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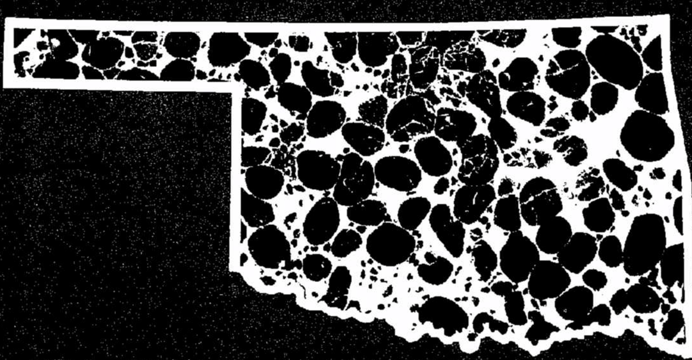
OKLAHOMA GEOLOGY NOTES



VOLUME 26 NUMBER 5 MAY 1966

Cover Picture

First Bromide Sands

The First Bromide sands (Simpson Group, Ordovician) in central Oklahoma produce large quantities of petroleum from depths ranging from less than 2,000 feet to more than 16,000 feet. The producibility of these sands depends upon a number of factors, such as environment of deposition, diagenesis, cementing material, permeability, and porosity. Porosity and the related parameters of packing density, packing proximity, and type and number of grain-to-grain contacts were studied in thirteen First Bromide cores with the aim of relating them to depth. Although the results are inconclusive because of the paucity of material available, a number of features worthy of note were observed.

Pictured on the cover is a thin section (approximately x14) from a core of the First Bromide taken at 16,336 feet in the Humble 1 Patterson well (sec. 23, T. 5 N., R. 6 W., Grady County, Oklahoma). The sample consists of medium-sized to very-fine, rounded to well-rounded quartz sand grains embedded in a matrix of secondary silica with some calcite. This was the deepest core examined in the study.

Published data insist that porosity decreases with depth. However, significant deviation from this assumed relationship was noted in the First Bromide cores. For example, the sample illustrated here has a porosity of 13 percent, which is substantially greater than that of cores taken at shallower depths.

The slide also shows a number of pressure-associated features, which are less common or absent in the shallower samples. Fractured individual sand grains become more abundant at depths below 8,000 feet. This fracturing may significantly affect porosity values, depending on whether the fractures remain open or are closed by cementation and/or tight packing of the fragments. The long and concavo-convex grain-to-grain contacts shown are also associated with pressure and are more common at depth than are the "floating" grains or tangential contacts, indicative of original packing, which characterize the shallower samples.

The study referred to herein and from which the cover picture is reproduced (pl. 6b) was published by Carl A. Moore and Lorenzo Luis Albano in volume 33 of the Tulsa Geological Society Digest.

—*Carl A. Moore*

Pennsylvanian Fusulinid Biozones in Southern Oklahoma*

Dwight E. Waddell†

This paper is a biostratigraphic report resulting from a detailed study of more than 2,000 fusulinid thin sections from more than 60 geographic localities throughout the Ardmore basin area and within the Mill Creek graben. The problem was to record the presence and succession of faunal zones represented in the largely clastic sequence of rocks of southern Oklahoma, in hopes that these zones might prove useful in solving subsurface problems.

The rock-stratigraphic nomenclature in the Ardmore basin, and thus in much of southern Oklahoma, is the result of work by Goldston and by Tomlinson in the 1920's. The over-all lithologic character of the Pennsylvanian rocks accommodates Tomlinson's tripartite formation subdivision of Dornick Hills, Deese, and Hoxbar despite revisions of the last ten years. Subdivisions of these major rock units have been made to the member level although in many cases it is difficult, even on the surface, to discriminate among them lithologically.

Interlocality correlations of subsurface and surface members is, in many cases, based upon fusulinid identifications rather than upon lithologic evidence. This rock correlation by fossil species is an erroneous practice. Some fusulinid species are so similar that, even in the ideal situation, they are separated with difficulty from species in rocks above or below. The Ardmore basin circumstance is a case in point; here thin fossiliferous units are separated by thick, nonfossiliferous clastic units, and yet species are similar. In areas of more continuous carbonate deposition, overlapping ranges of species make member identification by species identification even more difficult. Added to this are such problems as horizontal variation of species within a given rock unit owing to environmental influences, vertical variation by species crossing rock boundaries, and the fact that fossil similarities do not demonstrate physical rock continuity.

In some cases, identification of rock units paleontologically has created as many problems as it has solved and has forced the subsurface geologist into an untenable position. All the subsurface geologist wants, in most cases, is a chronologic framework within which he can correlate. What he often gets is a strait jacket of formation names. The biozones presented in this paper will allow the latitude necessary for the subsurface correlation of physical parameters within a geochronologic framework based upon fusulinid evolutionary development.

The zonation of the Pennsylvanian presented in this paper (fig. 1) is based exclusively upon fusulinid faunas, and it is only through fortuitous circumstance that a biozonal boundary coincides with a lithologic boundary. Also, all the zones are separated by gaps repre-

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* Paper presented at the Ninth Geological Symposium, Norman, Oklahoma, on February 28, 1966. Published with permission of Shell Oil Company.

† Shell Oil Company, Midland, Texas.

sented by nonfossiliferous strata. No attempt was made to manipulate boundaries up or down upon the basis of what was absent.

Fusulinids have been used reliably for both local and intercontinental correlation because of the nearly world-wide distribution of major genera. The time necessary for a genus to establish itself geographically is geologically insignificant compared to the generic range, and the first occurrence of a genus is essentially simultaneous throughout its areal distribution. It is thus no great feat for a Midcontinent paleontologist to look at a Moscovian or Westphalian fusulinid fauna and recognize that it is Desmoinesian.

