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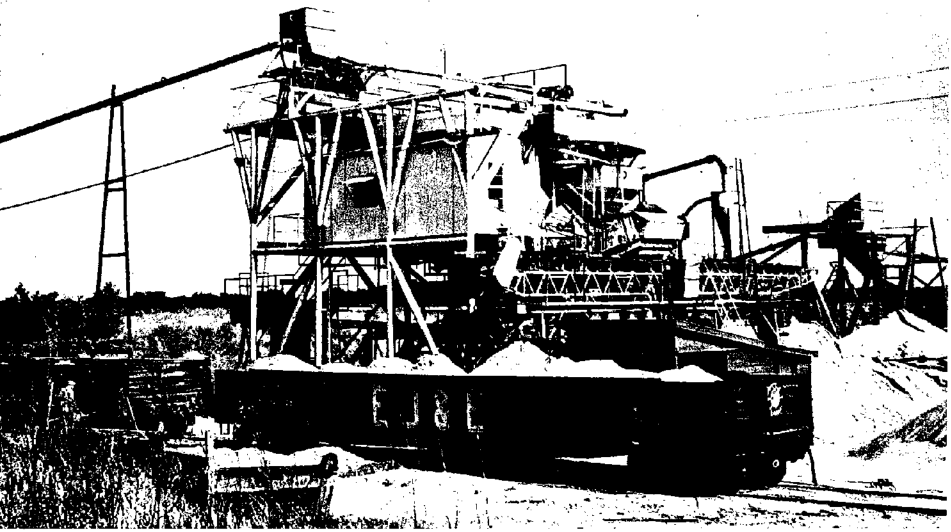
OKLAHOMA GEOLOGY NOTES



SAND-CLASSIFYING PLANT. KINGFISHER COUNTY

OKLAHOMA GEOLOGICAL SURVEY • THE UNIVERSITY OF OKLAHOMA • NORMAN, OKLAHOMA

Cover Picture

MINERAL INDUSTRIES OF OKLAHOMA

Sand and Gravel

Sand and gravel for construction are available throughout most of Oklahoma. The principal deposits are in the courses of the major eastward-flowing rivers. Associated with these are the older sand and gravel deposits of the Pleistocene river courses found in terraces along the present-day streams. A third source is the Tertiary Ogallala Formation, which covers a large part of western Oklahoma. Other sources are the present-day stream deposits in the mountainous eastern part of the State and local Paleozoic deposits in the Arbuckle and Wichita Mountains and central Oklahoma.

First recorded production of sand and gravel (less than 1,500 tons) was in 1904 and the cumulative production through 1963 was 136.7 million tons valued at $102.5 million. In response to the post-war building boom, the production of sand and gravel increased markedly in 1952, and the higher production rate has been sustained to the present. During the 12-year period 1952-1963, 77.1 million tons, valued at $70.6 million, was produced, an increase of about 29 percent in quantity and 120 percent in value over the preceding 48-year period.

Production in 1963 was 5.4 million tons valued at $6.1 million, from 35 counties. Seven counties, Johnston, Logan, McClain, Muskogee, Oklahoma, Pushmataha, and Tulsa, yielded 62 percent of the quantity. Tulsa County, where 10 operators work the deposits of the Arkansas River, produced 1.2 million tons, or 22 percent of the total.

Pictured on the cover is the sand-classifying plant of the Dover Sand Plant of The Dolese Company on the Cimarron River near Dover, Kingfisher County.

—A. N.

(Photograph courtesy of Dale Smith, The Dolese Company)

New Species of Trilobites from the Bromide Formation (Pooleville Member) of Oklahoma

George C. Esker, III*

Within the last few years, many excellent specimens of trilobites have been collected from the Pooleville Member of the Bromide Formation. The majority of these specimens were collected by A. Allen Graffham and most have not been previously described. The present work contains a description of five new species and the establishment of a new subgenus, and additional information and comments concerning the anatomy of the trilobite genera *Homotelus, Dolichoharpes,* and *Pandaspinapyga.*

Several additional species also occur in the Bromide Formation. Among these are *Calliops armatus* Ulrich and Delo, 1940, and *Lonchodomas mcgeheei* Decker, 1931, as well as representatives of *Bumastus, Illaenus, Encrinurus,* and *Amphilichas (Probolichas)*.

I am indebted to Dr. Carl C. Branson and Dr. E. A. Frederickson for the loan of many excellent trilobite specimens from The University of Oklahoma's paleontological collections that include the holotypes and paratypes of the new species, to Dr. G. A. Cooper for the loan of specimens from the U. S. National Museum for study purposes, and to Dr. H. B. Whittington for the loan of specimens from the Harvard Museum of Comparative Zoology for study purposes.

SYSTEMATIC DESCRIPTIONS

Family ASAPHIDAE Burmeister, 1843

Genus *Homotelus* Raymond, 1925

Homotelus bromidensis Esker, new species
Plate I, figures 5, 6

The cephalon is subtriangular, the width being about 1½ times the length (sag.) in most specimens but nearly as much as 1⅔ times in a few. The cephalon is slightly convex except for the anterior and the lateral portions that slope steeply down to the margin. There is no border. The posterior portion is outlined by shallow axial furrows that end about one-third of the length of the cephalon before the anterior margin. The axial furrows, separated about one-half the width of the cephalon where they begin at the posterior of the cephalon, curve inward as they approach the eyes. At the posterior part of the eyes, the axial furrows go straight forward until past the eyes, where they curve outward to where they end. Two pairs of faint arc-shaped glabellar furrows are visible on one specimen. The basal or posterior pair begins at the anterior corner of the eyes. The anterior pair begins just in front of the eyes. A faint narrow ridge runs down the

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middle of the glabella, dying out about half the distance of the length of the cephalon, beginning at the anterior margin. The eyes, situated behind the midlength of the cephalon, are of medium size and extend above the highest portion of the glabella. They are reniform and slope backward and upward. The lenses are minute, numerous, and arranged in diagonal rows. The facial sutures begin inside the genal angles and curve inward toward the eyes, where they curve outward, then inward, following the reniform shape of the eyes. They then curve inward just above the margin until they meet in the middle and curve downward to the anterior margin.

Specimens of the hypostoma were not available for study purposes, but in the photographs of Laudon (1939) the hypostoma appears to be of the general homotelid-isotelid type.

