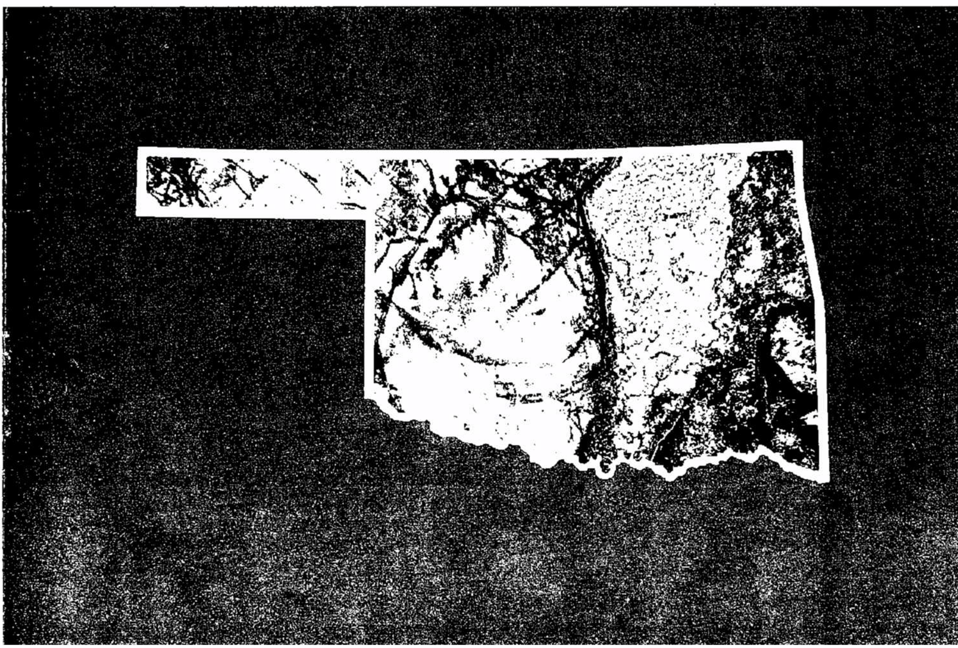
$2.00 PER YEAR • $0.25 PER COPY

# OKLAHOMA GEOLOGY NOTES



VOLUME 26 NUMBER 4 APRIL 1966

## *Cover Picture*

### ZEOLITIZATION

In the Wichita Mountains of southwestern Oklahoma are some scattered red outcrops of a bedded zeolite deposit originally described by C. A. Merritt and W. E. Ham in 1941 as the Tepee Creek Formation. Subsequent studies of this deposit were made by John W. Mayes in 1947 and by G. W. Chase in 1954. It was Chase who recognized these deposits as a facies of the Permian Post Oak conglomerates.

The zeolite outcrops occur on the sides of hills underlain by Cambrian(?) anorthosite (plagioclase = $An_{70\text{-}72}$) of the Raggedy Mountain Group or are closely associated with outcrops of the anorthosite. Thus it appears that, prior to zeolitization, the rock was a plagioclase arenite derived from the anorthosite. The alteration is thought to have been a diagenetic change, and the resulting zeolite probably has a composition in the analcite ($NaAlSi_2O_6 \cdot H_2O$)-wairakite ($CaAl_2Si_4O_{12} \cdot 2H_2O$) range. The zeolite is very fine grained, and X-ray diffraction studies are essential for its identification.

The cover photomicrograph (plain light, x38) shows a portion of a relatively fresh anorthosite pebble in a matrix of zeolitized plagioclase fragments. Replacement by zeolite has also occurred along the numerous fractures of the plagioclase crystals. Iron oxide stains some of the zeolitized areas and acts as a cementing agent along many of the grain boundaries.

—*William H. Bellis*

# FRESH-WATER OSTRACODE GENUS *Theriosynoecum**

CARL C. BRANSON

Ostracodes from a fresh-water deposit constituting a lentil in the Morrison Formation in SW¼ SW¼ NE¼ sec. 14, T. 44 N., R. 83 W., Johnson County, Wyoming, were collected by me in 1933. About 50 specimens belong to a new genus described as *Morrisonia* by Branson (1935, p. 521). The name was preoccupied and was replaced by the name *Theriosynoecum* by Branson (1936, p. 323).

At that time the specimens were misoriented, the muscle scars were not seen, the hinge not well known. The generic characteristics were insufficiently understood to enable scientists to assign species to the genus.

Jurassic and Cretaceous nonmarine ostracodes have been assigned to such extant genera as *Metacypris, Cytheridella,* and *Gomphocythere.* The assignment is unsatisfactory because species of these genera are identified upon the basis of study of soft parts and because similar species are not known from Upper Cretaceous or Tertiary rocks.

In recent years a considerable literature has been published about the genus, much of it erroneous. The original description of the genus has been emended by several authors and is here further emended.

The family and subfamily assignments have varied from author to author. Howe (1962, p. 230) summarized these assignments as follows (with additions):

| FAMILY | SUBFAMILY | AUTHOR | DATE |
|---|---|---|---|
| Cytheridae | Limnocytherinae | Howe | 1955 |
| Cytheridae | Xestoleberidinidae | Grekoff | 1958 |
| Cytheridae | Timiriaseviinae | Mandelstam | 1960 |
| Limnocytheridae | | Howe | 1962 |
| Limnocytheridae | | Coryell | 1963 |
| Cytheridae | Limnocytherinae? | Van Morkhoven | 1963 |

The synonymy of the generic name is as follows:

*Theriosynoecum* Branson, 1936

*Morrisonia* Branson, 1935, p. 521 (not *Morrisonia* Grote, 1874, Lepidoptera).

*Theriosynoecum* Branson, 1936, p. 323.

*Theriosynecum* (sic), Galeeva, 1955, p. 56. Generic name attributed to Teichert, 1939, and type species cited as *Cypris purbekensis* (sic), Forbes, 1885.

*Theriosynecum* (sic), Lyubimova, 1956, p. 156. Same errors as in Galeeva.

*Theriosynecum* (sic), Mandelstam, 1956, p. 138. Same errors as in Lyubimova.

*Theriosynoecum,* Peck, 1956, p. 97.

---

* This study was aided by a grant from The University of Oklahoma Faculty Research Committee.

*Gomphocythere*, Wicher, 1957.
*Theriosynoecum*, Grekoff, 1958, p. 28.
*Bisulcocypris* Pinto and Sanguinetti (part), 1958.
*Theriosynoecum*, Sohn, 1958.
*Theriosynoecum*, Peck, 1959, p. 119.
*Bisulcocypris*, Pinto and Sanguinetti (part), 1962.
*Theriosynoecum*, Sohn and Anderson, 1964.
*Theriosynoecum*?, Chen Te-chiung, 1965.
*Metacypris* (part), of authors.

The genus includes nonmarine fossil ostracodes from Jurassic and Lower Cretaceous rocks, quadrate to pear-shaped (females) in dorsal view, ovate to subrectangular in lateral view. Anterior end of carapace compressed. A distinct sulcus divides the valves into subequal halves.

Surface of valves pitted, reticulate. Posterior portion of most species with prominent nodes, in some cases lacking on females; anterior portion with fewer and less prominent nodes.

Hinge short, straight, with distinct hinge tooth at each end on right valve, sockets on left valve (Sohn and Anderson, 1964, text-fig. 1j).

Sexual dimorphism strongly developed; females inflated posteriorly, with fewer and less prominent nodes than males.

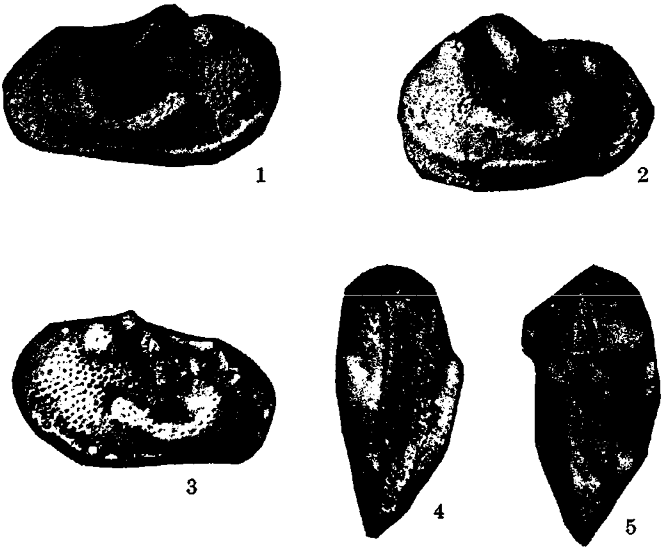
Muscle scars reported by Sohn (1958) are four parallel vertical grooves.

The type species by monotypy is *T. wyomingense* (Branson, 1935). At the time of the original description 50 specimens were at hand. Of these, four specimens were figured (Branson, 1935, pl. 57, figs. 17-21). The original of figure 20, upon which the description of the hinge was based, is lost. The other three figured specimens are in the University of Missouri collection as MU 6656.

In July 1964, I revisited the locality with James E. Keenan of Mobil Oil Company, Casper, Wyoming, and his son John. I now have several hundred isolated specimens, and washed samples undoubtedly containing several thousand more.

### *Theriosynoecum wyomingense* (Branson, 1935) Branson, 1936
Figures 1-5

**Morrisonia wyomingensis** Branson, 1935, Jour. Paleontology, vol. 9, p. 521-522, pl. 57, figs. 17-21.
**Theriosynoecum wyomingense** (Branson), Branson, 1936, Jour. Paleontology, vol. 10, p. 323.
**Theriosynoecum wyomingensis** (Branson), Peck, 1956, Wyo. Geol. Assoc., 11th Annual Field Conference, Guidebook, p. 97, fig. 22.
**Theriosynoecum wyomingensis** (Branson), Grekoff, 1958, Revue de Micropaleontologie, vol. 1, p. 28, pl. 1, figs. 15-16.
**Theriosynoecum wyomingensis** (Branson), Peck, 1959 Intermountain Assoc. Petroleum Geologists, 10th Annual Field Conference, Guidebook to the geology of the Wasatch and Uinta Mountains transition area, p. 119, pl. 2, fig. 24.
**Theriosynoecum wyomingense** (Branson), Howe, 1961, Treatise on invertebrate paleontology, part Q, p. 312, figs. 239a-c.




Theriosynoecum wyomingense (**Branson, 1935) x40**

**Figure 1. Left valve of lectotype. MU 6656A.**
**Figure 2. Right valve of lectotype. MU 6656A.**
**Figure 3. Right valve of lectotype. MU 6656A.**
**Figure 4. Ventral view of a syntype. MU 6656C.**
**Figure 5. Dorsal view of a syntype. MU 6656B.**
(Photographs by I. G. Sohn)

**Theriosynoecum wyomingensis** (Branson), Pinto and Sanguinetti, 1962, Rio Grande do Sul, Univ., Escola de Geologia, Pub. Especial 4, p. 73-74, pl. 1, figs. 7a-d, pl. 2, fig. 7a.

**Theriosynoecum wyomingensis** (Branson), Coryell, 1963, Bibliographic index and classification of the Mesozoic Ostracoda, vol. 1, pl. 12, figs. 5-7, vol. 2, p. 1149.

**Theriosynoecum wyomingensis** (Branson), Van Morkhoven, 1963, Post-Paleozoic Ostracoda, vol. 2, p. 412-416, fig. 690.

**Theriosynoecum wyomingense** (Branson), Sohn and Anderson, 1964, Palaeontology, vol. 7, p. 72-73, text-fig. 18j.

## Species referred to *Theriosynoecum*

Authors have described several species in the genus, and others have transferred species to the genus. Pinto and Sanguinetti (1962) transferred virtually all ornate Late Jurassic and Early Cretaceous ostracode species to their genus *Bisulcocypris*. Van Morkhoven (1963, p. 411-412, 415) adopted the opposite course and referred all Mesozoic fresh-water and brackish-water species assigned to *Metacypris*, *Gom-*

*phocythere*, *Cytherella*, and *Bisulcocypris* to *Theriosynoecum*. Both of these suggestions are regarded as too all-inclusive, and as tending to make for loose generic definitions.

Pinto and Sanguinetti somehow had the mistaken impression that *Theriosynoecum* is marine and Middle Jurassic; otherwise they are to be commended for an intelligent and thorough investigation.

