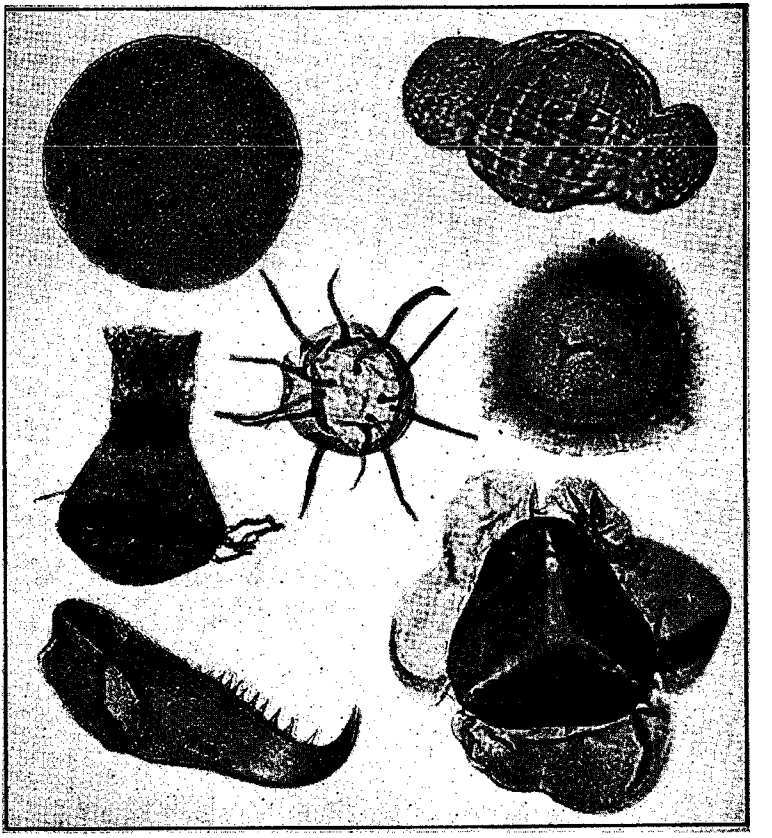
OKLAHOMA GEOLOGY NOTES



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Beyond the Panhandle

A geologic report on Union County, New Mexico, has been issued by the New Mexico Bureau of Mines and Mineral Resources as its Bulletin 63. Union County adjoins Cimarron County, Oklahoma, on the west.

Exposed rocks are of Triassic, Jurassic, Cretaceous, Pliocene, and Quaternary ages. It is of special interest to Oklahoma geologists to note the correspondence of units at the State line. The geology of adjacent Cimarron County was described by Schoff and Stovall in 1943. Stovall did not differentiate the members of the Dockum group (Triassic), and stated that the Sheep Pen formation probably is absent on the Oklahoma side of the State line and that the Sloan Canyon formation is present. He and Savage proved the Triassic age of the variegated mudstones (1939), and showed that the Exter (Exeter) sandstone lies beneath the Morrison. The Exeter sandstone was named by Lee in 1902 for the post office, the name of which was spelled Exter. The post office no longer exists. The present authors consider that the Sheep Pen may be units 15-21 of Stovall's measured section 30 (Schoff, 1943, p. 260).

The author of Part I (Baldwin) describes clastic plugs which he considers of post-Dockum and pre-Exeter age. These appear as isolated knolls 20 to 50 feet high, and he states that several are in the northwest corner of Oklahoma north of Black Mesa. Some of the New Mexico plugs contain copper minerals.

The report contains colored geologic maps on a scale of 1:125,000. Comparison with Schoff's and Stovall's (1943) map shows that we are faced with a "State-line fault." The area mapped as Cretaceous in New Mexico is much more restricted and Tertiary rocks are given more area. The rocks shown as Triassic in Oklahoma are largely shown as Exeter or as "covered" in New Mexico.

The bulletin consists of two parts: Part I, Geology of Union County, by Brewster Baldwin, and Part II, Volcanic rocks of the Des Moines quadrangle, by William R. Muehlberger. The book consists of 171 pages, 28 figures, and 17 plates, of which the colored maps are Plates 1a-d.

—C. C. B.

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Schoff, S. L., 1943, Geology and ground water resources of Cimarron County, Oklahoma, with a section on Mesozoic stratigraphy by J. W. Stovall: Okla. Geol. Survey, Bull. 64, 317 p., 27 figs., 23 pls., 24 tables.

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AUTHIGENIC APATITE AND MAGNESIUM CLAY FROM CADDO COUNTY, OKLAHOMA

S. D. Howery, W. E. Ham, and C. J. Mankin

Introduction—While mapping an area in northern Caddo County for a Master of Science thesis at The University of Oklahoma, S. D. Howery, during the winter of 1959-60, discovered some white concretionary nodules in siltstone of the Marlow formation which he submitted to Ham and Mankin for identification. X-ray, chemical, and optical data showed that this mineral is an abnormal type of sedimentary apatite that is characterized principally by a significant content of sulfate together with smaller amounts of carbonate and sodium. Field investigation by the writers later demonstrated that this apatite mineral is widely distributed in small amounts in the Marlow formation as well as in the overlying Rush Springs sandstone. Both formations are in the Whitehorse group, of middle Permian age, and both consist dominantly of reddish-brown sandstones, siltstones, and shales. Thin beds of gypsum also occur locally in the Marlow formation.

In the search for localities of the apatite mineral, the writers also collected samples of millimeter-sized white clusters in the Rush Springs sandstone which at first were believed to be concretionary apatite grains. However, laboratory examination revealed that the small grains are a magnesium-bearing clay mineral of authigenic origin.

The apatite concretions and the clay mineral have not been previously reported from western Oklahoma, and a record of their occurrence is made here pending more detailed investigations of their chemical composition and crystal structure.

The stratigraphic occurrences of these new minerals are shown in figure 1.

Authigenic Apatite—The apatite occurs as snow-white concretionary nodules or as cavity encrustations in loosely consolidated fine-grained sandstone, silty sandstone, or silty shale. In Caddo County they have been found only in the upper 20 feet of the Marlow formation and in the lower 15 feet of the Rush Springs sandstone, although it seems probable that additional field work will extend the known stratigraphic range both higher and lower.

The best exposures are in road cuts, and typical occurrences may be seen at the following localities:

A. One and one-half miles east of Lookeba, 600-800 feet east of SW cor. sec. 2, T. 10 N., R. 11 W. Nodules and cavity encrustations in upper part of Marlow and lower part of Rush Springs formations.

B. One-half mile northwest of Binger, SW¼ SW¼ SW¼ sec. 22, T. 10 N., R. 11 W. Small nodules and cavity encrustations in lower part of Rush Springs formation.

C. Five and one-half miles south of Binger, NW¼ SW¼ NW¼ sec. 22, T. 9 N., R. 11 W. Hollow concretions in lower part of Rush Springs formation.

At most localities the nodules are approximately 0.5 inch in diameter, but locally they are as much as 2.5 inches. They consist of needles that diverge from a central core and terminate exteriorly in irregular cuspate bundles (fig. 2). The smaller nodules and cavity encrustations are composed of extremely fine-grained fibers and grains.

