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## Echinoderm Zonules in the Devonian of Iowa

HARRELL L. STRIMPLE

*Abstract.* A tentative framework of ten echinoderm zonules, some of which are not new, is proposed: *Nortonechinus owensis* Zonule (upper Owen Member, Lime Creek Formation); *Dactylocrinus* Zonule (upper Cerro Gordo Member), *Xenocidaris* Zonule (lower Cerro Gordo Member, Lime Creek Formation); *Desmidocrinus* Zonule, *Belanskicrinus* Zonule, *Agelacrinites* Zonule (Mason City Member, Shell Rock Formation); *Strobilocystites* Zonule, *Euryocrinus* Zonule (upper Rapid Member), *Hexacrinites* Zonule (middle Rapid Member), *Megistocrinus clarki* Zonule (lower Rapid Member, Cedar Valley Formation). Some forms, or assemblages, appear to have decided stratigraphic significance, but more study is needed.

### ECHINODERMS OF THE LIME CREEK FORMATION

Very few echinoderms have been reported from the Lime Creek Formation of the Upper Devonian. Near the top of the Cerro Gordo member, the flexible crinoids *Dactylocrinus stellatimibasilis* Thomas, 1924, and *Clidochirus iowensis* Thomas, 1924, and the echinoid *Nortonechinus welleri* Thomas, 1924, have been reported. Near the base of the Cerro Gordo the echinoid *Xenocidaris americana* Thomas, 1924, and the crinoid *Cyathocrinus rockfordensis* Thomas, 1924, are represented by disarticulated plates. The echinoid *Nortonechinus owensis* Thomas, 1924, is represented by disarticulated plates in the upper Owen Member.

### ECHINODERMS OF THE AMANA BEDS

A new genus related to *Dactylocrinus* was found by Allen Grafham in the Amana Beds near Amana, Iowa. The specimen was repositied at the University of Iowa. Another species of the genus was found by Cal Levorson in the upper Cerro Gordo Member of the Lime Creek Formation in the pits of the Rockport Brick & Tile Company. The genus differs from *Dactylocrinus* in that the anal plate has lost its identity and contact with the C-D (posterior) basal, which plate has become slightly longer than the other four basals in the new genus.

The Amana beds are correlative with the Independence Shale and the Cerro Gordo Member of the Lime Creek Formation.

### ECHINODERMS OF THE INDEPENDENCE SHALE

The Independence Shale has been shown to be the result of stratigraphic leak from the Upper Devonian into the Middle Devonian. Reported species are:—*Arthracaantha mamelonifera* Thomas, 1924, and *Devonocidaris stainbrookii* Thomas, 1924.

ECHINODERMS OF THE SHELL ROCK

Most echinoderms known from the Shell Rock Formation are found in the Mason City Member around Nora Springs, Iowa.

Belanski Station 43 (unpublished Register) is representative and covered the Mason City Member exposed at the flume and surrounding area near Baumgardner's Mill, which interval is now well exposed in the Williams Quarry.

		Echinoderm Zonules
Lepidocentrus zone		
Cladopora zonule	24"	
Hexacrinus zone		Desmidocrinus zonule
Eatonia zonule	20"	
Trigonotreta zone (=Tenticospirifer)		
Cyrtoceras zonule	10"	
Symbathocrinus zonule	4"	Belanskicrinus zonule
Stropheodonta zonule	94"	
Poteriocrinus zonule (stems)	31"	Stems only
Agelacrinites faunule	no stratum	
Aulopora zone		Agelacrinites zonule
Pachyphyllum zonule	24"	
Dolomite zonule	121"	

Fauna of the *Desmidocrinus* zonule:—*Hexacrinus springeri* Thomas, 1924, has been referred to *Desmidocrinus* by Strimple, 1963. The only other reported species is *Hexacrinus iowensis* Thomas, 1924, which is only known from a dorsal cup that does not appear to have arm plates incorporated in the cup.

Fauna of the *Belanskicrinus* zonule:—*Bactrocrinus westoni* Belanski, 1928, has been assigned to *Belanskicrinus* by Strimple and Levorson, 1969. The type locality is probably an abandoned quarry in the southern part of Nora Springs. Two other localities were listed by Belanski. Material studied by Strimple and Levorson (*ibid.*, p. 19) was obtained in the north wall of Williams quarry. *Nassoviocrinus goldringae* Belanski, 1928, was found by that author on a slab from the abandoned quarry in Nora Springs next to *Belanskicrinus westoni*. It was referred to the genus *Quantoxocrinus* by Strimple & Levorson. No *Symbathocrinus* = *Synbathocrinus* has been found in the Belanski collection or in other collections from the Shell Rock.