**Theriosynoecum angularis** (Peck, 1941), Peck, 1962.
*Metacypris angularis* Peck, 1941, p. 302-303, pl. 44, figs. 1-14.
*Gomphocythere angularis* (Peck, 1941), Peck, 1959.
*Bisulcocypris angularis* (Peck, 1941), Pinto and Sanguinetti, 1962, p. 19.

**Theriosynoecum apprima** Mandelstam MSS in Lyubimova, 1956 (footnote, p. 138), is a nude name, referred to synonymy with **T. krysthofovichi** as a dimorphic equivalent.

**Theriosynoecum berwickense** (Martin, 1940), Van Morkhoven, 1963.
*Gomphocythere berwickensis* Martin, 1940, p. 344-345, pl. 12, figs. 176-181, text-figs. 1, 2. Referred to *T. fittoni* by Grekoff (1958, p. 26).
*Gomphocythere fittoni berwickensis* Martin, Wicher, 1959, p. 270-271, pl. 2, figs. 4a-c, 5a-c.
Sohn and Anderson (1964) refer to *T. fittoni* as moults.

**Theriosynoecum bradyi** (Jones, 1886) Van Morkhoven, 1963.
*Metacypris bradyi* Jones, 1886, p. 146, pl. 4, figs. 2a-c.

**Theriosynoecum diffusum** Mandelstam in Galeeva, 1955.
Nude name, p. 57.

**Theriosynoecum defensum** Lyubimova, 1956.
*Theriosynecum* (sic) *defensum* Lyubimova, 1956, p. 141-142, pl. 25, figs. 4a-c.
*T. defensum* Lyubimova, Howe and Laurencich, 1958, p. 500. Referred to synonymy with *T. praetuberculatum* by Pinto and Sanguinetti, 1962.
Lower Cretaceous, Dzumbain suite, Tugurig region, Mongolia.

**Theriosynoecum difensorum** Mandelstam, 1956.
*T. difensorum* Mandelstam, 1956, p. 139, pl. 26, figs. 5a,b (p. 320 as "gen. et sp. nov.").
*T. defensorum* (sic) Mandelstam, Mandelstam, 1960, p. 373, figs. 1037a, b.
*T. difensorum* Mandelstam, Howe and Laurencich, 1958, p. 500. Barremian: Trans-Baikal.

**Theriosynoecum fittoni** (Mantell, 1844) Sohn and Anderson, 1964.
*Cypris fittoni* Mantell, 1844, p. 545, fig. 119-2.
*Metacypris fittoni* (Mantell) Jones, 1888, p. 539.
*Gomphocythere berwickensis* Martin, 1940, p. 344-345, pl. 12, figs. 176-181.
*Bisulcocypris martini* Pinto and Sanguinetti, 1962, p. 69-70, pl. 10, figs. 5-9, pl. 17, figs. 2a-d.
*Bisulcocypris fittoni* (Mantell, 1844), Pinto and Sanguinetti, 1962, p. 70-72, pl. 11, figs. 1-13, pl. 17, figs. 3a-d.
*T. fittoni* (Mantell), Sohn and Anderson, 1964, p. 73-84, pl. 15, figs. 1-35, text-figs, 1a-f,h, 3, 4.

*Gomphocythere fittoni* (Mantell), Wicher, 1957, p. 270.
*"Metacypris" fittoni* (Mantell), Grekoff, 1958, p. 26-27, pl. 2, fig. 19.
*Gomphocythere fittoni fittoni* (Mantell), Wicher, 1957, p. 270, pl. 2, figs. 2a-c, 3a-c.

**Theriosynoecum forbesi** (Jones, 1885) Van Morkhoven, 1963.
*Metacypris forbesii* Jones, 1885, p. 345, pl. 8, figs. 13, 15-16. Middle Purbeck: England.
*Metacypris forbesii* Jones, Jones, 1886, p. 146, pl. 4, figs. 1a-c. Morrison Formation: Colorado.
*Metacypris forbesii* Jones, Martin, 1940, p. 336-337, pl. 6, figs. 89-94. Wealden: Germany.
*Gomphocythere forbesii forbesii* (Jones), Wicher, 1957, p. 270, pl. 1, figs. 3-3c. Kimmeridge: Germany.
*Gomphocythere forbesii* (Jones), Wicher, 1959, p. 43, pl. 7, figs. 8-8b, pl. 8, figs. 9-9b, 10-10b. Upper Jurassic and Lower Cretaceous: Bahia, Brazil.
*Bisulcocypris forbesii* (Jones), Pinto and Sanguinetti, 1962, p. 39-40, pl. 3, figs. 1-4, pl. 12, figs. 1c-d.

**Theriosynoecum kirtlingtonense** Bate, 1965, p. 754-756, pl. 110, figs. 1-11; pl. 111, fig. 1.

**Theriosynoecum krysthofovichi** Mandelstam in Galeeva, 1955.
*T. krysthofovichi* Mandelstam, 1955, p. 57, pl. 14, figs. 4a,b,v, and doubtfully figs. 5a,b,v,g,d,e.
*T. kristaphovitchi* (sic), Mandelstam, 1956, as gen. et sp. nov., p. 138, fig. 51.
*T. krystofovitschi* Mandelstam, 1956, Lyubimova, 1956, p. 137, pl. 24, figs. 7a,b. Spelled *T. kristofovitschi* in two places on p. 140 and on p. 142. Figures 10a,b are same as Mandelstam's figure 51 oriented rotated 180 degrees.
*T. kristofovitchi* Mandelstam, Mandelstam, 1960, p. 373, figs. 103a,b.
*T. kristaphovitchi* Mandelstam, Howe and Laurencich, 1958, p. 59.
Lower Barremian: Trans-Baikal.

**Theriosynoecum martini** (Pinto and Sanguinetti, 1962).
*Bisulcocypris martini* Pinto and Sanguinetti, 1962, p. 69-70 for *Gomphocythere fittoni berwickensis* of Wicher, 1957, not *Gomphocythere berwickensis* Martin, 1940.

**Theriosynoecum minnekahtense** (Roth, 1933) Van Morkhoven, 1963.
*Jonesina minnekahtensis* Roth, 1933, p. 399, pl. 48, figs. 1a-g. Referred to *"Metacypris" pahasapensis* as the female dimorph by Harper and Sutton, 1935, p. 625.

**Theriosynoecum pahasapense** (Roth, 1933), Van Morkhoven, 1963.
*Jonesina pahasapensis* Roth, 1933, p. 401, pl. 48, figs. 2a-g.
*Metacypris pahasapensis* Harper and Sutton, 1935, p. 624-625, pl. 76, figs. 3-11.
*Gomphocythere pahasapensis* (Roth), Martin, 1940, p. 340-342, pl. 6, figs. 95-97, pl. 7, figs. 98-100. Referred to *T. fittoni* by Wicher, 1957, to *T. alleni* by Pinto and Sanguinetti, 1962, p. 66.

*"Metacypris" pahasapensis* (Roth), Grekoff, 1958, p. 28, pl. 1, figs. 12-14, pl. 2, fig. 20.
*Bisulcocypris pahasapensis* (Roth), Pinto and Sanguinetti, 1958.

**Theriosynoecum persulcatum** (Peck, 1941), Peck, 1962.
*Metacypris persulcata* Peck, 1941, p. 302, pl. 44, figs. 15-21.
*Metacypris persulcata* of Loranger, 1951 (not Peck). See *T. albertense.*
*T. persulcatum* (Peck), Mandelstam, 1956, p. 139.
*T. persulcata* (sic) (Peck), Lyubimova, 1956, p. 142.
*Bisulcocypris persulcata* (Peck), Pinto and Sanguinetti, 1962, p. 19.

**Theriocynoecum planiverrucosum** (Klinger, 1955).
*Metacypris verrucosa* Klinger, 1955, p. 206-208, pl. 12, fig. 17a, pl. 13, figs. 17b-d (not *Metacypris forbesi verrucosa* Jones, 1885).
*Metacypris planiverrucosa* Klinger, 1955, p. 576 (new name for *M. verrucosa* Klinger, not Jones).
*Gomphocythere forbesii planiverrucosa* (Klinger), Wicher, 1957, p. 269, pl. 1, figs. 1a-c, 2a-c. Referred to *T. forbesi forbesi* by Pinto and Sanguinetti, 1962, p. 78.
*Theriosynoecum verrucosa* (Klinger), Van Morkhoven, 1963, p. 416.

**Theriosynoecum praetuberculatum** Lyubimova, 1956.
*T. praetuberculata* (sic) Lyubimova, 1956, p. 139-140, pl. 25, figs. 1-3.
*T. praetuberculata* Lyubimova, Howe and Laurencich, 1958, p. 501.
Lower Cretaceous, Dzunbain suite, Tugurig region, Mongolia.

**Theriosynoecum silvanum** (Martin, 1940), Van Morkhoven, 1963.
*Gomphocythere silvana* Martin, 1940, p. 345, 346, 348; pl. 6, figs. 87, 88; pl. 9, figs. 144-147; pl. 12, fig. 175. Referred to *T. striatum* by Pinto and Sanguinetti (1962, p. 19) as an immature form.
*Gomphocythere forbesii silvana* Martin, Wicher, 1957, p. 270, pl. 1, figs. 6a-c, pl. 2, figs 1a-c.
Wealden: Germany.

**Theriosynoecum striatum** (Martin, 1940).
*Gomphocythere striata* Martin, 1940, p. 342-344, pl. 7, figs. 101-104, pl. 12, fig. 174.
*Gomphocythere forbesii striata* Martin, Wicher, 1957, p. 270, pl. 1, figs. 4a-c, 5a-c.
Wealden: Germany.

**Theriosynoecum subcordatum** (Jones, 1893), Van Morkhoven, 1963.
*Metacypris subcordata* Jones, 1893, p. 388, pl. 15, figs. 2a-c.
Bear River Formation: Wyoming.

**Theriosynoecum uninodosum** (Pinto and Sanguinetti, 1958) Van Morkhoven, 1963.
*Bisulcocypris uninodosa* Pinto and Sanguinetti, 1958, p. 80-81, pl. 2, figs. 8-13; pl. 3, figs. 6-8; Pinto and Sanguinetti, 1962, p. 51-52, pl. 5, figs. 11-14, pl. 14, figs. 1a-d.
Upper Jurassic?: Brazil.

**Theriosynoecum verrucosum** (Klinger, 1955), Van Morkhoven, 1963, p. 416.
Apparently the species transferred by Van Morkhoven is **T. planiverrucosum.**

**Theriosynoecum verrucosum** (Jones, 1885).

*Metacypris forbesii verrucosa* Jones, 1885, p. 345-346, pl. 8, figs. 14-16.

*Bisulcocypris verrucosa* (Jones), Pinto and Sanguinetti, 1962, p. 61-62, pl. 8, figs. 1-4, pl. 16, figs. 1a-d.

Middle Purbeck: England.

The original description of the species (Branson, 1935) was made with incorrect orientation; anterior is actually posterior and right is left. Furthermore, dimorphism was not recognized. The description is emended as follows:

Holotype by subsequent designation of Pinto and Sanguinetti (1962, p. 74) MU 6656, now labeled A by me (1965).

Valves subquadrangular in males, compressed anteriorly, expanded posteriorly. Posterior emarginated by broad ridge; a median sulcus divides the upper two-thirds of the carapace approximately in two; rounded subcylindrical nodes lie behind the sulcus and extend somewhat obliquely well above the hinge. A large hemispherical node is on the posterior part behind the oblique node on each valve. The sulcus terminates ventrally above a crescentic ridge with posterior rounded node and anterior upward swing expanded into a swollen area terminated upward into two small rounded low nodes.

The female is inflated posteriorly and the posterior nodes are somewhat subdued. The shell surface of both sexes is marked by pits except in the sulci. The pits on the dorsal part of the cylindrical node are elongate.

The ventral surface is wide and bears pairs of false keels. The first pair of keels originates on the posterior margin and extends past the center of the shell. The second pair is introduced inside the first near the posterior end of the carapace, and additional keels are introduced in sequence anteriorly. Surface of valves pitted, reticulate. Ventral surface appears striate where false keels represent valve edges.