The thorax consists of eight segments. Axial furrows are shallow. Pleurae are divided into the inner, nearly flat portion and the outer, steeply sloping portion by the fulcrum. The facets are large. The pleural furrows are of medium width and become shallower as the individual grows in size. The pleural furrows begin near the inner anterior corner and end about midway on the pleurae at the fulcrum.

The pygidium, about 1⅓ times as wide as it is long, is slightly convex and triangular. The pygidial axis is slightly more than one-third of the width of the pygidium at the anterior margin and tapers backward to where it ends at about three-fourths of the length of the pygidium. The side lobes have large facets and distinct first furrows. About twelve faint pairs of ribs are visible on most specimens. The ribs and axis end at the border, which is broad and slopes steeply downward. Numerous small pits cover the surface of the trilobite.

Homotelus bromidensis can be distinguished from the only other definitely known species of the genus, *Homotelus ulrichi* Raymond, by the position of the two pairs of glabellar furrows. In *H. bromidensis* both pairs are situated toward the anterior of the palpebral lobes, whereas in *H. ulrichi*, the basal pair is opposite the posterior end of the

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Explanation of Plate I

Figures 1-4. Dolichoharpes proclivε, **new species.**

1. **Paratype OU 5065, x2; ventral view. From quarry in sec. 22, T. 5 S., R. 1 E., Carter County.**
2. **Holotype OU 5195, x2; adult cephalon. From Rock Crossing, sec. 35, T. 5 S., R. 1 E., Carter County.**
3. **Lateral view of holotype, x2.**
4. **Paratype OU 5208, x2; partly crushed cephalon and some thoracic segments. From Spring Creek, Criner Hills, Carter County.**

Figures 5-6. Homotelus bromidensis, **new species.**

5. **Specimen OU 3455, x4; young complete individual showing genal spines. From Criner Hills.**
6. **Holotype OU 3209, x1; complete adult specimen. From Spring Creek, Carter County.**

(Photographs by Jan Cannon)

Plate I

palpebral lobes. In addition, the two pairs of glabellar furrows are essentially parallel in *H. bromidensis* and are simple arcuate curves, whereas in *H. ulrichi* the furrows are not parallel and the second pair, after curving inward, curves backward sharply near the midline. The eyes are more anteriorly placed in *H. ulrichi* than in *H. bromidensis*. *H. ulrichi* has a more distinct pygidial axis.

Laudon (1938, 1939) and Loeblich (1940) both mentioned occurrences of abundant specimens of *H. bromidensis*, although each described them as *Isotelus gigas* De Kay. Each missed the obvious features of these specimens that are quite different from those of *Isotelus gigas*.

This species is placed in the genus *Homotelus* because it possesses two pairs of glabellar furrows and not in *Isotelus*, which, upon the basis of specimens I have seen, apparently has three pairs of glabellar furrows. Whittington (1950) suggested that *Homotelus* be placed in synonymy with *Isotelus* because of the close general similarities between the forms, ignoring the presence of the two pairs of "pits" on the glabella of some specimens. He reasoned that the specimens exhibiting these "pits" did not retain their full convexity. This explanation does not account for the presence or significance of the two pairs of "pits" on some specimens. Such "pits" indicate the position and number of glabellar furrows. Therefore, I suggest that trilobites having general similarities to *H. ulrichi* and possessing two pairs of glabellar furrows be placed in the genus *Homotelus*. Other isotelid-type trilobites should be more thoroughly investigated, with special attention to the presence of faint, shallow glabellar furrows that are present on some specimens of what appear to be species and genera having smooth glabellas that are nearly obsolete on the cephalons.

Specimens: Holotype OU 3209, Spring Creek, and specimen OU 3455, Criner Hills, both from Carter County, Oklahoma.

Family HARPIDAE Hawle and Corda, 1847

Genus *Dolichoharpes* Whittington, 1949

Dolichoharpes procliva Esker, new species

Plate I, figures 1-4

The cephalon is oval with the greatest width at approximately one-third of the length back from the anterior border. The maximum height is approximately one-third the width of the cephalon. The length of the cephalon is slightly less than twice the length of the prolongations, which curve inward at about midway of their length. The glabella tapers forward to the rounded anterior end and is longer than it is wide, being about one-fourth as long as the cephalon. The deep first glabellar furrows begin at approximately three-fifths of the length and extend inward and backward. The first glabellar lobes are small and triangular. Shallow furrows connect the inner ends of the first glabellar furrows with the occipital furrow. A ridge crosses these furrows from the median portion of the glabella onto the first glabellar lobes, where they form a curve convex toward the anterior. The second pair of glabellar furrows is shallow and short, about one-half the length of the glabella. From the inner parts of the first glabellar furrows, slight ridges run forward and outward in a curving path across the second glabellar lobes, eventually curving toward the posterior, where they end before reaching the first glabellar furrows. These ridges form oval areas that are part of the second glabellar lobes. The glabellar furrows of the third pair are short and shallow, ending about one-third the length of the glabella back from the anterior margin. The alae are semicircular and are about one-third the length of the glabella. They are slightly convex, having their outer margins distinctly depressed below the adjacent cheek lobes, and rise toward the shallow axial furrows. The occipital furrow is deep, curves forward toward the midline, and is constricted behind the outer portion of the first glabellar lobes. The occipital ring is thickest in the median line. The cheek lobes are gently convex in front of the alae and are sharply bent down at the margins. The eye tubercles, situated opposite a point at approximately one-third of the length of the glabella, are on the anterolateral portions of the cheek lobes. Narrow eye ridges run slightly forward to the axial furrows. The posterior marginal furrow is shallow and merges into the alae. The posterior border is increasingly raised laterally, becoming wall-like and continuous with the internal rim.

The fringe is divided by the girder into the high, vertical internal portion and the narrower, gently sloping external portion, the upper lamella of which is concave upward. External and internal rims are thick, and the broad marginal band has a median ridge. In the internal portion of the fringe, the pits anteriorly and laterally are coarse and are arranged in a reticulate pattern for one-third the length of the prolongations, behind which they become finer. In the concave portion of the upper lamella, the pits appear smaller and are arranged laterally in radiating rows. The pits are smaller on the brim except for a single row of larger pits next to the upper external rim. Lower lamellae of the brim curve slightly upward toward the marginal band, a lower external rim being absent. Pits of the lower external lamellae are similar in size and arrangement to those of the upper lamellae. The cheek lobes and the top of the glabella are ornamented with a network of raised ridges, with that of the glabella being of finer mesh and dying out near the sides of the glabella. At the outer margins of the cheek lobes, the ridges of ornament merge into those between the pits of the upper lamella of the fringe, the boundary between the cheek lobes and the fringe being revealed by the greater relief in the ornament of the latter.

