ON THE STRUCTURE AND SYSTEMATIC POSITION OF THE GENUS *RHIPIDOCRINUS* BEYRICH, 1879.

A. BREIMER

ABSTRACT

A very fine preserved specimen of *Rhipidocrinus spec.* cf. *R. perloricatus* W. E. Schmidt, 1905 is described in detail. Special attention in text and figures is drawn to the arm-structure. Arms proved to be composed of a monoserial main arm-trunk with biserial ramules placed in alternating order. The first ramules are fixed directly to the dorsal cup and placed regularly at the interradial sides of the radius.

The base of *Rhipidocrinus* is somewhat variably composed i. e. the radials may be in contact with the infrabasal plates. The author believes that this proves Ubaghs correct in regarding zygodiplobathrids and eudiplobathrids as variants of one and the same type of diplobathrid basal organisation.

INTRODUCTION

During a field trip with students to the Eifel region in Germany, one of the party's members, Mr. F. W. Beunderman, was so fortunate as to find a beautifully preserved crown of a *Rhipidocrinus* species near Pelm. The specimen was handed to the present author. It seemed that it was worth publishing a note on its affinities, mainly because it was found that the arm-structure of *Rhipidocrinus* still was poorly recorded in scientific literature despite the fact that beautifully preserved crowns of this genus have been kept for a long time in palaeontological collections. Until the present day the only known figure of *Rhipidocrinus'* arms was given by L. Schultze in his monograph of the echinoderms of the Eifel limestones. This figure is rather schematically drawn, although the general impression of the arm-structure is good. All authors after Schultze reproduced his drawing, so that it seemed worth to deal with the arm-structure in a greater detail. Moreover the organisation of the base, in museum specimens of *R. crenatus* proved to be very interesting. A comparison with Ubaghs' remarks on the organisation of basal and radial circlets in different diplobathrid genera could been made. So it seemed that it was justified to report to a larger degree on the systematic affinities of *Rhipidocrinus* as well.

SYSTEMATIC DESCRIPTION

Genus RHIPIDOCRINUS Beyrich, 1879

Type species by monotypy: *Rhodocrinites crenatus* Goldfuss, 1826.

Synonymy. *Rhodocrinus* auctt.-pars.

For bibliography of the genus:
Wachsmuth & Springer, 1881, p. 379
Bassler & Moodey, 1943, p. 661, to which bibliographies have to be added:
d'Orbigny, 1850, p. 104
Gürich, 1893, p. 109, Pl. 33, fig. 7
Koken, 1896, p. 284.

Diagnosis. A genus of Rhodocrinitidae characterised by radials that may in a variable number come in contact with infrabasal plates, so that basal plates may be separated from each other, or may all be in lateral contact; by 10 monoserial arms with pinnulated biserial ramules placed in alternating order, the first ramule fixed directly to the dorsal cup.

Distribution. The genus *Rhipidocrinus* is restricted to Givetian strata in Western Germany, where it is fairly common. A relative of this genus may be present in Spanish Devonian strata.

Rhipidocrinus spec. cf. *R. perloricatus* W. E. Schmidt, 1905

Pl. I fig. 1 and 2; Textfig. 1—4.

1905 *Rhipidocrinus perloricatus* nov. sp. — W. E. Schmidt, p. 543, pl. XXII, fig. 5a, b.
1943 *Rhipidocrinus perloricatus* Jaekel — Bassler & Moodey, p. 662.

Bassler & Moodey considered Jaekel as the author of the species. The only indication of such is found in Schmidt's paper on p. 499, where he states that Jaekel supported him in identification of his crinoid material. There is no direct evidence in support to Bassler & Moodey's opinion that Jaekel is to be regarded as the author. Even though Jaekel's opinion was that the species was new Schmidt published it without such an indication and therefore has to be regarded as the author.

Holotype. As the holotype of this species must be regarded the specimen figured by Schmidt. It is a very incomplete dorsal cup, consisting only of infrabasal, basal and radial circlets and a few interradial plates. The type was deposited in the Berlin Museum für Naturkunde.

Locus typicus. The type locality is near Lethmathe (Germany).