Hinge short, straight, with distinct hinge tooth at each end on right valve, sockets on left valve (Sohn and Anderson, 1964, text-fig. 1j).

Sexual dimorphism strongly developed; females greatly inflated posteriorly, with fewer and less prominent nodes than males.

Muscle scars reported by Sohn are four parallel vertical grooves.

In recent years paleontologists have recognized that *Theriosynoecum* is the only described Late Mesozoic fresh-water ostracode genus other than *Bisulcocypris* (which appears to be a junior synonym). In all probability several to many fresh-water genera lived during the Late Mesozoic.

The genus *Bisulcocypris* is based upon the type species *B. pricei* from the Upper Jurassic Jatobá Series of Brazil.

A grouping of the well-known species is here suggested. Each group probably deserves separate generic rank.

*Theriosynoecum* sensu stricto

Group of *Theriosynoecum wyomingense*

Median sulcus, ventral arc, pitted reticulate sculpture, muscle scars four vertical slots, large nodes.

*T. roberti* (Marliere, 1948), Lualaba series: Congo.
*T. defensum* Lyubimova, 1956, Lower Cretaceous: Mongolia.
*T. albertense* (Pinto and Sanguinetti, 1958), Blairmore Formation: Alberta, Canada.
*T. striatum* (Martin, 1940), Wealden: Germany.
*T. cornutum* (Grekoff, 1957), Lualaba series, Purbeckian: Congo Republic.
*T. kirtlingtonense* Bate, 1965, Bathonian: Oxfordshire.

Group of *Theriosynoecum fittoni*

Sulcate, numerous subconical to hemispherical nodes, short compared to height.

*T. alleni* (Pinto and Sanguinetti, 1958), Wealden: Germany, England.
*T. angulare* (Peck, 1941), Peterson and Kootenai Formations: Wyoming, Idaho, Montana.
*T. martini* (Pinto and Sanguinetti, 1953), Wealden: Germany.
*T. praetuberculatum* Lyubimova, 1956, Lower Cretaceous: Mongolia.

Group of *"Theriosynoecum" pahasapense*

*T. persulcatum* (Peck, 1941), Bear River Formation: Wyoming and Idaho.
*T. pahasapense* (Roth, 1933), Lakota Formation: South Dakota.
*"Metacypris" miaogouensis* Chen, 1956, Cretaceous: Kansu, China; *see* Hou, vol. 3, pl. 161, figs. 15-18.
*"Metacypris" umbulla* Hou and Chen, *in* Chen, 1965, Jurassic: Szechuan Province.
*Metacypris sinensis* Hou, 1957 (?), Lower Cretaceous: China.

Group of *Bisulcocypris pricei*

Rounded subquadrate, strongly bisulcate, surface pitted in reticulate pattern, dimorphic, muscle scars four, oval, closely spaced, diagonal, two linear teeth on left valve, sockets on right valve.

*Bisulcocypris pricei* (Pinto and Sanguinetti, 1958).
*Metacypris passaui* (Leriche, 1913).
*Theriosynoecum* sp. Chen, 1965, Upper Cretaceous: Kiangsu Province, China.

**References**


**Anderson, F. W.,** 1964, The law of ostracode growth: Palaeontology, vol. 7, p. 85-104.

**Bate, R. H.,** 1965, Freshwater ostracods from the Bathonian of Oxfordshire: Palaeontology, vol. 8, p. 749-759.

**Branson, C. C.,** 1935, Fresh-water invertebrates from the Morrison (Jurassic?) of Wyoming: Jour. Paleontology, vol. 9, p. 514-522, pls. 56, 57.

——— 1936, New name for a Morrison ostracode genus: Jour. Paleontology, vol. 10, p. 323.

——— 1961, Note on the fresh-water ostracode genus **Theriosynoecum**: Okla. Geol. Survey, Okla. Geology Notes, vol. 21, p. 246-247.

——— 1964, Morrison fresh-water fauna in Wyoming: Okla. Geol. Survey, Okla. Geology Notes, vol. 24, p. 238-243.

**Chen, Te-Chiung,** 1965, The ostracode genus **Metacypris** and its allies: Acta Palaeontologica Sinica, vol. 13, p. 1-28.

**Coryell, H. N.,** 1963, Bibliographic index and classification of the Mesozoic Ostracoda: Dayton (Ohio), Univ. Dayton Press, 2 vols., 1175 p.

**Galeeva, L. I.,** 1955 Ostrakodyi melovykh otlozhenii Mongol'skoy narodnoi Respubliki (Cretaceous ostracode succession of Mongolian Peoples Republic): Vsesouiznyi Nauchno-issledovatelskii Geologo-razvedochnyi Neftyanoi Institut, 98 p., 15 pls.

**Grekoff, N.,** 1958, Sur la taxionomie des genres **Gomphocythere** (Sars) et **Metacypris** (Brady et Robertson): Revue de Micropaleontologie, vol. 1, p. 22-30, pls. 1, 2.

**Harper, Frances,** and **Sutton, A. H.,** 1935, Ostracodes of the Morrison Formation from the Black Hills, South Dakota: Jour. Paleontology, vol. 9, p. 623-628, pl. 76.

**Hou, Y. T.,** 1957, **in** Chinese index fossils, vol. 3: Academia Sinica, Paleont. Research Inst., p. 318 and app., p. 19, pl. 161, figs. 15-18.

**Howe, H. V.,** 1955, Handbook of ostracod taxonomy: La. State Univ. Press, La. State Univ. Studies, Phys. Science Ser., no. 1, 389 p.

——— 1962, Ostracod taxonomy: La. State Univ. Press, 366 p.

**Howe, H. V.,** and **Laurencich, Laura,** 1958, Introduction to the study of Cretaceous Ostracoda: La. State Univ. Press, 536 p.

**Jones, T. R.,** 1885, On the Ostracoda of the Purbeck Formation; with notes on the Wealden species: Geol. Soc. London, Quart. Jour., vol. 41, p. 311-353.

——— 1886, On some fossil Ostracoda from Colorado: Geol. Magazine, vol. 23, p. 145-146.

——— 1888, Ostracoda from the Weald clay of the Isle of Wight: Geol. Magazine, vol. 25, p. 534-539.

——— 1893, On some fossil Ostracoda from southwest Wyoming, and from Utah, USA: Geol. Magazine, vol. 30, p. 385-391.

**Klinger, Wolfgang,** 1955, Microfaunistische und stratigraphisch-fazielle Untersuchungen im Kimmeridge und Portland des Weser-Aller-Gebietes: Geologischen Landesanstalten Bundesrepublik Deutschland, Geologisches Jahrbuch, vol. 70, p. 167-245, 575-576, pls. 6-21.

**Loranger, D. M.,** 1951, Useful Blairmore microfossil zone in central and southern Alberta, Canada: Amer. Assoc. Petroleum Geologists, Bull., vol. 35, p. 2348-2367.

**Lyubimova, P. S.,** 1956, Ostrakodyi melovykh otlozcheniy vostochnoi chasti Mongol'skoy narodnoi Respubliki i ikh znachenie dlya stratigrafii: VNIGRI, Trudy, new ser., no. 83, 174 p., 25 pls.

**Mandelstam, M. I.,** 1956, **Theriosynoecum, in** Materialy po paleontologii:

Vsesouiznyi Nauchno-issledovatel'skii G e o l o g i c h e s k i i Institut (VSEGEI), new ser., no. 12, p. 138-139.

——————1960, Subfamily Timiriaseviinae, in Osnovy Paleontologii [vol. 8]: Akad. Nauk SSSR, p. 372-375, figs. 1037, 1038.

**Martin, G. P. R.**, 1940, Ostrakoden des norddeutschen Purbeck und Wealden: Senckenbergiana Lethaea, vol. 22, p. 275-361, pls. 1-12.

**Peck, R. E.**, 1941, Lower Cretaceous Rocky Mountain nonmarine microfossils: Jour. Paleontology, vol. 15, p. 285-304, pls. 42-44.

——————1956, Rocky Mountain Mesozoic and Cenozoic nonmarine microfossils, in Jackson Hole: Wyo. Geol. Assoc., Guidebook, 11th Ann. Field Conf., p. 95-98.

——————1959, Stratigraphic distribution of Charophyta and nonmarine ostracods, in Guidebook to the geology of the Wasatch and Uinta Mountains transition area: Intermountain Assoc. Petroleum Geologists, Guidebook, 10th Ann. Field Conf., p. 115-121.

**Peck, R. E.**, and **Reker, C. C.**, 1948, The Morrison and Cloverly Formations, in Wind River Basin: Wyo. Geol. Assoc., Guidebook, 3rd Ann. Field Conf., p. 125-139.

**Pinto, I. D.**, and **Sanguinetti, Y. T.**, 1958, **Bisulcocypris**, a new Mesozoic genus and preliminary note about its relation with **Metacypris** and allied forms: Sociedad Brasiliera Geologia, Boletin, vol. 7, p. 75-90, pls. 1-3.

——————1962, A complete revision of the genera **Bisulcocypris** and **Theriosynoecum** (Ostracoda) with the world geographical and stratigraphical distribution (including **Metacypris, Elpidium, Gomphocythere,** and **Cytheridella**): Rio Grande do Sul, Universidade, Escola de Geologia, Pub. Especial 4, 115 p.

**Roth, Robert**, 1933, Some Morrison Ostracoda: Jour. Paleontology, vol. 7, p. 398-406, pl. 48.

**Sohn, I. G.**, 1958, Middle Mesozoic nonmarine ostracodes of the Black Hills, in Powder River Basin: Wyo. Geol. Assoc., Guidebook, 13th Ann. Field Conf., p. 120-126.

**Sohn, I. G.**, and **Anderson, F. W.**, 1964, The ontogeny of **Theriosynoecum fittoni** (Mantell): Palaeontology, vol. 7, p. 72-84, pl. 15.

**Van Morkhoven, F. P. C. M.**, 1963, Post-Paleozoic Ostracoda, their morphology, taxonomy, and economic use, volume II, Generic descriptions: Amsterdam-London-New York, Elsevier Pub. Co., 478 p.

**Wicher, C. A.**, 1957, Die Gattung **Gomphocythere** in Nordwestdeutschland und das Problem der brackischen Ostracoden: Micropaleontology, vol. 3, p. 269-275, pls. 1, 2.

——————1959, Ein Beitrag zur Altersdeutung des Reconcavo, Bahia (Brasilien): Geologischen Landesamten Bundesrepublik Deutschland, Geologisches Jahrbuch, vol. 77, p. 35-58, pls. 6-9.

**Wolburg, J.**, 1949, Ergebnisse der Biostratigraphie nach Ostracoden im Nordwestdeutschen Wealden, in Bentz, A., ed., Erdöl and Tektonik im Nordwestdeutschland: Hannover-Celle, Amt für Bodenforschung, p. 349-360.

# REMARKS ON *Fusulina insolita* THOMPSON

MAXIM K. ELIAS

The species "*Fusulina? insolita*" was introduced by Thompson (1948, p. 61) on a fusulinid sample collected by him from near the top of the Cuchillo Negro Limestone, the highest formation in the Derry Series of New Mexico. He stated in the descriptive text that the species "possesses characters of both *Fusulina* and *Fusulinella*," but placed it in *Fusulina* despite its stratigraphic occurrence high above the base of, but nevertheless within, the Derryan, which he correlated with the Atokan. He explained to me orally (1963) that he had placed a question mark after the generic name for the purpose of directing attention to the occurrence of this particular species of *Fusulina* below the *Fusulina* biostratigraphic zone.

In a recent comprehensive paper on the Pennsylvanian rocks and their fusulinids in southeastern Arizona, Ross and Sabins (1965, p. 173) compared their new species *Fusulina arizonensis* (from the middle of the Horquilla Limestone) with *Fusulina insolita* Thompson and stated that the latter "has more strongly folded septa than *F. arizonensis*," with no other differences mentioned. Thus, in this morphological respect, *F. arizonensis* could be considered closer to the genus *Fusulinella* than is *Fusulina insolita* Thompson; nevertheless Ross and Sabins placed it unhesitatingly in *Fusulina*, apparently according to their own understanding of how strong the septal folding should be in order to place a species in this genus.

