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The College

AS News

## Jim Brower

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**Brower CV**

## Research and Interests

My current research is centered on the paleobiology of Paleozoic crinoids and some blastozoan echinoderms. The Ordovician was a critical interval in the evolution of crinoids because all four Paleozoic subclasses appeared within about 30 million years. By the end of this time, crinoids had acquired a considerable amount of morphological disparity, developed most of the life styles and ecological strategies seen in later Paleozoic

crinoids, and invaded a wide variety of marine environments ranging from the shoreface to comparatively deep water. My approach is multidisciplinary and integrates geology, paleontology, biology, statistics, and mathematical modeling. Ongoing and recent research projects involve taxonomy, phylogeny, growth, functional morphology, paleoecology, and evolutionary ecology. Two current research projects are briefly outlined below. Over the years, my research has been supported by the National Science Foundation, The Petroleum Research Fund of the American Chemical Society, and Syracuse University.

## Current Research Projects

**Phylogeny and Taxonomy:** Although restricted to eastern North America, the Glyptocrinidae is one of the most important families of Lower Paleozoic camerate crinoids. Glyptocrinids were highly successful during the Upper Ordovician, and they are the most common camerates in many localities. Members of the family were widely distributed ecologically, and they extended from deep water below storm wave base to shallow areas near fair weather wave base as in some glyptocrinid beds. Although generalized ecologically, glyptocrinids only exploited a few life habits. As in all crinoids, glyptocrinids were passive suspension feeders that collected microscopic food particles from the surrounding water currents by direct interception with their tube feet. Their narrow food grooves limited them to feeding on a narrow range of small food particles that were generally less than approximately 130 microns in diameter. Based on the preserved food grooves and covering plates in conjunction with analogies from modern crinoids, it is possible to reconstruct the nature of the tube feet of fossil glyptocrinids. Their short, stiff and closely spaced food-catching tube feet were suitable for catching food particles over a wide range of current velocities which vary from several up to over 30 cm per second. The most common attachment device in the family was an open distal stem coil that lay directly on the

seafloor or was loosely coiled around a soft object such as a sponge.

The ancestry of the family is uncertain and remains to be determined. Relationships within the family are being investigated with statistical cladistic and phenetic methods. Considerable revision is needed to develop a phylogenetic taxonomy for the family. The origination of the Glyptocrinidae was explosive and six of the seven Ordovician genera appear during an interval of about a million years. Two poorly preserved descendent genera are found in the Lower Silurian. The Glyptocrinidae was ancestral to some important Silurian and Devonian lines of ancestry and descent, such as the Steliocrinidae, the Patelliocrinacea, and the Melocrinidae.



Complete small specimen of *Pycnocrinus argutus* (Walcott) from the Upper Ordovician Walcott-Rust Quarry of New York. The entire crinoid is about 32 mm high.



Crown and short stem segment of undescribed species of *Pycnocrinus* from the Upper Ordovician Martinsburg Formation near New Paltz, New York. The crown is 30 mm high.

### **Allometric Growth and Functional**

**Morphology:** Pleurocystitids are strange rhombiferan echinoderms that developed a flattened theca in response to life on the seafloor. Wagging, sculling or sinusoidal movements of the stem from side to side could have slowly pushed or pulled the animal along the seafloor in a “Rube Goldbergish” fashion. The food grooves and their tube feet faced the substrate and they probably used their tube feet to feed on microscopic organisms and organic detritus on or just below the surface of the sediment. Respiration of the theca was most likely carried out by the pore rhombs and cloacal pumping as in some living echinoderms. The cloacal pump of pleurocystitids was provided by the flexible integument studded with small plates on the bottom of the theca facing the seafloor.

Abundant specimens of *Pleurocystites beckeri* Foerste from the Upper Ordovician Maquoketa Formation of northern Iowa are highly suitable for the study of allometric growth and functional morphology. Pore rhombs are lacking in the smallest individuals with thecal heights of about 6 mm. The initial pore rhombs are seen in slightly larger specimens. By the time the theca is about 14 mm high, all three pore rhombs are present and each contains a small number of pore slits. Allometric growth adds new pore slits and increases the length of old ones in progressively larger thecae with heights up to 60 mm. All thecal respiration of the smallest specimens of *P. beckeri* was by cloacal pumping, but the pore rhombs on the upper side of the theca become progressively more important in larger specimens. Data from living echinoderms, especially holothurians, will be employed to model the respiratory budgets of *P. beckeri* at various sizes and ages.





Large specimen of *Pleurocystites beckeri* showing lower side of theca having flexible integument studded with small plates used for cloacal respiration. Height of theca is 48 mm.



Small specimen of *Pleurocystites beckeri* with three pore rhombs and relatively small number of pore slits. Height of theca is 14 mm.