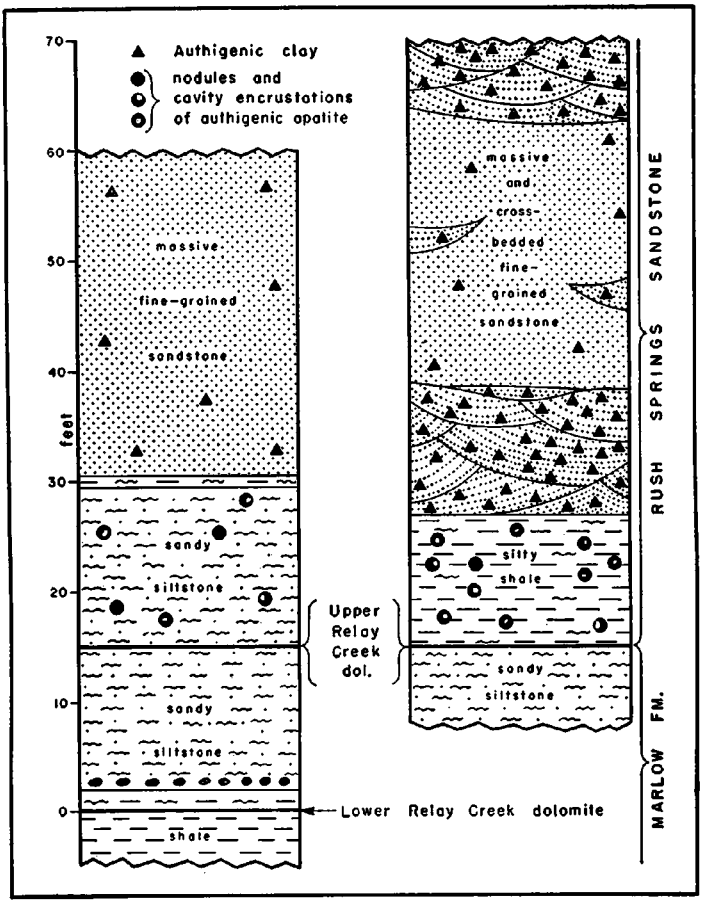

FIGURE 1. Stratigraphic occurrences of authigenic clay and authigenic apatite in northern Caddo County, Oklahoma.

Incomplete chemical analyses show that the mineral is mainly calcium phosphate with significant Na, SO_4, CO_2, F, and Cl. The chemical composition is variable, as the omega index of refraction ranges from 1.605 to 1.632 in different nodules. The more common indices of refraction are omega=1.612±0.003 and epsilon=1.606±0.003. From X-ray diffraction studies it is known that the mineral belongs in the group of apatite minerals.

MAGNESIUM CLAY MINERAL—At the apatite localities and elsewhere in northern Caddo County, in the lower 50 feet of the Rush Springs sandstone,

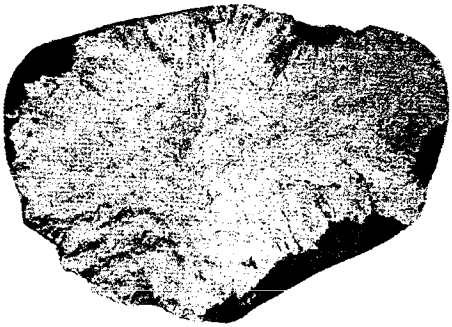

FIGURE 2. Section through a typical large nodule of authigenic apatite, showing fibrous habit and irregular growth form. Specimen is 1.75 inches long.
(Photograph by R. E. Denison)

a magnesium clay mineral has been formed authigenetically as white clusters or grains 0.5 to 1.0 mm in diameter (fig. 3). Although widely distributed, they are particularly abundant and well exposed in the road cut 5.5 miles south of Binger (locality C. above). The concretionary clusters are built up of platy books that show eminent basal cleavage and distinct pearly luster. A pseudohexagonal crystal outline is locally developed.

FIGURE 3. Authigenic clusters of magnesium clay mineral in Rush Springs sandstone, x4. The largest clusters are 1 mm in diameter.
(Photograph by R. E. Denison)

X-ray, chemical, and optical studies show it to be a magnesium clay mineral of the chlorite type. Under the petrographic microscope, flakes lying on the basal cleavage plane are seen to be sensibly uniaxial or with 2V nearly zero. The optic sign is positive; and the alpha index of refraction as determined on cleavage flakes, although variable, is mostly 1.568±0.003. Partial chemical analysis indicates that the mineral is mainly a hydrous magnesium aluminum silicate.

GENETIC SIGNIFICANCE—The northern part of Caddo County lies in the axial region of the Anadarko syncline, which is the dominant surface structural feature of west-central Oklahoma. The outcropping strata here are almost entirely clastic reddish-brown sediments of the Whitehorse group. They dip gently southwestward 20 to 50 feet per mile (Howery, 1960 pl. III). They are anticlinal noses and synclines. These strata therefore are essentially undisturbed, and furthermore they are not known to have been involved in any magmatic or hydrothermal activity.

The apatite nodules and magnesium clay aggregates grew authigenetically within the framework of the red clastic sediments. Although marine fossils are lacking, occasional lenses and thin beds of gypsum show a desiccating environment at least locally and indicate a probable marine environment for the entire clastic sequence. The authigenic growth of the sulfatian apatite and of the magnesium clay is here attributed to reorganization of constituents from marine waters that were approaching the threshold of evaporite deposition.

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Howery, S. D., 1960, Areal geology of northeastern Caddo County, Oklahoma: unpublished Master of Science thesis, University of Oklahoma.

AUTHIGENIC APATITE AND CLAY MINERALS FROM ROGER MILLS COUNTY, OKLAHOMA

F. D. LOVETT, C. J. MANKIN, AND W. E. HAM

INTRODUCTION—The discovery of authigenic apatite and clay minerals in the Permian sedimentary rocks of Caddo County, reported in the preceding article of this journal, led to a search for similar minerals by Lovett in the eastern part of Roger Mills County, where he is currently engaged in mapping for a Master of Science thesis at The University of Oklahoma. In this area the outcropping rocks are fine-grained reddish-brown sandstones in the upper part of the Rush Springs formation, and reddish-brown sandstones and silty shales, together with thin beds of massive white gypsum, in the overlying Cloud Chief formation. These Permian strata are on the north flank of the Anadarko syncline and dip southwestward generally less than one-half degree.

Authigenic apatite in small concretionary clusters was found at two localities in the lower part of the Cloud Chief formation, and at each locality

authigenic overgrowths on detrital apatite grains also were found. Field investigation by the writers during the spring of 1960 resulted in the additional discovery of a magnesium clay mineral as small nodules, veinlets, and cavity encrustations, and of a thin bed of waxy magnesium-calcium

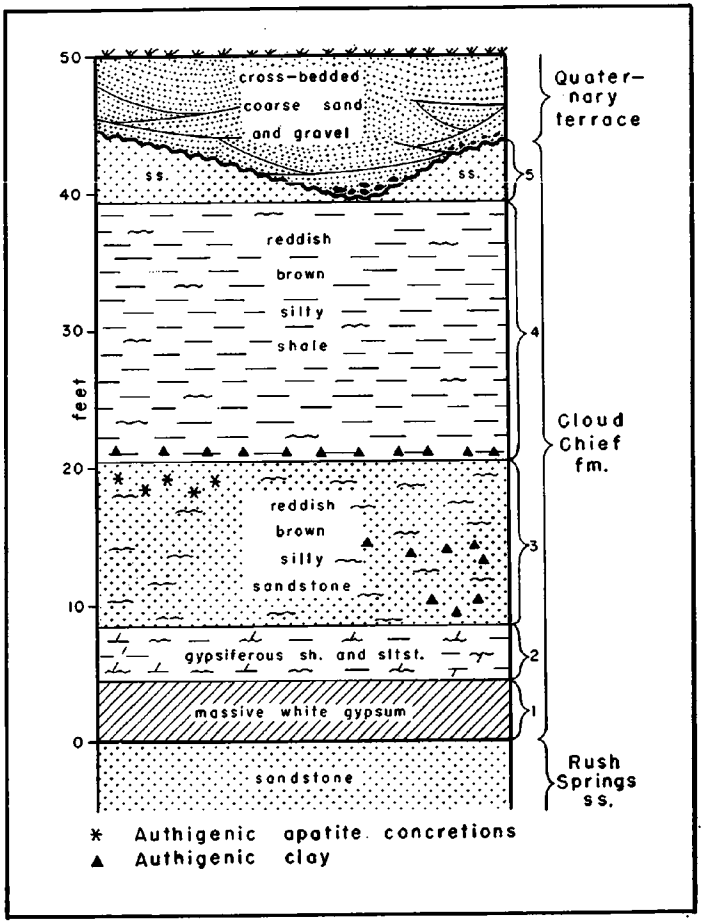


FIGURE 1. Stratigraphic section of lower part of Cloud Chief formation as exposed in bank on west side of Hay Creek, SW¼ SW¼ SE¼ sec. 26, T. 16 N., R. 21 W. Lithologic unit 3 is loosely consolidated sandstone 13 feet thick. It contains small concretionary bundles of authigenic apatite, as well as authigenic overgrowths on detrital grains of apatite. Authigenic clay occurs in the lower half of unit 3 as cavity encrustations and small nodules. Near base of unit 4 is authigenic waxy magnesium-calcium montmorillonite.