Because of the geographical proximity and lithological similarity of the massive Horquilla limestones to the Derryan limestones of New Mexico, it appears that the comparable two species lived in about the same environments of the local Pennsylvanian sea. If so, there appears to be no reason for a possible reversal in the particular lineage of *F. arizonensis-F. insolita* of the well-established evolutionary trend in the early fusulinids toward increasing septal folding (fluting). Therefore we could reasonably expect to find *F. arizonensis* in the Derry Series of New Mexico at a level below that of *Fusulina insolita*.

The circumstances regarding this species became still more interesting with its identification among the fusulinids of the Ardmore basin by Waddell, who found *Fusulina insolita* "sparingly" in NW¼ NE¼ sec. 22, T. 6 S., R. 2 E., Love County, Oklahoma (1964, p. 62). The species was found in the basal limestone of the rocks classified by Waddell as Desmoinesian. He stated that, in comparison with Thompson's original specimens of *F. insolita*, this fusulinid has "better developed midplane fluting" (1964, p. 61). Waddell's drawing of the Atokan-Desmoinesian boundary directly below the occurrence of his *F. insolita* is harmonious with the evolutionary trend toward greater intensity of septal folding (fluting) and the position of *F. insolita* Thompson below this boundary in New Mexico; and it appears to indicate that the phylogenetic lineage represented by this species crosses this stratigraphic boundary without noticeable effect upon this evolutionary trend.

This is not the case, however, with the position of the postulated boundary in Arizona, where the form apparently ancestral to *F. insolita, F. arizonensis,* happens to be directly above the Atokan-Desmoinesian line. It is quite understandable, however, that Ross and Sabins have chosen this position of the boundary in view of the occurrence directly above it of two additional new species of *Fusulina*: *F. hayensis,* with only slightly folded septa comparable to those in *F. arizonensis,* and *F. portalensis,* with moderately folded septa.

Without further analysis of the comparative degree of folding in the latter species, it is apparent that Ross and Sabins' judgment of the intensity, or strength, of septal folding required to discriminate between *Fusulina* and *Fusulinella* differs from Thompson's. It seems that uniformity in this understanding may be attained by the development of a quantitative method for the measurement of intensity of folding, possibly by counting the number of folds per given length in the middle third of the septa, at given radius vector, to be averaged from values obtained in several septa in more than one shell. When standardized, such a method of biometric study would have to be extended over topotypes of the type species of *Fusulina* and *Fusulinella.* For greater accuracy the values will have to be obtained on tangential sections or peels taken from such sections.

This biometric study is likely to lead to differentiation of more than one subgenus or genus within the presently understood *Fusulina,* as we already realize that it consists of more than one phylogenetic lineage. Each of these lineages appears to have its own somewhat different manner of septal folding, and the tempo of its development appears to be different in each lineage .

Pending an anticipated clarification and/or modification of the current concept of the development of *Fusulina* from *Fusulinella,* an apparently polyphyletic process, it seems unnecessary to force the present concept of the lower boundary of the *Fusulina* biostratigraphic zone to correspond to the original, lithologically defined top of the Atoka Formation (Taff and Adams, 1900). It appears more useful to concentrate on determining the paleontological contents of the Atoka, as is possible in the fossil-bearing section north of Clarita, Oklahoma.

## References Cited


**Ross, C. A.,** and **Sabins, F. F., Jr.,** 1965, Early and Middle Pennsylvanian fusulinids from southeast Arizona: Jour. Paleontology, vol. 39, p. 173-209.

**Taff, J. A.,** and **Adams, G. I.,** 1900, Geology of the eastern Choctaw coal field, Indian Territory: U. S. Geol. Survey, 21st Ann. Rept., pt. 2, p. 257-377.

**Thompson, M. L.,** 1948, Studies of American fusulinids: Kans., Univ., Paleont. Contr. [no. 4], Protozoa, art. 1, 184 p.

**Waddell, D. E.,** 1964, Statistical analysis of the fusulinid genera **Fusulinella, Fusulina, Wedekindellina?,** and **Triticites** in the Ardmore basin, Oklahoma: Okla., Univ., unpublished doctoral dissertation, 270 p.

# Some Notes Concerning the Allagecrinidae

Harrell L. Strimple*

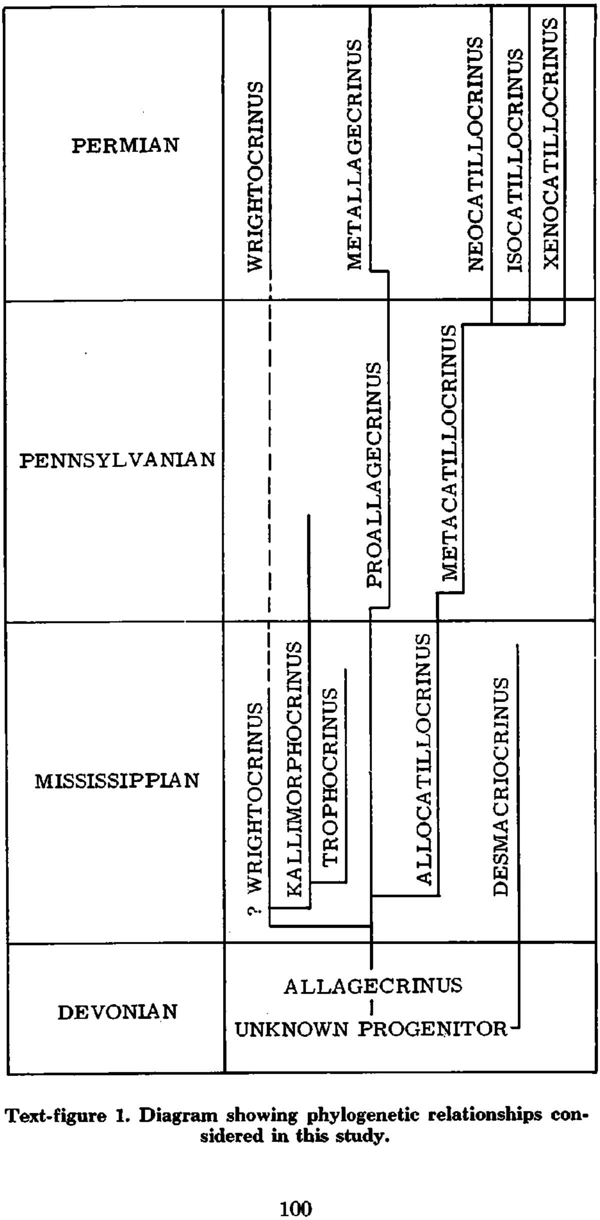
Although several studies of the allagecrinids have been made previously, some features of this group are still imperfectly understood. The present study is an attempt to provide a sound basis for future studies and the eventual resolution of the remaining problems.

Based upon existing published information so little difference exists between early allagecrinids and typical *Allagecrinus* that the suppression of *Hybochilocrinus* seems desirable. This problem was discussed at such length by Strimple and Koenig (1956, p. 1226-1229) that it does not warrant repetition here, but will be considered briefly under generic discussions.

A close relationship between *Allagecrinus* and *Kallimorphocrinus* is obvious, but the evolutionary process has not been expressed. From information of other forms of crinoids one would expect a form like *Kallimorphocrinus,* with no anal plate, to have evolved from a form like *Allagecrinus,* with an anal plate. The earliest allagecrinid. *Allagecrinus americanus,* typically has five arms, but may develop as many as eight (Strimple and Koenig, 1956, p. 1228). The younger *A. austinii,* type species of the genus, has eight arms in early maturity, but a single radial plate may bear as many as four individual facets (Wright, 1932, p. 341), and thus one could anticipate at least a twelve-armed form. *A. garpelensis* Wright, 1932, which is apparently the progenitor of *Allocatillocrinus scoticus* (Wright) typically has six to nine arms in maturity. The species *Allagecrinus elongatus* Wright, 1932, was assigned to *Kallimorphocrinus* because it lacked an anal notch (or plate) in the posterior interradius although it has a maximum of eight arms, whereas other species of *Kallimorphocrinus* develop no more than five arms, and all retain their oral plates in maturity. *A. elongatus* is apparently transitional in regressive evolution to a five-armed *Kallimorphocrinus;* subsequent studies may justify the need for a separate genus.

*Wrightocrinus* Moore, 1940, has as its type species the Permian form *Allagecrinus jakovlevi* Wanner, which species lacks an anal notch. The species *Allagecrinus biplex* Wright from the Lower Limestone series (Mississippian, Scotland) was also assigned to the genus, although it was known to have a pronounced anal notch, and the anal plate had been observed in place. *Wrightocrinus* was reported by Moore (1940, p. 92) to differ from *Allagecrinus* as follows: "The radial plates are unequal, the laR and raR being narrower than the others and being distinguished further by having only one facet at the summit instead of two or more as in the case of the others." The statement is true concerning the right anterior radial (raR) which is multiple arm-bearing but is incorrect as to the left anterior radial (laR) which always carries a single arm in *Allagecrinus* and *Isoallagecrinus,* new genus.

* University of Iowa, Iowa City.



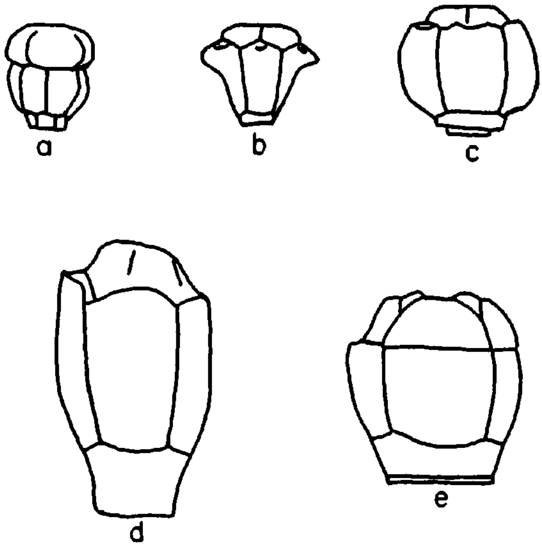

**Text-figure 1. Diagram showing phylogenetic relationships considered in this study.**

*Trophocrinus* Kirk, 1930, is an apparent derivative of *Kallimorphocrinus*, being modified in the development of one or two scooplike projections extending above the summit of the orals.

The form described as *Coenocystis moreyi* Peck, 1936, was referred to *Kallimorphocrinus* by Connelly (1950, p. 23-26) and by Koenig (in Strimple and Koenig, 1956, p. 1231). Connelly reported a specimen with well-developed arm facets on the right posterior radial, right anterior radial, and left anterior radial. The form differs from *Kallimorphocrinus, Allagecrinus,* and *Isoallagecrinus,* which have either three basals or one fused basal, in having well-defined basals. One other allagecrinid species, *Kallimorphocrinus weldenensis* Strimple and Koenig, 1956, has five basals, and the largest specimen has not developed arm facets. A new genus, *Desmacriocrinus,* is proposed, with the species *Kallimorphocrinus weldenensis* as the type species. Evolution is normally toward fusion and reduction in the number of proximal cup plates; therefore *Desmacriocrinus* could hardly have evolved from *Allagecrinus, Kallimorphocrinus,* or the younger *Isoallagecrinus,* and may not be closely related to those genera.

*Allocatillocrinus scoticus, A. carpenteri* (Wachsmuth, 1882), and *A. rotundus* Moore, 1940, have not appreciably changed the cup shape from that of typical *Allagecrinus* except for specimens considered by Moore (1940) to be the young of *A. rotundus*. The species *Allocatillocrinus morrowensis* (Strimple) shows a change toward bulbosity of the radial plates and a sharp differentiation between basal and radial circlets, which trend leads to the low cup of *Metacatillocrinus* Moore and Strimple, 1942, and the Permian genera *Neocatillocrinus* Wanner, 1937, *Isocatillocrinus* Wanner, 1937, and *Xenocatillocrinus* Wanner, 1937.

