

## A New Crinoid Fauna from the Harrodsburg Limestone (Mississippian) of Southern Indiana

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### *Abstract*

A recently discovered crinoid fauna from the lower three meters of the Harrodsburg Limestone (Osagian; Mississippian) along Judah Branch, southern Monroe County, Indiana, provides new evidence for the age relations of the Bono and Canton crinoid faunas in Indiana. Fossils from Bono, Lawrence County, and Canton, Washington County, were collected in the 19th century and these localities and their stratigraphic positions are not now known. The new site has yielded 15 species of crinoids, nine of which have been reported from Canton and three from Bono. Other species found include one known from the Ramp Creek Formation below the Harrodsburg and one also found in the Salem Limestone above. This new locality thus supports the hypothesis of Lane (1972) that the Canton fauna is of early Harrodsburg age and that the Bono fauna is slightly younger, but also of Harrodsburg age. The Judah Branch fauna is almost equally divided between inadunate crinoids (8 species) and camerates (6 species) with one flexible crinoid. The fauna is thus intermediate in terms of community evolution between the Canton fossils, dominated by inadunates, and the Bono crinoids, in which camerates are predominant.

### Introduction

During the latter part of the 19th century a series of Mississippian age crinoid faunas were described from Indiana that were typically attributed to what was called a "Keokuk" age. This meant that these Indiana rocks and fossils were judged to be of the same age as the Keokuk Limestone, the uppermost formation of the Osagian series of the Mississippian, which crops out along the west side of the Illinois Basin. This crude correlation included rocks that were limestones as well as siltstones and shales and there was little attempt to relate these various Indiana faunas to each other. One such attempt resulted in placement of these crinoid faunas in an upside-down sequence (1).

Two of these important crinoid faunas were described from Canton and Bono, Washington and Lawrence counties, Indiana. These localities have been lost for many years and attempts to rediscover the levels from which crinoids were collected have so far been unsuccessful. This paper reports for the first time the definite occurrence of elements of both of these older faunas in the lower part of the Harrodsburg Limestone, thus providing firm evidence that it was at or near this stratigraphic position from which both of the older faunas were obtained.

Although much of the Harrodsburg Limestone is crinoidal limestone, occurrences of articulated, well-preserved crinoids are rare. This is unfortunate because the Harrodsburg marks a major environmental and depositional change from deltaic sedimentation (Borden Group) to a shallow-water carbonate bank (Salem Ls.), and important changes in the composition of crinoid faunas occur within this interval (2).

### Stratigraphy

The Harrodsburg Limestone is the middle unit of the Sanders Group (4) and grades into the overlying Salem Limestone and underlying Ramp Creek Formation, which together make up the Sanders Group. The new crinoid fauna (Table 1) was found 2.5 m above the Ramp Creek Fm. (fig. 1), which is commonly called part of the lower Harrodsburg in older literature. This fauna, along with fossil crinoids from Canton and Bono, constitute the youngest crinoids known from the Osagian Series of the Mississippian. The Osage-Meramec boundary occurs someplace in the middle of the Harrodsburg Limestone. Crinoids from the Ramp Creek on Indian Creek, Montgomery Co., Indiana, and from the lower Harrodsburg record youngest occurrences of Osagian crinoids known. Several genera and families of crinoids become extinct after final appearances in the Ramp Creek or lower Harrodsburg. One suborder, the dicyclic camerate crinoids Diplobathrida, is also last represented in these faunas. The upper Harrodsburg Limestone contains a

TABLE 1. *Fauna from the Harrodsburg Limestone at Judah Branch Creek roadcut, Monroe County, Indiana.*

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#### *Crinoids*

Abrotocrinus orestes (Worthen)  
 Abrotocrinus sp.  
 Baryocrinus cf. B. stellifer Miller  
 Cribanocrinus benedicti (Miller)  
 Cyathocrinites gurleyi (Miller)  
 Cyathocrinites harrodi (Wachsmuth & Springer)  
 Cyathocrinites nodosus (Wachsmuth & Springer)  
 Decadocrinus bellus (Miller & Gurley)  
 Dichocrinus simplex (Shumard)  
 Dichocrinus ulrichi Miller & Gurley  
 Dizygocrinus cantonensis (Wachsmuth & Springer)  
 Dizygocrinus facetus (Miller & Gurley)  
 Forbesiocrinus cf. F. washingtonensis Miller & Gurley  
 Histoocrinus sp.  
 Hylodeocrinus asper Kirk  
 Hypselocrinus hoveyi (Worthen)  
 Platyrcrinites bonoensis (White)

#### *Other Echinoderms*

Cryptoblastus sp.  
 Onychaster sp.  
 Postibulla legrandensis (Miller & Gurley)  
*Other Invertebrates*  
 Cladochonus beecheri (Grabau)  
 Cleiothyridina hirsuta (Hall)  
 Echinococonchus alternatus (Norwood & Pratten)  
 Fenestrate bryozoans  
 Fistulipora compressa Rominger  
 Fistulipora spergenensis Rominger  
 Ovatia ovata (Hall)  
 Phillipsiid sp.  
 Platyceras (Orthonychia) sp.  
 Spirifer tenuicostatus Hall  
 Spirifer washingtonensis Weller  
 Sulcoretepora, sp.  
 Zaphrentoides sp.

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crinoid fauna that is Meramecian in aspect and is closely similar to that of the overlying Salem Limestone.

The Osagian-Meramecian boundary is one of the most important boundaries for change in fossil crinoids in the entire Paleozoic sequence. These two series names are commonly grouped together into the Valmeyeran Series, or Middle Mississippian, but because of the paleontological significance of this boundary Osagian and Meramecian are preferred here to Valmeyeran.