The hypostoma is unknown.

One specimen has at least seventeen thoracic segments. Apparently the most complete specimen of *Dolichoharpes* known, it gives information concerning the number of thoracic segments in species of this genus. The axial ring is highly arched, and the axial furrows are indistinct. The ring is strongly convex longitudinally and the posterior margin is straight. The ring doublure extends forward medially to below the articulating furrow, its forward edge a smooth, convex curve. The articulating furrow is transverse, broad, and shallow medially with fine reticulate network; it then curves forward, becoming narrower and deeper toward the anterior margin. The half ring is as convex longitudinally as the axial ring and is longer medially than the axial ring. The anterior border is convex forward, with the crest well below that of the axial ring behind.

The inner part of the pleura has straight, parallel anterior and posterior borders. A deep, wide furrow separates the pleura into anterior and posterior portions along its midline. The portions are approximately equal in length, but the furrow is longer. The portions and furrow are unequal in width. The anterior portion is slightly higher and more convex than the posterior portion. At the fulcrum, the pleural furrow narrows and curves backward into a sharp point, where it ends. Around this extremity, the posterior portion curves backward and remains the same, whereas the anterior portion becomes narrower where it curves backward. The outer part of the pleura is bent sharply downward, is short, and has an anterolateral facet with straight anterior and rounded distal borders.

The pygidium is composed of three ankylosed segments, having three distinguishable axial rings that become less distinct posteriorly. It is short, wide, and triangular, with a maximum width about four times the midlength. The axis is strongly convex anteriorly and slopes gently toward the posterior, with the maximum width being across the first axial ring. The axial surface becomes smoothly confluent with the median posterior portion of the pygidium. The three axial rings are transverse. There are three pairs of pleural ribs. The pleural furrows become shallower towards the border but reach it. Only the first pair of pleural ribs has a pleural furrow separating it into subequal convex anterior and posterior portions. The anterior portion is smaller than the posterior portion. The pleural furrow continues straight across the pleural rib for about one-half the distance to the pygidial border, where it curves backward sharply and dies out after a short distance. The pygidium has a border, which is widest anteriorly and which narrows rapidly as the median is approached, where the border ceases, thus causing a slight indentation in the outline of the pygidium posterior of the axis. Two small knobs are on the smooth posterior portion of the axis. The border of the pygidium is covered with small tubercles, whereas the ribs have a few scattered tubercles. The axis is smooth except for the two small knobs.

The genus *Dolichoharpes* has four other species: *D. uniserialis, D. arctica, D. reticulata,* and *D. dentoni.*

The length of the cephalon in *D. procliva* is only slightly more than twice the sagittal length, whereas in *D. uniserialis,* the length of the cephalon is nearly three times the sagittal length, which means that the prolongations of *D. procliva* are shorter. Alae in *D. uniserialis* are longer, being about one-half the length of the glabella, whereas in *D. procliva,* the alae are about one-third the length of the glabella. The preglabellar area of *D. procliva* descends to the brim less steeply than does that of *D. uniserialis*. The pygidium of *D. procliva* has three axial rings and pleural ribs, whereas *D. uniserialis* has four axial rings and pleural ribs.

In *D. arctica*, the preglabellar area is much steeper than that of *D. procliva*. The length of the cephalon of *D. procliva* is slightly less than that of *D. arctica*.

D. reticulata has greater length of cephalon compared to the sagittal length, being nearly three times as long, whereas *D. procliva* has the length of the cephalon twice as long as the sagittal length. The preglabellar area of *D. procliva* slopes much more gently than does that of *D. reticulata*. *D. procliva* has three axial rings on the pygidium, whereas *D. reticulata* has four or five axial rings and pleural ribs.

In *D. dentoni*, the prolongations are shorter but the preglabellar area is much steeper than are those in *D. procliva*. The alae are narrower in relation to the length of the glabella in *D. procliva* than in *D. dentoni*.

D. procliva appears to differ from all other species of *Dolichoharpes* in having a preglabellar area that slopes less steeply and alae that are narrower in comparison to the length of the glabella. The pygidium is apparently quite distinct also, but the pygidium is not known in two of the species used for comparison purposes. The specific name is derived from the Latin word *procliva*, referring to the forward sloping preglabellar area.

Specimens: Holotype OU 5195, sec. 35, T. 5 S., R. 1 E.; paratypes OU 5065, sec. 22, T. 5 S., R. 1 E., and OU 5208, Spring Creek; all from Carter County, Oklahoma.

Family CHEIRURIDAE Salter, 1864

Genus *Ceraurus* Green, 1832
Subgenus *Eoceraurus* Esker, new subgenus

Eoceraurus differs from *Ceraurus* (*Ceraurus*) in that the first or basal glabellar furrows are not lateral glabellar furrows but are connected across the glabella by a shallow continuation of the deeper lateral parts of the basal glabellar furrow. Another difference is that *Eoceraurus* has a median notch on the anterior part of the glabella where the border bends upward in the middle of the glabella that is absent in *Ceraurus* (*Ceraurus*). *Eoceraurus* appears to have more of a crest and flattened glabellar lobes than *Ceraurus* (*Ceraurus*). The pygidium, thorax, and hypostoma have no distinct differences between the two subgenera.

Ceraurus (*Eoceraurus*) *trapezoidalis* Esker, new species
Plate II, figures 1-4

The cephalon is subtriangular. The maximum width of the cranidium is about five to two in younger forms to about three to one in the more adult forms. The glabella expands forward and is more noticeable in the younger forms because it increases in width more than in length from younger to more adult forms. The axial furrows are deep and are similar in depth and width to the glabellar furrows. There are three pairs of glabellar furrows. The first pair curves inward and then bifurcates, the anterior portion dying out slightly more than midway through the second glabellar lobe, whereas the posterior portion curves backward, combining with the anterior projection of the occipital ring to nearly isolate the first pair of glabellar lobes, and the middle portion continues across the glabella after becoming very shallow. The second and third pairs of glabellar furrows are lateral and nearly straight, directed slightly forward. The first pair of glabellar lobes is nearly circular and is well below the crest of the glabella, the second pair is slightly rounded, and the third pair is rectangular. The glabellar lobes decrease in convexity from the first to the third pair. The glabella is trapezoidal when viewed from the front, having nearly flat sloping sides and a broad flat crest. A median notch occurs on the glabella where the border curves upward toward the middle of the glabella. The occipital ring is slightly convex forward, highly arched, and stands above the highest portion of the glabella. The eye lobes are opposite the second glabellar furrows, almost at the border. The facial suture begins at the anterior part of the cephalon from the border, running nearly straight backward across the border, then diagonally across the cheek until it reaches the palpebral lobe, after which it runs nearly straight across laterally until it reaches the border again, where it curves backward, ending before the genal angle is reached. The cheeks are moderately convex and are covered with small tubercles, ridges, and pits. A portion of the posterior border from the palpebral lobes approximately to the genal angles has only a few small scattered tubercles. The genal spines are long and recurving, being about twice as long as the cephalon (sag.). The border widens slightly near the genal spines.