montmorillonite. Laboratory studies of the chemical, optical, and X-ray properties of these minerals are continuing, although it is now clear that the authigenic apatite and magnesium clay are similar in character and origin to those of Caddo County. The two areas are about 65 miles part, and it therefore seems probable that both minerals will be found in the region between them, and perhaps in the Cloud Chief and Rush Springs formations throughout much of western Oklahoma as well.

HAY CREEK SECTION—The lower 50 feet of the Cloud Chief formation is wholly exposed along the west bank of Hay Creek, just north of the bridge on the county section-line road, in SW¼ SW¼ SE¼ sec. 26, T. 16 N., R. 21 W., 11 miles north of Hammon in east-central Roger Mills County. The stratigraphic section and occurrences of the different minerals at this locality are shown in figure 1. Here called the Hay Creek section, these exposures contain (a) authigenic apatite as clustered bundles of acicular crystals and as crystal overgrowths on detrital apatite grains, and (b) two kinds of authigenic clay minerals.

Apatite. Needle-like crystals of apatite arranged in divergent white clusters as much as 0.5 inch in diameter are sparsely scattered in the upper part of a silty sandstone (unit 3, fig. 1) about 20 feet above the base of the Cloud Chief formation. X-ray diffraction studies show that this mineral is in the apatite family, and chemical tests show that it contains sulfate and carbonate as well as calcium and phosphate. It is thus allied to the apatite from Caddo County, but differs from it having higher indices of refraction and probably less carbonate and sulfate. The indices of the Hay Creek apatite are slightly variable but are mainly as follows: omega=1.643± 0.003; epsilon=1.638±0.003.

A completely unexpected occurrence of authigenic apatite was found by routine heavy mineral studies of this sandstone. Rounded grains of detrital apatite occur with similarly rounded zircon and tourmaline, and with subrounded ilmenite-leucoxene, garnet, and epidote. Each apatite grain is overgrown in optical continuity by a subhedral rim of authigenic apatite, as shown in figures 2 and 3. No other heavy mineral is characterized by authigenic overgrowth. Rounding of the apatite grains clearly took place by mechanical abrasion during transportation before the grains were deposited as part of the Cloud Chief formation; and the unabraded overgrowths were formed just as clearly by chemical precipitation *in situ*. Formation of the apatite overgrowths presumably took place at the same time as the precipitation of the authigenic clusters, both having been derived from marine waters of the Permian sea.

Apatite overgrowths of the type described here apparently have not been described from other localities.

Clay Minerals. Two contrasting types of authigenetically formed minerals are found in strata of the Hay Creek section. In the lower half of sandstone unit 3, figure 1, a white magnesium clay occurs as cavity encrustations, as tiny aggregates and clusters and as thin veinlets in the loosely consolidated silty sandstone. This flaky clay mineral has pearly luster and eminent basal cleavage, and resembles talc when spread between the fingers. It is biaxial positive with 2V=0-5 degrees. The alpha index of refraction is generally 1.554-1.557 but it ranges higher and lower. Well-crystallized apatite needles with omega refractive index of 1.630 occur in some of the clay books.

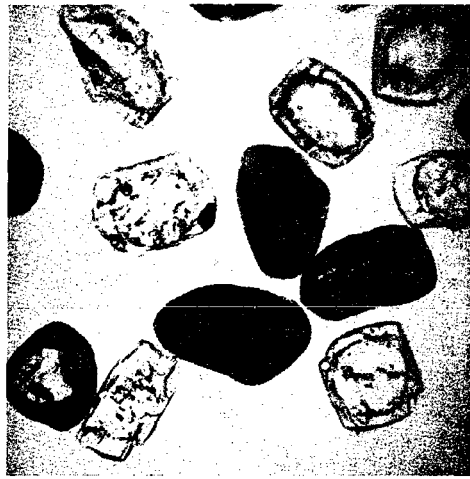


FIGURE 2. Photomicrograph showing a field of heavy minerals from lower part of Cloud Chief formation at Hay Creek. Grains of high relief are zircon; dark well-rounded grains in center are tourmaline. All other grains are apatite with authigenic overgrowths. x175.
(Photograph by R. E. Denison)

FIGURE 3. Photomicrograph of authigenetically enlarged detrital apatite from Cloud Chief formation on branch of Quartermaster Creek. Original rounded outline of the abraded grain is shown by a concentration of dark particles and by the abrupt termination of elongate inclusions. The authigenic overgrowth is optically continuous with the earlier core. x790.
(Photograph by R. E. Denison)

The X-ray diffraction pattern of the chloritic clay is virtually identical with that of the magnesium clay mineral from Caddo County.

A second type of clay, white to light gray and waxy to unctuous, occurs as a discontinuous layer 0.5 to 1 inch thick, about one foot above the base of the shale that comprises unit 4. The clay layer breaks locally into anastomosing stringers and veinlets, plainly demonstrating its secondary origin within the reddish-brown shale. X-ray and chemical studies indicate that the waxy clay is a magnesium-calcium montmorillonite.

No clay of this type has been previously described from middle Permian sandstones and shales of western Oklahoma.

BRANCH OF QUARTERMASTER CREEK.—A similar suite of minerals is found in exposures of the lower part of the Cloud Chief formation in gullies along a branch of Quartermaster Creek, NW¼ NE¼ NE¼ sec. 5, T. 14 N., R. 21 W., seven miles northwest of Hammon. Apatite occurs in sandstone that is equivalent to unit 3 of the Hay Creek section, both as bundles of divergent fibers and as overgrowths on detrital grains; and authigenic white clay occurs as aggregates in gypsiferous sandstone immediately above the basal gypsum bed of the Cloud Chief formation.

Other localities in the eastern part of Roger Mills County are being investigated in the hope of finding additional occurrences of these interesting minerals.

New Survey Publications in Process

Several publications of the Oklahoma Geological Survey are currently in various stages of preparation.

Circular 54, *Coal mining and landscape modification in Oklahoma*, by Arthur H. Doerr, is being edited and will reach the printer shortly.

Circular 55, *The genus* Paragassizocrinus *in Oklahoma*, by Harrell L. Strimple, is in press and will be issued in September.

Circular 56, *Pollen and spores from the Permian deposits of Cherdynsk and Aktyubinsk areas, Cis-Urals*, by S. R. Somoilovich, will also be issued in September. This document, translated from the Russian by M. K. Elias, is of particular importance to the study of the Permian stratigraphy of Oklahoma.

Bulletin 89, *Geology of Blaine County, Oklahoma*, by Robert O. Fay, will include sections on the mineral resources of this area. It is scheduled for publication early in 1961.

Bulletin 90, *Stratigraphy of the Frisco and Sallisaw formations of Oklahoma*, by Thomas W. Amsden, will give the physical stratigraphy of these formations as a setting for subsequent descriptions of their faunas. T› be published early in 1961.

