

ON '*DENDROCRINUS*' *CAMBRIENSIS* HICKS,
THE EARLIEST KNOWN CRINOID

by DENIS E. B. BATES

ABSTRACT. *Dendrocrinus cambriensis* is re-described from new material and referred to *Ramseyocrinus* gen. nov., and placed in the family Eustenocrinidae.

THE crinoid remains described by Hicks from the lower Ordovician rocks of Ramsey Island and the adjacent mainland of Wales are the earliest yet reported, and, as such, might be expected to yield significant information on the origin of the class. Several writers (Moore 1950, p. 32, Ubaghs 1953, p. 744, Regnéll 1960, p. 172) have referred to their early stratigraphical occurrence, and Ramsbottom (1960, p. 5) has re-investigated Hicks's specimens, without being able to add significantly to Hicks's information. Unfortunately none of Hicks's specimens shows the posterior side, and hence the anal tube was unknown. The writer has had the opportunity of examining the extensive collection of material from Ramsey Island made by Dr. F. J. North for the National Museum of Wales, kindly made available by Dr. D. A. Bassett, and has based his description on specimens from it.

Class CRINOIDEA J. S. Miller 1824
Subclass INADUNATA Wachsmuth and Springer 1881
Order DISPARATA Moore and Laudon 1943
Family EUSTENOCRINIDAE Ulrich 1924

Monocyclic crinoids with a slender cylindrical crown about equal in diameter to the stem; calyx composed of three (?) to five basals, four radials, and an equal-sized infer-radial; four arms, branching isotomously; infer-radial bearing a series of unbranched quadrate plates presumably supporting an anal sac.

Genus *Ramseyocrinus* gen. nov.

Diagnosis. A genus of the Eustenocrinidae with a four-lobed stem composed of columnals of irregular thickness; basals probably three in number, separated by well-developed sutures.

Type species. *Dendrocrinus cambriensis* Hicks 1873.

Discussion. The described species of *Eustenocrinus* have a round smooth column, with two alternating sets of thin columnals, one set twice as thick as the other. The five basal plates are all imperfectly fused one to another. In *Ramseyocrinus* there are, apparently, fewer basals, and the sutures between them are as well defined as those between the radials.

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Ramseyocrinus cambriensis (Hicks)

Plate 76, figs. 1-5

1873 *Dendrocrinus cambriensis* Hicks, p. 50, pl. 4, figs. 17-20.1960 *Iocrinus?* *cambriensis* (Hicks) Ramsbottom, pp. 5-6, pl. 3, figs. 9-11.

Diagnosis. Basals low, over twice as wide as high; rectangular radials wider than high, and highly convex; nine or more primibrachs, arms branching at least three times.

Type specimens. The syntypes (Ramsbottom 1960, p. 5) are preserved in the Sedgwick Museum, with some gutta-percha impressions in the Geological Survey Museum. Ramsbottom's description is mainly based on a specimen preserved in the British Museum (BMNH E 3). The author has also discovered in the Sedgwick Museum the counterpart mould of one of Hicks's syntypes, and the specimen now bears the numbers SM 16739a-b. The description below is mainly based on a specimen from the National Museum of Wales, preserved as counterpart moulds (29 308 G296 and G318).

Type locality. All the specimens figured by Hicks come from the Porth Gain Beds of Bay Ogof Hên, Ramsey Island (Pringle 1930, p. 12), although specimens are recorded from near Llanveran Farm, on the mainland near Pen Berry. No specimens have been seen or found by the writer from the latter locality.

Description. Cup slightly wider than high, sides flaring slightly upwards, surface of plates smooth. Basals apparently not more than four in number, and probably only three, just less than half the height of the calyx and over twice as wide as high, pentagonal, with the upper surfaces concave, and the lower surfaces sharply bent inwards between the petals of the stem. Radials four in number, quadrangular, wider than high, with convex lower and concave upper surfaces, highly convex, especially towards their lateral margins. Anal series commencing with an infer-radial similar in width and convexity to the radials, but only half their height, the succeeding three plates of the anal series similar in size and height. The radials and first primibrachials almost equal in height to the infer-radial and the succeeding two plates of the anal series. Lowermost brachials not interlocking and probably not included in the cup.