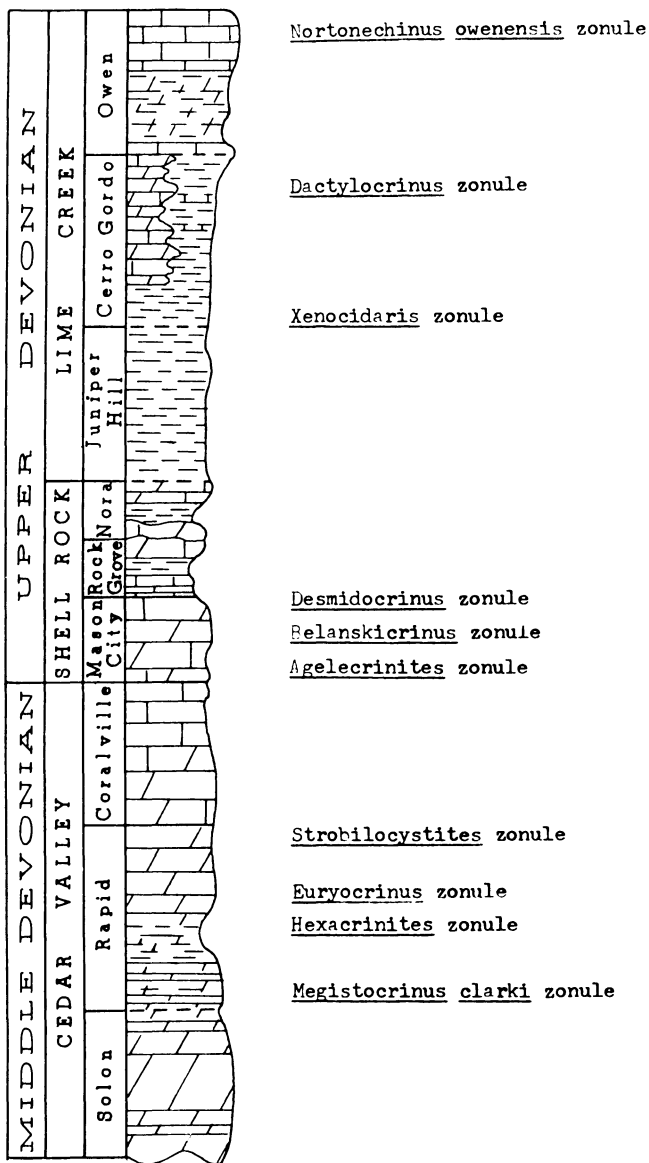


Figure 1. Chart showing echinoderm zonation of the Devonian of Iowa.

Fauna of the *Agelacrinites* zonule:—A report on the *Agelacrinites* zonule at Williams Quarry was made by Koch and Strimple, 1968, and will not be repeated here. *Adocetocystis williamsi* Strimple and Koch, *Agelacrinites hanoveri* Thomas, ?*Agelacrinites* sp., *Strobilocystites calvini* White, 1876, have been found in close association. *Strobilocystites schucherti* Thomas may be an immature *S. calvini* and is from or slightly above the same horizon.

#### ECHINODERMS OF THE CEDAR VALLEY

Most of the echinoderm assemblages are within the Rapid Member of the Cedar Valley Formation and have been recognized in the vicinity of Iowa City, Johnson County. The *Strobilocystites* zonule is near the top and is followed (usually 8' to 10' below) by a coral biostrome. The *Euryocrinus* zonule is about 4' to 7' thick and is below the coral biostrome. Stratigraphic placement of the *Hexacrinites* zonule is questionable but is thought to be upper middle or lower upper Rapid.

Fauna of the *Strobilocystites* zonule:—*Agelacrinites fentonae*, *Botryocrinus* sp., *Halysiocrinus* sp., *Megistocrinus fitzpatricki*, *M. latus*, *M. pernodosus*, *Melocrinites nodosus*, *Nucleocrinus bondi*, *Stereocrinus bentonensis*, *S. harberti*, *S. triangularis liratus*, *Strobilocystites calvini*, *Taxocrinus interscapularis*.

Fauna of the *Euryocrinus* zonule:—*Botryocrinus thomasi*, *Decadocrinus crassidactylus*, *D. pachydactylus*, *D. spinulifer*, *Euryocrinus barrisi*, *Eutaxocrinus gracilis*, *Halysiocrinus barrisi*, *H. carinatus*, *H. elephantinus*, *Megistocrinus farnsworthi*, *M. fitzpatricki*, *M. latus*, *Nucleocrinus obovatus*, *Poteriocrinites buffaloensis*, *Synbathocrinus matulinus*.