Stratum typicum. Schmidt mentions as such the Grenzkalk in the Lenneschiefer. According to his opinion this limestone forms the lowermost member of the Upper Middle-Devonian (= Givetian). He was not sure whether this Grenzkalk is an equivalent of the Eifel "Krinoidenschicht" or not.

Diagnosis. An exact diagnosis was not given by Schmidt. This is not surprising if we consider that the species was based on fragmentary cups only. He mentioned four points of difference with *R. crenatus*:

1) The ratio diameter central plate/length of the basal is 1.50 whereas in *R. crenatus* it is no higher than 1.25. 2) The lobes of the axial canal are larger than in *R. crenatus.* 3) The cup plates are convex and lack ornamentation. 4) The edge of the basal that is in contact with the central plate forms an angle of 130° with the rest of the plate, so forming a kind of rim. In connection to this feature the basals seem to be more convex than other cupplates.

Remarks on diagnostic characters. It is believed here that such characters as absence or presence of ornamentation, flat or convex cupplates may constitute real diagnostic characters. The present specimen agrees in these features with the original description of the type and this forms the only support as to the opinion that it has to be attributed to *R. perloricatus.*

It is doubted that Schmidt's further characters are of any diagnostic value at all. With regard to the ratio diameter central plate/length of the basal we must state that a value of 1.50 may occur in *R. crenatus* as well. Measurements of this ratio on specimens of *R. crenatus,* stored in the Rijksmuseum van Geologie en Mineralogie at Leiden (Holland), give values between 1.04 and 1.67 for average length of basals. Schmidt's statement that a difference in this ratio between the both *Rhipidocrinus* species exists is not proved to be true since values of 1.50 may occur in both species. The variability of this ratio is mainly caused by the variable size of the basals. Some specimens have basals that are only half as large as f. e. the radials, other specimens have basals that are approximately as large as the radials. Even when for both species a ratio of 1.50 is present they may differ in the diameter of the central plate and consequently the diameter of the stem. The present specimen had a fairly thick column.

The same fact as above mentioned may be true for the size of the lobes of the axial canal. This character is highly variable in *R. crenatus.* Some specimens certainly have such large lobes as Schmidt drawed for his specimen.

We can not give a conclusive answer whether Schmidt's opinion on the angles and rims on the basals means anything particular or not. One cannot rely on the present specimen since some plates of the patina are weathered and pressed down. On the other hand some basals in *R. crenatus* specimens suggest that such a rim could occur in this species as well.

Concluding we must state that the true *R. perloricatus* has to be defined as a *Rhipidocrinus* species with smooth and globose calyx plates. Perhaps the stem was thicker as in *R. crenatus.*

Material. A complete and perfectly preserved crown (no. 97955) found by Mr. F. W. Beunderman near Pelm (Germany) in the Fleringer Schichten; some slabs with two other, rather crushed specimens (numbers 97956 and 97957). All the material is stored in the collection of the Rijksmuseum van Geologie en Mineralogie at Leiden (Holland).

Description. Form and dimensions of the dorsal cup. The cup of the figured specimen is somewhat flattened in lateral direction. The base is compressed and consequently some of the basal and radial plates are not quite in the right position to the adjoining plates. The base probably was

Plato I. *Rhipidocrinus spec.* cf. *R. perloricatus.* The specimen 97955 in the collection of the Rijksmuseum van Geologie en Mineralogie at Leiden (Holland). Left figure as seen from right side; right figure as seen from left.

flat with only a slight depression for the reception of the stem. The height of the cup is about 22 mm. The length of the cup in antero-posterior direction is 32 mm, in lateral direction 22 mm at the level of primibrachs, but only 18 mm at the level were arms become free. The cup becomes somewhat constricted towards its ventral edge. The cupplates are convex and sutures somewhat depressed. Radial series are not conspicuous and interradial areas are not depressed. There is no trace of ornamentation.

The plate formed by the anchylosed infrabasals has a diameter of 8 mm. Sutures between the distinct infrabasals cannot been observed. The diameter of the circle in which the 5 lobes of the axial canal ly is 4.5 mm.

