

NEW UPPER ORDOVICIAN ECHINODERM SITE: BULL FORK FORMATION, CAESAR CREEK RESERVOIR (WARREN COUNTY, OHIO)¹

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ABSTRACT. The Emergency Spillway of Caesar Creek Reservoir (Warren County, Ohio) exposes 21.3 m of the middle Bull Fork Formation (Peck 1966). Eight echinoderm genera from 2 classes have been recovered from this section including the crinoids *Cincinnatiocrinus pentagonus*, *Cupulocrinus polydactylus*, *Dendrocrinus casei*, *Dendrocrinus* sp., *Gauvocrinus nealli*, *Lichenocrinus* sp. and *Xenocrinus* sp. and the stelleroids *Kenothecaster* sp. and (?) *Petraster* sp. Stratigraphic position and notes on the depositional environment are given for each echinoderm occurrence.

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INTRODUCTION

Caesar Creek Reservoir, located 64 km northeast of Cincinnati, Ohio, is one of several flood control reservoirs planned in the 1930s by the U. S. Army Corps of Engineers. In the early 1970s during construction of the reservoir, 61 m of Upper Ordovician sedimentary rocks were exposed. The upper 21.3 m of this section are exposed in the Emergency Spillway and are assigned to the Bull Fork Formation, Richmondian Stage. In addition to numerous species of fossil invertebrates, this locality has produced fossil specimens of 2 echinoderm classes including 8 genera (Ausich and Schumacher 1980). We are presenting additional information on this section. Despite the fact that amateur paleontologists have collected this locality, it has not been formally described in the scientific literature. Also in many instances at this site, the exact stratigraphic position of echinoderm occurrences is known. This type of information is vital for a more thorough understanding of the paleoecology, biostratigraphy and taxonomy of these organisms.

Fossil specimens studied for this report are deposited in the collections of the University of Cincinnati Geology Museum.

STUDY SITE AND STRATIGRAPHY

The Caesar Creek spillway is located at longitude 84° 3' 33" W, and latitude 39° 29' 30" N in Massie Township, Warren County, Ohio (Oregonia, 7.5-minute Quadrangle, WSU-64; Wright State locality number) (fig. 1). Several independent systems of stratigraphic names have

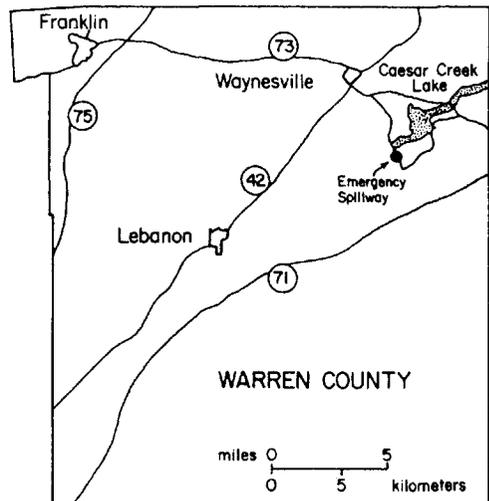


FIGURE 1. Map of Warren County, Ohio, illustrating the location of the Caesar Creek Emergency Spillway.

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been used for subdividing the Cincinnati Series, including the informal biostratigraphic nomenclature of Caster et al. (1955), the nomenclature adapted by the Indiana Geological Survey (Brown and Lineback 1966), and the nomenclature of Peck (1966) (fig. 2). This report will use the formal nomenclature of Peck (1966) supplemented by Caster et al. (1955) for a more exact placement of the spillway section. Accordingly, the rocks under consideration are situated in the middle of the Bull Fork Formation.

The second and third *Glytorthis insculpta* (Hall) fossil zones (fig. 3) as defined by Caster et al. (1955) were located within the Caesar Creek Spillway section. Stratigraphically these zones range from the uppermost Waynesville Formation to the lower one-third of the Liberty Formation. The lower, middle and upper units of the Bull Fork Formation defined in fig. 3 correspond to the upper Waynesville, Liberty

and lower Whitewater formations of Caster et al. (1955).