All genera listed in figure 1 range through two or more zones and would appear not to lend themselves to subdividing the continuum. However, species of all genera have sufficient characteristics to provide for biozonation. As previously stated, it is impossible to establish thin rock unit correlations upon the basis of fusulinid species. However, the fusulinid zonation is on a biologic scale, subdivides only the biologic continuum, and is independent of lithologic implications.

The Zonation

The lowest local range zone, stratigraphically, in southern Oklahoma can be identified by the presence of *Fusulinella dakotensis* and *Fusulinella* new species, and is called Zone I (fig. 2). The base of Zone I is near the base of the Bostwick Member where *Fusulinella dakotensis* first occurs, and the top is above the top of the Bostwick where the highest occurrences of *Fusulinella* new species are found. Strata con-

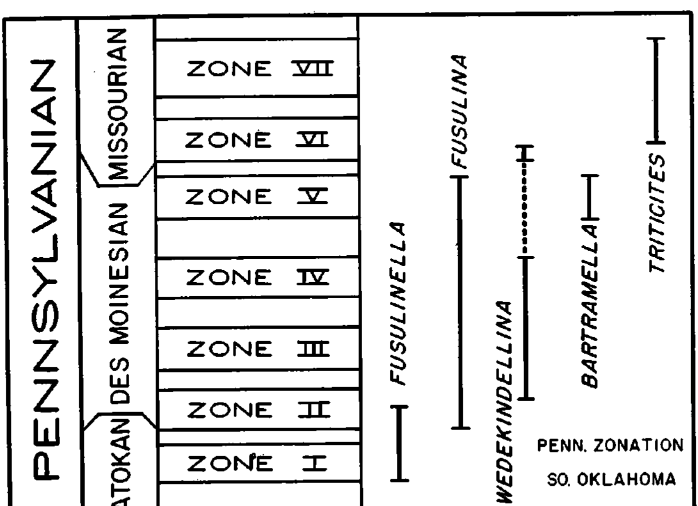
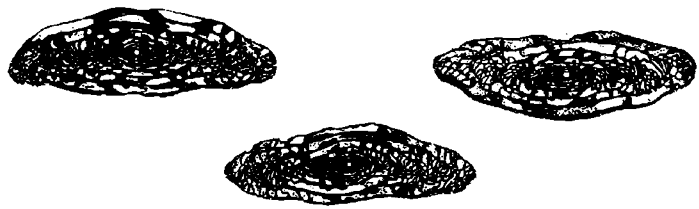


Figure 1. Fusulinid biozones of the Pennsylvanian System in southern Oklahoma.



Fusulinella new species

Fusulinella dakotensis

Figure 2. Late "Atokan" fusulinids (x7.5) of Zone I.

taining Zone I fusulinids occur on the surface in the Overbrook anticline. The only named rock unit in the zone is the Bostwick Member. Zone I is not present in either the Brock anticline or the Pleasant Hill syncline. It is also absent over most of the fields to the northwest of the outcrop area.

In secs. 24, 25, 36, T. 5 S., R. 1 E., approximately 50 feet of conglomerate beds have been mapped and assigned to the Bostwick Member (fig. 3). It is extremely unlikely that this assignment is correct. Although these strata are among the oldest cropping out in the area adjacent to the Criner Hills, they do not contain Zone I fusulinids. A thin, deeply weathered wackestone (micrite) crops out about 30 or 40 feet below the conglomerate, and from it a number of rather poorly preserved fusulinids were recovered. The fusulinids from this limestone (fig. 4) belong to the genus *Fusulina* without question. They are more advanced than the Zone II types and more primitive than the Zone V types. These relationships imply that they belong in Zone III or Zone IV, but a definite assignment is not possible because of the poor state of preservation.

Zone I is late "Atokan" in age, whereas the fusulinids from the wackestone underlying the conglomerate beds are Desmoinesian in age. These conglomerate beds support the thesis of continued spasmodic, local uplift along the Criner lineament well into the Desmoinesian Epoch. The structural lineament was thus not necessarily an area of low relief during Desmoinesian time, as indicated by some of the literature. Because this conglomerate is not so widely distributed as are the conglomerates in the Bostwick Member, it is suggested that the relief of the later uplift was not as great as that of the earlier.

In Texas, fusulinids of the Zone I type occur only in the uppermost part of the Marble Falls Formation. In eastern Oklahoma the