Guide Book X, *Common minerals, rocks, and fossils of Oklahoma*, by William E. Ham and Neville M. Curtis, Jr., is now in press and will be issued in September. This guide book is intended for use in secondary schools and will be distributed with an accompanying set of twenty rocks, minerals, and fossils.

CONOSTICHUS

CARL C. BRANSON

The curious genus *Conostichus* has now been definitely identified in more than 20 Pennsylvanian stratigraphic units. All specimens are sand casts and the fossil is no more than a shape. The fossils occur in mudstone beds in which sand or silt filled the cavities in the mud where the animals lived. The fossils occur where there is a relatively small amount of sandstone; in most cases the sandstone is present in lenses or thin tongues and in some cases only in the *Conostichus* specimens.

In no case are there hard parts of animals in the same bed. The only associated larger fossils are worm casts (mere distorted cylindrical bodies), rare trails of the type attributed to nudibranchs, and sand casts of an animal with pentagonal symmetry (pl. IV, figs. 6-10). L. R. Wilson has recovered spores and carbonaceous material from a specimen of the pentagonal organism.

Some localities are in marginal sediments of the platform facies. One fine specimen (OU No. 321) was collected from a shale bed above the middle limestone of the Emporia formation. A prolific locality near Deerfield, Missouri, is in the sandy claystone above the Rowe coal and below the Bluejacket sandstone. The Illinois type specimen of the genotype species, *C. ornatus* Lesquereux, is from a sandy zone in the Liverpool cyclothem. Stout's Ohio specimens are from a gray shale below the underclay of the Quakertown coal and above the Anthony coal.

The more prolific localities in Oklahoma are not in recognizably cyclic sediments, but are in transitional strata marginal to the McAlester basin. Thousands of specimens have been found in the middle part of the Coffeyville formation near Red Fork, Tulsa County. Hundreds of specimens were found in the upper part of the Holdenville formation in Tulsa and south of Tulsa. The Labette formation yielded no specimens, perhaps because its sediments are too sandy. Atoka specimens are numerous at one locality but are poorly preserved.

The known specimens clearly referable to *Conostichus* cannot be reliably divided into species. Few specimens retain the form of the basal disk, and even fewer have the form of the subsequent layers. The numerous names are here considered useful only as indicative of stratigraphic and geographic position except for *C. ornatus*, the genotype. These names are *C. broadheadi* Lesquereux, 1880; *C. prolifer* Lesquereux, 1880; *C. wycherlyi* (King), 1955, and *C. typicus* (King), 1955, and *C. ulrichi* (King), 1955. *Conostichus ulrichi* was described and figured as Problematicum by Ulrich (1893, p. 88, pl. 5, figs. 23a-b) and by Kieslinger (1939, p. A 102, fig. 36). It was considered as of Early Devonian age because the rocks seen some miles to each side of the containing sediments are Devonian, but the form is clearly Pennsylvanian. *Conostichus wycherlyi*, *C. typicus*, and *C. ulrichi* were referred to a new genus of medusids, *Duodecimedusa*, by King, but the genus is *Conostichus* and the name is a synonym.

Conostichus is considered an adult now recapitulated in the strobilization stage of living scyphomedusids. The animal lived in a pit in the mud, but was unable to endure the presence of sand. When sand drifted over the muddy bottom, the medusid struggled upward and eventually expired. In

those rarer cases in which the medusid died rapidly, the form and symmetry of the exterior were preserved. The longer the medusid struggled, the larger and the more asymmetrical became the sand cast. The complete gradation from cylindrical strobili to fluted asymmetrical cones seems accountable in no other way.

Such scyphozoans as *Aurelia* developed from the scyphistoma, in seasons of plentiful food, a succession of segments like nested saucers. The dividing polyp (strobila) divided into as many as twelve inverted medusoids (ephyrae).

Several individuals commonly lived crowded together in only a few sites, notably in the Coffeyville. Only two such specimens were found in the Holdenville, and none in the Nellie Bly, in the upper part of the Savanna or in the Atoka. Successive individuals occur in the upper part of the Savanna, and rarely in the Jackson, Ohio, locality.

The life habit is like that of some marine worms, but no modern or fossil worm has the twelve-part symmetry nor the structural pattern of *Conostichus*.

The pattern of silt or sand deposition in the sand cast is revealing. In fluted cones the sides and bottoms of the cones consist of thin layers of sand, cross-laminated on the slopes. A central core is essentially structureless and is believed to be the filling of the place where the dead and shriveled organism was situated before it was floated away.

The present specimens exhibit a variety of sand types. A few are siltstone, most are fine-grained sandstone. The specimens in the Nowata shale are incomplete in the upper part because the sand supply was insufficient to fill the hollows, and a mudstone extension of the short sandstone cone is present in each case. Some specimens of the accompanying pentagonal organism at this locality are composed of oolites and ostracod carapaces. One specimen from the Seminole formation is composed of crinoid columnals and shell fragments. The specimen is the only coarse-textured one in the collection.

The occurrence of specimens is dependent upon sand supply. *Conostichus* occurs only where a mud bottom was occasionally swept over by enough sand to kill some of the medusids and to fill their burrows. Too much sand or a frequent influx of sand inhibited life and no specimens occur in truly sandy units. All specimens are erect, with disk or point of cone directed downward.

Description of Specimens

CONOSTICHUS ORNATUS Lesquereux, 1876
Plate I, figures 1-4

Conostichus ornatus Lesquereux, 1876. Indiana Geol. Survey, 7th Annual Report, p. 142-144, pl. 1, fig. 6.
Conostichus ornatus, Lesquereux, 1880. Penn. Geol. Survey, Report of Progress P 1, vol. 1, p. 17, Atlas plate B, fig. 4.
Conostychus ornatus, Lesquereux, 1883. Indiana Dept. Geology Nat. History, 13th Annual Report, p. 35, pl. 2, fig. 5.
Conostychus ornatus, Lesley, 1889. Penn. Geol. Survey, Report of Progress P 4, p. 143, text figure (errata, p. XV, changes to *Conostichus*).
Conostichus ornatus, Branson, 1959. Okla. Geol. Survey, Okla. Geology Notes, vol. 19, p. 82-83.

Type locality and horizon: Bed 4, Liverpool cyclothem, below Colchester coal, basal part of Carbondale group; Walnut Creek, Rock Island County, Illinois.

Holotype: The sole specimen, illustrated by Lesquereux by line drawing, was not found. The other and larger specimens said by him to be in the collection of the Illinois Gological Survey, are not now to be found unless the two specimens cataloged as No. 8689 and labeled *C. broadheadi* are those referred to. The specimens are fluted cones of the *C. broadheadi* type, but on present interpretation belong to the species *C. ornatus*. Four specimens deposited in the Davenport Public Museum were lent by Donald G. Herold, Director of that institution. The four specimens are without labels, but inasmuch as the specimens resemble Lesquereux' description and figure and considering that the type locality is but a few miles from Davenport, the four specimens are probably topotypes.

Specimen A (pl. I, fig. 1) is 10.7 cm high, 8.3 cm in diameter. It is a massive asymmetrical cone, somewhat flattened and with one side of the cup broken away. The basal unit is 3.3 cm in diameter, is hemispherical, pattern destroyed by weathering. The cone has nine tiers of molds of plates.

Specimen B (pl. I, fig. 4) is 4.8 cm high, 6 cm in diameter. The basal disk is nearly flat, marked in 12 wedge-shaped segments radiating from a central boss. Cone of 16 plate molds in first row, these grading upward into flutings in the next two rows.

Specimen C (pl. 1, fig. 3) is 4 cm high, 4 cm in diameter. It is a weathered cone with basal disk bearing twelve-sided pattern; cone in four tiers, irregularly fluted.

Specimen D (pl. I, fig. 2) is 3.6 cm high, 4 cm in diameter. The basal disk is 1.2 cm in diameter, bears small central node from which 12 wedge-shaped areas radiate. The segmented cone has four layers of plate molds, one fluted tier, and an abruptly expanded upper tier.