The basals are nearly foursided plates. They all seem to be separated from each other by the intervening proximal point of the radials. The height of the basals varies from 3.5—4.8 mm, their widths from 3.8—4.2 mm.

The radials are fivesided plates wider than high, all separated from each other by the intervening basals and first interradials or anal. The height of the radials is from 4.5—5.2 mm, the width is high up in the plate and varies from 6.4—7.3 mm. The point of the radials is directed to the infrabasals and may come into contact with them.

Two primibrachs per radius are incorporated in the cup. The first primibrach is a wide plate, about twice as wide as high, the width varies from 6.5—8 mm, the height from 3.5—4 mm. The outline of this plates in five-or-sixsided: l. post. IBr 1 and ant. IBr 1 are fivesided, other IBrr 1 are sixsided plates. The second primibrach is axillary, five- or six-sided and smaller as the first primibrach. Heights of these plates vary from 3.4—3.8 mm. The greatest width is about at half height in the plate and varies from 5.0—5.5 mm. L. post. IAx and ant. IAx are six-sided, all other IAxx five-sided. It is shown that in l. post. and ant. rays IBrr 1 are five-sided and IAxx are six-sided. This feature is due to the very high nature of adjoining antero left IR 1 and postero left IR 1, that come in contact with IAx, so the iRR 2 have no suture with IBr, making the plate five-sided; IAx is six-sided because it is in contact not only with one of the iRR 2 but with iR 1 as well.

Generally two secundibrachs are incorporated in the cup. Only the right half of the r. ant. radius has three secundibrachs. The first IIBr is always the larger of the two, much wider than high and invariably six-sided. The width varies from 4.2—5.0 mm, the height from 2.5—3 mm. At the distal sides of the plates they are in contact with an intersecundibrachial plate, resting on the shoulder of two adjoining IIBrr 1. Lateral the plates are invariably in contact with two different interradial plates. The second secundibrach is axillary, with exception of the right IIBr 2 in the right half of the r. ant. radius, where IIBr 3 is axillary. Axillary IIBrr are five-sided plates with exception of the right IIAx in the l. ant. ray, that is six-sided, smaller than preceding secundibrachs, but still wider than high. Width is about 4 mm, height about 2 mm. Axillary IIBrr give off series of brachials of higher order. Internally there plates form the main arm; externally they form the fixed small ramules.

Distal from the IIBrr an area of at least 6—7 mm high has brachials of higher order incorporated in the cup and laterally in contact by means of sutures. This means that a series of about 8 (or 9) brachials of higher order are incorporated in the cup. Lateral the brachials of higher order become firmly in contact with each other when only one or two interbrachials are present.

The amount of interbrachials is 1—4. The ant. radius has two (three?) interbrachial plates in line with each other, the l. post radius has four interbrachials; r. post, and r. ant. radii have two interbrachials in line, the second minuscule. The l. ant. radius has only one interbrachial plate (see textfig. 1). The first interbrachials are always the larger ones, with 6, 7 or 8 sides, higher than wide (about 2.5 × 2 mm). The second interbrachials in ant. and l. post. rays are not so small as in other interbrachial areas.

The two main arms of ant. and l. post. rays grow together laterally by means of a high interbrachial area, whereas in the other radii the arms grow together by lateral contact of a series of brachials of higher order.

Interradial areas are composed of 7—9 elements. The posterior interradius contains 10 (perhaps 11) plates. Interradial areas are widest at the level of the first ranch of plates following iR 1 or A; ventrally they narrow rapidly. At the lateral sides they are limited by the brachial plates of lower order; ventral they are limited by the brachials of higher order trat form the fixed ramules. The two ramules coming from different rays laterally come in contact ventral from the interradius.

In normal interradial areas iR 1 is a very large plate, intervening between the radials and in contact with the basals. They are the largest plates of the cup. Heights vary from 5.5—6 mm, the widths from 6.7—7.5 mm. The outline is seven- or eight-sided.

The antero left and postero left iR 1 are eight-sided because they come in contact with adjoining ant. and l. post. IAxx.

The first interradial plates are succeeded by two series of plates, gradually becoming smaller. In the posterior interradius A is folowed by three plates in second and third ranches, and further by two series of plates. A median series of plate does not occur.