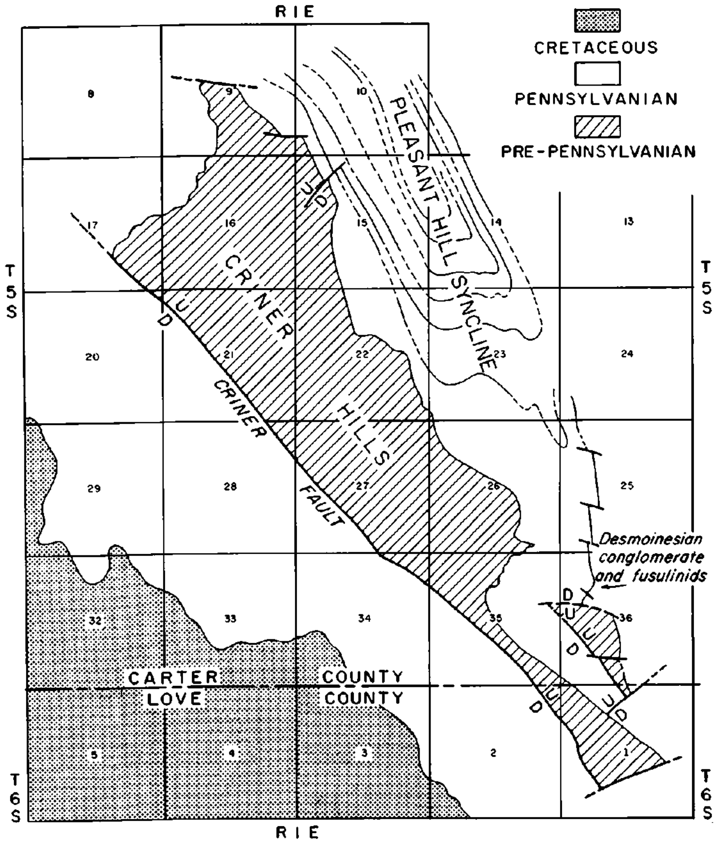
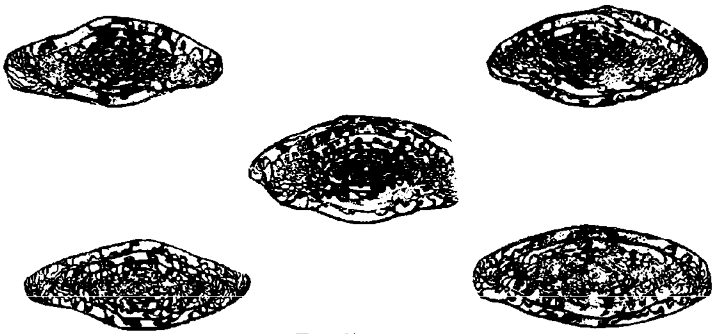


Figure 3. Generalized geologic map of the area south of Ardmore (modified from Frederickson, 1957).

Fusulinella prolifica fauna of the Atoka Formation is related to the Zone I fauna. Zone I fusulinids so far found are distinct from those that occur above them. They define a zone of similar morphological advancement within the genus *Fusulinella* that relates the zone to the relative geologic time scale.

Zone II is characterized by a rather primitive *Fusulina* fauna and by the presence of *Wedekindellina,* the lowest stratigraphic occurrence of this genus in southern Oklahoma (fig. 5). *Fusulina insolita* and *Fusulina* new species characterize the lower one-half of the zone, and *Fusulina plattensis, Fusulina pumila,* and *Wedekindellina* sp. A the upper one-half. The named rock units that fall within the bounda-



Fusulina sp.

Figure 4. Specimens of Fusulina (x7.5) from the limestone 30 to 40 feet below the conglomerate previously assigned to the Bostwick Member. The forms are Desmoinesian and possibly assignable to Zone III or Zone IV.

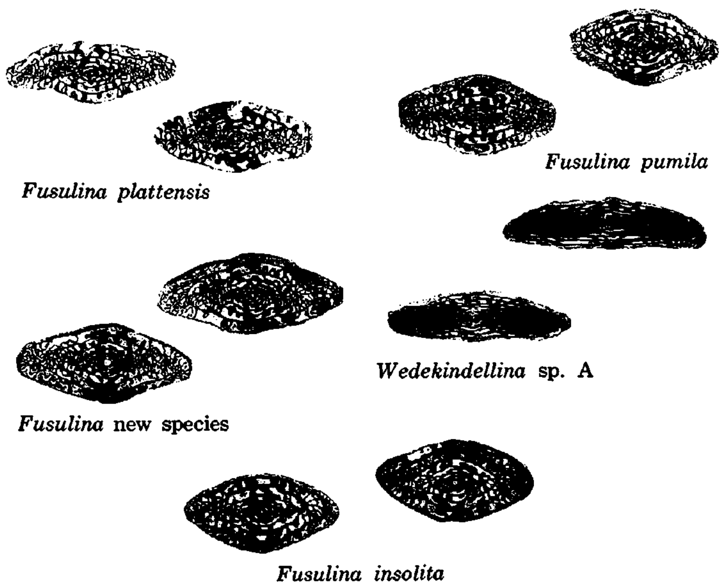


Figure 5. Early Desmoinesian fusulinids (x7.5) of Zone II.

ries of Zone II, the Lester Member and the Frensley Member, are those that have been least studied and least understood in the Ardmore area. The type section of the Frensley Member was discovered to be in Zone III, Pumpkin Creek, rocks, and I therefore proposed a new type section (see Tomlinson, 1959, p. 317, footnote 4).

The fusulinids of Zone II are early Desmoinesian in age. For cartographic convenience the "Atokan"-Desmoinesian boundary should be placed at the base of the lower Lester Member. Although this has necessarily constituted a redefinition of the "Atokan"-Desmoinesian boundary in southern Oklahoma, it should not have been an automatic redefinition of the Lake Murray Formation and the Big Branch Formation as suggested by C. C. Branson (in Tomlinson and McBee, 1962, p. 479, footnote 10). In the first place, the so-called Lake Murray Formation is a much better biozone than it is a formation and should be retained as originally defined for whatever merits justify its further existence. Secondly, series and systemic boundaries are not mappable units and do not necessarily conform to mappable lithologic units. Rock-stratigraphic units are not time bounded, neither are time-stratigraphic units rock bounded.

Zone II rocks crop out in the Overbrook anticline and are particularly well exposed west of Anadarche Creek in the area of the Frensley type locality. Fusulinids are found throughout most of the limestones in this area. In the Caddo anticline Zone II rocks occur in both the northeast and the southwest limbs. The relationship of Zone II to the northern Texas region is partly obscured because the "Caddo" limestone does not crop out. Core information, however, indicates that the "Caddo" does contain Zone II fusulinids. In eastern and northeastern Oklahoma no outcropping rocks of which I am aware contain the Zone II fauna.