*Allagecrinus* evolves to *Isoallagecrinus* through the lowering of the cup height, increased bulbosity of the radial plates, and the sharp delineation between basal and radial circlets. The forms differ from *Allocatillocrinus, Metacatillocrinus, Neocatillocrinus, Isocatillocrinus,* and *Xenocatillocrinus* mainly in having fewer arms and therefore less distortion of multiple arm-bearing radials. The oldest form which could be referred to *Isoallagecrinus* is found among those specimens considered by Moore (1940, figs. 6c-n) to be the young of *Allocatillocrinus rotundus*. The only explanation of this occurrence appears to be a concept of "genesis," termed proterogenesis by Schindewolf, wherein a change appears in the inner volutions of an ammonoid (young stages) and becomes more pronounced in a later form, yet with no ancestral form involved. Several species of Desmoinesian age are known and are referred herein to *Isoallagecrinus*. These are *Allagecrinus pecki* Moore, 1940, from the upper Cherokee; *A. constellatus* Moore, 1940, and *A. dignatus* Moore, 1940, from the Oologah Limestone; and *A.* sp. cf. *A. bassleri* Moore, 1940, from the Wewoka Formation. The type species of the genus is *Allagecrinus bassleri* Strimple, 1938, from the Missourian. Other Missourian species are *Allagecrinus copani* Strimple, 1949; *Allagecrinus strimplei* Kirk, 1936; *Allagecrinus kylensis* Strimple, 1948; and *Allagecrinus status* Strimple, 1951, = *Allagecrinus bassleri* var. *status*. The variety described as *Allagecrinus bassleri* var. *nodosus*



**Text-figure 2. Outline sketches of various allagecrinids.**

a. Desmacriocrinus weldenensis (**Strimple and Koenig**), **x25.**
b. Kallimorphocrinus astrus **Weller, x15.**
c. Isoallagecrinus illinoisensis (**Weller**), **x15.**
d. Allagecrinus americanus **Rowley, x25. Large specimen after Strimple and Koenig (1956).**
e. Metallagecrinus quinquebrachiatus (**Wanner**), **x7.3. Note primibrachs in place.**

Strimple, 1951, is herewith referred to as conspecific of *Isoallagecrinus bassleri.* One species, *Allagecrinus graffhami* Strimple, 1948, is of Virgilian age. A new form is described as *Isoallagecrinus eaglei,* new species, from the Red Eagle Formation, Lower Permian. It is one of the larger species known and does not differ appreciably from the type of the genus.

A mildly divergent trend among species of *Isoallagecrinus* is found with *I. strimpeli,* wherein three single arms are robust. Typically only two arms are robust. Normally all of the arms are narrow except two which are of the right posterior and the left anterior. This characteristic of *I. strimplei* is shared by *I. copani,* which is a younger species.

The trend which led to the broad, shallow cup of *Isoallagecrinus* was apparently successful in that it lasted throughout the Pennsylvanian and into the Early Permian, but regression took place in the Permian, as shown by the Russian and Indonesian species which have the plain, evenly expanded, cone-shaped cup form found in the older *Allagecrinus* species. All of the known Permian species, except *Wrightocrinus jakovlevi,* have the same distribution of arms found in *Allagecrinus* and *Isoallagecrinus,* and many have a transverse ridge on the articular facet of the radial plate. The Russian and Indonesian species are regressive (primitive) in the retention of the orals in maturity. Separation into *Metallagecrinus,* new genus, is proposed. The genus is progressive in having eliminated the anal plate from the posterior interradius of the cup. Some groups included in the genus are distinctive in having restricted arm-articular facets, or exceptionally high oral plates, or fused basals, or other features but no effort is made here to evaluate their generic significance. Some may be derivatives of *Kallimorphocrinus* rather than *Allagecrinus* through *Isoallagecrinus.*

I am grateful to W. M. Furnish for suggestions and criticism and to C. C. Branson for making the specimen of *Isoallagecrinus eaglei,* new species, available for study.

## SYSTEMATIC DESCRIPTIONS

### Family ALLAGECRINIDAE Carpenter and Etheridge, 1881, emend. Moore, 1940

### Genus *Allagecrinus* Carpenter and Etheridge, 1881, emend. Wright, 1932

*Synonymy.*—*Hybochilocrinus* Weller, 1930.

*Type species.*—*Allagecrinus austinii* Carpenter and Etheridge, 1881.

*Diagnosis.*—Dorsal cup more or less evenly expanded; three basals or one fused; five radials; five orals or none; notch for anal in posterior interradius; arms none to twelve.

*Discussion.*—This genus was not fully understood until Wright (1932) reexamined the type specimens of the type species and discovered the existence of five oral plates, in place, in a small but mature specimen. Before this information was available, Weller (1930) had proposed the genera *Kallimorphocrinus* and *Hybochilocrinus* for small forms having oral plates, the former differing in lacking a notch for an anal plate in the cup. The difference between *Allagecrinus americanus* Rowley, the species taken as the type of *Hybochilocrinus,* and young specimens of *Allagecrinus austinii* does not warrant separation. Moore (1940) has pointed out the apparent absence of a transverse ridge on the articular facet of the radial plate of *A. americanus,* but this is true of almost all of the small forms assigned to *Allagecrinus* or *Kallimorphocrinus.* The shape of the latter genus is also essentially the same as that of typical *Allagecrinus.*

In a study of Scottish allagecrinids, Wright (1932, p. 345) listed the number of arms borne by large specimens of *Allagecrinus austinii,* and it was found that in forms with more than five arms the left posterior and right anterior radials were the first to have multiple arms, but with eight or more arms the anterior radial became multiple arm-bearing. The right posterior and left anterior radials have the primary arms and do not become multiple arm-bearing. Wright in a postscript (p. 365) listed a large specimen with ten arms plus an anal series.

The species *Allagecrinus garpelensis* Wright is atypical in cup shape in that mature specimens are sharply flared at the summit of the cup.

Peck (1935, p. 766) noted that in *Allagecrinus americanus* the arms are first introduced on the right posterior and left anterior radials, then on left posterior and right anterior radials, and finally on the anterior radial. Strimple and Koenig (1956, text-fig. 4[28-31]) figured a specimen with nine arm facets which were distributed as follows: RPR - 1, RAR - 2, AR - 3, LAR - 1, LPR - 2. The notch for an anal plate in mature *A. americanus* is quite pronounced and the orals are sharply indented in the anal area, features which leave a gaped appearance characteristic of the species.

The following species have been referred to *Allagecrinus*:

| SPECIES | AGE | PRESENT ASSIGNMENT |
|---|---|---|
| *Allagecrinus austinii* Carpenter and Etheridge | L. Carb. | *Allagecrinus** |
| *Allagecrinus carpenteri* Wachsmuth | L. Carb. | *Allocatillocrinus** |
| *Allagecrinus scoticus* Wright | L. Carb. | *Kallimorphocrinus* |
| *Allagecrinus scoticus* var. *contractus* Wright | L. Carb. | *Kallimorphocrinus* |
| *Allagecrinus biplex* Wright | L. Carb. | ?*Wrightocrinus* |
| *Allagecrinus elongatus* Wright | L. Carb. | *Kallimorphocrinus* |
| *Allagecrinus garpelensis* Wright | L. Carb. | *Allagecrinus* |
| *Allagecrinus americanus* Rowley | U. Dev. | *Allagecrinus* |
| *Allagecrinus rowleyi* Peck | L. Carb. | *Allagecrinus* |
| *Allagecrinus bassleri* Strimple | Penn. | *Isoallagecrinus** |
| *Allagecrinus strimplei* Kirk | Penn. | *Isoallagecrinus* |
| *Allagecrinus copani* Strimple | Penn. | *Isoallagecrinus* |
| *Allagecrinus constellatus* Moore | Penn. | *Isoallagecrinus* |
| *Allagecrinus dignatus* Moore | Penn. | *Isoallagecrinus* |
| *Allagecrinus* sp. cf. *A. bassleri* Moore | Penn. | *Isoallagecrinus* |
| *Allagecrinus graffhami* Strimple | Penn. | *Isoallagecrinus* |
| *Allagecrinus kylensis* Strimple | Penn. | *Isoallagecrinus* |
| *Allagecrinus status* Strimple | Penn. | *Isoallagecrinus* |
| *Allagecrinus donetzensis* Yakovlev | M. Carb. | ?*Isoallagecrinus* |
| *Kallimorphocrinus pocillus* Weller | Penn. | ?*Isoallagecrinus* |
| *Kallimorphocrinus illinoisensis* Weller | Penn. | ?*Isoallagecrinus* |
| *Allagecrinus jakovlevi* Wanner | Perm. | *Wrightocrinus** |
| *Allagecrinus quinquebrachiatus* Wanner | Perm. | *Metallagecrinus** |
| *Allagecrinus multibrachiatus* Wanner | Perm. | *Metallagecrinus* |

| | | |
|---|---|---|
| *Allagecrinus uralensis* Yakovlev | Perm. | *Metallagecrinus* |
| *Allagecrinus uralensis* var. *nodocarinatus* Yakovlev | Perm. | *Metallagecrinus* |
| *Allagecrinus dux* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus inflatus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus acutus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus excavatus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus indoaustralicus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus quinquelobus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus procerus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus ornatus* Wanner | Perm. | *Metallagecrinus* |

* Type of genus.

### Genus *Isoallagecrinus* Strimple, new genus

*Type species.—Allagecrinus bassleri* Strimple.

*Diagnosis.*—Dorsal cup low, broad, with sharp delineation between basal and radial circlets and marked by tumidity of radial plates; three basals, with sutures usually visible, form low disk; five radials of unequal size in maturity, articular facet marked by transverse ridge; orals none to five; arms none to thirteen, one arm on right posterior and left anterior radials, maximum number of arms on left posterior radial; notch for anal plate pronounced. The open latticelike, or trabecular, composition of the plates is readily visible under low magnification.

*Discussion.—Isoallagecrinus* is known to occur throughout the Pennsylvanian and into the Lower Permian in North America. It is a derivative of the Devonian-Mississippian genus *Allagecrinus* through the lowering of the cup height and increased bulbosity of the radial plates. The first described species of *Isoallagecrinus* occurs in the Desmoinesian. All species assigned to the genus are listed under the discussion of *Allagecrinus* except for *Isoallagecrinus eaglei*, new species, which is from the Lower Permian of Oklahoma.

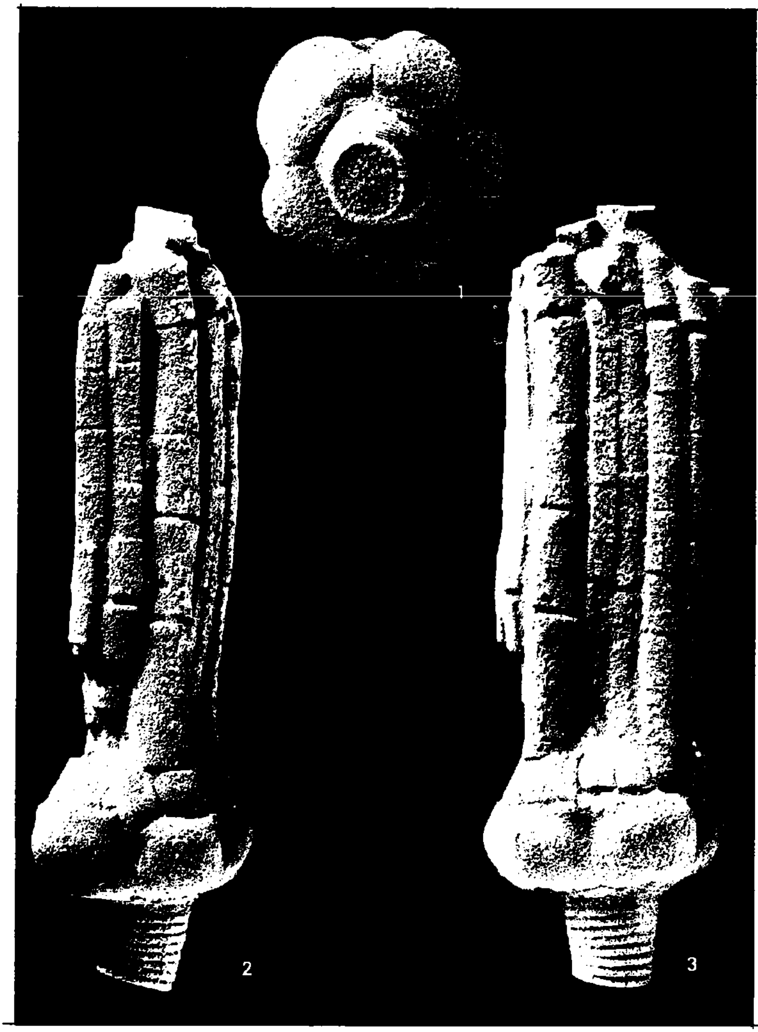
The order of appearance of arm facets is given by Moore (1940, p. 125) for *Isoallagecrinus pecki* as follows: right posterior radial is first, left anterior radial is second, right anterior radial is third, left posterior radial is fourth, and the anterior radial is fifth.