Primibrachs nine to twelve, wider than high, almost circular in cross-section, with a deep narrow ventral groove, secundibrachs four to nine, as high as wide; tertibrachs seven or more; quadribachs at least eight; arms branching isotomously at least three times.

Stem wide, petaloid, four lobed, the lobes proximally almost parallel-sided with deep indentations, distally becoming less marked so that the stem becomes rectangular in cross-section; columnals of irregular height.

Discussion. Moore and Laudon (1943, p. 26) described the two lowermost plates in each ray of *Eustenocrinus* as infer-radial and super-radial, homologizing them with the compound radials of genera such as *Ectenocrinus* (op. cit., fig. 3). However, in a later paper (1950, p. 30) Moore has proposed a simpler nomenclature, regarding the lowermost plate in each ray (excepting that beneath the anal tube) as radial, and the plates above and incorporated in the cup as fixed brachials. The latter procedure is followed here.

The chief differences from the described species of *Eustenocrinus* are in the form of the stem and the number of basals, which warrant separation of the Welsh species into a new genus. There are at least three basals, one of which, on the anterior side, may be formed

from two plates fused together and showing traces of the suture between them (Pl. 76, fig. 1). In addition *E. springeri* (Ulrich 1924, p. 99) has arms which bifurcate only once, and its diameter at the top of the basals appears to be less than at either the base or top of the cup (op. cit., fig. 14A). *E. milleri* (Wetherby 1880, p. 153) has the radial plates higher than wide, with a thickening of their upper extremity which gives the species a somewhat swollen appearance at the top of the calyx.

Eustenocrinus was considered by Moore and Laudon (1943, p. 25) as the most primitive member of the homo-synbathrocrinids, the major stock of the Disparata. Stratigraphically, however, it post-dates the earliest members of that stock, and hence is not itself the ancestor. The features considered by Moore to be primitive include the steep-sided conical cup, the convex base showing the lowest plates, isotomous arm branching, and the lack of any fused super and infer-radial plates. The occurrence of *Ramseyocrinus* at the base of the Ordovician, and its similar structure, further strengthens Moore's claim for this stock to be the ancestor of the Disparata.

The most striking features of *Ramseyocrinus* are the four-lobed stem and the four arms. It was hoped that *Ramseyocrinus* would prove to be a possible ancestor for the whole class Crinoidea, but these features indicate that it post-dates the splitting up of the ancestral crinoid stock into at least the sub-classes Inadunata and Flexibilia. Most other contemporary or older pelmatozoans have a well-developed five-fold symmetry, and thus it is likely that the Eustenocrinidae arose from an ancestor having five arms, one arm being replaced by an anal tube. Thus the Eustenocrinidae must first have lost the right posterior arm during the late Cambrian and then regained it during the early Ordovician, if they were, in fact, ancestral to the bulk of the Disparata. That this happened is questionable; it seems more probable that the Eustenocrinidae constitute an early simplified offshoot from the Disparata.

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EXPLANATION OF PLATE 76

- Ramseyocrinus cambriensis* (Hicks) from the Porth Gain Beds of Bay Ogof Hên, Ramsey Island. All photographs are of latex casts, whitened with ammonium chloride. None has been retouched.
 Figs. 1-3. Specimen 29 308 G296/G318 (Nat. Museum of Wales). 1. Anterior view, showing stem of irregular columnals, and two (?) basal plates partially fused together, $\times 5.8$. 2. Posterior view, showing the anal tube, two of the four (?) basals, and food grooves on two of the arms, $\times 5.5$. 3. Stem viewed from below, showing the four lobed cross-section, $\times 4.5$.
 Figs. 4-5. Syntype, specimen SM. 16739a-b (Sedgwick Museum, Cambridge). 4. Posterior (?) view, $\times 2.0$. 5. Anterior (?) view, $\times 3.1$. The basal and radial plates cannot be positively identified, nor can the anal series, which may be missing.

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BATES, *Ramseyocrinus cambrensis* (Hicks)