The spillway section is subdivided into 3 lithologic units. The basal 6.1 m (Upper Waynesville Formation) are predominantly calcareous blue-gray shales with gray fossiliferous limestone lenses (packstones of Dunham (1962)). This portion of the spillway section is generally interpreted to have been deposited in a lower energy environment below normal wave base with periodic disturbances by storms. Supporting evidence for a lower energy environment consists of a lack of wave-rippled limestones, shingled brachiopods, broken and abraded fossils and cross-bedded limestones. However, the presence of graded beds, partly winnowed limestones, and well preserved echinoderms indicates high energy sedimentologic events such as storms influenced the unit periodically. Kreisa et al. (1981) reported evidence of storms in Caesar Creek limestones, and Fox (1962) had a similar interpretation for the same stratigraphic interval in southeastern Indiana.

The middle 6.1 m (Liberty Formation) (266.7-272.8 m) are characterized by roughly equal amounts of grey fossiliferous limestone (packstones and grainstones of Dunham (1962)) and calcareous blue-gray shale. This unit represents a transitional zone between the lower energy unit below and the higher energy unit above. This interpretation is based on the increased number of limestone beds which have been winnowed of most, if not all, of the silt and clay size material, rare wave-rippled limestones, shingled brachiopods, and an increase in abraded and broken fossils from the previous unit.

The upper 9.1 m (Whitewater Formation) (272.8-282.0 m) are characterized by wavy-bedded argillaceous limestones with thin discontinuous calcareous shale interbeds. Higher energy conditions are inferred for this unit on the basis of abundant completely winnowed limestones (grainstones), lower faunal diversity, increase in encrusting bryozoans, cross laminations, and abraded fossils.

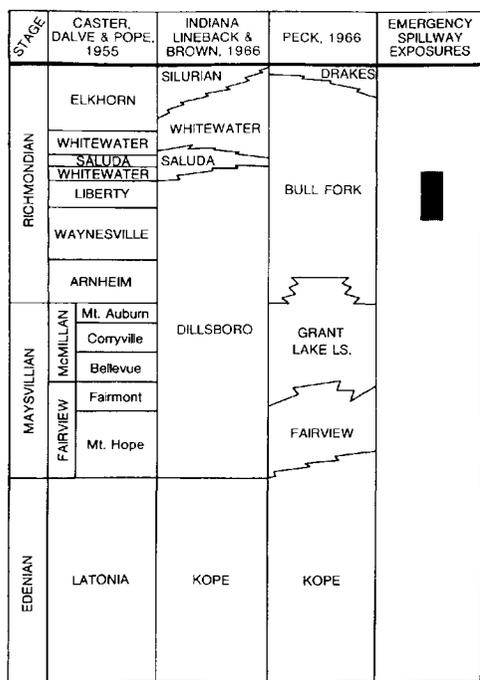


FIGURE 2. Correlation chart for stratigraphic nomenclatures applied to Upper Ordovician rocks in the vicinity of Cincinnati, Ohio.