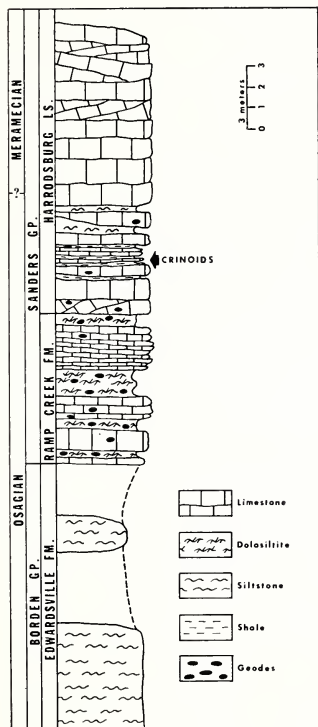


FIGURE 1. Measured section on Bypass SR 37 at Judah Branch Creek showing the stratigraphic location of the Harrodsburg crinoid fauna (at arrow). Section starts in the bed of Judah Branch Creek and extends south up the hill to the top of the roadcut. Contact between the Harrodsburg and overlying Salem Ls. is not exposed. Exact position of the Osagian-Meramecian boundary is uncertain.

### Locality Description

This fauna comes from a roadcut on the SR 37 bypass where it ascends the hill on the south side of Judah Branch Creek, in the NE $\frac{1}{4}$ , SE $\frac{1}{4}$  sec. 32, T. 7 N., R. 1 W.: Monroe County, Indiana, Indiana University Locality No. 13395. The locality was originally discovered by Alan S. Horowitz (Indiana University) and Donald B. Macurda (University of Michigan) in the summer of 1974; subsequent quarrying at the site produced much additional material.

Crinoids were collected from two different "pockets" at the same horizon on opposite sides of the highway. On the east side of the road, the fossils occur on the upper surface of a discontinuous limestone bed overlain by 6 cm of shale. The edrioasteroid, *Postibulla legrandensis*

(Miller and Gurley, 1894), was found in this "pocket" only where specimens were attached to the inside of brachial valves of *Echinoconchus alternatus* that were lying upside-down on the limestone surface. The blastoid, *?Cryptoblastus*, was also only found in this "pocket".

Crinoids from the west side of the road were in the lowermost 0.5 cm of a silty shale bed overlying a bioclastic limestone bed; all within an area of 1.5 sq. m. As many of the crowns still have long segments of stem attached and occur at one thin level, they were probably killed and buried by a single influx of silt and clay that formed the shale bed.

Curiously, the blastoid, *Pentremites*, was not present within either "pocket", although common both above and below this horizon. The echinoid, *Melonechinus*, was also collected at this outcrop but not from either "pocket". Many other invertebrates were associated with the crinoids; an incomplete listing is given in Table 1.

### Significance of the Crinoid Fauna

This new crinoid fauna shows closest resemblance, at the species level, to the fauna that was collected near Canton, Indiana. The following species found at the new locality have been reported in the literature, or are present in the Springer collection of the U.S. National Museum, from Canton: *Barycrinus stellifer*, *Cyathocrinites gurleyi*, *C. harrodi*, *Hypslocrinus hoveyi*, *Decadocrinus bellus*, *Forbesiocrinus washingtonensis*, *Dizygocrinus cantonensis*, *D. jacetus* and *Platycrinites bonoensis*. This represents 9 of the 15 crinoid species that could be identified to the species level found at the new site. Of these nine species two, *C. harrodi* and *C. nodosus*, are also found at the old Indian Creek locality and one, *P. bonoensis*, is also found at Bono, Indiana, where it was the most abundant crinoid. Two species, *D. ulrichi* and *C. benedicti*, have been found at Bono but not reported elsewhere from the eastern side of the Illinois Basin. One species, *D. simplex*, is known from the overlying Salem Limestone but has not been reported previously from the Harrodsburg or older rocks. Finally, *Abrotocrinus orestes* was described from the Keokuk Limestone but has not been reported previously from Indiana.

These species relationships suggest that the crinoids from the new site are similar in faunal composition to the Canton fauna. However, the three most abundant crinoids at Canton, *Actinocrinites*, *Scytalocrinus*, and *Synbathocrinus*, are not present in the new fauna. The Judah Branch fauna is seemingly intermediate in relationship to the Indian Creek fauna from the Ramp Creek and to the Bono fauna.

The differences and similarities among these several closely related crinoid faunas may be ascribed to slight differences in ages of the rocks that contain the fossils, or to differing environmental conditions that controlled the presence or absence of crinoid species. A strong case for overall environmental control on gross taxonomic composition of crinoids in communities of this age has been made by Lane (3), who showed that in passing from deltaic to carbonate bank conditions there was a progressive diminution in proportion of inadunate crinoids and an enhancement of camerate crinoids. The new Judah Branch fauna fur-

nishes additional evidence for such sequential changes in these communities. Details of age relations among these crinoid communities are poorly known and await further study. Two outstanding questions concern whether or not the Ramp Creek Formation is equivalent to the upper part of the Borden Group or to the lower Harrodsburg in those areas where the former unit is absent or very thin, and whether the Harrodsburg may not be time-transgressive as carbonate sedimentation gradually encroached over the Borden delta. If such time relations were to be demonstrated then the Indian Creek crinoids of the Ramp Creek, situated north of other faunas, may be equivalent in age to the Canton or Bono faunas farther south. The differences among these faunas would then be due to differing environmental controls across central and southern Indiana during early Mississippian time.

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