The middle body of the hypostoma is evenly and moderately convex. It is widest at about one-third of its length. The anterior border

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Explanation of Plate II

Figures 1-4. Ceraurus (Eoceraurus) trapezoidalis, new species. **From quarry in sec. 22, T. 5 S., R. 1 E., Carter County.**

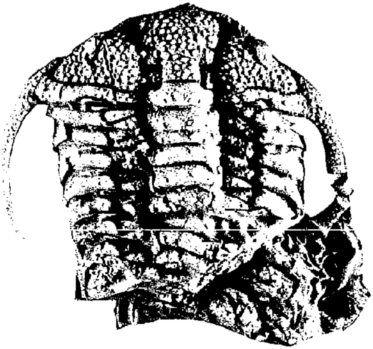
1. **Holotype OU 5197, x2; partial individual.**
2. **Paratype OU 5196, x2; nearly complete enrolled individual. From 25 feet below top of face in upper quarry.**
3. **Paratype OU 5063, x2; pygidium.**
4. **Paratype OU 5062, x2; hypostoma.**

Figures 5-7. Pandaspinapyga salsa, **new species. From Spring Creek, Carter County.**

5. **Paratype OU 5200A, x4; broken pygidium of adult.**
6. **Holotype OU 5200, x4; nearly complete small individual.**
7. **Paratype OU 5207, x2; pygidium, thorax, and part of the hypostoma.**

(Photographs by Jan Cannon)

Plate II



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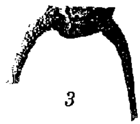

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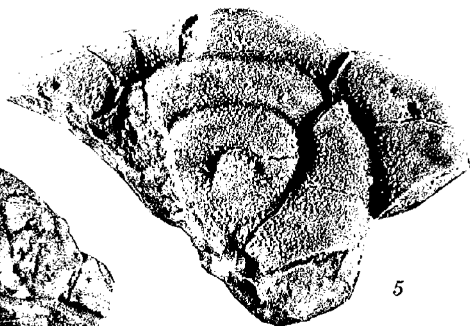

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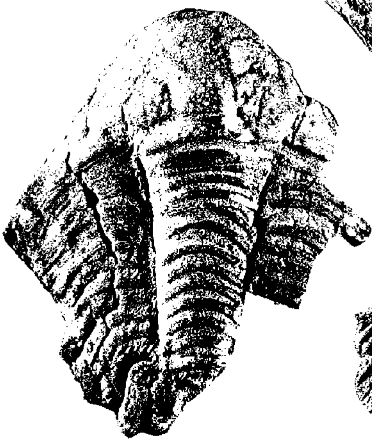

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is nearly absent, the main body overhanging the border for the most part, the border appearing slightly before the side is reached and widening outward to the base of the anterior wing. The anterior border furrow is shallow. The lateral and posterior border furrows are deep, being wider laterally than posteriorly. The lateral and posterior borders are convex, widening at the shoulders, inflating slightly, and widening slightly opposite the posterior end of the main body to form faint points.

This new species has eleven thoracic segments, typical for this genus in number and appearance. The axial rings are strongly convex and the posterior slope is vertical. The articulating furrow deepens laterally. Inner pleural parts are transverse and the margins are essentially straight. The transverse, articulating flanges are broad and well defined. Outer pleural parts are broad flattened spines that curve steeply downward. The pleural furrow runs diagonally back across the inner part; the anterior and the posterior bands are inflated and subtriangular. The maximum inflation of the pleura is at the fulcrum. The entire surface is covered with fine tubercles except on the outer pleurae.

The pygidium is typical for this genus, having a long pair of recurving outer spines that originate from the anterior segment. The outer segments are strongly ankylosed. Two pairs of small spines are formed by the two inner segments. The axis is slightly convex. The entire surface is covered with fine tubercles.

The name is derived from the trapezoidal outline of the glabella as viewed from the front. This form can be distinguished from other species of *Ceraurus* by the basal transglabellar furrow, trapezoidal outline of the glabella as viewed from the front, and the median notch on the glabella.

Specimens: Holotype OU 5197; paratypes OU 5196, OU 5062, and OU 5063, all from sec. 22, T. 5 S., R. 1 E., Carter County, Oklahoma.

Genus *Pandaspinapyga* Esker and Levin, 1964

Pandaspinapyga salsa Esker, new species

Plate II, figures 5-7

The cephalon is subtriangular. The glabella is semicircular; however, when viewed anteriorly across the third glabellar furrows, it appears subelliptical, and, when viewed across the basal glabellar furrows, it appears subtriangular because the glabellar lobes become flattened and the crest is more pronounced. The basal glabellar furrows curve backward, becoming very faint and shallow about two-thirds of the way back on the basal glabellar lobes, before going straight back until the occipital furrow is reached. The basal pair of glabellar furrows curves backward to join the occipital furrow. The shallow part of the basal glabellar furrows becomes less distinct as the size of the individual increases. The second pair of glabellar furrows curves slightly forward before curving backward, forming a smooth, even curve. The third pair of glabellar furrows curves slightly backward, being straight and nearly transverse. The glabella is widest across the basal glabellar lobes. The occipital ring is slightly convex forward, being longest between the points where the basal glabellar furrows reach the strongly convex occipital ring.

The fixed cheeks are small and triangular, ending in genal spines. The facial suture forms a right angle approximately, beginning opposite the third glabellar furrow, going straight backward until slightly posterior to the beginning of the first glabellar lobes, where it goes nearly straight across the cheeks until it ends at the border. The cephalon is ornamented over the entire surface with small tubercles, a few scattered larger tubercles being present, and scattered large pits and ridges being present on the cheeks with the exception of the border.

