JOURNAL OF PALEONTOLOGY, V. 46, NO. 5, P. 773–780, 2 TEXT-FIGS., SEPTEMBER 1972

PALEONTOLOGICAL NOTES

MORE ABOUT *AETHOCRINUS MOOREI* UBAGHS, THE OLDEST KNOWN DICYCLIC CRINOID

G. UBAGHS
University of Liège, Belgium

ABSTRACT—A new interpretation of the thecal plating of *Aethocrinus moorei* Ubaghs proposed by Philip and Strimple (1971) is critically examined and rejected.

The *Aethocrinus moorei* Ubaghs from the Lower Ordovician of France shows two unusual features (Ubaghs, 1969, Text-fig. 1a, b):

1. The plates of the lowermost circlet of the theca (originally interpreted as infrabasals) have the same orientation as the pentameres of the stem.
2. The plates of the third circlet of the theca —which in any normal dicyclic crinoid should be identified as radials—are not in line with the first brachial plates but rather alternate with them.

Recently Philip and Strimple (1971, Text-fig. 1a) have considered the proximal plates of the theca of this crinoid to be plates homologous with columnal pentameres rather than infrabasals as interpreted by Ubaghs (1969, Text-fig. 1b). Accordingly they call infrabasals the plates originally designated as basals, basals those formerly identified as radials, and radials those that were taken for the first brachials in the original description. The purpose of the present paper is to offer a critical examination of this new interpretation of the thecal plating of *Aethocrinus moorei.*

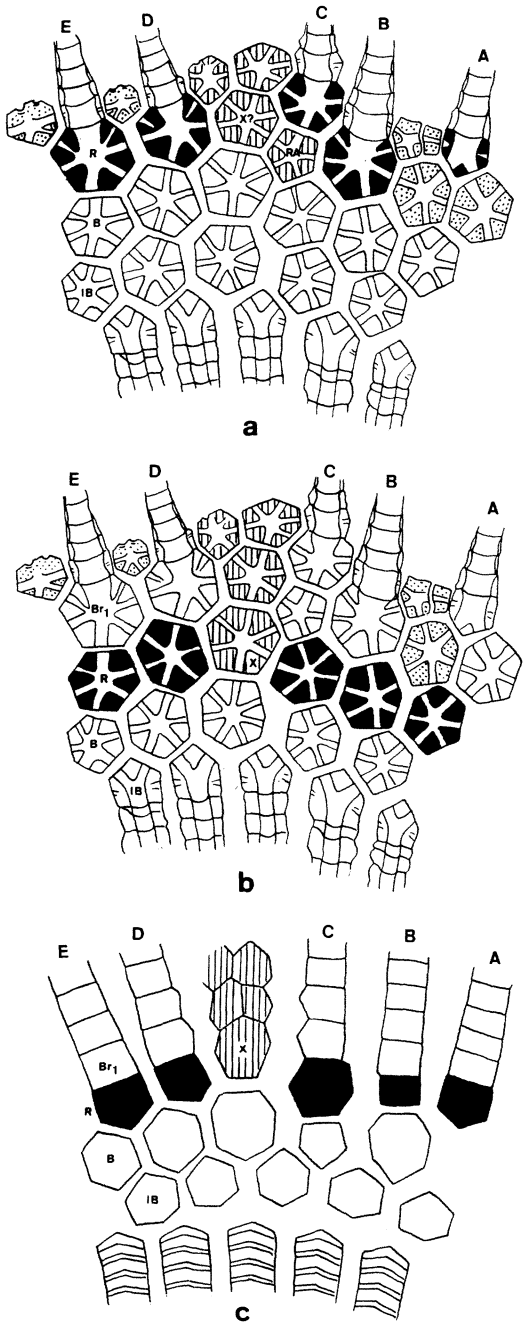
The plates of the lowermost circlet of the theca differ from the columnal pentameres by their shape and the fact that the five longitudinal ridges from the stem bifurcate on their surface. If these ridges, as is the case in this crinoid, follow the course of the axial aboral nerve cords, the site of bifurcation indicates the location of the chambered organ, which in Recent crinoids is housed at the bottom of the theca. This suggests that the lowermost circlet of plates morphologically belongs to the theca, and therefore represents the infrabasal circlet.

Such identification appears to be fully consistent with: a) the predominantly perradial orientation of these plates; b) the perradial orientation of the aboral extensions of the entoneural system within the stem, as strongly suggested by the orientation of the lobes and other features of the lumen of the stem; c) the fact that the site of introduction of new columnal pentameres could only have been *below* these plates, since their special shapes and other peculiarities preclude that it could have been above them. If the infrabasals in *Aethocrinus moorei* do not alternate with the columnal pentameres, as in most crinoids, it is simply because the entoneural cords of the column were situated in the middle of the pentameres.

Ordinarily in quinquepartite stems these cords and the angles of the lumen correspond in position to the vertical sutures of the stem. It is important however to notice that apparently *Aethocrinus moorei* is not the only known exception to this rule: in *Grenprisia billingsi* (Springer) and several species based on columnals (Stukalina, 1967, p. 205) the angles of the lumen are half-way between the sutures. Stukalina (1967, p. 205) suggested that the occurrence of two main types of quinquepartite stems presumably is related to differences in basal organization of the calyx—a hypothesis seemingly supported by *Aethocrinus moorei.*

According to Philip and Strimple, it is the next circlet of plates that represents the infrabasal circlet (Text-fig. 1a). This is very unlikely, because these plates are interradially disposed, and apparently have not the same orientation as the axial nerve cords of the stem. In all known dicyclic crinoids, these conditions characterize basal (not infrabasal) plates.