Fauna of the *Hexacrinites* zonule:—*Decadocrinus* sp., *Hexacrinites occidentalis*, *Palaester* n. sp., *Arthacantha* sp.

Fauna of the *Megistocrinus clarki* zonule:—*Megistocrinus clarki*, *M. merrilli*, *Melocrinites nodosus irregularis*, *Stereocrinus littletonensis*.

Stratigraphically undifferentiated Rapid fauna:—*Decadocrinus vintonensis*, *Megistocrinus nodosus*, *M. robustus*, *Melocrinites tiffanyi*, *M. linderi*, *Nucleocrinus elegans*, *N. meloniformis*, *Stereocrinus triangulatus*, *Strobilocystites polleyi*, *S. schucherti*.

#### ECHINODERMS OF THE THUNDER BAY FORMATION, MICHIGAN

There have been 21 species and 1 subspecies, divided among 11 genera, reported from the Thunder Bay Limestone. Eight of the species and one subspecies have been reported from the Rapid Member, Cedar Valley Formation; however, *Synbathocrinus matulinus*, which was formerly reported from the Thunder Bay, has

been referred to a new species by Kesling and Smith (1963). The percentage of conspecific forms found in both formations is rather low, which, together with the existence of transitional forms between *Dolatocrinus* and *Sterocrinus* found in the Thunder Bay Limestone, has led to the conclusion that the echinoderm fauna is probably slightly older than the upper Rapid fauna.

One species, *Halysiocrinus carinatus* has been reported from the Rapid Member, Cedar Valley Formation of Iowa, Alpena Formation of Michigan and Sellersburg Formation of Indiana. *Megistocrinus nodosus* has been reported from the Rapid Member, Cedar Valley Formation of Iowa and the Thunder Bay and Alpena Formations of Michigan. *Halysiocrinus barrisi* has been reported from the Rapid Member, Cedar Valley Formation of Iowa and the Alpena Formation of Michigan.

Seven species of echinoderms have been reported from the Calloway Formation (=Mineola Limestone) of Missouri but none of them are conspecific with those from Michigan, Iowa, or Indiana. No effort has been made to investigate the validity of their specific identities.

Based on conodont zonation, (personal communication, G. Klapper) the Mineola Formation of Missouri, Tully formation of New York, Cedar Valley Formation of Iowa and the Thunder Bay Formation are considered correlatives; however, conodonts have not been thoroughly studied from the echinoderm horizon at Thunder Bay, Michigan, which is the type locality of the Formation.

Echinoderms from the Thunder Bay Formation are: *Aoracrinus casedayi* (Lyon), *Botryocrinus thomasi*, *Codaster gracile* (Wachsmuth), *Dactylocrinus alpena* Springer, *Dolatocrinus asterias* Wood, *Dolatocrinus tridactylus* Barris, *Euryocrinus barrisi* Springer, *Lipsanocystis traversensis* Ehler & Leighly, *Megistocrinus concavus* Wachsmuth, *Megistocrinus multidecoratus* Barris, *Megistocrinus nodosus* Barris, *Megistocrinus novus* Wood, *Megistocrinus tuberatus* Wood, *Nucleocrinus elegans?* Conrad, *Nucleocrinus meloniformis* (Barris), *Nucleocrinus obovatus* (Barris), *Pentremitidea americana* Barris, *Pentremitidea milwaukensis* Weller, *Stereocrinus barrisi* Wachsmuth & Springer, *Stereocrinus triangulatus* Barris, *Stereocrinus triangulatus liratus* Barris, *Synbathocrinus matutinus* Hall = *S. sp. cf. S. michiganensis* after Kesling & Smith.

#### ECHINODERMS OF THE MINEOLA FORMATION OF MISSOURI

Correlation notes have been given in the preceding section. Species are: *Megistocrinus missouriensis* Branson & Wilson, *M. mineolaensis* Branson & Wilson, *M. broadheadi* Branson & Wilson, *Nucleocrinus verneuili* (Troost) Branson & Wilson, *Stereocrinus moori* Branson & Wilson, *S. springeri* Branson & Wilson, *S. vanderveri* Branson & Wilson.

