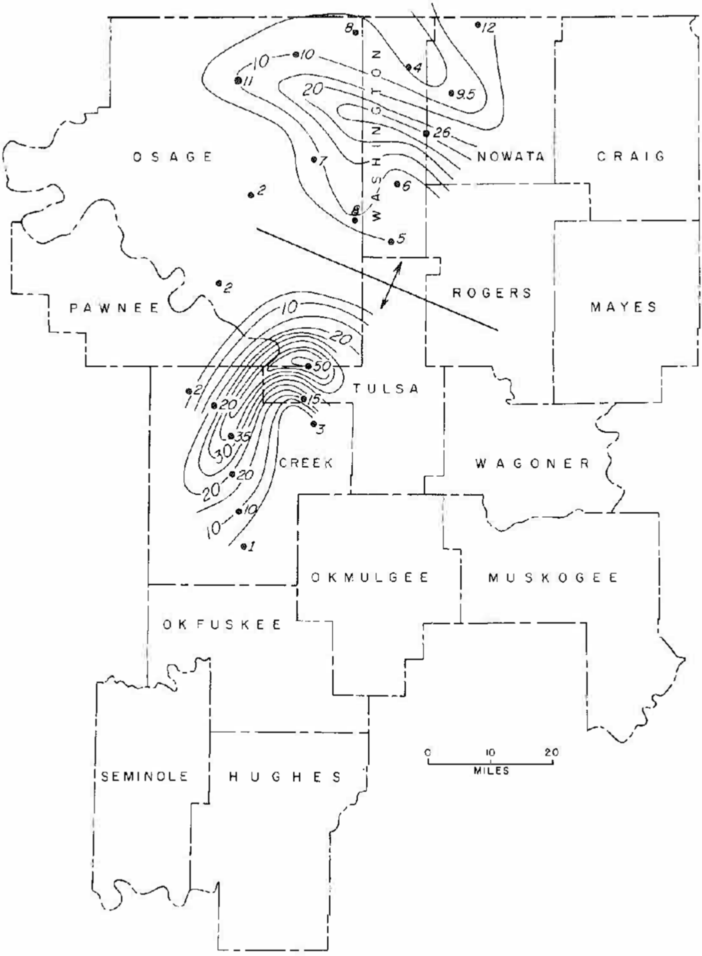

Figure 4. Thickness map, Hogshooter Limestone. The formation thins to less than 5 feet across the axis of the Caney River arch. Thickened portions in Washington and Tulsa Counties are reefs; that in Tulsa County exceeds 50 feet in thickness.

has two areas of more than normal thickness. In each case one thick area is on the north flank of the Caney River arch, near Bartlesville, and the other on the south flank, near Sand Springs. Within the thickened portions these formations exceed 75 feet; between the thick areas they are generally less than 10 feet. This pattern of distribution and thickness is highly suggestive of some sort of structural control. It is postulated that during Hogshooter and Dewey deposition the Caney River arch was a slightly elevated submarine topographic feature. This elevation, however slight, appears to have had an effect upon the deposition of limestone. Significant changes in depositional pattern in the sandstone and shale formations resulting from the arch remain to be proved, but thickness mapping in some sandstone strata, notably the Tallant Formation, suggests that the arch may also have affected deposition during that interval.

Overlap of the post-Desmoinesian unconformity probably proceeded from south to north across northern Oklahoma, although, as pointed out above, a southerly component of overlap is strongly indicated in the vicinity of the northern Arbuckle Mountains. The Seminole seas overlapped the Caney River arch in a series of roughly concentric shorelines which converge on the flanks of the uplift. Shortly after submergence the entire region was elevated to or slightly above sea level, resulting in the formation of an extensive coal swamp (Dawson coal). Later Pennsylvanian history of the region is characterized by repeated advances and withdrawals of the sea. During some, perhaps each, of the periods of sea retreat, the Caney River feature was gently rearched.

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Correlation Notes on the Upper Wapanucka Limestone of Southeastern Oklahoma

H. L. Strimple* and W. W. Nassichuk†

INTRODUCTION

The Morrowan Wapanucka Limestone, which underlies the Atoka Formation and overlies the Caney Shale, was named by Taff (1901). The strata in descending order are by original definition: (1) white massive limestone, oölitic in many places; (2) cherty sandy limestones and shales; (3) massive white limestone, absent in places; (4) calcareous and cherty sandstones grading into shales and into nearly pure ferruginous sandstones. The type locality is near Wapanucka, Johnston County, Oklahoma.