The base of Zone II occurs from 90 feet to 150 feet below the Lester Member of Tomlinson (Lester in the restricted sense, 1929). The top of the zone is placed at the top of the highest limestone in the Frensley Member at the type locality.

Zone III is defined upon the basis of *Fusulina* cf. *F. novamexicana*, *F. euryteines*, *Wedekindellina* sp. B, and *W.* sp. C (fig. 6). Its fauna is of typical early Desmoinesian character. The base of Zone III, in the Overbrook anticline, is below the lowest of three unnamed limestone beds underlying the Pumpkin Creek Member. In the maximum outcrop section in the southeastern part of the Overbrook anticline the base is approximately 250 feet below the Pumpkin Creek Member. The top of the zone is placed at a thin, discontinuous limestone zone about 100 feet above the Devils Kitchen Member in the Caddo anticline just north of Ardmore.

W. E. Ham of the Oklahoma Geological Survey and I have been working on the lower Desmoinesian rocks of the Mill Creek graben that crop out in the area of the "Buckhorn" asphalt quarry. In this area the lowest resistant mappable bed is an encrinite containing Zone III fusulinids and the red algae?/stromatoporoid genus *"Komia."* *"Komia"* has not been reported to date in the literature on Oklahoma geology, and this may well be the first reported occurrence. *"Komia"*

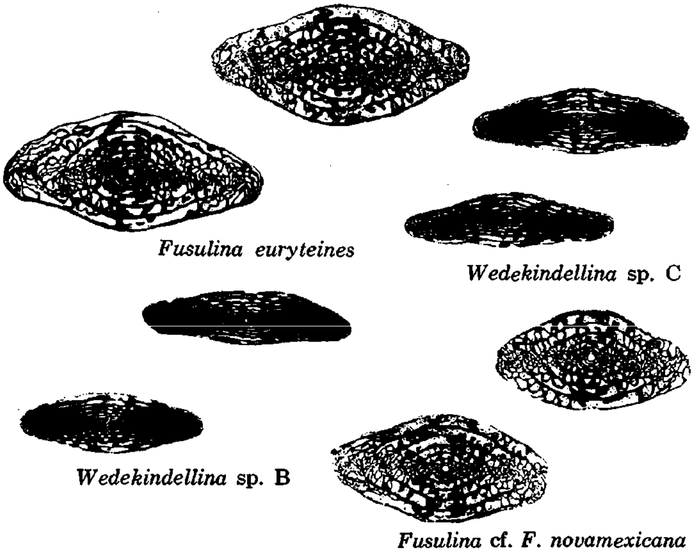


Figure 6. Early Desmoinesian fusulinids (x7.5) of Zone III.

is important in north-central Texas as a zone marker because in many cases leached porosity is associated with its branches and because of its paleoecological implications. The lower part of the Krebs Group, Zone III of eastern Oklahoma, possibly at or near the Spaniard vicinity, correlates to the Zone III encrinite bed of the Mill Creek graben.

The fusulinids of Zone III form a closely related group that is widespread and important in the subsurface of southern Oklahoma and northern Texas. Differentiation of rock units upon the basis of paleontology is impossible with such a closely related fauna, even if such practice were not objectionable philosophically.

In northern Texas, Zone III fusulinids are found in the Kickapoo Falls, Dennis Bridge, Meek Bend, and Brannon Bridge Members. In southern Oklahoma the named rock units of the zone include the Pumpkin Creek Member and the Devils Kitchen Member. In some areas the zone includes 1,000 feet or more of rocks. In northeastern Oklahoma this zone includes rocks of the middle and upper parts of the Krebs Group.

Zone IV is one of the more distinctive faunal zones in southern Oklahoma and north-central Texas. It is characterized by specialized, rather primitive *Fusulina* and by advanced forms of *Fusulina*, as well as by both primitive and advanced forms of *Wedekindellina* (fig. 7). In the Arnold Member of this zone are the youngest forms of *Wedekindellina* from surface exposures in southern Oklahoma. In northern Texas the zone begins somewhere above the Brannon Bridge Member

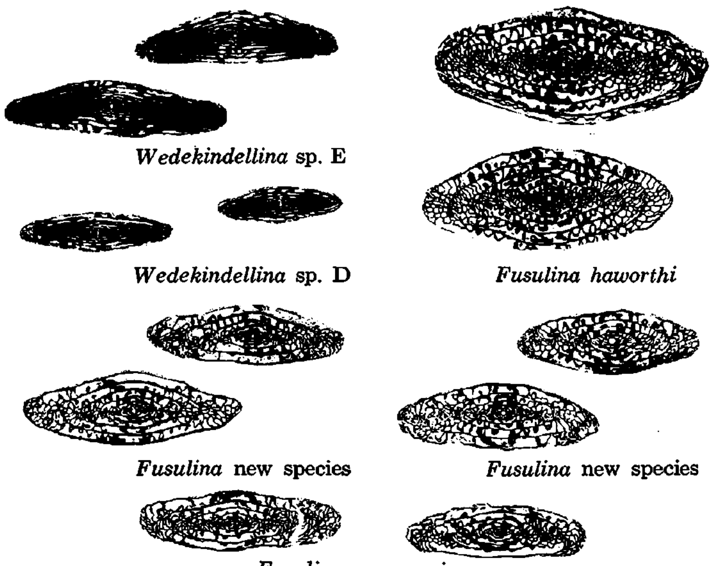


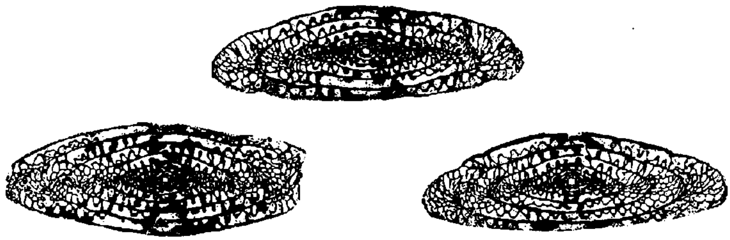
Figure 7. Middle Desmoinesian fusulinids (x7.5) of Zone IV.

and continues approximately through the Santo Member. On the surface of the Bend arch the zone is poorly developed, but it is distinct on the eastern shelf of the Midland basin and in the Palo Duro basin.