## NOTES ABOUT SYNATHOCRINUS

The holotype of *Synathocrinus matutinus* Hall (1855, p. 483) was reported by Thomas (1920, p. 476) to be from the *Strophodontia demissa* bed in the Cedar Valley Limestone exposed near New Buffalo (now Buffalo), Iowa. Several specimens collected by Belanski from the vicinity of Buffalo, Iowa are in the Repository of the Geology Department, the University of Iowa. In addition, a specimen was collected by the writer from the Rapid Member at the Donovan quarry northeast of Iowa City, Iowa. Specimens of *S. matutinus* have formerly been reported from the Thunder Bay Limestone, but in an extensive study by Kesling and Smith (1963) it was reported that no specimens were located from that formation. *Synathocrinus* sp. cf. *S. michiganensis* was reported (ibid, p. 189) from the Thunder Bay Limestone.

*Synathocrinus michiganensis* Kesling & Smith, 1963, is from the Dock Street Clay, Four Mile Dam Formation, which is known to be older than the Cedar Valley Formation.

*Synathocrinus expansus* Goldring, 1935, from the Tully Formation and the other species discussed above, have one feature in common, i.e., a low, wide cup. Species from older strata, as well as younger strata, have proportionately higher cups with more erect sides.

## NOTES ABOUT DOLATOCRINUS AND STEREOCRINUS

Strimple (1963, p. 10) suggested the term "*portentum*" be applied to modifications in crinoid structure that reflect features which in the course of time and evolution became diagnostic characters at the generic level. Within the family Dolatocrinidae the genus *Dolatocrinus* typically has two primibrachs in each ray, and the younger genus *Stereocrinus* has only one primibrach in each ray. Kesling & Mintz, 1963, reported instances of *portentum* for the genus *Dolatocrinus* wherein one or two rays have axillary primibrach 1. This condition is rare in specimens from the Dock Street Clay and is fairly common in those from the Thunder Bay Limestone. They suppressed the variable *Dolatocrinus triadactylus*, a Thunder Bay species, as a synonym of *Stereocrinus triangulatus*, the type species of *Stereocrinus* from the Cedar Valley Formation, in order to establish the existence of a variable condition for the species and therefore for the genus *Stereocrinus*.

When dealing with large populations there are always a few specimens which are variable, particularly when an evolutionary change is imminent. There has never been any doubt that *Stereocrinus* evolved directly from the slightly older *Dolatocrinus* and it is significant that *Stereocrinus* is common in late Middle Devonian rocks (Rapid and Callaway = Mineola) whereas *Dolatocrinus*

has not been observed in them. The change from axillary primibrach 2 to axillary primibrach 1 is generally considered to be of generic stature. It is proposed here to retain *Dolatocrinus tridactylus* as a valid species, recognizing occasional variants (portentum) in the number of primibrachs in one or two rays. *Stereocrinus* is recognized as a valid genus with the understanding that a large population might disclose a few specimens that retain the axillary primibrach 2 in one or two rays.

It is postulated that the Thunder Bay Limestone is slightly older than the *Stereocrinus* bearing Rapid and Callaway (= Mineola).

#### CURRENT STUDIES

Field work is being carried out in north central Iowa in Upper Devonian rocks by Cal Levorson and research on the material is being done by Strimple and Levorson.

Considerable material has been recovered in recent years by various staff members and graduate students in the Rapid Member, Cedar Valley Formation, Middle Devonian, in the vicinity of Iowa City. Many crinoids and cystoids have been found at Vogel Quarry north of Iowa City. A small colony of small *Melocrinites nodosus* with arms attached has been found on the Coralville Dam and more recently another sizeable colony has been recovered at Klein Quarry west of Iowa City. Occasional crowns (calyx with arms attached) of *Megistocrinus* sp. have been found.

Recently, the first ophiuroid found in the Devonian of Iowa was discovered in the lower portion of the Cedar Valley formation by Roger Rudesill at Mahaffey Bridge, north of North Liberty.

Last year (1969) the presence of crinoids in the Wedling Bros. Quarry north of Moscow, Iowa in the middle Cedar Valley Formation was discovered by Jan Schroeder. Mike McGinnis and Amel Priest recovered crowns of *Hexacrinites* sp. and one excellent starfish. Strimple and Priest excavated the pocket and recovered additional specimens. Cecilia Duluk found two partial calyces of *Anthrachantha* sp. in a slightly different zone. The genus has previously been known only from disarticulated plates.

During 1969, Don Koch of the Iowa Geological Survey found a small colony of *Megistocrinus* sp. crowns in the lower Cedar Valley in an abandoned quarry near Solon. The complete stem, including a root-like anchor, is present on one specimen.

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