### *Isoallagecrinus eaglei* Strimple, new species

**Plate I, figures 1-3**

The dorsal cup is low, broad, and the radials overhang and almost obscure the low basal circlet. The three basals extend beyond the large proximal columnal, are of unequal size, and form a low circlet. Five radials are the dominant cup elements and are protruded as bulbous knobs. The lateral sides of multiple-arm-bearing radials project toward the adjacent single-arm-bearing radials at the summit of the cup, with the surfaces depressed below the projected areas. Twelve arm facets are present, the left posterior radial has four arms and the right anterior

Plate I




Isoallagecrinus eaglei Strimple, new species, holotype OU 4993, approximately x4.8.

1. Basal view 2. Posterior view 3. Right posterior view.

and anterior radials have three arms each. The right posterior radial carries a robust arm, as well as an elongate anal plate. The lower end of the anal plate is wedge shaped. The left anterior radial is small and carries a single robust arm. All of the smaller arms have flattened outer surfaces but the two primary arms have rounded surfaces. The crown has no surface ornamentation.

The stem is round, curved, and composed of thin segments which decrease rapidly in width in the preserved proximal portion. The lumen is minute and round.

The cup has a maximum width of 7.7 mm and a height of 3.4 mm. Over-all height of the crown as preserved is 22.3 mm.

*Remarks.*—The outline of the cup as viewed from below is somewhat comparable to a mature specimen of *Isoallagecrinus constellatus,* but the individual radial plates of *I. eaglei* are not quite as angular. Mature specimens of *I. bassleri* are closely comparable but the radials have a more rounded outline when viewed from below, and the radials are marked by pustules. *I. status* lacks pustules but the radials present a more rounded outline when viewed from below.

*Types.*—Holotype OU 4993 collected by A. Hruby, a former student at The University of Oklahoma, is in the paleontological collections, The University of Oklahoma. Plastoholotype SUI 12383 is in the paleontological collections, University of Iowa.

*Occurrence.*—Red Eagle Limestone Formation, Lower Permian; southeastern part of Burbank Stone Company quarry, NE¼ sec. 36, T. 26 N., R. 5 E., Osage County, Oklahoma.

### Genus *Allocatillocrinus* Wanner, 1937

*Type species.*—*Allagecrinus carpenteri* Wachsmuth, 1882.

*Diagnosis.*—Dorsal cup of medium height, evenly expanded; three basals; five radials, right posterior and left anterior small and carry one arm each, others of unequal size and carry multiple arms; maximum number of arms observed 32; notch for anal plate in posterior interradius.

*Discussion.*—It is apparent that *Allocatillocrinus* must have developed from a form like *Allagecrinus*; for example, from a form like *A. garpelensis* to a form like *Allocatillocrinus scoticus.*

### Genus *Kallimorphocrinus* Weller, 1930

*Synonymy.*—*Callimorphocrinus* Moore, 1936 (as editor), 1940.

*Type species.*—*Kallimorphocrinus astrus* Weller, 1930.

*Diagnosis.*—Dorsal cup high, evenly expanded; five orals prominent and persist in maturity; three basals or one fused; five radials of equal size, arms none to five (exception *K. elongatus* which has as many as 8 arm facets); no notch or other evidence of an anal plate.

*Discussion.*—*Kallimorphocrinus* differs little from the young of *Allagecrinus* other than the presence of a notch in the posterior interradius for the reception of an anal plate in the latter and its absence in the former. It appears that *Kallimorphocrinus* is a derivative of typical *Allagecrinus,* and that it is the progenitor of *Trophocrinus.*

The type species of this genus is from Desmoinesian rocks but the congeneric species extend well down into the Mississippian. Mature specimens retain their oral plates and typically do not develop more than five arms; both features could be termed regressive or primitive.

In the description of *Kallimorphocrinus scoticus* (Wright, 1932, p. 357-358) details as to the state of development of arm-articular facets were given. More variability was involved than one would expect but in general the following features were most common:

1. The facet on the left anterior radial (LAR) is almost always well developed.
2. The facet on the right posterior radial (RPR) is almost as well developed as that on the LAR.
3. The facets on the anterior (AR) and the right anterior (RAR) radials are slower to develop than those in LAR and RPR.
4. The facet on the left posterior radial (LPR) is decidedly the weakest with few exceptions.

Strimple and Koenig (1956, p. 1233-1234) gave the order of appearance of arm facets for *Kallimorphocrinus angulatus* as follows;

1. Arm facet on RPR is first.
2. Arm facet on LAR is second.
3. Arm facets on LPR and RAR appear next at about the same time.
4. Arm facet on AR is fifth.

The following species have been referred to *Kallimorphocrinus* (= *Callimorphocrinus*).

| SPECIES | AGE | PRESENT ASSIGNMENT |
|---|---|---|
| *Callimorphocrinus pristinus* Peck | Miss. | *Kallimorphocrinus* |
| *Callimorphocrinus puteatus* Peck | Miss. | *Kallimorphocrinus* |
| *Kallimorphocrinus angulatus* Strimple and Koenig | Miss. | *Kallimorphocrinus* |
| *Kallimorphocrinus tintinabulum* Strimple and Koenig | Miss. | *Kallimorphocrinus* |
| *Coenocystis moreyi* Peck | Miss. | *Desmacriocrinus* |
| *Kallimorphocrinus weldenensis* Strimple and Koenig | Miss. | *Desmacriocrinus** |
| *Allagecrinus scoticus* Wright | L. Carb. | *Kallimorphocrinus* |
| *Allagecrinus scoticus* var. *contractus* Wright | L. Carb. | *Kallimorphocrinus* |
| *Allagecrinus elongatus* Wright | L. Carb. | *Kallimorphocrinus* |
| *Kallimorphocrinus extensus* Wright | L. Carb. | *Kallimorphocrinus* |
| *Kallimorphocrinus astrus* Weller | Penn. | *Kallimorphocrinus** |
| *Kallimorphocrinus astrus* var. *intermedius* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus astrus* var. *pyramidalis* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus piasaensis* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus lilius* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus indianensis* Weller | Penn. | *Kallimorphocrinus* |

| | | |
|---|---|---|
| *Kallimorphocrinus vanpelti* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus infacetus* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus knighti* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus expansus* Weller | Penn. | *Kallimorphocrinus* |
| *Kallimorphocrinus pocillus* Weller | Penn. | *Isoallagecrinus* |
| *Kallimorphocrinus illinoisensis* Weller | Penn. | *Isoallagecrinus* |
| *Allagecrinus quinquebrachiatus* Wanner | Perm. | *Metallagecrinus** |
| *Allagecrinus uralensis* Yakovlev | Perm. | *Metallagecrinus* |
| *Allagecrinus uralensis* var. *nodocarinatus* Yakovlev | Perm. | *Metallagecrinus* |
| *Allagecrinus acutus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus procerus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus indoaustralicus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus quinquelobus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus excavatus* Wanner | Perm. | *Metallagecrinus* |
| *Allagecrinus ornatus* Wanner | Perm. | *Metallagecrinus* |

* Type of genus.

## Genus *Desmacriocrinus* Strimple, new genus

*Type species.*—*Kallimorphocrinus weldenensis* Strimple and Koenig, 1956.

*Diagnosis.*—Typically a large oral circlet composed of five orals overshadows the dorsal cup; five basals; five radials, with arm-articulating facets very slow to develop and in fact only RPR, RAR, and LAR are known; no anal notch in posterior interradius.

*Remarks.*—The type species of the genus, *D. weldenensis*, has an appearance of being short partly because of the sharply flexed radials which curve into the narrow, erect basal circlet, and the tumidity of the radials and orals. *Desmacriocrinus moreyi* has an evenly expanded cup with an appearance more like that of *Kallimorphocrinus*. Both species differ from *Kallimorphocrinus* in having five basals and a dominating oral circlet. Although only two species of *Desmacriocrinus* are known at this time, two specimens from the Louisiana Limestone recently examined by the author could be assigned to the genus based on the cup shape; that is, they resemble *D. weldenensis*. Therefore, future study will probably extend the range of the genus into the Upper Devonian.

This genus does not seem to have a clear affinity with other allagecrinids and may belong to another lineage.

## Genus *Metallagecrinus* Strimple, new genus

*Type species.*—*Allagecrinus quinquebrachiatus* Wanner.

*Diagnosis.*—Dorsal cup evenly expanded, more or less conical; three basals or commonly one fused; five radials; five orals normally retained; normally five arms; no anal notch.

*Discussion.*—This is a regressive genus in that a return to highly primitive characters in evident. Several small groups within the genus differ in having a high oral dome, or narrow arm-articulating facets, etc., but a detailed analysis is not attempted here. Most of the present forms exhibit a transverse ridge on the arm-articulating facet which is absent in *Kallimorphocrinus.* Some of the species assigned to *Metallagecrinus* may be found to have evolved through *Kallimorphocrinus* rather than through *Isoallagecrinus,* the latter being considered the primary lineage.

### References


**Carpenter, P. H.,** and **Etheridge, Robert, Jr.,** 1881, On **Allagecrinus,** the representative of the Carboniferous limestone series: Annals Magazine Nat. History, ser. 5, vol. 7, p. 281-298, pls. 15, 16.

**Connelly, J. R., Jr.,** 1950, Kinderhookian and Osagean micro-crinoids: Mo., Univ., unpublished Master of Science thesis.

**Kirk, Edwin,** 1930, **Trophocrinus,** a new Carboniferous crinoid genus: Washington Acad. Sciences, Jour., vol. 20, p. 210-212, 1 text-fig.

——————1936, A new **Allagecrinus** from Oklahoma: Washington Acad. Sciences, Jour., vol. 26, p. 162-165, 1 text-fig.

**Moore, R. C.,** 1940, Relationships of the family Allagecrinidae, with description of new species from Pennsylvanian rocks of Oklahoma and Missouri: Denison Univ., Sci. Lab., Jour., vol. 35, p. 55-137, 2 pls.

**Peck, R. E.,** 1935, Growth stages of **Allagecrinus americanus** Rowley: Jour. Geology, vol. 43, p. 765-770, 1 text-fig.

——————1936, Lower Mississippian microcrinoids of the Kinderhook and Osage groups of Missouri: Jour. Paleontology, vol. 10, p. 282-293, pls. 46, 47.

**Rowley, R. R.,** 1895, Description of a new genus and five new species of fossils from the Devonian and sub-Carboniferous rocks of Missouri: Amer. Geologist, vol. 16, p. 217-223.

**Strimple, H. L.,** 1938, A group of crinoids from the Pennsylvanian of northeastern Oklahoma: Bartlesville, Okla., H. L. Strimple, 13 p., 2 pls.

——————1940, Some new crinoid species from the Morrow subseries [Okla.]: Bull. Amer. Paleontology, vol. 25, p. 89-98, 1 pl.

——————1948, Two new species of **Allagecrinus** from the Pennsylvanian of Kansas and Texas, **pt. I of** Crinoid studies: Bull. Amer. Paleontology, vol. 32, p. 15-30, 1 pl.

——————1951, Pennsylvanian crinoids from Lake Bridgeport, Texas: Jour. Paleontology, vol. 25, p. 200-207, pls. 36-39.

**Strimple, H. L.,** and **Koenig, J. W.,** 1956, Mississippian microcrinoids from Oklahoma and New Mexico: Jour. Paleontology, vol. 30, p. 1225-1247, 4 text-figs.

**Wanner, Johann,** 1916, Die permischen Echinodermen von Timor, Teil I: Paläontologie von Timor, vol. 6, Teil 11, 329 p., pls. 96-114, text-figs. 1-88.

——————1929, Neue Beiträge zur Kenntnis der permischen Echinodermen von Timor, I, **Allagecrinus,** II, **Hypocrinites:** Dienst van den Mijnbouw in Nederlandsche-Indië, Wetenschappelijke Mededeelingen 11, p. 1-116, pls. 1-7, 16 text-figs.