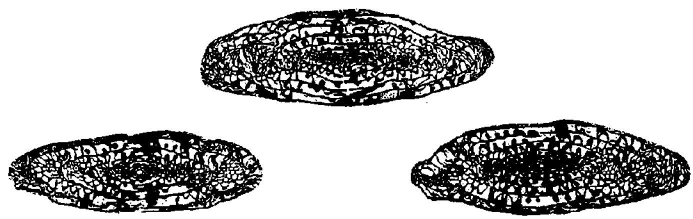
In the Mill Creek graben in the area about the "Buckhorn" quarry, Zone IV is approximately 1,200 feet thick. A comparison of the fauna of the Ardmore basin with that of the Mill Creek graben indicates that the latter is identical (excluding the encrinite bed) to the Zone IV fauna. The most characteristic of the common species is *Fusulina* new species, which occurs toward the base of both sections. This species could be mistaken as *Fusulinella* and possibly termed "Atokan" if it were studied alone. The Mill Creek fauna does not seem to be so young, where it is overlapped and cut out by the Vanoss conglomerate, as the fauna in the upper part of the zone in the Ardmore basin. The upper part of the Mill Creek section correlates below the Arnold Limestone in the Ardmore basin and in the neighborhood of the Inola Limestone in the northeastern Oklahoma area.

In the subsurface of southern Oklahoma the lower "*Fusulina*" sand may be equivalent to the upper part of Zone IV. In northeastern Oklahoma, Zone IV is represented in the rocks of the uppermost part of the Krebs Group and by rocks of the lower one-half of the Cabaniss Group.

Zone V is identified by the presence of *Fusulina* aff. *F. whitaker*



Fusulina acme



Fusulina aff. *whitakeri*

Figure 8. Late Desmoinesian fusulinids (x7.5) of Zone V.

and *Fusulina acme* (fig. 8). These species indicate a late Desmoinesian age for the zone. The zone species are found in the Capps-Village Bend sequence of rocks in northern Texas and in the Marmaton Group of northeastern Oklahoma. In the Ardmore basin outcrops, Zone V contains only one named rock unit, the Camp Ground Member. Zone V has been identified on the surface in the Overbrook anticline and in the Pleasant Hill syncline.

A diagnostic fusulinid that has not been found on the surface in either Oklahoma or Texas, but is rather wide-spread downdip in the subsurface of north-central Texas and the eastern Midland basin, is *Bartramella*. Core information indicates that it is an element in the Zone V fauna. Whether it occurs in the subsurface of Oklahoma is unknown to me. It would be surprising if it does not.

Zone VI is characterized by a distinctive fauna of *Triticites* toward the top and of *Wedekindellina*? in the lower part (fig. 9). The rocks of this biozone are basal and early Missourian in age. The fusulinids of Zone VI are widespread throughout the subsurface and/or surface in Wyoming, Nebraska, Colorado, Kansas, Missouri, New Mexico, Oklahoma, and Texas.

Because of degree and rapidity of morphological changes within the fusulinid group, the Desmoinesian-Missourian boundary is the most easily identified boundary in Permian-Pennsylvanian rocks. However, this boundary is not without its problems. Little besides cartographic convenience can justify drawing the Desmoinesian-Mis-

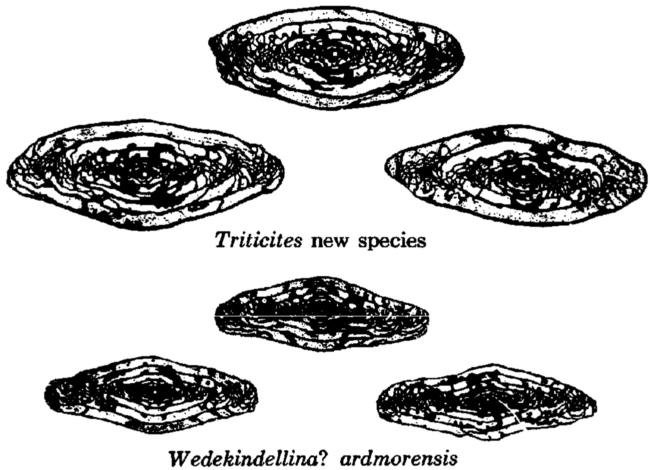


Figure 9. Early Missourian fusulinids (x7.5) of Zone VI.