A further refined definition was proposed by Wallis (1915), who recognized eight lithologic divisions within the Ouachita area. Girty and Roundy (1923) divided the Wapanucka Formation into two parts, the lower of which was assigned to the Caney Formation as a Pennsylvanian member, and the upper to the Glenn Formation as its lowest member. They also considered the Otterville Limestone (Morrowan) to be equivalent to the lower part of the Wapanucka Formation.

Ulrich (1927) proposed to redefine the Wapanucka Limestone to include the shaly lower beds with Early Pennsylvanian faunas, such as described by Morgan (1924), as "Upper Caney." Ulrich restricted the definition of the Caney Shale to the Mississippian portion, a view which is currently accepted. Miser (1934) proposed the name Springer Formation for the rocks underlying the Wapanucka Limestone which were formerly included in the Caney Shale.

Harris and Hollingsworth (1933) described several conodonts which they ascribed to a "Cromwell member" of the Wapanucka Formation (NE¼ sec. 29, T. 3 N., R. 7 E.) in Pontotoc County, Oklahoma. The "Cromwell sand" was a subsurface term used in the Cromwell oil field. The Cromwell sand was recognized as the Union Valley Sandstone Member of the Wapanucka Formation by Hollingsworth, who defined the Union Valley in 1934. Hyatt (1936, p. 959) referred to the Union Valley as a formation with a Union Valley Limestone Member above that grades into the Union Valley Sandstone below. The Union Valley Formation is below the Wapanucka Formation.

Quinn (1962, p. 119) gave the age of the Union Valley cephalopod fauna as slightly younger than a typical Brentwood Limestone assemblage.

Harlton (1938) further restricted the formation and made several subdivisions which are not currently recognized.

Goldstein and Hendricks (1962) divided the Wapanucka Limestone broadly into four units in the area of the Ouachita Mountains,

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† Geological Survey of Canada.

of which the upper unit is the principal ridge-forming member. The upper member is reported by them to have a lower dark-gray, siliceous and oölitic limestone. This limestone is apparently equivalent to the great bed of oölite, about 150 feet thick, which crops out on Delaware Creek in Johnston County, about 1 mile southeast of Bromide, Oklahoma.

Rowett and Sutherland (1964) recognized two coral zones in the Wapanucka Formation. *Barytichisma*, which characterizes the lower faunal zone, had been reported by Plummer (1945) as occurring primarily in the Sloan Member in the lower part of the Marble Falls Formation. Rowett and Sutherland reported that *Koninckophyllum* (described as *Neokoninckophyllum* by Moore and Jeffords, 1945) and *Amplexocarinia*, which occur primarily in the upper Lemon Bluff Member of the Marble Falls Formation, characterize the upper coral zone in the Wapanucka Formation. This latter comparison is regarded as misleading because other evidence indicates that the Lemon Bluff is post-Morrowan in age (Thompson, 1947). Division of the lower part of the Wapanucka into recognizable lower and upper coral units and the presence of massive oölitic limestones in the upper part can apparently be established for most of the outcrop areas.

CORRELATION

Correlation with Morrowan formations in other areas has been somewhat obscure. The literature is confusing as to the biostratigraphic relations of the Hale and Bloyd Formations in northeastern Oklahoma. Moore and Jeffords (1945) described corals from specimens which were mainly procured at a locality below the dam at Greenleaf Lake, Muskogee County. They assigned the strata to the Hale Formation, but Huffman (1958, pl. 4) mapped this area as part of the Bloyd Formation. Upon the basis of personal observation, the authors consider that the shale lens from which Moore and Jeffords obtained most of their specimens is low in the spillway of the dam at Greenleaf Lake and is known to be part of the Bloyd Formation, probably the Brentwood Limestone Member.