The hypostoma is poorly known, only the posterior tip being preserved in one specimen. The border is widest laterally and narrows posteriorly as it bends sharply upward toward the midline. The main body is flat.

From two nearly complete specimens, the first complete specimens of this genus known, the thorax is found to consist of twelve or thirteen segments. The axis is evenly convex and tapers toward the posterior at about 10 to 12 degrees. The axial ring is slightly convex toward the anterior. The inner parts of the pleurae are nearly straight but the outer parts curve backward at about an angle of 45 degrees. Outer pleurae (spines) curve downward but curve upward before ending, giving the outer pleurae a concave appearance. The thoracic segments are covered with fine tubercles plus a single row of large pits that are present on the pleurae. A fulcral process with a fulcral socket is on a slightly curved fulcral ridge on the ventral part of the thoracic segments, represented by an upward, triangular extension of the pleurae. An axial socket is on the posterior part of each thoracic segment. The doublure extends almost across the entire underside of each thoracic segment, tapering only slightly toward the sides of the axial ring to form a small, nearly circular opening at the sides for the muscles.

The general shape of the pygidium of a mature individual is unknown. The axis is slightly convex. The two axial rings taper toward the posterior at approximately 35 degrees. The terminal axial portion is subtriangular, being rather sharply pointed. The ring on the terminal axial portion curves around the terminal axial segment, being slightly wider at the angle of the corner where the ring curves around the sides of the terminal axial segment. The terminal axial segment is represented by a knob that is pointed anteriorly. The terminal axial portion is nearly equal to the smallest width of the two axial rings, so that the pygidial axial furrows taper almost directly inward and backward, forming a nearly straight line.

The species has two pairs of broad, flat pleural spines, but the spines have been broken so that their length and curvature cannot be determined. There are two pairs of short pleural ribs, the anterior pair having a single large pit on each rib. The pygidium of a small individual has long pointed pleural spines, a distinct axis, and distinct pleural ribs. The two pairs of rib furrows are much more distinct than in the mature individual, whereas the furrow dividing the spines and the terminal axial portion are less distinct in the immature individual. Also at least three more pits are on the anterior pair of pleural ribs of an immature individual. The ornamentation of the pygidium consists of fine tubercles scattered over the surface of the pygidium plus the large pit or pits.

The cephalon of *P. salsa* differs from *P. projecta* principally in lacking the projection of the glabellar crest toward the posterior. Also, *P. projecta* is more circular in outline, not tapering forward as much as *P. salsa,* and it lacks the triangular basal glabellar lobes of *P. salsa,* besides having more flattened basal glabellar lobes. The pygidium of *P. salsa* differs from *P. projecta* in that the terminal axial portion is more sharply pointed and longer. The terminal axial portion is more pointed anteriorly, and the pygidial axial furrow is nearly straight in *P. salsa*. The name is derived from the Latin word *salsa* for the sharply pointed knob on the terminal axial portion.

Specimens: Holotype OU 5200; paratypes 5200A, and 5207, all from Spring Creek, Carter County, Oklahoma.

Family LICHIDAE Hawle and Corda, 1847

Genus *Amphilichas* Raymond, 1905

Amphilichas subpunctatus Esker, new species
Plate III, figures 1-4

The cranidium is subtriangular and has a maximum width about $1\frac{1}{2}$ times the midlength. The glabellar sides are subparallel posteriorly, curving outward slightly toward the anterior corner of the palpebral lobes. The axial furrow narrows slightly a little before the occipital furrow, at a distance from the occipital furrow that is about equal to the length of the occipital ring. The axial furrows are equally impressed throughout their lengths, beginning back of the anterior corner of the palpebral lobe. Dorsally viewed, the posterior margin of the occipital ring is slightly convex forward. The occipital ring is defined laterally by the axial furrows, which are convex outward. The median portion of the occipital furrow is transverse and straight. Each lateral portion behind the tricomposite lateral lobes is slightly concave forward, trending outward and backward at an angle of about 70 degrees to the midline. The median portion of the occipital ring is nearly flat

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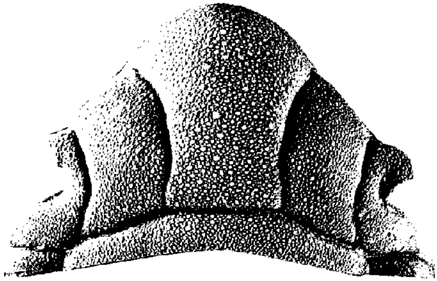
Explanation of Plate III

Figures 1-4. Amphilichas subpunctatus, **new species. From Rock Crossing, sec. 35, T. 5 S., R. 1 E., Carter County.**
1. **Holotype OU 5202, x2; complete cranidium.**
2. **Anterior view of holotype, x2.**
3. **Ventral view of holotype, x2.**
4. **Paratype OU 2468, x2.**

(Photographs by Jan Cannon)

Plate III



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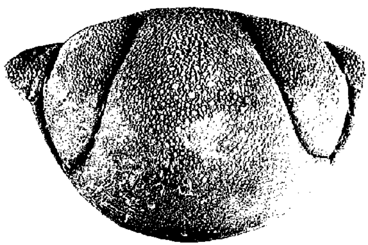

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and slopes steeply down to the sides, being only slightly convex longitudinally. The width of the median portion is about one-fourth the total width of the occipital ring. The posterior portion of the median lobe is nearly twice the width of the tricomposite lateral lobes. The prolonged anterior lateral furrows begin slightly back of the anterior corner of the cranidium, a short distance in front of the eyes, curving upward, inward, and backward, becoming parallel to the axis. The frontal lobe is evenly rounded, projecting in front of the lateral lobes. The median lobe is about 1½ times as long as the lateral lobes, although the length decreases with the greater size of the individual. In side view, the median lobe appears flat on the dorsal surface, before curving downward anteriorly and forward, then curving backward where it ends. The dorsal surface is ornamented with numerous small tubercles and a few larger tubercles. The tubercles become minute before dying out anteriorly on the dorsal part of the median lobe. The surface becomes punctate as the tubercles become minute, and the ventral surface of the median lobe is punctate to the ventral border.