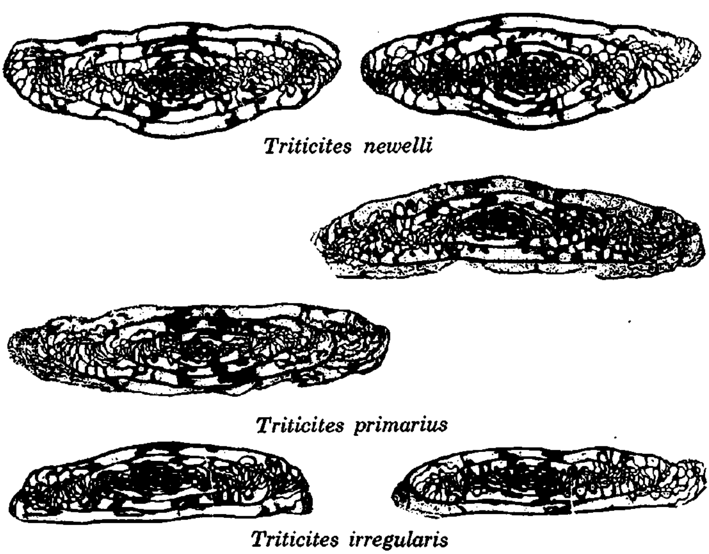


Figure 10. Early to middle Missourian fusulinids (x7.5) of Zone VII.

sourian boundary at the base of the Confederate Member because Missourian fusulinids (*Wedekindellina? ardmorensis*) have been collected as much as 75 feet below it. Whichever resistant limestone is used to define the boundary (Confederate Member or Natsy Member), it should be recognized as only a convenient term for mapping and for constructing cross sections. The stratigraphic distribution of *Wedekindellina* of the group *W. ultimata* does not exceed 200 feet in the Palo Duro basin or in the eastern shelf of the Midland basin. As far as I can determine, its range is not so thick in Oklahoma. Based upon this evidence, it would be greatly surprising for this species-zone in the Ardmore basin to exceed 200 feet in the subsurface. The observed range of 100 feet in the Overbrook anticline may be closer to the actual value, in which case the base of the Confederate Member would be a reasonable compromise, but still a compromise.

The base of Zone VI defines the base of the Missourian in Oklahoma. In southern Oklahoma the zone contains the Confederate Member and the Crinerville Member. If extended into north-central Texas, the zone would include the Keeche Creek Member and part of the lower Palo Pinto Member.

Zone VII, the youngest fusulinid outcrop zone in the Ardmore basin, is identified by its elongate-*Triticites* fauna (fig. 10). The fauna is early and middle Missourian in age. In north-central Texas, Zone VII includes the rocks of the upper parts of the Palo Pinto, Adams Branch, and Winchell Members. In southern Oklahoma the zone includes the Anadarche and Daube Members. In the subsurface of Oklahoma the County Line Limestone is within this zone.

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__________1959, Best exposures of various strata in Ardmore basin, 1957, in Petroleum geology of southern Oklahoma, vol. II: Tulsa, Amer. Assoc. Petroleum Geologists, p. 302-334.

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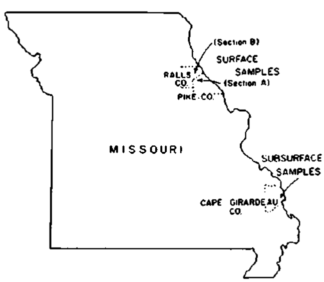
Ordovician Chitinozoa from Missouri

Dorothy J. Echols* and Harold L. Levin*

Abundant, well-preserved chitinozoans (extinct microscopic Paleozoic Problematica, Ordovician-Devonian) were recovered from limestones of Middle and Late Ordovician age from Missouri.

Chitinozoans are becoming increasingly valuable as a micropaleontologic tool in stratigraphic analysis. Although zoologically little is known about their morphologic relationship, continued investigations of their lithic and faunal associations may shed light on their habitat and origin.

Eisenack (1931) was the first to describe and figure these Problematica from Ordovician and Silurian sediments of the Baltic region in East Prussia. With the exception of a few significant contributions published since that time, these tiny forms have been neglected, especially when one considers the wealth of literature published weekly on other microscopic organisms.



Text-figure 1. Index map of Missouri showing locations of Ordovician localities sampled for this study.

The present study involves the recoverable microscopic organic remains found in acetic acid residues from samples of Ordovician Mohawkian and Cincinnatian rocks obtained from five core holes drilled into the Plattin Limestone (pl. I) and from two surface outcrops in which the Plattin Limestone, Decorah Shale, Kimmswick Limestone, and Maquoketa Shale are exposed (pl. II).

The cores were obtained from tests drilled by the Marquette Cement Company on the Hunze farm within an area of about 700-foot radius in NE¼ SE¼ NW¼ sec. 18, T. 30 N., R. 14 E., Cape Girardeau County, Missouri. Eight samples from the following cores and depths were examined.

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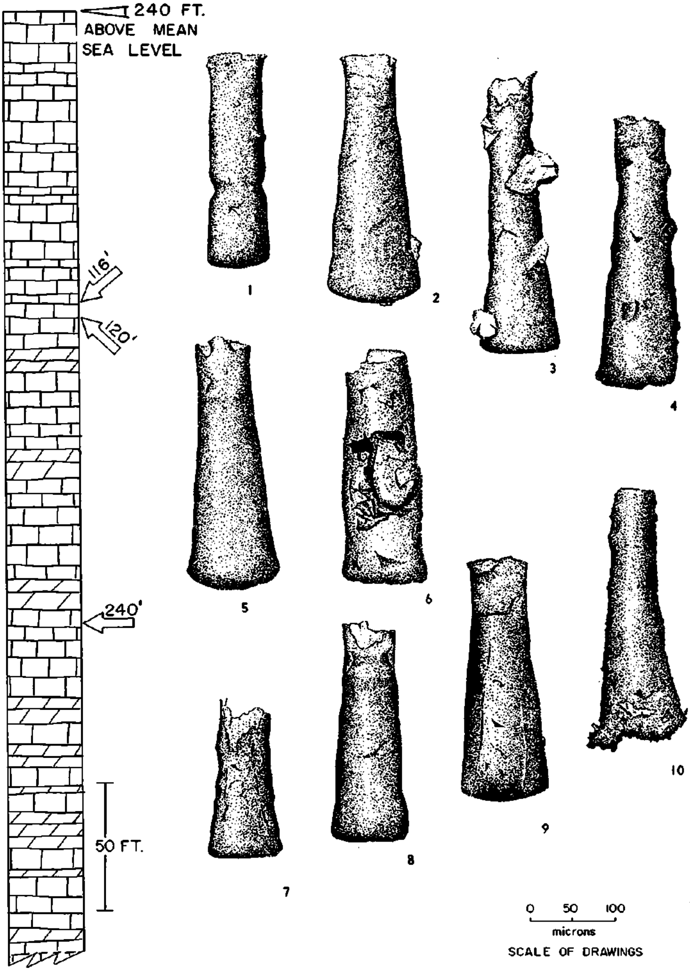
Explanation of Plate I