In April 1965, a field party from the State University of Iowa, consisting of H. L. Strimple, W. W. Nassichuk, and Claude Spinosa, collected fossils, particularly goniatites, of Morrowan, Atokan, and Desmoinesian ages at several localities in Johnston, Coal, and Pontotoc Counties in Oklahoma. The collection of goniatites made by C. L. Rowett for the study published by Rowett and Sutherland (1964), were borrowed through the courtesy of C. C. Branson, director of the Oklahoma Geological Survey, prior to the expedition, but no species was of a sufficiently selective range for precise correlation. Rowett and Sutherland's locality 7 (NE¼ NE¼ sec. 33, T. 3 N., R. 7 E.), Pontotoc County, yielded an excellently preserved specimen of *Axinolobus quinni* McCaleb and Furnish (pl. I, figs. 1-3). Several other species of typically Morrowan goniatites were found, but *A. quinni* has a highly restricted range. A large specimen of *A. quinni*, in poor preservation, was also recovered at Rowett and Sutherland's locality 28, which is apparently the same as Girty and Roundy's station

4046 on Delaware Creek (NE$\frac{1}{4}$ SE$\frac{1}{4}$ NE$\frac{1}{4}$ sec. 5, T. 2 S., R. 8 E.), Johnston County. At locality 7 the exact horizon exposed is questionable; however, it is oölitic limestone just below Atokan rocks and likely represents the upper part of the Wapanucka Formation. The specimen at locality 28 was found in massive oölitic rock from high in a quarry wall and is certainly from the upper part of the Wapanucka.

A third representative of *A. quinni* was found at an exposure of Gene Autry Shale (sec. 34, T. 3 S., R. 4 E.) in Johnston County near the location given as the "type section" in one place by Elias (1956), although the type locality is almost certainly at the exposures some 2 miles north of Gene Autry, as defined by Elias (1956, p. 99), in Carter County, Oklahoma (SE$\frac{1}{4}$ sec. 1 and adjacent part of sec. 12, T. 3 S., R. 2 E.). The Gene Autry is by definition above the Primrose Sandstone, which Elias believed correlates with the Hale Formation of Arkansas. The fossils occur about 100 feet below the Morrowan Otterville Limestone.

Axinolobus quinni has previously been reported by McCaleb and Furnish (1964) from several exposures of the lower middle part of the Bloyd Formation (Dye Shale of Henbest, 1962) in Arkansas and from the Gene Autry Shale of southern Oklahoma. Gordon (1964, p. 82, 276) has recorded the occurrence of *Axinolobus* cf. *A. modulus*, a form which we consider synonymous with *A. quinni*, in the conglomerate above the Woolsey Member and in the Kessler Limestone Member of the Bloyd Formation. Gordon (1964) also recorded the species from the Witts Springs Formation (Glick, Frezon, and Gordon, 1964) at Greers Ferry dam site, Little Red River, Cleburne County, Arkansas. Strata at this locality have yielded typical *A. quinni*, according to McCaleb and Furnish (1964), and are referred by the latter to the Dye Shale Member (of Henbest, 1962) of the Bloyd Formation.

Familial relatives of *Axinolobus*, which occur stratigraphically higher in the Atoka Formation, are quite distinct. No similar occurrence below the Bloyd is evident.

ACKNOWLEDGMENTS

The authors are indebted to C. L. Rowett and C. C. Branson, who provided for study several Wapanucka ammonoid collections, with stratigraphic and locality information. W. M. Furnish critically read the manuscript, and Claude Spinosa assisted the authors in assembling collections in the field.

SUMMARY

The Wapanucka Formation consists of at least three distinct facies in descending order: (1) white massive oölitic limestone grading into thin-bedded limestone to the northwest; (2) cherty limestone, spicular limestone, and shale in the Ouachita region, and limestone and shale in the Arbuckle region; (3) limestone and shale (prolific coral and crinoid zones). The upper zone contains *Axinolobus quinni* and is therefore correlated with the lower middle part of the Bloyd Formation (below upper Kessler Limestone and above Brentwood Limestone) of northeastern Oklahoma and northwestern Arkansas.

Similarly, this zone correlates with the Gene Autry Formation, below the Morrowan Otterville Limestone and above the Primose Sandstone in Johnston and Carter Counties, on the south flanks of the Arbuckle Mountains, in southern Oklahoma.