Each palpebral lobe is flat and semicircular in side view, slightly below the median height. The fixed cheeks are smaller than the palpebral lobes, and the posterior portion is inclined backward, whereas the anterior portion is inclined forward. The fixed cheeks are continuous with the palpebral lobes and are separated from the posterior portion by a nearly straight depression going from the meeting point of the occipital furrow and the axial furrow to the posterior portion of the eye. The posterior portion of the fixed cheeks is inclined steeply downward toward the posterior, which is narrow. The posterior border is convex (exsag.) and narrowest at the axial furrow. The facial suture forms a sigmoidal curve, being farthest from the median line at the posterior end from where the facial suture curves inward, then becoming straight, essentially parallel to the median line. Next the facial suture curves sharply outward and then around the eye lobe, finally ending after curving inward and downward. The border is narrower anteriorly in front of the median lobe, widening laterally toward the median lobe.

Because another species of *Amphilichas* is associated with this species, no pygidium can be definitely assigned to *A. subpunctatus* as of this writing. Hypostoma and thorax are unknown.

A. subpunctatus appears to be distinct from all closely related species in the nature of the ornamentation of the median lobe, which becomes punctate as the median lobe curves from the dorsal to the ventral anteriorly. The most closely related species are the following: *A. cornutus, A. conifrons, A. prominulus, A. minganensis, A. aspratilis,* and *A. subdisjunctus* = *A. antiquarius.* In addition to the ornamentation, other distinctive features serve to distinguish *A. subpunctatus* from the above-mentioned species.

The specific name is derived from the Latin word *punctatus,* referring to the punctate nature of the median lobe ventrally, and *sub,* referring to the ventral location of the punctate ornamentation.

Specimens: Holotype OU 5202 and paratype OU 2468, both from sec. 35, T. 5 S., R. 1 E., Carter County, Oklahoma.

DIMENSIONS

Homotelus bromidensis (mm)	*Dolichoharpes procliva* (mm)	*Ceraurus trapezoidalis* (mm)	*Pandaspinapyga salsa* (mm)	*Amphilichas subpunctatus* (mm)
sag. 43	sag. 14	sag. 7.5	sag. 10	sag. 18
11	7	7		12
tr. 20	tr. 21	tr. 30	tr. 16	tr. 33
9	8	18		
complete specimens	cephala	cephala	cephalon	cranidia
OU 3209	OU 5195	OU 5197		OU 5202
OU 3455	OU 5208	OU 5196	OU 5200	OU 2468

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Esker, G. C., III, and **Levin, Harold,** 1964, **Pandaspinapyga,** a new trilobite genus from the Kimmswick Limestone (Ordovician) of Missouri: Jour. Paleontology, vol. 38, p. 776-778, 1 fig.

Laudon, L. R., 1938, Abundant occurrence of **Isotelus gigas** De Kay in the South Criner Hills of Oklahoma (abs.): Geol. Soc. America, Proc., 1937, p. 283.

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Loeblich, A. R., Jr., 1940, An occurrence of **Isotelus gigas** De Kay in the Arbuckle Mountains, Oklahoma: Jour. Paleontology, vol. 14, p. 161-162.

Whittington, H. B., 1950, Sixteen Ordovician genotype trilobites: Jour. Paleontology, vol. 24, p. 531-565.

Fall Field Trip in Tulsa-Bartlesville Area

The Oklahoma City Geological Society will sponsor a field conference on limestone banks and facies changes of the Marmaton and Missouri Groups. The trip will be made in chartered buses which will leave Oklahoma City on October 29. Registration will be held that afternoon and evening in the Mayo Hotel in Tulsa, where geologists will spend the night. On October 30, the group will see exposures to the northeast and will spend the night in Bartlesville. On October 31, the trip will be southward to Tulsa, and the buses will return to Oklahoma City.

Participation will be limited to 225 geologists. The guidebook, edited by Alex P. Aven, was written by Jack A. Allen, Carl C. Branson, Charles J. Mankin, Norval Ballard, Mike Wolfson, William Cronoble, Martin Cassidy, and Richard Schmitz. The field trip chairman is William P. Siard, c/o Oklahoma City Geological Society, P. O. Box 609, Oklahoma City, Oklahoma.

Cost of the field trip is $30, which pays for transportation, five meals, and the guidebook.

Record of *Edestus* in Oklahoma

Carl C. Branson

No edestid has been correctly recorded from Oklahoma. *Edestus vorax,* which ostensibly came from Indian Territory, has been shown to be in all probability from Illinois (Branson, 1963). Allen Graffham of Ardmore has sold us a weathered specimen of *Edestus vorax*? (fig. 1) which he collected from the lower part of the Deese Formation in C sec. 29, T. 3 S., R. 2 E., Carter County, Oklahoma.

Figure 1. View of left side of anterior element of Edestus. **Natural size. Specimen OU 4999.**
(Photograph by Jan Cannon)

The specimen is part of the first unit of the dorsal spine with the weathered toothlike element at its anterior tip. The toothlike element is coarsely serrate and its enamel-covered base has the characteristic configuration of *Edestus vorax* in so far as can be determined. *Edestus* remains a genus with but one species, now known from Illinois and Oklahoma.

Reference Cited

Branson, C. C., 1963, Type species of **Edestus** Leidy: Okla. Geol. Survey, Okla. Geology Notes, vol. 23, p. 275-280.

New Theses Added to O. U. Geology Library

A Master of Science thesis, *Post-Mississippian geology of Love County, Oklahoma,* by Robert H. Redman, and a doctoral dissertation, *Statistical analysis of the fusulinid genera* Fusulinella, Fusulina, Wedekindellina?, *and* Triticites *in the Ardmore basin, Oklahoma,* by Dwight E. Waddell, were added to The University of Oklahoma Geology Library in July 1964.

Another Master of Science thesis, *Ostracoda from the Brownstown (Cretaceous) Formation in southwestern Arkansas,* by Michael E. Guest, was added in August.

Hunton (Silurian) Production in Le Flore County, Oklahoma

Louise Jordan

Humble Oil & Refining Company recently completed a gas-productive well in rocks of the Simpson and Hunton Groups in the West Milton field of Le Flore County. This is the first Hunton production on the Oklahoma side of the Arkoma basin. Nearest Hunton production in the Arkoma basin lies 40 miles to the east in the Shell Oil Company well in the Bonanza field, Sebastian County, Arkansas. The Shell well, completed in April 1962, was the first Hunton well in the entire basin.