Composite section and chitinozoan faunal assemblage of the Plattin Limestone in core holes of the Marquette Cement Company at NE¼ SE¼ NW¼ sec. 18, T. 30 N., R. 14 E., Cape Girardeau County, Missouri.

Figure 1. **Form provisionally assigned to** Conochitina.
Figures 2-4. **Form resembling** Conochitina.
Figures 5-10. Conochitina **spp.**

Plate I



240 FT.
ABOVE MEAN
SEA LEVEL
116'
120'
240'
50 FT.
1
2
3
4
5
6
7
8
9
10
0 50 100
microns
SCALE OF DRAWINGS

CORE NUMBER	SAMPLE DEPTH (FEET)
5	116
6	240, 374
7	132, 414
8	120, 325
10	385

The surface samples of the Plattin, Decorah, and basal Kimmswick were collected from an outcrop along U. S. Highway 61, SE¼ SE¼ sec. 21, T. 55 N., R. 4 W., Ralls County, Missouri (pl. II, section B). The Maquoketa Shale was collected from a roadcut on State Road C just east of Spencer Creek bridge, SE¼ NW¼ sec. 13, T. 54 N., R. 5 W., Pike County, Missouri (pl. II, section A). The outcrop samples were collected during the 26th Annual Field Conference of the Kansas Geological Society in 1961. Text-figure 1 indicates the localities sampled.

In all the examined samples that contained well-preserved, recognizable chitinozoans, the accompanying fossils consisted of forms of one, several, or all of the following groups: conodonts, polychaete worm jaws and teeth, graptolite remains, and golden-yellow spheres of *Leiosphaeridia.*

Of the eight Plattin core samples studied only three contained excellent chitinozoans, and one contained a fair but fragmented fauna. The Plattin outcrop samples contained excellent chitinozoans; the assemblage, however, differs from that of the Plattin core samples.

From outcrop samples of Decorah Shale no chitinozoans were recovered, but the basal Kimmswick Limestone, which immediately overlies the Decorah in the area, contained an excellent assemblage, similar to, but not identical with, those of the Plattin cores and outcrops.

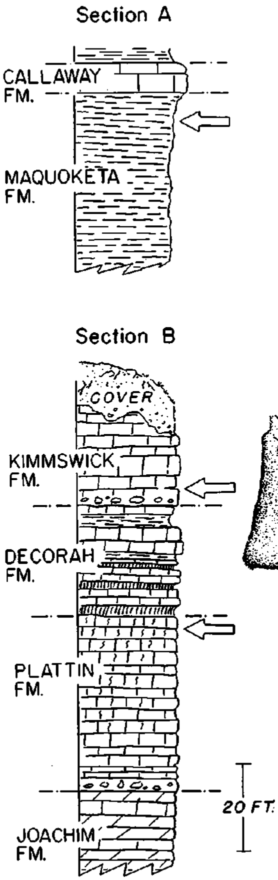
The Maquoketa Shale, next youngest formation in the vicinity, yielded an assemblage of *Rhabdochitina* (pl. II, figs. 1, 2) that appears to be identical to Stauffer's *R. minnesotensis* from the Decorah of Minnesota (Stauffer, 1933). This genus was not encountered in any of the other samples studied for this report.

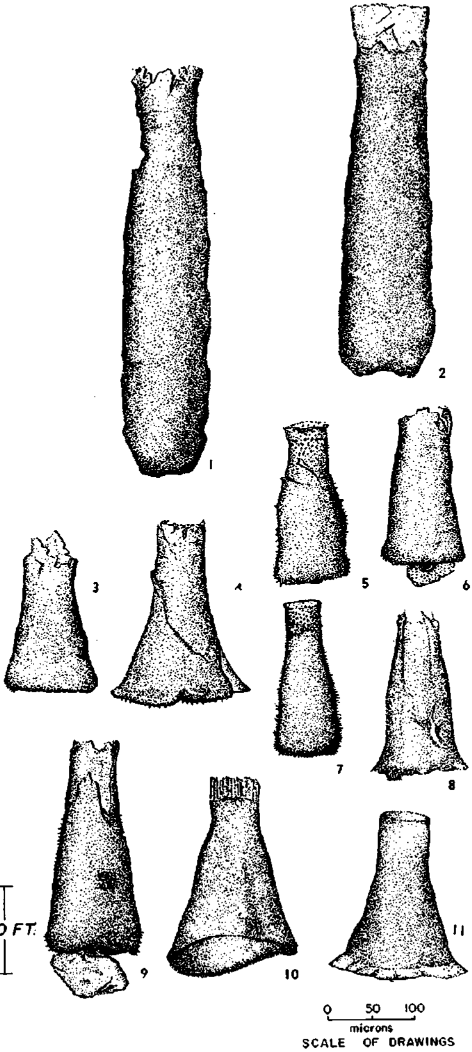
Explanation of Plate II

Composite columnar section and chitinozoan faunal assemblage of Ordovician outcrops in northeastern Missouri. Section A is in SE¼ NW¼ sec. 13, T. 54 N., R. 5 W., Pike County. Section B is in SE¼ SE¼ sec. 21, T. 55 N., R. 4 W., Ralls County. Sections are modified from Martin and Koenig (1961).