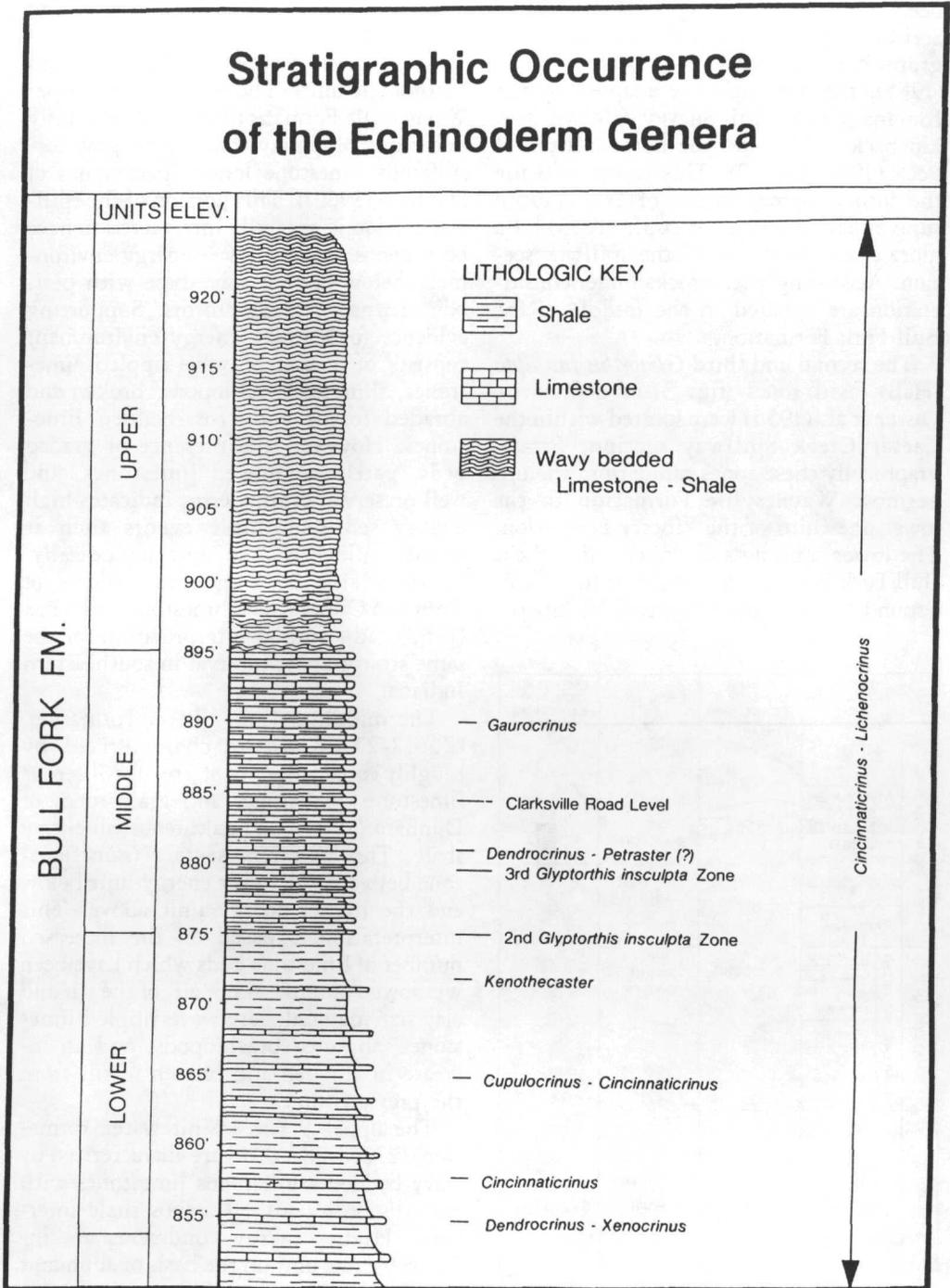


FIGURE 3. Stratigraphic occurrence of echinoderm genera at Caesar Creek Emergency Spillway.

ECHINODERMS

Eight echinoderm genera (one represented by a crinoid holdfast) are recorded from the 21.3 m of the Bull Fork Formation at Caesar Creek. In most cases, well preserved echinoderms were found in localized lenses at discrete stratigraphic levels.

The lowest occurrence of complete echinoderms is a lens at the 256.5-m level. At this position, 2 specimens of the crinoid *Dendrocrinus* sp. and 9 specimens of *Xenocrinus* sp. were found in a siltstone capping a thin argillaceous limestone (packstone). The crinoid preservation is excellent. Complete or nearly complete crowns with one to 3 cm of column, scattered individuals or groups of *Xenocrinus* sp. arms with delicate pinnules, and articulated column segments up to 10 cm are preserved. The associated fauna consists of ramose bryozoan fragments, *Flexicalymene meeki* (Foerste) and *Isotelus* sp. fragments, *Lepidocyclus capax* (Conrad), *Zygospira modesta* (Hall), *Platystrophia clarksvillensis* (Foerste), *Caritodens demissa* (Conrad), scolecondonts, and pascichnia trace fossils. The limestone is composed of trilobite fragments, crinoid columnals, complete and fragmented brachiopod valves, ostracod valves, and ramose bryozoan fragments. The limestone's lower surface displays sole marks and possible ripple marks.