Conostichus cf. C. wycherlyi (King)

Plate IV, figures 1-2

A specimen from the Emporia formation at a level below the Elmont limestone, SE¼ SW¼ sec. 29, T. 17 N., R. 6 E., Lincoln County, Oklahoma. Height 6.4 cm, diameter 3.5 cm, diameter of disk 2.2 cm. The basal disk has a broad, low, central raised area, from which radiate the notches which mark the disk into twelve wedges. A succeeding tier of plate casts consists of twelve units, each centered over a disk wedge. Four more tiers of plate casts can be made out; the upper third of the specimen is irregularly fluted. The core is off-center and is one-third as long as the specimen (OU No. 321). The specimen is unique and a thorough search by L. R. Wilson and myself of outcrops of the claystone above the Reading limestone failed to provide a second specimen. The specimen is the best preserved of those so far found in any formation. It is possible that *C. wycherlyi* (King) is the species to which the present specimen should be referred. A similar specimen was collected by Strimple from the Wann shale in N½ SW¼ sec. 1, T. 25 N., R. 12 E., Washington County, Oklahoma, and he collected 19 specimens from the Wann near the center of sec. 21, T. 24 N., R. 13 E.

Conostichus ulrichi (King)

Duodecimedusa ulrichi King, 1955, Kansas, State Geol. Survey, Bull. 114, p. 159, pl. 1, figs. 2, 5.

The sole specimen is a disk 33-34 mm in diameter. It was found in Bolivia in rocks identified as Lower Devonian; here referred to the Pennsylvanian on the basis of occurrence of *Conostichus*.

Conostichus typicus? (King)

Duodecimedusa typica King, 1955, Kansas, State Geol. Survey, Bull. 114, p. 158, pl. 1, figs. 3-4.

King described and figured a single specimen from the Hickory Creek member of the Plattsburg formation, Lansing group, Missouri series. Our collection contains 38 specimens from the Barnsdall formation, Missouri series. The specimens appear referable to *C. typicus*. The disk is twelve-lobed, the lobes separated by deep grooves and at the border by deep notches. The disks range from 2.5 to 4.0 cm in diameter. In better specimens a tier of plate casts occurs above the disk, and the upper part of the cone is in some specimens fluted, in others nodose. The maximum diameter of one specimen is 7 cm. The height is not determinable, but is at least 6 cm. Five specimens of the species were collected from the same formation in SW¼ sec. 21, T. 22 N., R. 10 E. The larger collection is from SE¼ sec. 21, T. 22 N., R. 10 E., Osage County, Oklahoma. The collection was made by Harrell Strimple and Jack Hood. A poorly preserved specimen was collected by Strimple from the Wann shale just below a crinoidal shale in SW¼ sec. 36, T. 25 N., R. 12 E., Washington, County, Oklahoma. Two specimens were collected by Strimple from the Chanute shale, 8 feet below the Iola limestone in SE¼ sec. 4, T. 19 N., R. 10 E., Tulsa County.

Conostichus broadheadi Lesquereux

Conostichus broadheadi Lesquereux, 1880, Penn. Geol. Survey, Report of Progress, P, vol. 1, p. 15-16, atlas pl. B, figs. 1-2.

Conostichus broadheadi, White, 1899, U. S. Geol. Survey, Mon. 37, p. 12-13, pl. 2, figs. 1-5.

Conostichus broadheadi, Branson, 1959, Okla. Geol. Survey, Okla. Geology Notes, vol. 19, p. 83-87, figs. 1-5 on p. 83.

Conostichus prolifer Lesquereux, 1880, Penn. Geol. Survey, Report of Progress, P, vol. 1, p. 16, atlas pl. B, fig. 3.

Conostichus prolifer, White, 1899, U. S. Geol. Survey, Mon. 37, p. 13, pl. 2, fig. 6.

Conostichus broadheadi is a large fluted cone. Probably specimens with the disk would be classified as *C. ornatus*. No specimen with the disk has been found at the type locality (SW¼ sec. 5, T. 35 N., R. 32 W., Vernon County, Missouri), shale below the Bluejacket sandstone, in the upper few feet of the Savanna formation and 12 feet above a thin coal seam (Rowe? coal). Dr. Serge Mamay kindly located and sent the types to me. The holotype is USNM Paleobotany 10250 (not 250, as in White 1899). The labels state that the collector was R. D. Lacoe and that the determination was by Lesquereux.

Explanation of Plate I

Figure 1. Lateral view of specimen considered a possible topotype of *C. ornatus* Lesquereux (Davenport Public Museum).

Figure 2. Basal view of another topotype (?) of *C. ornatus*.

Figure 3. Lateral view of third topotype (?) of *C. ornatus*.

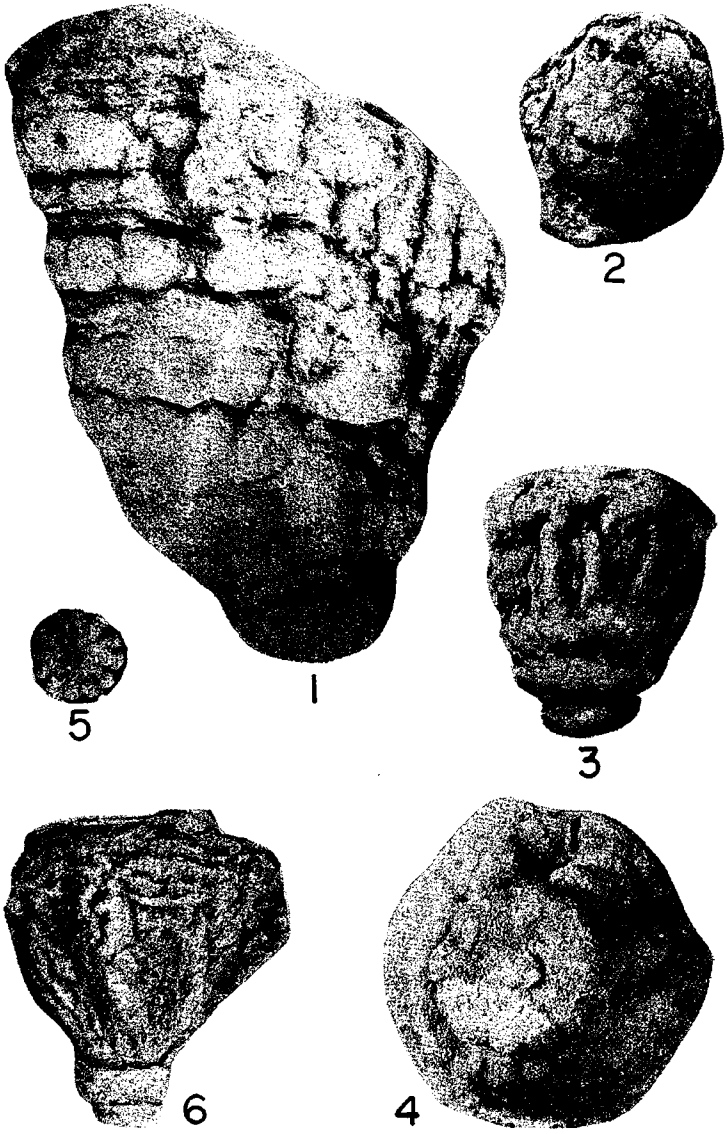
Figure 4. Basal view of a fourth topotype (?), a specimen which resembles, but clearly is not, Lesquereux' holotype.

Figure 5. Ventral view of an isolated basal disk, found in the base of a siltstone member of the Nellie Bly formation (OU No. 3239).

Figure 6. Lateral view of a specimen from Early Pennsylvanian of Jackson County, Ohio (University of Cincinnati).