Figures 1, 2. Rhabdochitina.
Figure 3. Conochitina **sp.**
Figure 4. Cyathochitina.
Figures 5-7, 9. Forms assignable to either Conochitina infraspinosa **or** Belonechitina **sp. cf.** B. robusta.
Figures 8, 10. Cyathochitina?
Figure 11. Cyathochitina campanulaeformis.

Plate II


Section A
CALLAWAY FM.
MAQUOKETA FM.
Section B
COVER
KIMMSWICK FM.
DECORAH FM.
PLATTIN FM.
20 FT.
JOACHIM FM.


1
2
3
4
5
6
7
8
9
10
11
0 50 100
microns
SCALE OF DRAWINGS

Plates I and II illustrate the stratigraphic positions of the chitinozoans recovered from the samples studied.

Plate I represents a composite section of the Plattin core holes. The form shown in figure 1 is provisionally assigned to *Conochitina*. The encircling constriction on this form, one-third the height from the base, is distinctive. If this constriction is not the result of deformation of the test during fortuitous mineral growth, it may be a diagnostic character of a new genus. The forms shown in figures 2-4 resemble *Conochitina*. However, the more elaborate prosome structure apparent in figure 4 might indicate that this form belongs to *Tanuchitina ontariensis* Jansonius, 1964 (Maeford-Dudas, Cincinnatian, Upper Ordovician, Ontario). The remaining forms shown on plate I (figs. 5-9) are species of *Conochitina*.

Plate II shows a composite section of the outcrop localities modified from Martin and Koenig (1961, p. 15, 19, 20), and the stratigraphic occurrence of the chitinozoan fauna at these localities. The Maquoketa Shale has yielded specimens of *Rhabdochitina* (pl. II, figs. 1, 2). The Kimmswick fauna consists of *Conochitina* sp. (pl. II, fig. 3), *Cyathochitina* and *C.*? (pl. II, figs. 4, 8), and a form (pl. II, figs. 5-7) that may be assignable to either *Conochitina infraspinosa* Wilson and Dolly, 1964, or *Belonechitina* sp. cf. *B. robusta* (Eisenack, 1959) Jansonius, 1964. (*Conochitina infraspinosa* is from the Tulip Creek Formation of the Simpson Group, Middle Ordovician, of Oklahoma; *Belonechitina* sp. cf. *B. robusta* is from the Laggan Burn Limestone, basal Caradocian, Middle Ordovician, of Ayrshire, Scotland.) This same form was found in the Plattin (pl. II, fig. 9). The Plattin also yielded specimens of *Cyathochitina*? sp. (pl. II, fig. 10) and *Cyathochitina campanulaeformis* (Eisenack, 1931) (pl. II, fig. 11). *C. campanulaeformis* has been described from the Ordovician and Silurian of the Baltic region.

This preliminary survey of Ordovician subsurface and surface samples from Missouri indicates that chitinozoans are distinctive not only within a geologic period but within a formation.

The recorded occurrences of these Problematica from a variety of marine sediments, in this country and abroad, tend to indicate a free-floating mode of life. If this is true, they are potentially good index fossils. Although their tests are relatively resistant to chemical attack, they are so delicate that it would be unlikely for them to survive erosion and reworking into younger sediments.

With detailed sampling and analysis, chitinozoans might be useful in correlating thick Ordovician, Silurian, and Devonian carbonate sequences that appear lithologically similar.

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Maurice G. Mehl

1888-1966

Maurice Goldsmith Mehl contributed to Oklahoma geology in several ways. He was an early consultant in petroleum geology in the 'teens. For two years he was chairman of the Department of Geology at The University of Oklahoma. He was a charter member of the Southwestern Association of Petroleum Geologists (now American Association of Petroleum Geologists) and was its first secretary-treasurer (1917). He was made an honorary member in 1961. At the semicentennial meeting in St. Louis this April he was to have been recognized as an honored founder.

"Doc," as his students called him, was a devoted teacher, especially in his excellent course, "Life of the Geologic Past." His writings on Oklahoma geology include a description of *Trematops thomasi* (1926) and, with E. B. Branson, description of conodont faunas from the Caney Shale (1940) and Simpson (1943). Most of his writings were on vertebrate fossils of western United States and on conodonts. A paper on the Domebo elephant is in press.

On March 30, 1966, Dr. Mehl passed away suddenly in his car at his home as he was preparing to drive to his office. His continued scientific productivity, remarkable at his age, is thus regrettably ended.

—C. C. B.

New Theses Added to O. U. Geology Library

The following Master of Science theses were added to The University of Oklahoma Geology Library in March 1966:

Subsurface stratigraphic analysis of northern Pottawatomie County, Oklahoma, by Gonzalo A. Gamero.

Areal geology of the Flint area, Delaware County, Oklahoma, by Gary Lee Garner.

Geology of eastern Bryan County, Oklahoma, by Lawrence J. Olsen, Sr.

The Springer Group of the southeastern Anadarko basin in Oklahoma, by H. W. Peace, II.

—L. F.

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