——————1930, Neue Beiträge zur Kenntnis der permischen Echinodermen von Timor, III, Hypocrininae, **Paracatillocrinus** und **Allagecrinus dux:** Dienst van den Mijnbouw in Nederlandsche-Indië, Wetenschappelijke Mededeelingen 13, p. 1-30, 2 pls.

———1937, Neue Beiträge zur Kenntnis der permischen Echinodermen von Timor, VIII-XIII: Palaeontographica, Supp. Bd. 4, Abt. 4, Lieferung 2, p. 57-212, pls. 5-14, 82 text-figs.

**Weller, J. M.**, 1930, A group of larviform crinoids from lower Pennsylvanian strata of the eastern interior basin: Ill. State Geol. Survey, Rept. Inv. 21, 38 p., 2 pls.

**Wright, James**, 1932, The Scottish species of **Allagecrinus**: Geol. Magazine, vol. 69, p. 337-366, pls. 23-25, 35 text-figs.

———1933, Two new crinoids from the Scottish Carboniferous limestones, with notes on the Allagecrinidae: Geol. Magazine, vol. 70, p. 193-208, pls. 13, 14, 15 text-figs.

———1939, The Scottish Carboniferous Crinoidea: Roy. Soc. Edinburgh, Trans., vol. 60, pt. I (no. 1), p. 1-78, 12 pls., 85 text-figs.

———1952, A monograph on the British Carboniferous Crinoidea, Part IV: Palaeontographical Soc., p. 103-148, pls. 32-40.

**Yakovlev, N. N.**, 1927, Faune des echinodermes du Permocarbonifère de l'Oural à Krasnooufimsk, II: Comité Geologique SSSR, Bull., vol. 46, p. 181-191, pl. 6.

# *Cappasporites*, a New Pennsylvanian Spore Genus from the Des Moines Series of Oklahoma*

L. L. Urban†

## INTRODUCTION

During a palynological study of the Drywood and Bluejacket coals (Urban, 1965), several spore types were observed that appear to be undescribed. An abundant and easily recognized type which may prove to be restricted to the Boggy Formation is described here as a new genus and a new species.

Similar spores have not been observed, either by the writer or by Bordeau (1964), in the underlying Drywood coal (Savanna Formation), nor have they been reported by investigators who examined the overlying Senora Formation (Gibson, 1961; Ruffin, 1961; Urban, 1962; Bond, 1963; Dolly, 1965).

The samples containing specimens were taken from Bluejacket coal on the north side of Inola Mound in sec. 10, T. 19 N., R. 17 E., Rogers County, Oklahoma, and from a road cut on the north side of U. S. Highway 60 northwest of Vinita, SE¼ SE¼ NW¼ sec. 8, T. 25 N., R. 19 E., Craig County, Oklahoma. The specimens illustrated herein are in the palynological collections of the Oklahoma Geological Survey.

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

† Phillips Petroleum Company, Bartlesville, Oklahoma.

Appreciation is expressed to the National Science Foundation for aid under Grant GB-1850 during the study of the Drywood and Bluejacket coals, to Dr. L. R. Wilson, who directed the investigation, and to Phillips Petroleum Company for permission to publish.

SYSTEMATIC DESCRIPTIONS

Anteturma SPORITES H. Potonié, 1893
Turma TRILETES (Reinsch, 1881) Potonié and Kremp, 1954
Subturma AZONOTRILETES Luber, 1935
Infraturma LAEVIGATI (Bennie and Kidston, 1886) R. Potonié, 1956

*Cappasporites*, new genus

Spores radial, trilete, circular to rounded triangular in equatorial views; proximal hemisphere wall extremely thin, membranous, 0.5 to 2.0 microns thick, almost transparent; distal wall thicker, less transparent, 2.0 to 4.0 microns thick at distal pole, becoming thinner toward equator; many specimens of the genus are marked by a triangular foramen which suggests the presence of the triradiate line of weakness in the exine. Present known size range is 39 to 66 microns in diameter.

The name of the genus is derived from the Latin word cappa, meaning hood.

*Comparison*.—*Cappasporites* is similar to *Crassispora*, particularly in the manner of the Y-mark as discussed by Bhardwaj (1957, p. 125) where he stated:

---

**Explanation of Plate I**

**An assemblage of Cappasporites distortus, new genus and new species, from sample OPC 1065E, showing range of form, size, and preservation.**

**Figures 1, 2. Holotype OPC 1065E-10-3. 60.5 x 46.8 microns. Spore showing triangular opening (fig. 1) and distal thickening.**

**Figure 3. OPC 1065E-10-8. 44.9 x 42.9 microns.**

**Figure 4. OPC 1065E-10-12. 50.7 x 44.9 microns.**

**Figure 5. OPC 1065E-10-19b. 52.7 x 48.8 microns.**

**Figure 6. OPC 1065E-10-16a. 56.6 x 39.0 microns. Spore showing contrast in thickness of proximal and distal walls.**

**Figure 7. OPC 1065E-11-9. 58.5 x 48.8 microns. Showing triradiate folds in proximal wall of spore.**

**Figure 8. OPC 1065E-10-5. 50.7 x 44.9 microns.**

**Figure 9. OPC 1065E-11-3. 60.5 x 54.6 microns.**

**Figure 10. OPC 1065E-10-13a. 64.4 x 52.7 microns.**

**Figure 11. OPC 1065E-10-13b. 66.3 x 52.7 microns.**

**Figure 12. OPC 1065E-10-6a. 56.6 x 54.6 microns. Showing faint partially opened trilete mark.**

**Figure 13. OPC 1065E-10-4b. a: 60.5 x 48.7 microns. b: 62.4 x 46.8 microns.**

**Figure 14. OPC 1065E-10-6b. 54.6 x 50.7 microns.**

> Although no distinct Y-mark is normally seen in the spore, this triangular opening suggests that there does exist a triradiate line of weakness in the exine which opens out to give rise to this window.

However, *Cappasporites* differs from *Crassispora* by the absence of a crassitudo, or thickening of the exine in the equatorial region, which in *Crassispora* extends slightly into both spheres, whereas the exine of *Cappasporites* is thickest in the distal hemisphere and thins toward the equator with the proximal wall becoming membranous. Placement of *Cappasporites* in *Planisporites* is rejected because the generic description, as originally stated by Knox (1950, p. 314) and emended by Potonié and Kremp (1954, p. 129), is too broad.

**Plate 1**

*Cappasporites distortus*, new species
Plate I, figures 1-14

Description as for genus; size range from 39 to 66 microns; exine laevigate, except for a random scattering of granules (1-4 microns in diameter) on both proximal and distal surfaces of the spores.

The specific name refers to the misshapen form of the species.

*Remarks.*—*Cappasporites distortus* is one of the dominant forms in the shale and underclay of the Bluejacket section at Inola Mound, and the species attains a maximum of 26 percent of the assemblage (level OPC 1065E). *C. distortus* is present only in two levels (OPC 1067E and 1067F) of the Bluejacket coal in Craig County, where it accounts for 5 percent and 1 percent of the assemblage, respectively. *Cappasporites distortus* has been found associated with the following forms (listed in decreasing order of relative abundance): *Lycospora, Laevigatosporites, Endosporites, Leschikisporis, Calamospora, Punctatisporites, Potonieisporites, Wilsonites, Granulatisporites, Vestispora, Florinites, Triquitrites,* and *Raistrickia.*

*Holotype.*—OPC 1065E-10-3 (pl. I, figs. 1, 2), 60.5 x 46.8 microns. This specimen is from the underclay 5.5 inches below the Bluejacket coal on the north side of Inola Mound in sec. 10, T. 19 N., R. 17 E., Rogers County, Oklahoma.

**References Cited**


**Bhardwaj, D. C.**, 1957, The spore flora of Velener Schichten (Lower Westphalian D) in the Ruhr Coal Measures: Palaeontographica, Abt. B, vol. 102, p. 110-138, pls. 23-26, 9 figs., 3 tables.

**Bond, T. A.**, 1963, Palynology of the Weir-Pittsburg coal (Pennsylvanian) of Oklahoma and Kansas: Okla., Univ., unpublished Master of Science thesis, 103 p., 5 pls.

**Bordeau, K. V.**, 1964, Palynology of the Drywood coal (Pennsylvanian) of Oklahoma: Okla., Univ., unpublished Master of Science thesis, 207 p., 11 pls.

**Dolly, E. D.**, 1965, Palynology of the Bevier coal (Pennsylvanian) of Oklahoma: Okla., Univ., unpublished Master of Science thesis, 115 p., 6 pls.

**Gibson, L. B.**, 1961, Palynology and paleoecology of the Iron Post coal (Pennsylvanian) of Oklahoma: Okla., Univ., unpublished doctoral dissertation, 239 p., 8 pls.

**Knox, E. M.**, 1950, The spores of **Lycopodium, Phylloglossum, Selaginella,** and **Isoetes** and their value in the study of microfossils of Palaeozoic age: Bot. Soc. Edinburgh, Trans., vol. 35, p. 209-357, pls. 8-19.

**Potonié, Robert**, and **Kremp, G. O. W.**, 1954, Die Gattungen der paläozoischen Sporae dispersae und ihre Stratigraphie: Geologischen Landesanstalten Bundesrepublik Deutschland, Geologischen Jahrbuch, vol. 69, p. 111-194, pls. 4-20, 5 figs.

**Ruffin, J. H.**, 1961, Palynology of the Tebo coal (Pennsylvanian) of Oklahoma: Okla., Univ., unpublished Master of Science thesis, 124 p., 7 pls.

**Urban, J. B.**, 1962, Palynology of the Mineral coal (Pennsylvanian) of Oklahoma and Kansas: Okla., Univ., unpublished doctoral dissertation, 146 p., 7 pls.

**Urban, L. L.**, 1965, Palynology of the Drywood and Bluejacket coals (Pennsylvanian) of Oklahoma: Okla., Univ., unpublished Master of Science thesis, 91 p., 6 pls.

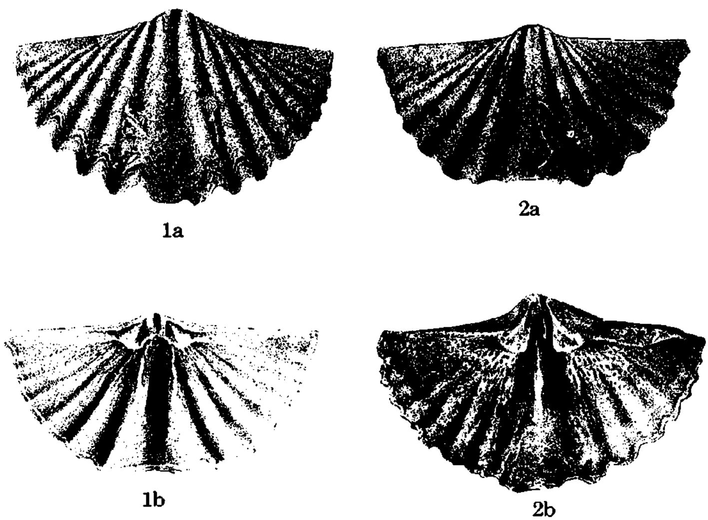
# *Reticulariina* in Oklahoma

Carl C. Branson

The spiriferinidid genus *Reticulariina* was named by Fredericks (1916, p. 16) and *Spirifer spinosus* Norwood and Pratten, 1855, was designated as type species. *R. spinosa* was described from material from the Chester Group of Illinois and Missouri. Our material (OU 4991) assigned to the species is from the Chester Series 10 miles northwest of Rome, Floyd County, Georgia. These shells are robust, have prominent sinus and fold, a small central plication in the fold, prominent plications bordering the sinus, and four lateral plications. Five lateral plications border the sinus.

The shell surface, particularly on the anterior surface, bears stout spines, those on the sides of the plications directed perpendicular to the shell surface and some nearly meeting across the interspace. The entire shell surface is minutely papillose.