(Photographs by Thomas W. Amsden)

PLATE I



The specimen is 9 cm in diameter, 6 cm high. A specimen determined by Lesquereux and figured by White (pl. 2, figs. 3-5) is USNM Paleobotany 10251 (not 250, as in White). White (1899, p. 12) mistakenly stated that figure 4 is an Arkansas specimen. The *C. broadheadi* type of fluted cone has been found in Rock Island County, Illinois, the area of the type of *C. ornatus*. Two specimens with no stratigraphic label and damaged locality label are Illinois Geological Survey No. 8689. *C. prolifer* Lesquereux is but a stacked sequence of specimens. The holotype is USNM Paleobotany 6035. The label states that the specimen is from "lower Carboniferous." White (1899, p. 13) in one place gave the specimen number under *C. broadheadi*. The specimen is 10 cm high, the bottom cone 6 cm in diameter, 4 cm high, and the top cone is 7 cm in diameter.

Mr. Frank Greene of Missouri Geological Survey has collected many specimens from the type locality of *C. broadheadi* and generously lent these to me.

One specimen from the type locality of *C. broadheadi* has four or five striated bands on the basal part of the cone (OU No. 3022). A similar specimen, this one with five grooved bands, was found by Richard Alexander in the Savanna shale in NW¼ sec. 27, T. 3 N., R. 7 E., Pontotoc County, Oklahoma (OU No. 3241, pl. III, figs. 3-4).

Fluted cones of the *C. broadheadi* type are common in the Holdenville and Coffeyville formations of Oklahoma, but are believed to be distinct.

Conostichus, Holdenville types
Plate IV, figures 3-4; Plate II, figure 6

Conostichus is amazingly abundant in the Holdenville formation. At one prolific locality no disk was found, but 61 fluted cones were collected (Branson, 1959, p. 86, figs. 3-4 on p. 83). Mr. Jack Hood found a disk with five tiers of plates (OU No. 3224). The specimen is the smallest one found. A locality on the Tulsa-Okmulgee bee-line highway just north of the south line of Tulsa County has yielded several specimens with disk (SW cor. sec. 14, T. 16 N., R. 12 E., Tulsa County, Oklahoma). Jack Hood collected a fluted cone with hemispherical basal disk divided by grooves into twelve wedges (OU No. 3226, pl. II, fig. 6). This specimen is conspecific with OU No. 3224. Harrell Strimple collected five specimens from the same locality. Three of these consist of disks and tiers of plate casts, one with four tiers (OU No. 3222, pl. IV, figs. 3-4). The disk is nearly flat-based, the grooves shallow, but distinct. One specimen appears to be a succession of individuals, or a succes-

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Explanation of Plate II

Figure 1. Lateral view of specimen (OSUM 10872) figured by Stout.

Figure 2. Lateral view of a characteristic specimen from the Nowata shale (OU No. 3240).

Figure 3. Another specimen from the Nowata shale (OU No. 3240).

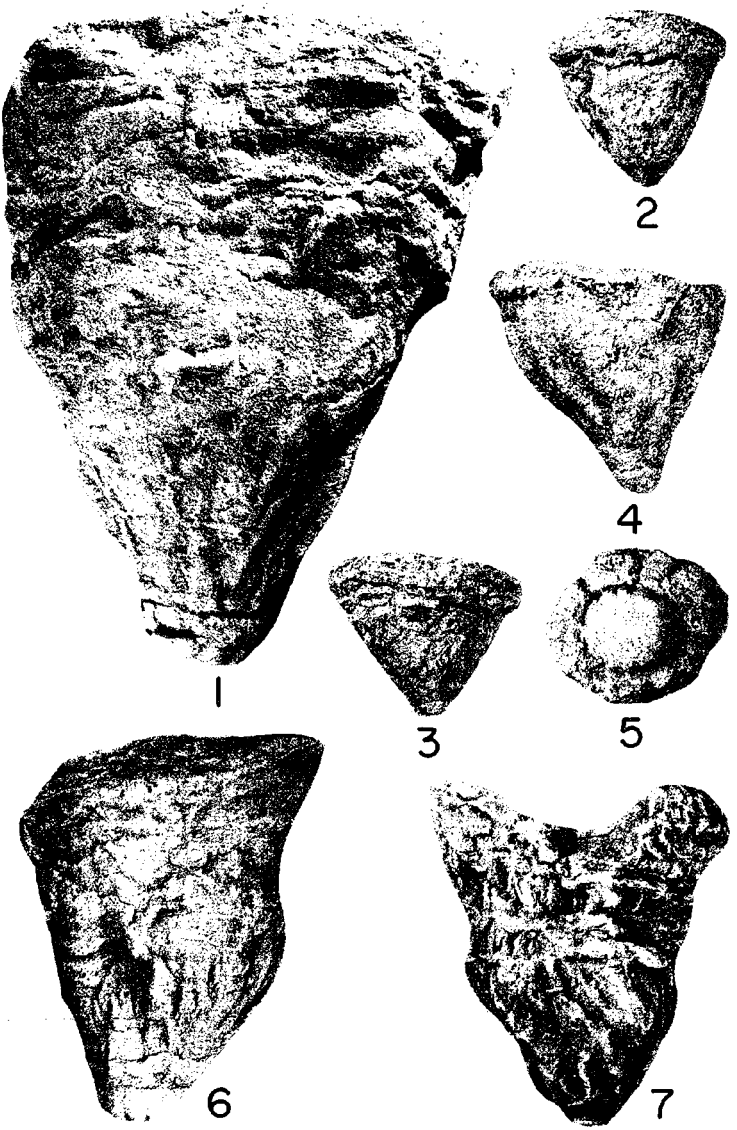
Figure 4. Lateral view of the Indiana specimen (Univ. Indiana, No. 3,684).

Figure 5. Basal view of a specimen from Potteville beds, Jackson County, Ohio (University of Cincinnati).

Figure 6. Lateral view of a fluted cone with basal disk, Holdenville formation (OU No. 3226).

Figure 7. Lateral view of a fluted cone, Nellie Bly formation (OU No. 3406).
(Photographs by Thomas W. Amsden)

PLATE II



sion of casts representing positions of upward movement in the mud. The disk is missing at the bottom, a disk shows at the side about an inch from the base, and another disk is at the side three-fourths of an inch from the top. Nine specimens, five with disks preserved, and three with tiers of plates, were collected by Jack Hood at this locality. A third collection from the locality contains two layered cones, two fluted cones, and one disk with plate tiers (OU No. 3223).

A collection of about one hundred specimens was obtained by Harrell Strimple from a stream cut in Okmulgee County east of the Okmulgee highway and two miles south of the Tulsa County line. These are low, flat cones, none with well-preserved disk, a few with flutings showing twelve-part symmetry. They seem unlike the other two Holdenville types in all respects.

Conostichus, Seminole type

Twenty-four specimens were found in the Seminole formation on the Tulsa-Okmulgee bee-line highway 13.6 miles from the intersection with Interstate Highway 44 (sec. 15, T. 16 N., R. 5 E., Tulsa County). None shows the basal disk well enough to be characterized, but it is small and nearly hemispherical. Two imperfect cones were found 10.1 miles south of Interstate Highway 44 on the same highway. A single medium-grained sandstone conical cast was found by Jack Hood in NW¼ NW¼ NW¼ sec. 23, T. 17 N., R. 12 E. Four specimens, poorly preserved, were collected by Jack Hood in NE¼ NE¼ sec. 2, T. 17 N., R. 12 E., Tulsa County. One appears to have a broad, flat disk.

One specimen, collected by Jack Hood from a bed below the Dawson coal in NE cor. sec. 2, T. 17 N., R. 12 E., is an irregular cone consisting of crinoid stem ossicles and other calcareous grains. The basal portion is bulbous, nearly smooth, and has a depression where a brachiopod shell has spalled out. The disk is absent. The specimen is the only coarse-grained one in the collection (OU No. 3432).