The deeper-pool dual producer, Humble 1 Hartley Bledsoe (NW¼ NW¼ SE¼ sec. 9, T. 8 N., R. 23 E.), penetrated the upper 387 feet of Arbuckle carbonates to a total depth of 7,116 feet. The regular pays of the field are Spiro and Cromwell. Formation tops of pre-Chattanoogan rocks (datum elevation: 676 feet) are as follows: Hunton 6,140 feet, Sylvan 6,178 feet, Simpson 6,311 feet, and Arbuckle 6,729 feet. The Hunton, perforated between 6,160 and 6,170 feet, produced at a calculated-open-flow rate of 36,700 MCF per day. Simpson perforations from 6,336 to 6,404 feet and from 6,420 to 6,501 feet gauged open flow at 4,227 MCF of gas daily.

Hunton rocks in this well are 38 feet thick and undoubtedly are of Silurian age. The Silurian-Devonian carbonate rocks in northeastern Oklahoma, which are called Hunton by the oil geologist and the industry, consist (in descending order) of the Sallisaw Formation, Frisco Formation, and St. Clair Formation. The upper two formations, not more than 30 feet thick in the outcrop area, are Devonian in age, whereas the St. Clair Formation, measured at the surface and in a core hole, is 187 feet thick (Amsden, 1961, p. 22, 43, 58) and is Silurian in age. According to Amsden (Amsden and Rowland, in press) fossils in the St. Clair indicate that the formation is at least in part correlative with the Henryhouse and Chimneyhill Formations of the Arbuckle Mountains area. In summary, in this northeastern area of Oklahoma, the Silurian-Devonian carbonate section includes: (1) the Sallisaw Formation, which is younger than the Hunton Group of the Arbuckle area, (2) the Frisco Formation, and (3) the St. Clair Formation. The Frisco rests upon the Silurian St. Clair Formation, and the Bois d'Arc and Haragan equivalents of the Arbuckle area are absent.

Another interesting area of so-called Hunton is in the Hollis basin or eastern Palo Duro basin of Oklahoma, west of the Altus field in the northwestern corner of Jackson County. A core, which cut the Devonian-Ordovician unconformity, was taken a number of years ago in this area. The upper part of the core contains definite Frisco (Devonian) fossils according to G. A. Cooper and T. W. Amsden, and the bottom part of the core contains Ordovician Fernvale or Viola fossils. Here, then, we have a condition where the uppermost formation of the Hunton (Frisco) rests upon either Trentonian or early Cincinnatian Ordovician, and where the Bois d'Arc, Haragan, Henryhouse, and Chimneyhill equivalents of the Hunton, and the Sylvan Shale are absent. The Sylvan is present eastward and possibly what is called Hunton in the area east of Altus contains Frisco and younger Devonian carbonate rocks. The Woodford Shale is absent. The relationships of the Devonian and Silurian rocks are not simple in Oklahoma.

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Amsden, T. W., 1961, Stratigraphy of the Frisco and Sallisaw Formations (Devonian) of Oklahoma: Okla. Geol. Survey, Bull. 90, 121 p.

Amsden, T. W., and **Rowland, T. L.** (in press), Silurian stratigraphy of northeastern Oklahoma: Okla. Geol. Survey, Bull. 105.

Removal of Colloidal Material from Palynological Preparations*

Thomas A. Bond

One of the major problems in processing palynological specimens is the presence of colloidal material in preparations from inorganic sediments, particularly clays. In many cases colloidal materials remain after normal digestion techniques have been applied and their elimination is necessary for clean palynological residues. Various chemicals have been used and among the more common are zinc chloride (Funkhouser and Evitt, 1959) and stannic chloride (Urban, 1961; Davis, 1961). Zinc chloride corrodes microfossils if left standing and stannic chloride, although less corrosive, is more expensive.

Neither of these chemicals has proved entirely suitable for the removal of colloidal material from clay sediments. Experimental processing with various laboratory detergents, such as Calgon, Alconox, and Alcojet, has proved partly successful. Calgon gave fairly satisfactory results but best results were obtained from Alcojet. This is a nonionic laboratory detergent available from many laboratory-supply companies and it is nominal in cost.

Procedure for Removal of Colloidal Material

Place the fossil-bearing clay in a quart jar with a cover, add several hundred cubic centimeters of distilled water and agitate in a shaker for 24 hours. Remove from shaker and allow sediment to settle, pour or siphon off excess water. (If the clay is calcareous, remove the calcium carbonate by treating the sample with hydrochloric acid.) Place the sample in a copper or plastic beaker and add 52% hydrofluoric acid. Allow 24 hours for digestion of the silica. Add distilled water and wash until the sample is neutral. If the organic matter is aggregated, place the sediment in a glass beaker and treat several hours with Schultze's solution. Add distilled water and wash until neutral.

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

A portion of the residue is then placed in 15-ml centrifuge tubes, filling about 1/4 of the volume of each tube. The remaining 3/4 of each tube is filled with an Alcojet solution made by dissolving 10 grams of Alcojet detergent in 1 gallon of distilled water. Each centrifuge tube is agitated until the residue is suspended in the solution and then centrifuged at 2,200 rpm for approximately 2 minutes. Best results are obtained with a centrifuge in which the tubes are spun horizontally and no braking action is applied. After the tubes have come to rest the supernatant liquid which contains the suspended colloidal material is poured off. In some cases, the Alcojet fails to saturate the residue completely and the supernatant liquid remains clear. In such cases, if the agitation and centrifuging are repeated a second time, the colloidal material will go into suspension.

The specific gravity of the solution is approximately 1.004 at 25°C, and most microfossils will go to the bottom of the tube, whereas the colloidal material will remain in suspension. Centrifuging must be limited to 3 minutes to prevent the colloidal material from being forced to the bottom of the tube. Washing and centrifuging are repeated until the supernatant liquid is clear and free of the detergent solution. The residue can then be mounted on slides or stored according to preference.

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Davis, P. N., 1961, Use of stannic chloride for heavy-liquid flotation of palynological fossils: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 259-260.

Funkhouser, J. W. and **Evitt, W. R.,** 1959, Preparation techniques for acid-insoluble microfossils: Micropaleontology, vol. 5, p. 369-375.

Urban, J. B., 1961, Concentration of palynological fossils by heavy-liquid flotation: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 191-193.