Fixed ramules. Each secundaxil gives off at is external upper margin a series of small elements that gives rise to an independent and fixed ramule. This series of brachials is regularly built. In all half-rays the first two tertibrachs are somewhat larger plates, the second placed perfectly ventral to the first and lateral from he last interradial. Their widths are from 2—2.5 mm, their heights 1.5—2 mm. Two series of brachials succeed the IIIBr 2: an external one composed of plates comparable in size to IIIBr 2 but ventral rapidly becoming smaller, and an internal one of really miniscule elements. The internal series of tertibrachs is in close contact to the adjacent brachials forming part of the main arm trunk. The external series of tertibrachs comes ventrally to the last interradial plate in close contact to a similar external series of tertibrachs of an adjoining half-ray. Three or four subsequent brachials of adjoining series are placed alternating to the others and have sutures. After these three or four tertibrachs the arrangement of plates in each ramule becomes perfectly biserial. At this point it is believed that the fixed ramule becomes free. It is shown thus that this ramule comes directly from IIAx and in its most proximal part is fixed to the cup.

Main arm trunks (Rami). The rami are very stout structures. The diameter of the arms at the level where they become free is 7.5 mm. The total length is about 40 mm. The arm bears up to 16 ramuli at each side. They are placed in alternating order (see textfig. 1). Total arm structures can be characterised as monoserial rami giving off pinnulated biserial ramuli in alternating order.