Conostichus in the Nowata shale

Plate II, figures 2-3

About a hundred specimens of cones were collected by Harrell Strimple from the upper part of the Nowata shale in a quarry in SW¼ sec. 32, T. 18 N., R. 13 E., Tulsa County, Oklahoma. They are short cones preserved as fine-

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Explanation of Plate III

Figure 1. Lateral view of a group of fluted cones from the Coffeyville formation (OU No. 3407).

Figure 2. Dorsal view of a specimen from the Pottsville of Jackson County, Ohio (Univ. of Cincinnati).

Figure 3. Lateral view of a five-banded specimen from the Savanna formation (OU No. 3241).

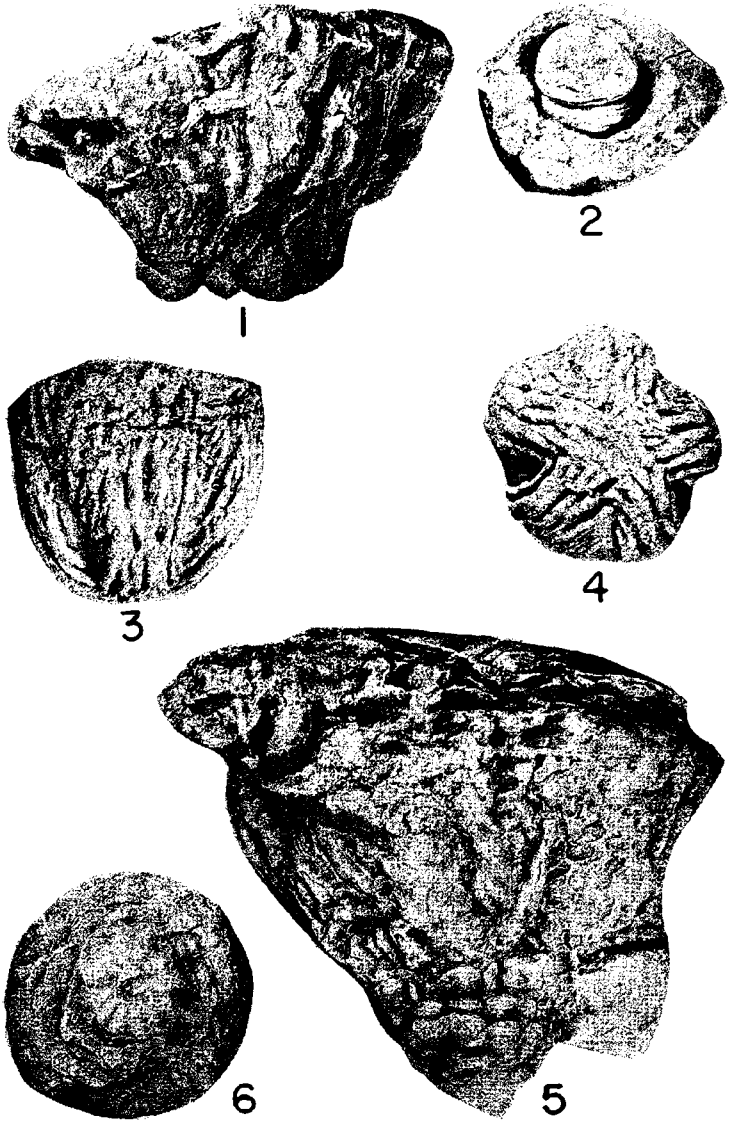
Figure 4. Ventral view of same specimen (OU No. 3241).

Figure 5. Lateral view of two interlocked specimens from the Pottsville, near horizon of Coal No. 2, Ohio (OSUM 10372b).

Figure 6. Basal view of one of the few specimens from the locality on which the form of the basal disk is preserved. Pennsylvanian, Jackson County, Ohio (Univ. of Cincinnati).

(Photographs by Thomas W. Amsden)

PLATE III



grained argillaceous sandstone. Few are fluted and none retains the basal disk. The sand supply was insufficient to fill the burrow and the upper part of each cone is clay. Associated with the cones are holothurian (?) casts composed of oolites, ostracod carapaces, and shell fragments. The figured specimens are OU No. 3240.

Conostichus, Coffeyville type
Plate III, figure 1

Conostichus is extraordinarily abundant in the middle part of the Coffeyville formation, west of Red Fork in the Berryhill area. Jack Hood found the locality and gave specimens to our collection. Two specimens were figured by Branson (1959) as figures 1-2 (OU No. 3144) and 3 (OU No. 3145). Literally bushels of specimens have been collected, but none from the locality retains the disk. Many of the Coffeyville forms from here are compound laterally. Eight specimens were found near the east quarter corner of sec. 4, T. 18 N., R. 12 E., Tulsa County, and the one preserved disk is like that of the small Holdenville form. A few specimens have been found at other scattered localities in the area. Worm casts occur with them, and at one locality two pentagonal casts were found.

Conostichus in the Nellie Bly shale

A single fluted cone (OU No. 3225) was collected by Jack Hood at NW cor. sec. 19, T. 19 N., R. 11 E., Tulsa County, in the Nellie Bly shale.

Conostichus in unnamed shale below Birch Creek limestone

Eight specimens were collected by Jack Hood about five miles north of Copan, Washington County. Three specimens retain the disk and each disk is small (0.5 to 1.0 cm in diameter). The cone is in tiers and expands rapidly, unlike the subcylindrical type of most formations. The largest cone is 3.8 cm in maximum diameter. Six cones from the same stratigraphic level near the middle of the south line of sec. 21, T. 20 N., R. 13 E., are not as well preserved but have the same characteristics.

Explanation of Plate IV

Figure 1. Specimen from Emporia formation, Lincoln County, Oklahoma. Lateral view (OU No. 321).

Figure 2. Basal disk of same specimen.

Figure 3. Lateral view of specimen from the Holdenville formation, Tulsa Co., Oklahoma (OU No. 3222).

Figure 4. Basal view of a specimen from the same horizon and locality (OU No. 3222).

Figure 5. Lateral view of a specimen from the Missouri in Kansas City, Kansas (OU No. 353).

Figures 6, 10. Pentameral organisms from the Holdenville, City of Tulsa (OU No. 3416).

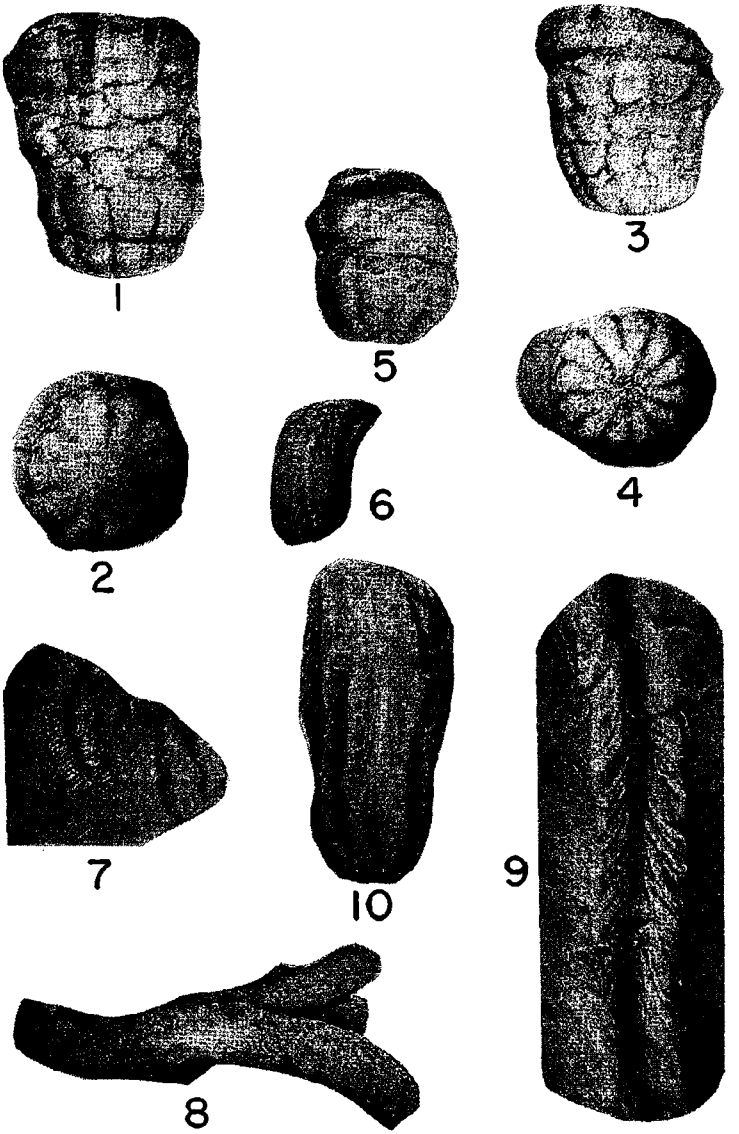
Figure 7. Annelid trails, Holdenville formation (OU No. 3414).