The lower part of the Marble Falls Formation (Sloan Member) of central Texas is considered to be of Morrowan age and therefore probably equivalent in some part to the Wapanucka. The upper part of the Marble Falls Formation is Atokan.

SYSTEMATIC PALEONTOLOGY

Order AMMONOIDEA Zittel, 1884
Suborder GONIATITINA Hyatt, 1884
Superfamily GONIATITACEAE de Haan, 1825
Family SCHISTOCERATIDAE Schmidt, 1929
Subfamily AXINOLOBINAE Ruzhencev, 1962

Genus *Axinolobus* Gordon, 1960

Axinolobus quinni McCaleb and Furnish, 1964
Plate I, figures 1-4; text-figure 1

1956 **Winslowoceras** cf. **W. henbesti** Elias, Petroleum geology of southern Oklahoma, vol. I, p. 101.

1957 **Winslowoceras** sp. Miller and Furnish, Treatise on invertebrate paleontology, pt. L, p. 65.

1958 **Winslowoceras** sp. Miller and Furnish, Jour. Paleontology, vol. 32, pl. 33, fig. 10.

1964 **Axinolobus quinni** McCaleb and Furnish, Jour. Paleontology, vol. 38, pl. 40, figs. 1, 4, 5, 7; text-figs. 1E, 2A, 3A.

1964 **Axinolobus** cf. **A. modulus** Gordon, U. S. Geol. Survey, Prof. Paper 460, pl. 30, figs. 5, 6, 17, text-fig. 89B.

Description.—The state of preservation of two of three newly discovered specimens of *A. quinni* from southeastern Oklahoma excludes the addition of any morphologic information to the comprehensive description of the species by McCaleb and Furnish (1964). Both of these specimens, SUI 12273 and 12274, attained a diameter of at least 90 mm and in each case, despite poor preservation, a shallow concave venter is apparent. On the Delaware Creek specimen (SUI 12273) a suture line exhibiting an axe-like prong of the ventral lobe, a feature which characterizes the genus, is apparent (text-fig. 1B).

The immature specimen (SUI 12272) recovered from Pontotoc County (Rowett and Sutherland loc. 7) is entirely septate to its maximum diameter of about 14 mm and is well preserved (pl. I, figs. 1-3; text-fig. 1A). At a diameter of 14 mm, whorl width is 5 mm and whorl height 3.5 mm. The protoconch and earliest volutions are clearly displayed. A triangular outline of at least the first seven volutions (to a diameter of 9 mm) is distinct. Because the ultimate preserved (eighth) volution is incomplete, triangularity at maximum size cannot be ascertained. Whorls are strongly depressed and, at a diameter of about 9 mm, the ratio of whorl height to whorl width (H/W) approximates 50 percent.