New Geologic Map of Kansas

The State Geological Survey of Kansas has issued a fine new edition of the *Geologic map of Kansas.* The scale is 1:500,000, approximately 8 miles to 1 inch. The map is in full color. A helpful feature is the strip of adjacent states showing townships and counties of that part of those states. The compilation was done by the staff of the Survey under the supervision of J. M. Jewett.

The explanation of the map is easily readable and incorporates the nomenclatorial changes published by O'Connor (1963). These are Gearyan Stage, Cimarronian Stage, and deletion of Pedee Group. The Tacket Formation, for post-Checkerboard pre-Hertha rocks is unfamiliar, and the spelling Blue Jacket is not approved by our staff. The sign on the railroad station reads Blue Jacket, but the post office is Bluejacket, and the original author (Ohern) spelled it as one word, the form used in all subsequent Oklahoma publications. Many will not consider Neogene a satisfactory substitute for Late Tertiary and Quaternary.

Disagreements in placement of boundaries on the new map as compared with the Oklahoma map (Miser, 1954) arise largely from differences in terminology and in selection of mapping units. The Kansas Survey emphasizes Cenozoic sediments to a much greater extent than does the Oklahoma Survey. Most of what in Oklahoma (Texas and Beaver Counties) is mapped as undifferentiated Tertiary is, on the Kansas side, shown as loess and dune sand; and eastward the Oklahoma map shows mainly bedrock, whereas the Kansas map shows wide areas of alluvium, older alluvium, and loess.

The new Kansas map is easily readable and is a highly useful tool for geologists. The Kansas Survey may well be proud of its staff and pleased with the printer (Williams & Heintz Map Corporation). Copies of the map are obtainable, rolled in a tube, from the State Geological Survey of Kansas, Lawrence, Kansas, at $2.50 each.

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Miser, H. D., 1954, Geologic map of Oklahoma: Okla. Geol. Survey and U. S. Geol. Survey.

O'Connor, H. G., 1963, Changes in Kansas stratigraphic nomenclature: Amer. Assoc. Petroleum Geologists, Bull., vol. 47, p. 1873-1877.

—C. C. B.

Lake Murray Meteorite and its Probable Age

A. Allen Graffham

Thirty-three years ago Mr. J. C. Dodson, a farmer, discovered a large mass of iron exposed in a gulley on his farm. After some testing with a sledge hammer, he concluded correctly that it was a meteorite. Subsequently the Dodson farm became a part of Lake Murray State Park.

Shortly after the author began converting Tucker Tower at Lake Murray Park into a geological museum in July 1952, Mr. Dodson visited the museum and related the story of the meteorite. A short time afterward the author accompanied Mr. Dodson to the site.

The meteorite was exposed in the bank of a gulley (fig. 1) in C N½ sec. 24, T. 5 S., R. 2 E., Carter County, Oklahoma. The author called Dr. Lincoln LaPaz of the Institute of Meteoritics at the University of New Mexico. Dr. LaPaz, accompanied by Dr. Paul Healy, arrived the next day to aid in the excavation and removal of the iron.

The iron core of the meteorite was encased in a layer of rust or oxidate approximately 6 inches thick. The entire mass was embedded in the Antlers Sandstone of Lower Cretaceous age. As excavation progressed, it was noted that the sandstone above the meteorite was undisturbed, indicating that the iron had fallen into the sand during deposition.

When exposed, the meteorite was found to be roughly kite shaped, some 16 by 23 inches in size, with a thickened nose under the widest part of the iron. The thick broad portion was inclined to the east and away from the thinner exposed portion on the face of the gulley. After removal, the nickel-iron core was found to weigh 560 pounds, and the oxidate collected from around the core and that which had weathered down the gulley weighed more than 1,000 pounds.

Dr. LaPaz interpreted scattered masses of the oxidate as representing impact points of smaller portions of the meteorite. However, the author feels that these scattered masses were weathered from the main body and transported down the gully.

In December 1952, the iron was taken to the Institute of Meteoritics, where it was sawed in half with a mud saw, the division requiring 312 hours of sawing.

After study, the meteorite was identified as a granular hexahedrite and the largest of its kind ever to be found in the world. It is also the largest meteorite found to date in Oklahoma. Dr. LaPaz computed the original weight of the meteorite on impact to be approximately 3,040 pounds. The nickel-iron core is composed of coarse intergrown crystals of schreibersite and kamacite, and the freshly etched surface is one of exceptional beauty.

At the time of discovery only five granular hexahedrites had been found in the world. The next largest was a 57-pound mass found in Texas.

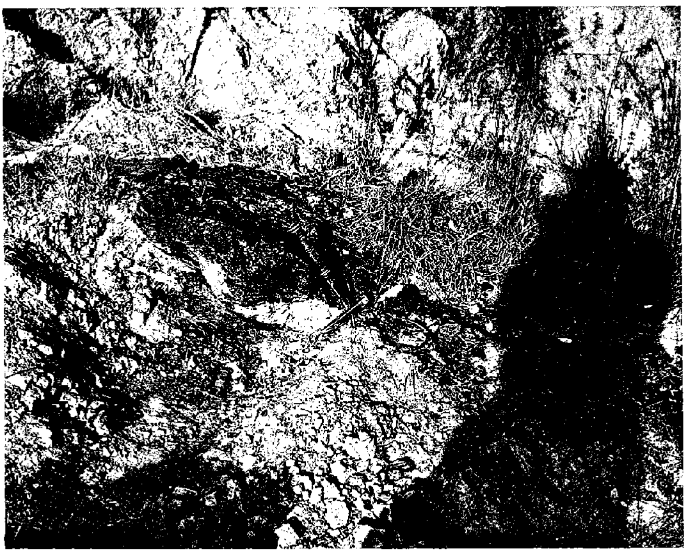

Figure 1. Lake Murray meteorite in situ in the Antlers Sandstone.
(Photograph courtesy of the Institute of Meteoritics)

During excavation it was noted that the sandstone around the meteorite was slightly mineralized. No evidence that the sand above the iron had been disturbed could be detected. The thickness of undisturbed sand above the mass ranged from 12 inches to 18 inches at the back of the mass where it inclined downward into the sandstone. It appeared most likely that the iron had fallen into the sand during deposition. The presence of an extremely thick rust sheath supports this observation, especially because nickel-iron is known to weather slowly. It therefore appears that this meteorite is of Lower Cretaceous age and perhaps is the oldest known meteorite discovered to date.

One of the sawed halves of the meteorite is now on display at Tucker Tower Museum in Lake Murray Park.

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