Figure 8. Worm cast from the Holdenville (OU No. 3417).

Figure 9. Nudibranch (?) trail from the Nellie Bly formation, Creek County, Oklahoma (OU No. 3415).

(Photographs by Thomas W. Amsden)

PLATE IV



CONOSTICHUS in the Pottsville of Ohio

Plate II, figure 1; plate III, figure 5

Conostichus has been figured by Stout (1956, figs. 1-2, p. 31) from shale above the Anthony coal and below the underclay of the Quakertown coal at Sciotoville, Scioto County, Ohio. The specimen figured as figure 1 is No. 10872a in the Ohio State University Museum. It has a rather flat and shallow twelve-lobed disk, one level of plate casts, and a fluted cone grading upward into a laterally ridged cone. The disk is 1.2 cm in diameter; the cone 11.3 cm high, 8.5 cm in diameter. The specimen is the largest one known from any locality.

Another specimen (OSUM No. 10872b) is a double specimen (pl. III, fig. 5, Stout's fig. 2). A third specimen from the locality (OSUM 10872c) is a fluted cone with poorly preserved basal disk, clearly like the first specimen above. Two other specimens are in the collection from the locality, neither adding to the knowledge of the species. A specimen collected from the base of the Pottsville in Jackson County, Ohio, by H. Laviers in 1898 (OSUM No. 8447) is a fluted cone with a basal disk.

These specimens were lent me by Dr. John J. Stephens, Curator of the Geological Museum of Ohio State University.

CONOSTICHUS from Jackson County, Ohio

Plate III, figures 2, 6; plate II, figure 5; plate I, figure 6

Dr. Kenneth E. Caster of the University of Cincinnati lent me 258 specimens collected from U. S. Highway 35, 2 miles northwest of Jackson, Jackson County, Ohio. The specimens were collected by Kelley Hale and by Dr. A. H. Blickle. The collection came from Pottsville shales at about the same stratigraphic level as Stout's specimens.

The specimens are fluted cones of fine-grained sandstone. One specimen has a poorly preserved basal disk, characteristically lobed and apparently with a central depression. A second specimen has a basal disk with the characteristic outline, but the central part is not preserved.

CONOSTICHUS from other localities

White (1899, p. 12) reported *Conostichus* from Arkansas and probably had some from there although he was in error in stating that his plate 2, figure 4 was from Arkansas.

Stout (1956, p. 30) gave six localities in Ohio and stated that *Conostichus* occurs in the Olive Hill region of Kentucky.

Dr. Lloyd G. Henbest (letter of June 8, 1959) stated that he has specimens from the Woolsey member of the Bloyd shale, a photograph of one in the Cane Hill member of the Hale formation, and a large species from the Atoka, all from Arkansas. He stated that there are many specimens from the Appalachian region in the U. S. National Museum.

Frank C. Greene called attention to a specimen from the Muncie Creek shale west of Kansas City, Kansas, in the collection of A. C. Carpenter of Ottawa, Kansas.

I have seen specimens in the Atoka of Horse Ridge about three miles northeast of Alamogordo, New Mexico.

A single specimen from Indiana was lent to me by Dr. G. K. Guennel of the Indiana Geological Survey (U. Indiana No. 3,684). The label reads

"Fossil medusa, Penn. ss., above Glen Dean ls., 1 mi. W and ½ mi. N. of Shoals, Ind., coll. by J. E. Reeves, 1938." Dr. J. J. Galloway located it in the collections. The specimen is a fluted cone of moderate size (pl. II, fig. 4).

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Rock Wool From Volcanic Ash

Volcanic ash (pumicite) is one natural mineral which occurs in abundance throughout much of the Great Plains area but which is used commercially in diminishing quantity. The June 1960 issue of *Rock Products* carries an article by Dr. Maynard P. Bauleke, ceramic engineer of the State Geological Survey of Kansas, in which it is shown that Kansas volcanic ash, which is similar to Oklahoma volcanic ash, plus the addition of lime, will produce a satisfactory mineral wool. Because of the high iron content, it is not possible to draw fibers through platinum orifices but fibers may be produced by blowing or spinning.

—A. L. B.

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A recent gift to the Geology Library of The University of Oklahoma, by Mrs. Maurice H. Merrill of Norman, is the 1915 Catalogue No. 8 of the Lucey Manufacturing Corporation. The Lucey Manufacturing Corporation was "Manufacturers of and Dealers in Machinery & Tools for Rotary and Cable Systems. Tools, Supplies and Equipment for Oil, Gas and Water Wells, Pipe Lines and Refineries," with offices throughout the United States and in Mexico, Roumania, Russia, Japan, Trinidad, South America, and England. The catalog consists of 999 pages and it is a compendium of every conceivable tool or item of equipment, from six-penny nails (p. 831) to fully equipped drill rigs (p. 191-197), used in the oil fields of that time.

To those of us of the younger generation the technical sophistication achieved by the oil-well-equipment industry at this "early" date is quite impressive. Some tools (e. g., hammers, spades) have changed little during the intervening years. Other items have undergone radical change and improvement. For example, the highly specialized vehicles of today's oil fields can hardly be credited as legitimate offspring of the vehicle illustrated here.

—A. N.

Oil Country Buckboard

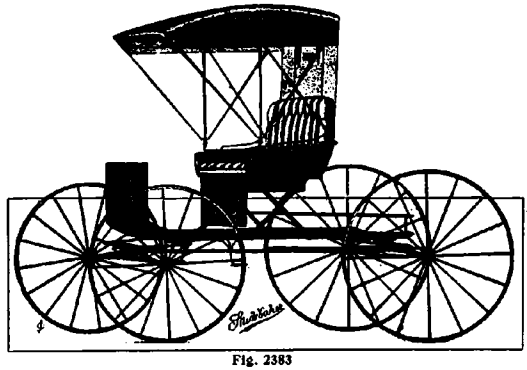

Fig. 2383

Gear—1½-inch arch axles. Wide or narrow track.
Wheels—Sarven patent, 1-inch, 40 and 44-inch. Screwed rims.
Body—26 inches wide. Slat bottom.
Seat—Regular with No. 21 panel seat as illustrated.
Painting—Body black, gear dark green or carmine.
Trimming—Regular with genuine leather. (Imitation leather on order.)
Top—Regular with 4-bow, rubber top, rubber lined. (Leather quarter or full leather on order.)
Shafts—Ironed over heels and truss braced. Quick shifters.
Fittings—15-inch leather dash. Storm apron.
Net weight packed for export, 375 pounds.
Gross weight, 700 pounds.
Cubic Measurement, 55 cubic feet.

With top Each $133.75
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