Working with comatulid crinoids, Meyer (1971) and Liddell (1975) demonstrated that pinnules and distal arm segments disarticulated within a day or 2 after death. The complete crinoid skeleton disarticulated within 6 days if left exposed on the sea floor. However Liddell (1975) demonstrated that buried specimens showed no signs of degradation at all after 6 days. Both workers concluded rapid burial is a prerequisite for complete echinoderm preservation. In accordance with these taphonomic considerations, specimens with complete arms with delicate pinnules are interpreted to have been buried rapidly. Similar graded beds have been described from the Upper Martinsburg Formation of southwestern Virginia (Kreisa 1981) and

from Caesar Creek (Kreisa et al. 1981). Kreisa interpreted these fining upward sequences as storm deposits. We agree with this interpretation as a burial mechanism for this crinoid occurrence.

At 257.4 m, 3 specimens of the crinoid *Cincinnatiocrinus pentagonus* (Ulrich) were found weathered from a gray calcareous shale. Each specimen retains the calyx and roughly one cm of column. Because the specimens were not found *in situ*, no associated fauna could be determined. This unit was deposited under low energy conditions based on the earlier discussion for the shales of the basal unit (Waynesville Formation).

Lenses most productive in echinoderms occur at approximately the 259.5-m level. Twenty-four specimens of the crinoid *Cupulocrinus polydactylus* (Shumard) and 2 specimens of *Cincinnatiocrinus pentagonus* were collected from weathered float. Preservation of *Cupulocrinus polydactylus* ranged from complete crowns with 3 cm of column attached to crowns with no columnals and only primibrachials intact. *Cincinnatiocrinus pentagonus* was preserved with a few columnals attached to the calyx. Fragments of *Flexicalymene meeki*, *Isotelus* sp., ramose bryozoans, *Caritodens demissa*, *Ambonychia* sp. and *Thaodontia clarksvillensis* (Foerste) were found associated with the crinoids at this level. Because the exact stratigraphic position of this occurrence is unknown, no environmental interpretation can be given.

At the 261.6-m level, a partial specimen of the stelleroid *Kenothevester* sp. was found in a massive gray-blue calcareous shale bed. Other fossils found in this bed include *Flexicalymene meeki*, *Isotelus* sp., *Zygospira modesta*, *Orthonybyoceras* sp., and *Loxoplocus bowdeni* (Safford). This shale bed can be inferred to have been deposited in low energy conditions because of whole unabraded fossils and even bedding.

One specimen of the crinoid *Dendrocrinus casei* (Meek) and the stelleroid (?) *Petraster* sp. were found on a limestone bedding plane at the 264.3-m level. The

nearly complete *Dendrocrinus casei* crown (only the distal most brachials are missing) and roughly one-half of a (?) *Petraster* sp. specimen indicate this bedding plane was buried rapidly, probably by storm action. Ramose bryozoans fragments, unidentified brachiopod fragments, and fine silt-size material compose the remainder of the bedding plane.

At the 267.0-m level, 2 specimens of *Gaurocrinus nealli* (Hall) were found. One individual was weathered free in the float, whereas the other was discovered in a thin, barren (except for *Gaurocrinus nealli*) shale bed. Both *Gaurocrinus nealli* specimens were preserved with the calyx, partial arms with pinnules and with no column. The preservation represented at this level is nearly identical to that of the *Xenocrinus-Dendrocrinus* occurrence. This shale probably represents a storm deposit, based on the earlier environmental discussion for the *Xenocrinus-Dendrocrinus* occurrence.

In addition to these specific occurrences, the crinoid *Cincinnatiocrinus pentagonus* represented by abundant column sections and the crinoid holdfast *Lichenocrinus* sp. were found at stratigraphic positions scattered throughout the entire section at Caesar Creek Spillway.

This report is a pilot study on the echinoderms from exposures near Caesar Creek Reservoir. An understanding of the stratigraphic occurrences and community associations of echinoderms here and elsewhere will lead to a better appreciation of the paleoecology, biostratigraphy and taxonomy of these animals throughout Upper Ordovician strata.

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