Therefore if the two first circlets of plates comprise the infrabasals and the basals respectively, the third circlet of plates must con-



TEXT-FIG. *1*—a and b, structure of *Aethocrinus moorei* Ubaghs. a, Identification of plates suggested by Philip and Strimple (1971); b, Identification of plates proposed by Ubaghs (1969); c, Structure of *Ottawacrinus typus* Billings, for comparison with *Aethocrinus moorei*. Radial plates black, anal plates with vertical hachuring, interradial plates stippled. Abbreviations: IB, infrabasal; B, basal; R, radial; Br_1, first primibrach; X, anal X; RA, radianal. Designation of rays according to the Carpenter system.

tain the radials (Text-fig. 1b). This conclusion is fully in accordance with the fact that the latter are five in number, nearly equal in size, situated on the same level, and in contact with one another except in CD interray where an anal plate intervenes. This structure is identical with that occurring in many cladid inadunate crinoids (Text-fig. 1c).

Philip and Strimple raise two objections against this interpretation: a) the radials as interpreted in Text-fig. 1b are not in line with the following ray plates but alternate with them; b) it is not upon them that the most proximal branching of the ray ridges (considered as a surface manifestation of the brachial nerves) takes place but upon the plates of the fourth circlet (which consequently they identify as radials, as shown in Text-fig. 1a). But doing so they seem to overlook that this fourth circlet of plates comprises eight plates, and that the plates they designate as radials are unequal in size, not placed on the same level, and separated from one another not only in CD interray but also in AB interray —all features very unusual for a radial circlet and its components.

The objections they raise to my interpretation do not appear to be insuperable. To begin with, a reexamination of the material at hand reveals that, if fifty percent of the plates originally designated as radials are interradially disposed, twenty-two percent are perradially situated, and twenty-eight percent occupy an intermediate position between a radius and an interradius. In the next circlet, forty-two percent of the plates are strictly perradial, and fifty-eight percent are more or less distinctly displaced toward one of the adjacent interradii; and none are interradial in position. In contrast to the opinion of Philip and Strimple, it therefore appears that in the present case the location of radials and fixed brachials relative to radii and interradii is highly variable and cannot be of great significance in identifying radials.

As for the proximal branching of the ray ridges, it is easily explained by the fact that in extending onto the cup these ridges—the primary function of which is mechanical—meet other ridges from adjacent elements and tend to be lost in the stellate ornamentation of the calyx. Of course they may follow the course of the aboral nerve cords, but any forking of these ridges does not necessarily correspond to a similar forking of the nerves. On the other hand, it seems very likely that the branch nerves were connected with each other and

with those of other radii by as many commissures as thecal circlets, forming a rather complicated network all around the cup.

With the designation as radials of the plates originally identified as the first primibrachs, Philip and Strimple think the anal plates of *Aethocrinus moorei* are comparable with those of other inadunate crinoids. This is not quite true because the plate they tentatively identify as anal X (Text-fig. 1a) rests upon a plate the presence of which brings to six the number of components of the circlet below (the basal circlet according to these authors). Six plates in the basal circlet are known, for instance in *Carabocrinus* and *Thenarocrinus*, but in these genera the supplementary plate (or plates), which is considered as a radianal, rests on the C infrabasal, and not, as in *Aethocrinus*, on a plate in CD position. If on the other hand one admits with Philip and Strimple that it is this sixth plate in the basal circlet which represents the anal X, then anal X would be located well below the level of the radianal—a condition that is never found among crinoids.

The designation of thecal plates as originally done (Ubaghs, 1969) avoids all these difficulties: the basal circlet comprises five plates and the radial circlet six, one of which is the anal X (Text-fig. 1b). As for the C radial, it differs in no way from the other radials and there is no need to call it a radianal (though it is morphologically equivalent to such an element). Almost identical organisation of the anal area occurs in *Cupulocrinus, Dendrocrinus, Grenprisia, Ottawacrinus* (Text-fig. 1c), *etc.*, and probably it represents the most primitive known arrangement of anal plates in dendrocrinine crinoids.

In conclusion, I do not see any compelling evidence for changing the original identification of the thecal plates of *Aethocrinus moorei*. On the contrary, more problems seem to be raised than solved by the alternative interpretation proposed by Philip and Strimple. *Aethocrinus moorei* is admittedly an unusual crinoid. Yet in many respects it approximates the well known archaic genus, *Ottawacrinus*. It is still more primitive, however, and may well represent an early but perhaps somewhat aberrant offshoot of the ancestral stock of the dicyclic inadunate crinoids.

Thanks are given to Porter M. Kier, United States National Museum of Natural History, J. W. Durham, University of California, Berkeley, and J. C. Brower, Syracuse University, New York, for reading my manuscript and offering helpful suggestions.

Note—The column of *Aethocrinus moorei* terminates distally in a mass of small, thick, irregular ossicles, which probably functioned as ballast to maintain the organism in a vertical position. This structure was originally interpreted as resulting from a secondary proliferation of small plates following a rupture of the column. It is now believed that it may represent a primary feature of the crinoid because a similar termination of the stem occurs among primitive crinozoans such as the Middle Cambrian *Gogia* and Early Cambrian *Lepidocystis* (J. Sprinkle, personal communication).

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MANUSCRIPT RECEIVED SEPTEMBER 21, 1971