Prominent ribs extend from the umbilical seam onto the ventro-

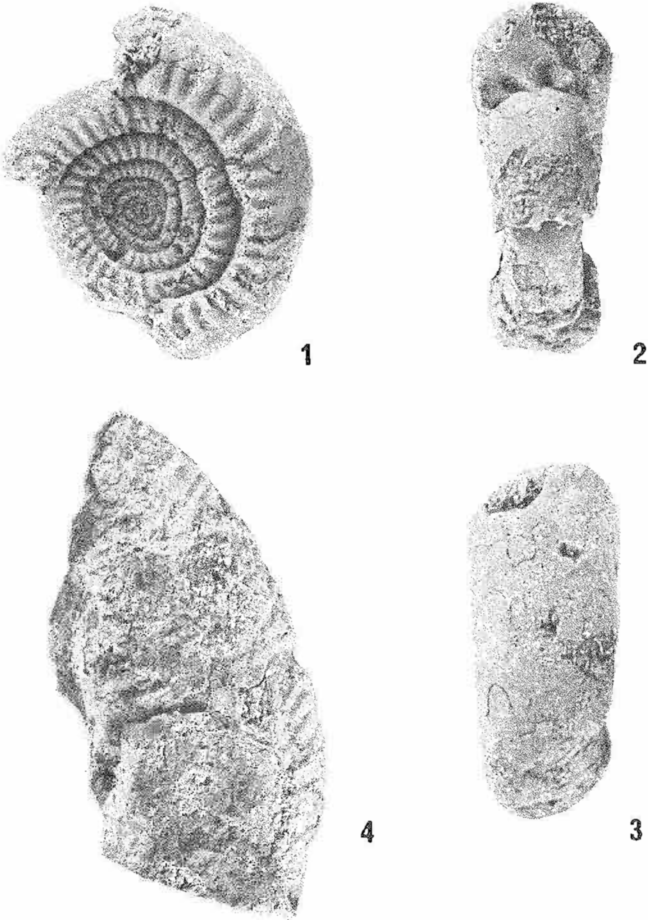
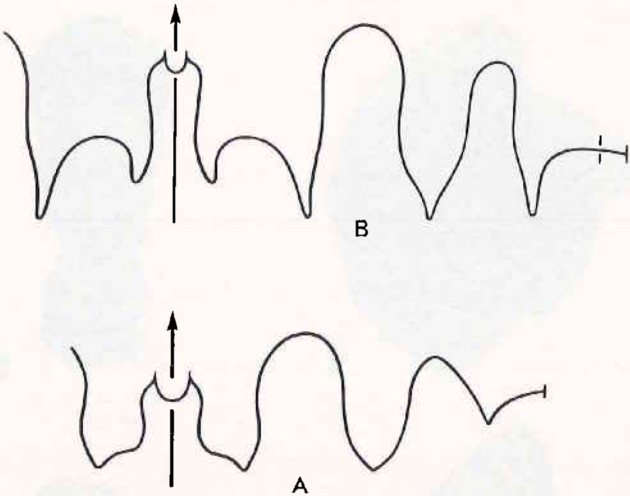


Plate I

Figures 1-3. Axinolobus quinni McCaleb and Furnish, hypotype SUI 12272; x4; from locality 7, Pontotoc County, Oklahoma.

Figure 4. Axinolobus quinni McCaleb and Furnish, hypotype SUI 12273; x1.25; from Delaware Creek locality, Johnston County, Oklahoma.



Text-figure 1. Diagrammatic representation of external sutures of Axinolobus quinni **McCaleb and Furnish.**

A. Hypotype SUI 12272 at a conch diameter of 13.5 mm, x15.

B. Hypotype SUI 12273 at a conch diameter of about 90 mm, x7.

lateral flanks to about the position of the first lateral lobe. On the penultimate volution, at a diameter of about 9 mm, 34 such ribs are present. Curiously, no ribs are present on the first volution, but they are conspicuous on all others.

A subdivision of prongs of the ventral lobe has not occurred at a diameter of 9 mm but is clearly apparent at maximum size (14 mm).

Discussion.—The single small Pontotoc specimen reveals for the first time a triangular coiling of the early volutions of *Axinolobus*. Of the four subfamilies of the Schistoceratidae (Schistoceratinae, Welleritinae, Axinolobinae, and Christioceratinae) only Christioceratinae, represented by *Christioceras* Nassichuk and Furnish from the Canadian Arctic, lacks forms that exhibit triangular coiling. *Axinolobus*, however, with *Christioceras*, remains unique among the Schistoceratidae in lacking ventrolateral grooves during early ontogenetic stages.

A. quinni can be distinguished from *A. modulus* upon the basis of conch form; in *A. quinni* transverse lirae of the test are most pronounced and a ventral concavity is apparent.

As suggested by McCaleb and Furnish (1964), the coincident occurrence of *A. modulus* and *A. quinni* indicates the possibility of their being sexual dimorphs. A similar possibility is expressed by Gordon (1964) for his *Axinolobus modulus* and *Axinolobus* cf. *A.*

modulus. The latter is currently considered conspecific with *A. quinni* because it possesses prominent ribbing and a characteristically concave venter.

Hypotypes.—The three specimens, SUI 12272, 12273, and 12274, are at the State University of Iowa, Iowa City, Iowa.

