CRINOIDs AND CALLIXYLOn.

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ABSTRACT. Description of a block of silicified Callixylon wood from the Upper Devonian Ohio shale with which are associated several crinoid heads, numerous columnals and root-discs. One head appears to represent an immature Melocrinus, and the root-discs show attachment of young crinoids to the wood before fossilization.

RECENTLY the writer called attention to the association of the stems of crinoids with logs of Callixylon in the Upper Devonian black shales of Ohio. The specimens known at that time showed only stems of crinoids; nor was there any direct evidence that these stems had been attached in some way to the wood. It was suggested that they were, perhaps, caught in the shrinkage cracks of the wood as the latter drifted in the black shale sea. It was further suggested that the crinoid was a Melocrinus, related to, or identical with M. baindrigensis Hall and Whitfield. The new specimen described below is particularly interesting because it now provides evidence of direct fixation of young crinoids to Callixylon wood.

During the early part of last year A. H. Blickle of the Department of Botany at the University of Cincinnati kindly lent the writer a portion of a silicified trunk of Callixylon from the Ohio shale (exact locality unknown, but the specimen was found in a collection of Callixylon material from Adams County, Ohio), on one side of which are portions of five crinoid heads, many column and arm ossicles, several short sections of column, and a number of root-discs.

The fossil wood (Plate I, Fig. 1) is slightly compressed, 11 to 14 cm. in length, 11 × 20 cm. in diameter, completely decorticated and evidently much softened from prolonged immersion before burial, for some of the crinoid stem sections are deeply impressed into the surface. All the crinoid remains are upon one surface, the under surface of the log while floating.

The largest column ossicles are articulated sections, 4.5 to 6 mm. in diameter, identical with those of Melocrinus found on the log described in 1939. As will be seen by reference to Plate I, Fig. 1, the larger articulated column sections are oriented a

Fig. 1. Under surface of portion of trunk of Callixylon Newberryi with associated parts of crinoids. Ohio shale, Adams County, Ohio, x½.

Fig. 2. Enlargement of portion of Fig. 1. a—Best preserved crown of Melocrinus; b—Root discs; c—Double root disc. x1½.
little athwart the length of the log, as in all other cases of this same association. Besides these large columnals there are several other articulated sections of the same type but smaller,—2 to 3 mm. in diameter, some of them placed directly across the trunk. There are also scattered groups of disarticulated ossicles, mostly columnals ranging from 2 to 0.75 mm. in diameter, averaging 1.5 mm.

The five heads or crowns, unfortunately are poorly preserved, four consisting of portions of the arms only, and one retaining most of the arms, the calyx, and proximal columnals and impression of a centimeter of column about 3 mm. in diameter. This latter specimen (Plate I, Fig. 2a) does not show distinctly the arrangement of the plates of the calyx, but the arms are in fair condition. It appears to represent an immature individual of Melocrinus about one-third the size of adult M. bairdigenis. The inner and outer rami are developed almost equally. The inner rami of each ray are close to each other but not apposed. In typical adult Melocrinus the outer rami are absent (disappeared) and the inner rami of each ray are closely apposed forming a single compound arm. The developmental stages of Melocrinus have not been described but those of Ctenocrinus paucidactylus have been figured by Miss Goldring. In this species the outer rami of each ray were first developed, followed by the inner rami which soon equalled the outer ones. As the crinoid approached maturity the outer rami failed to develop further while the inner rami became larger and longer with several armlets. In the adult stage they were apposed to form the compound arms. In Ctenocrinus the outer rami remained as small auxiliary arms, whereas in Melocrinus they completely disappeared.

Kirk suggested that the following genera form a series leading to Melocrinus: Alisocrinus (M. Silurian) → Promelocrinus (U. M. Silurian) → Ctenocrinus (U. Silurian—L. Devonian) → Melocrinus (M.—U. Devonian). Under this supposition the crinoid described and figured here may be regarded as an immature Melocrinus in the "Alisocrinus-stage." That it is not wholly Alisocrinus, however, is indicated by the presence of arm-

lets on the outer as well as on the inner rami; armlets were not developed on the inner rami in *Alsocrinus*.

The dozen or more root discs (Plate I, Fig. 2b) are particularly interesting because they prove attachment of the crinoids to the wood not only indirectly by accidental entanglement but also directly from the first stages of larval fixation. Nine of them are well-preserved convex discs, averaging 3.5 mm. in diameter, impressed slightly into the wood, some of them with central depressions, others retaining 3 to 8 small columns slightly over 1 mm. in diameter. They are very much like those figured by Ehrenberg\(^4\) for *Encrinus libiformis*. Those with part of the stem still attached have the stem not perpendicular to the plane of the disc but more or less inclined to it, as in the root of the Recent *Calamocrinus diomedae*\(^5\). It is notable that all are inclined in the same direction,—which would seem to indicate that the inclination was influenced by currents as growth took place after the log came to rest on the bottom or by the steady drifting of the log if the crinoids dwelt on its under surface while it was still afloat. The writer thinks the latter surmise more likely considering probable conditions in the area of deposition of the black shales.

One of the root discs (Plate I, Fig. 2c) is oval and bears two columns side by side, like the much larger example from the Middle Devonian Columbus limestone (Ohio) figured by Ehrenberg\(^6\)—the result of the coalescence of the root discs of two adjacent individuals.

The small size of all the discs and their columns suggests that fixation of the crinoids was not maintained beyond a fairly early developmental stage, as is the case in many living crinoids, and that the presence of larger columns indicates that some of the free adults remained associated with the floating log either through some sort of volition or by entanglement.

\(^4\) Ehrenberg, K.: *Pelmatzoan Root-Forms (Fixation)*. Bull. Amer. Mus. Nat. Hist., lxi, 55, Fig. 34c, 1929.


\(^6\) Ehrenberg: *op. cit.*, 62, Fig. 38.

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