Our collection contains a specimen of a dorsal valve (OU 4990) which differs markedly from that of *R. spinosa*. The valve is 28 mm wide and 13 mm long. The fold is broad near the front margin and is




**Figures 1-2. Specimens of Reticulariina and Punctospirifer from the Fayetteville Shale, 1 mile east of Vinita, Craig County, Oklahoma.**

**Figure 1.** Reticulariina cf. R. spinosa. **OU 4990.**
**a. View of the exterior.**
**b. View of the interior.**

**Figure 2.** Punctospirifer transversus. **OU 4992.**
**a. View of the exterior.**
**b. View of the interior.**

**(Photographs by Phillip Blackwell; all figures x2)**

flat on top. Six rounded plications lie upon each slope. The shell surface bears minute forward-directed spines, about five or six in a square millimeter. A new species is indicated but will not be named here because we have but the single valve.

By coincidence the other shell in the same lot is a ventral valve of almost the same size and general appearance, but it is clearly a specimen of *Punctospirifer transversus* (McChesney). It has been segregated and cataloged as OU 4992 (fig. 2).

*Reticulariina spinosa* is known from the Chesterian rocks of Illinois, Missouri, Kentucky, Michigan, Indiana, Oklahoma, Arkansas, Wyoming, Alabama, Arizona, West Virginia, Tennessee, Nevada, and Montana. The species *R. spinosa* is widespread, *R. campestris* (White, 1874) of limited distribution. Easton (1962, p. 82-85) in his excellent discussion of the genus referred *R. browni* (Branson and Greger, 1918) to the synonymy of *R. spinosa*. The form named *Spiriferina spinosa cochisensis* by Heron (1935, p. 685, pl. 82, fig. 1) appears to be *Punctospirifer transversus*. Ivanova (1960, p. 280) gave the range of the genus as Carboniferous to Permian and in the explanation of plate 64, figures 17a,b,v,g, erected the nude name *R. netschaewi* for shells from Upper Permian rocks of the Volga basin. This shell is minutely papillate.

*Reticulariina* is confined to Mississippian rocks of the United States, and the Permian forms referred to it are not of this genus (Stehli, 1945, p. 345).

*Spiriferina subspinosa* Weller, 1920, probably does not belong to the genus *Reticulariina*. It occurs in the Shetlerville Formation of Hardin and Pope Counties, Illinois, and Crittenden County, Kentucky, and in the Renault of western Kentucky (Weller, 1931, p. 260, pl. 40, figs. 2a,b). The name *Spiriferina spinosa siebenthali* appears in several lists of Chester fossils in West Virginia counties, but a search for its description, author, and date failed.

### References Cited

**Branson, E. B.**, and **Greger, D. K.**, 1918, Amsden formation of the east slope of the Wind River Mountains and its fauna: Geol. Soc. America, Bull., vol. 29, p. 309-326.

**Easton, W. H.**, 1962, Carboniferous formations and faunas of central Montana: U. S. Geol. Survey, Prof. Paper 348, 126 p., 13 pls.

**Fredericks, G.**, 1916, On some Upper Paleozoic Brachiopoda of Eurasia: Russia, Geologicheskii Komitet, Trudy, new ser., vol. 156.

**Hernon, R. M.**, 1935, The Paradise formation and its fauna: Jour. Paleontology, vol. 9, p. 653-696.

**Ivanova, E. A.**, 1960, Order Spiriferida, in Osnovy Paleontologii [vol. 7], Mshanki, Brakhiopody; Prilozhenie: Foronidy: Akad. Nauk SSSR, p. 264-280.

**Stehli, F. G.**, 1954, Lower Leonardian Brachiopoda of the Sierra Diablo: Amer. Museum Nat. History, Bull., vol. 105, art. 3, p. 261-358.

**Weller, J. M.**, 1931, Mississippian fauna, in Jillson, W. R. ed., The paleontology of Kentucky, a symposium: Ky. Geol. Survey, ser. 6, Bull. 36, p. 251-291.

# Late Mississippian Lycopod Branch from Arkansas

Royal H. Mapes*

A nearly complete branch of the fossil lycopod, *Lepidophloios* sp., has recently been collected from the Fayetteville Formation (Chesterian) in Washington County, Arkansas.

Mississippian fossil plants are rare in northwestern Arkansas because most of the Carboniferous rocks are of marine origin. Some fossil plant fragments occur in the Wedington Sandstone Member of the Fayetteville Formation (White, 1937). Fossil plant fragments also occur in the Fayetteville Shale below the Wedington Sandstone. Most of these are partial petrifactions, impressions, or casts, which retain some internal and external structures.

The specimen of *Lepidophloios* sp. (fig. 1) was collected from the east bank of Cato Springs Branch, 1½ blocks east of the intersection of Pettegrew Street and Sturman Avenue, Fayetteville, Washington County, Arkansas (SW¼ sec. 21, T. 16. N., R. 30 W.). Additional plant fragments obtained from this exposure include a strobilus now in the collection of the Chicago Natural History Museum. A number of nautiloids and goniatites have also been recovered from the same stratum and area. Among these is a specimen of the orthoconic nautiloid *Rayonnoceras solidiforme* Croneis, 1926, which is 96 cm long and 26 cm across the partly crushed living chamber. The goniatites include *Muensteroceras pisiforme* Gordon, 1965, *Paracravenoceras ozarkense* Gordon, 1960, *Goniatites* cf. *G. granosus* Portlock, 1843, *Cravenoceras fayettevillae* Gordon, 1965, *Eumorphoceras plummeri* Miller and Youngquist, 1948, *Tumulites varians* McCaleb, Quinn, and Furnish, 1964, and *Paradimorphoceras* sp. Ruzhencev, 1947. These goniatites range in diameter from 2 to 50 mm.

*Description.*—The lycopod specimen has twelve branch endings, some of which are curved and all of which are more or less crushed. The limbs branch dichotomously at a mean angle of 76.5 degrees, and at an interval of about 24.4 cm. The branch limbs retain a covering of pyritized "bark" and a stele which has been calcified. An intervening space was occupied by a compressible but unknown substance. Compaction of enclosing mud caused the collapse of the "bark" around the stele which remains essentially undistorted, thereby providing the unusual cross-sectional shape of the fossil (fig. 2).

Leaf cushions (fig. 3) which are in high relief above the cortex, spiral upward around the branch from left to right in parallel rows approximately 2 mm, or one-third of their width, apart. The cushions are broadly diamond shaped, and are acutely terminated at the upper end with a narrow carina, or keel, above the leaf scar and are obtusely terminated at the lower end without a pronounced keel.

Leaf scars, on the lower one-third of the leaf cushion, are roughly rhombohedral in outline, obtusely angular at the base, and acutely angular laterally with drooping lateral crests. The vascular scar is in

* Geology student, University of Arkansas, Fayetteville.

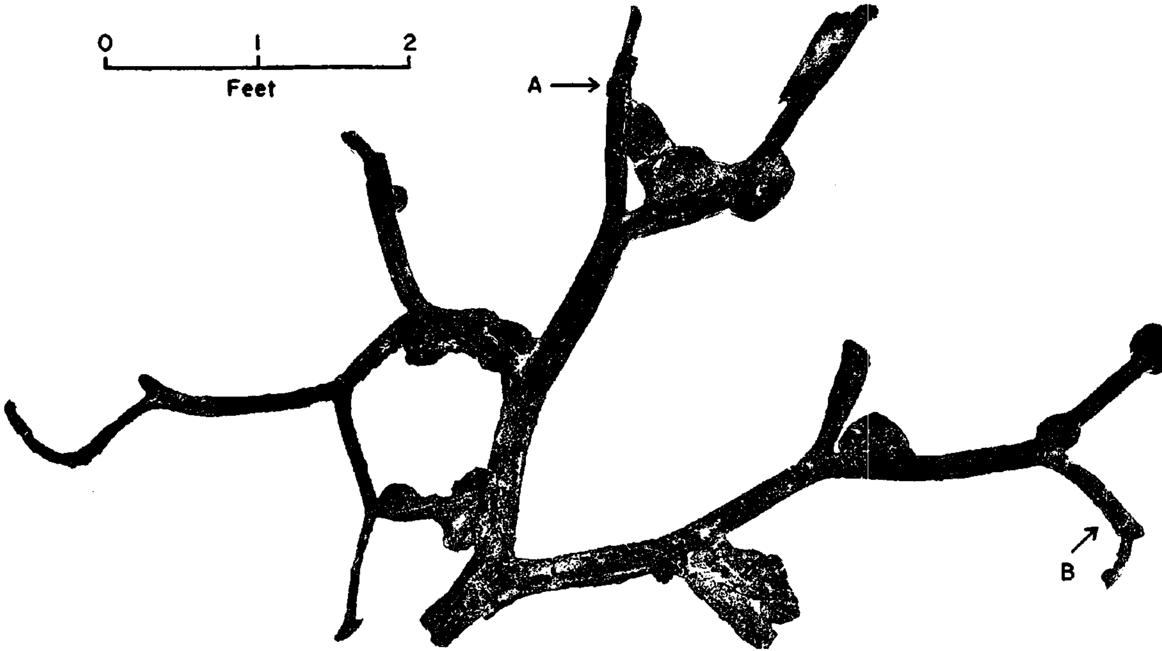



**Figure 1.** Specimen of *Lepidophloios* sp., x0.079, collected from the Fayetteville Formation, Washington County, Arkansas. Letter A indicates position of cross section shown in figure 2. Letter B indicates branch segment shown in figure 3.

the lower center of the leaf scar, and the parichnos scars are on the same level as the vascular scar. The vertical diameter averages 4 mm and is two-thirds the lateral diameter of 6 mm.

*Remarks.*—The shape, form, and size of the leaf scars on *Lepidophloios* sp. resemble those of *Lepidodendron volkmannianum* Steinberg, 1825, provided the latter is oriented in reverse to the growth

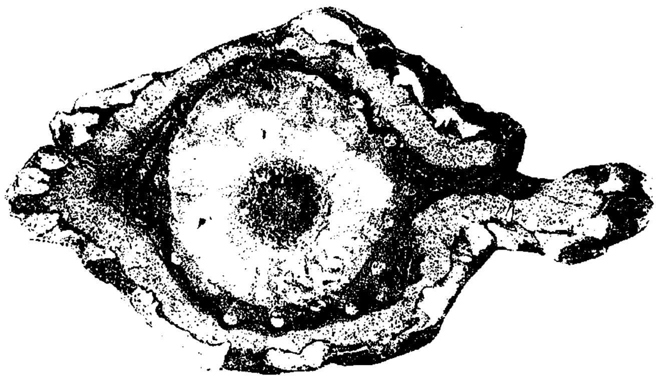


**Figure 2.** Lepidophloios sp. **Cross section of branch, x2, showing pyritized "bark" and calcified stele.**
(Photograph by J. H. Quinn)

**Figure 3.** Lepidophloios sp. **Leaf cushions and scars, x1.2, oriented in growth position.**
(Photograph by J. H. Quinn)

position. White (1937, p. 31) described a carbonized fragment of a branch, from the Wedington Sandstone Member of the Fayetteville Formation, as *Lepidodendron* sp. 2. Lacey and Eggert (1964, p. 981) referred the specimen to *L. volkmannianum.*

In fact, *Lepidodendron* sp. 2 has no transverse wrinkles on the lower keel, a feature characteristic of *L. volkmannianum.* Because these wrinkles are absent and no branch limbs are attached, it is not clear in which direction the specimen should be oriented. White may have reversed his specimen (1937, pl. 7, fig. 8) and described it as *Lepidodendron* sp. 2 rather than *Lepidophloios* sp.

*Acknowledgments.*—Work of collecting and mounting the specimen was facilitated by the aid of William McMoran, W. Bruce Saunders, and Joe Saunders, University of Arkansas. Valuable criticism and advice were provided by Dr. James H. Quinn, University of Arkansas, W. Bruce Saunders, University of Arkansas, Dr. Eugene S. Richardson, Chicago Natural History Museum, and others to whom I express my appreciation.

### References Cited

**Lacy, W. S., and Eggert, D. A.,** 1964, A flora from the Chester Series (Upper Mississippian) of southern Illinois: Amer. Jour. Botany, vol. 51, p. 976-985.

**White, C. D.,** 1937, Fossil flora of the Wedington Sandstone Member of the Fayetteville Shale, in Shorter contributions to general geology: U. S. Geol. Survey, Prof. Paper 186, p. 13-41.

---

## OKLAHOMA GEOLOGY NOTES

Volume 26 April 1966 Number 4

### In This Issue

*Page*