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New Specimens of *Homotelus* from the Bromide Formation

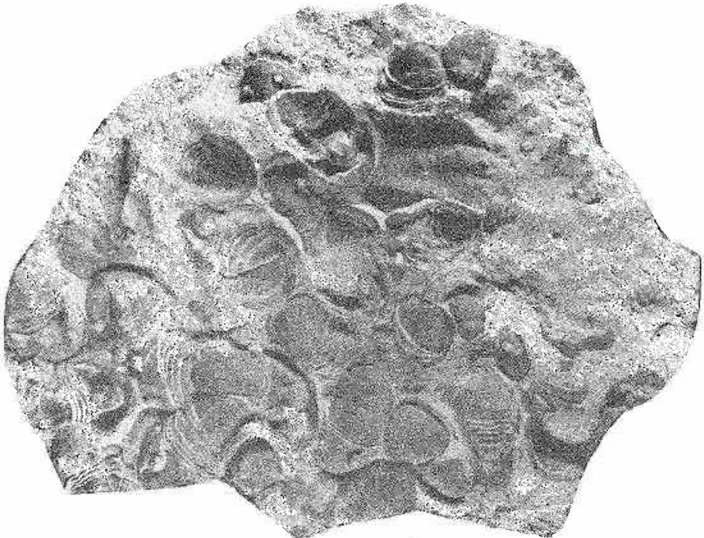
Carl C. Branson

The species *Homotelus bromidensis* was described by Esker (1964, p. 195-198, pl. 1, figs. 5, 6) upon the basis of three specimens. The holotype (OU 3209) is from Spring Creek in the type section of the Pooleville Member near the section line between secs. 8 and 17, T. 2 S., R. 1 W., Murray County (not Carter County as stated by Esker), Oklahoma. A second specimen is on the same slab, and the third specimen illustrated (OU 3455) is from Rock Crossing in the Criner Hills (near C sec 35, T. 5 S., R. 1 E.), Carter County, Oklahoma.

Laudon (1939) had mentioned and figured slabs of Bromide Limestone from Rock Crossing, one with 111 specimens of trilobites on it. These were identified by him as *Isotelus gigas*, but were assigned to *Homotelus bromidensis* by Esker (1964, p. 198). Loeblich (1940) mentioned *Isotelus gigas* from the Spring Creek locality (NE¼ sec. 17, T. 2 S., R. 1 W., Murray County), and these were referred to *Homotelus* by Esker (1964, p. 198).

We have recently obtained for our collection a fine slab collected by and prepared by Allen Graffham. The slab is from the Pooleville Member of the Bromide Formation in the lower part of the quarried section in the upper quarry near C sec. 22, T. 5 S., R. 1 E., in the Criner Hills, Carter County. The slab (OU 4549) contains 28 specimens of *Homotelus bromidensis,* seven of which show the hypostoma of which Esker did not have specimens. It is of the characteristic isotelid type. Graffham has several larger slabs in his Ardmore collection.

In addition to the holotype and companion specimen of *Homotelus bromidensis,* one of the paratypes of *Dolichoharpes procliva,* and the holotype and paratypes of *Pandaspinapyga salsa* are from Spring Creek on the southwestern flank of the Arbuckle Mountains in Murray County. All were given by Esker as from Carter County because our labels were incorrect.



1

2

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Homotelus bromidensis **Esker, 1964. Bromide Formation, Pooleville Member, Criner Hills, Carter County, Oklahoma.**

Figure 1. Prepared slab with 28 individuals, x0.46.
Figure 2. Ventral side of specimen, showing hypostoma, x1.5.
Figure 3. Hypostoma of another individual, x1.5.
(Photographs by Phillip W. Blackwell and Jan Cannon)

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New Theses Added to O. U. Geology Library

The following Master of Science theses were added to The University of Oklahoma Geology Library during September 1965:

Petrography of the Calvin Formation in Pontotoc and part of Okmulgee Counties, by William M. Greene.

Geology of northern McClain County, Oklahoma, by John M. Markas.

The following Master of Geological Engineering theses were also added during September 1965:

Relation of physical and geochemical factors to porosities in sandstones of the Bromide (Simpson) of Oklahoma, by Lorenzo Luis Albano.

Geological engineering study of Redfork sand (Pennsylvanian) in a portion of Oklahoma County, Oklahoma, by Bijan Esfandiari.

A study of Oklahoma water flood statistics, by Ernesto Fronjosa.

Geological engineering study of T. 16 N., R. 5 W., Kingfisher County, Oklahoma, by Abdul Razzak Sheikh.

—L. F.

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