Adult specimen of *Pleurocystites beckeri* with three pore rhombs and numerous pore slits. Height of theca is 48 mm.



Large slab with complete crinoids from the Upper Ordovician Dunleith Formation of southern Minnesota. The slab is about 36 cm long.

## Selected Recent Publications

2000a Seriation of an original data matrix as applied to biostratigraphy, p. 72-85. In H. S. Pandalai and P. K. Sarawati (editors), *Geological data analysis: Statistical methods*, (Volume of papers in honor of Professor B. K. Sahu), *Recent Researches in Geology*, v. 18, Hindustan Publishing Corporation (India), New Delhi.

2000b In conjunction with C. R. Newton and N. Bonuso. Statistical methods for determining community structure and stasis: Devonian Hamilton Group, central New York. *Geological Society of America Abstracts Volume for 2000*, v. 32, no. 7, p. A96.

2001a Flexible crinoids from the Upper Ordovician Maquoketa Formation of the northern Midcontinent and the evolution of early flexible crinoids. *Journal of Paleontology*, 75, p. 370-382.

2001b In conjunction with D. F. Merriam. Thematic map analysis using multiple regression. *Mathematical Geology*, v. 33, no. 3, p. 353-368.

2002a *Cupulocrinus angustatus* (Meek and Worthen), a cladid crinoid from the Upper Ordovician Maquoketa Formation of the northern midcontinent of the United States. *Journal of Paleontology*, v. 76, p. 109-122.

2002b In conjunction with N. Bonuso, C. R.

Newton and L. C. Ivany. Statistical testing of community patterns: uppermost Hamilton Group, Middle Devonian (New York State: U.S.A.). *Palaeogeography, Palaeoclimatology, Paleoecology*, v.185, p. 1-24.

2002c *Quintuplexacrinus*, a new cladid crinoid genus from the Upper Ordovician Maquoketa Formation of the northern midcontinent of the United States. *Journal of Paleontology*, v. 76, p. 993-1006.

2002d In conjunction with N. Bonuso, C. R. Newton and L. C. Ivany. Does coordinated stasis yield taxonomic and ecologic stability?: Middle Devonian Hamilton Group of central New York. *Geology*, v. 30, p. 1055-1058.

2005 The paleobiology and ontogeny of *Cincinnatiacrinus varibrachialus* Warn and Strimple, 1977 from the Middle Ordovician (Shermanian) Walcott-Rust Quarry of New York. *Journal of Paleontology*, v. 79, p. 152-174.

2006 Ontogeny of the food-gathering system in Ordovician crinoids. *Journal of Paleontology*, v. 80, p. 430-446.

2007a Upper Ordovician crinoids from the Platteville Limestone of northeastern Iowa. *Journal of Paleontology*, v. 81:103-115.

2007b In conjunction with N. I. Azzolina, D. I. Siegel, S. D. Samson, M. H. Otz, and I. Otz. Can the HGM Classification of small, non-peat forming wetlands distinguish wetlands from surface water geochemistry? *Wetlands*, v. 4, no. 4, p. 884-893.

2007 The application of filtration theory to food gathering in Ordovician crinoids. *Journal of Paleontology*, v. 82:1281-1297.

2008a Some disparid crinoids from the Upper Ordovician (Shermanian) Walcott-Rust Quarry of New York. *Journal of Paleontology*, v. 82:56-76.

2008b Systematics and paleoecology of *Haptocrinus buttsi*, a new species of disparid crinoid from the Upper Ordovician Hatter Limestone of central Pennsylvania. *Journal of Paleontology*, v. 82:576-584.

2008c Euclidean Distances and Singular Value Decomposition: Useful Tools for Geometric Morphometrics in Biology and Paleontology, p. 393-415. In G. Bonham-Carter and Qiuming Cheng (eds.), Progress in Geomathematics. Springer-Verlag, Berlin.

2010 Camerate and cladid crinoids from the Upper Ordovician (Katian, Shermanian) Walcott-Rust Quarry of New York. *Journal of Paleontology*, v. 84:626-645.

2011 Paleoeecology of Suspension-Feeding Echinoderm Assemblages from the Upper Ordovician (Katian, Shermanian) Walcott-Rust Quarry of New York. *Journal of Paleontology*, v. 85:369-391.

In press. Paleoeecology of echinoderm assemblages from the Upper Ordovician (Katian) Dunleith Formation of northern Iowa and southern Minnesota. *Journal of Paleontology*.

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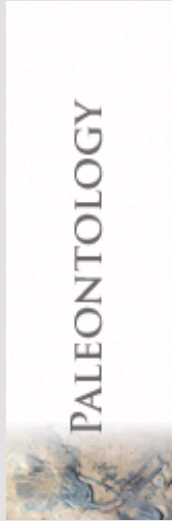
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