The IIAxx give support at their upper internal surfaces to a series of very

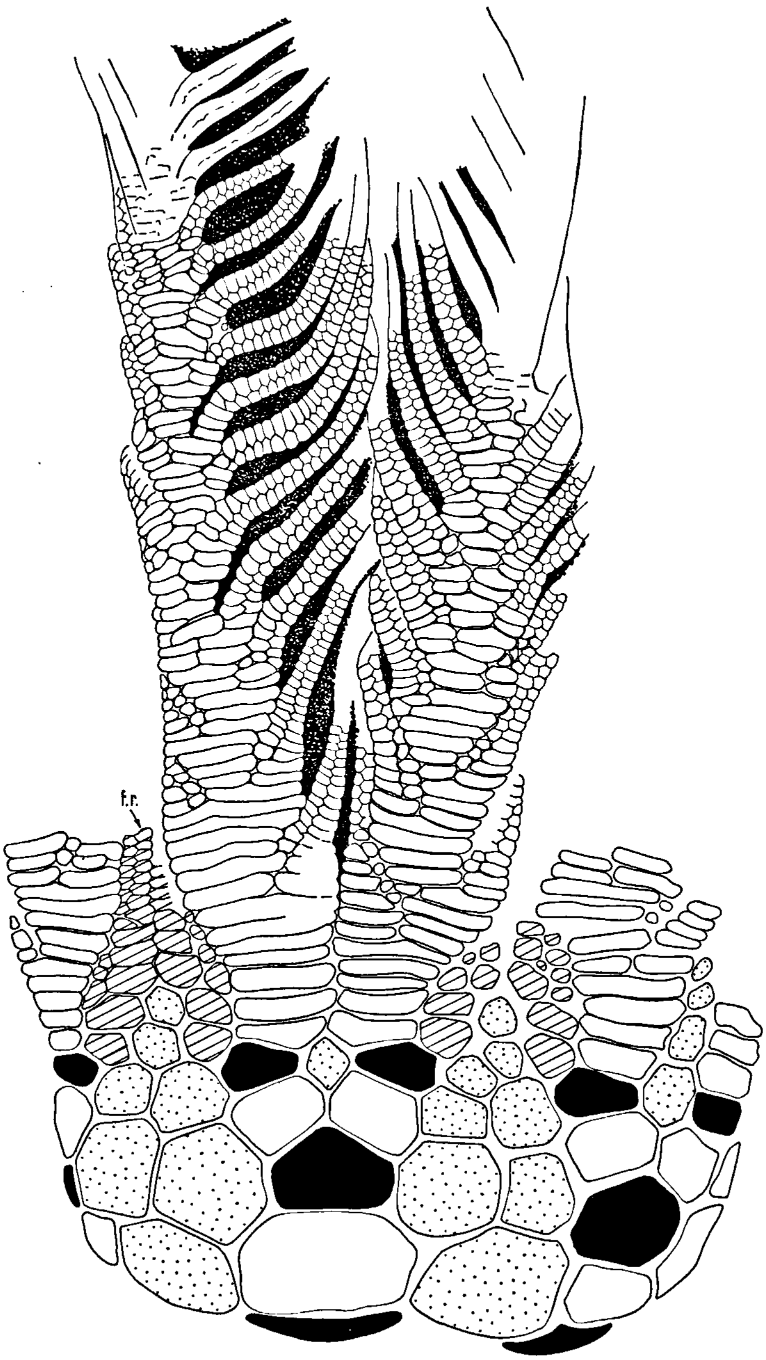

Fig. 1. *Rhipidocrinus* cf. *perloricatus*. Dorsal cup and free arm trunks of l. ant. radius of specimen no. 97955. Radials and axillar plates indicated in black, interradials and interbrachials dotted, brachial plates forming fixed ramule shaded.
f. r. = fixed ramule.

low (1 mm) but very wide (4—5 mm) brachials. The first seven or eight of these brachials are at their external sides in contact with the tertibrachials forming part of the fixed ramule and at their internal edges with interbrachials or — when only one or two interbrachials are present — with the brachials of the adjoining half ray. This part of the arm is fixed to the dorsal cup. After these series of brachials the arm becomes free. Throughout its length it is composed of very wide and low brachials. It is believed that many plates of the arm can be held for a kind of axillary plates. Such plates always support two brachials next to the other. The outer of these two brachials gives rise to the ramule, the inner one supports brachials that form part of the arm. After each 'axillary' plate alternately the left and right series of brachials develops largely so as to form a further part of the arm while the other series starts to give off a ramule. In the proximal part of the arm the series of brachials that take part in the formation of the arm itself consist of one to five elements, every succeeding plate somewhat wider than the preceding one and generally in lateral contact with the proximal brachials of the ramule series, although some plates may loose that contact. The proximal two or three brachials of the ramule series may be very wide and take part in the formation of the total armtrunk as well. In the distal part of the arm the total structure is more dense than in the proximal arm part because the brachial series that form the arm only consist of just one brachial and one axillary plate. Proximal brachials of the ramule series as a rule are in contact with the other brachials.

The total arm-structure of this specimen may be characterised by saying that not only the regular brachial series but the proximal brachial series of the ramules take part in their formation as well.

R a m u l e s. The ramules are placed in alternating order at both sides of the arm. From the moment that ramules become free they are strictly biserial built. The length of the ramules is about 20 mm or half as long as the total arm. The diameter is 2 mm. The most proximal part of the ramules are fixed to the arm by two or three larger brachials that still form part of the main armtrunk (see textfig. 1 and 3) and support the two series of brachials that form the ramule. The lower series is directly free from the main arm but the proximal plates of the upper series still are in lateral contact with the brachials of the main arm.

In the proximal part of the arm the ramules are wider placed than in the distal part, because in the latter region the brachial series mainly forming the arm are shorter than in the proximal area.

P i n n u l e s. Pinnules can be observed in ant. ray on 2nd, 3rd and 4th ramules and in r. ant. rami on the 10th ramule. It is believed that all ramules coming from the main arm were pinnulated. They are very partially exposed. It cannot been stated how long pinnules were, and how many pinnulars constitute one pinnele. It is observed that at least five pinnulars were present. The plates are very elongated, about four times as high as wide. They are simple cylindrical plates, with a very slight thickening at the facets. The first pinnular has a rather broad facet with the brachial on which it is placed (see textfig. 2). Its upper proximal edges may come in contact with the succeeding brachial. In no one case is it shown that the most proximal brachials of the ramule series, still largely fixed to the main arm trunks, had pinnules. Unfortunately it is not shown that the fixed ramules bear pinnules. None of them is sufficiently well exposed to make a statement on it.

L i g a m e n t a r y a r t i c u l a t i o n. Many indications of articulation of brachial plates have been found in the specimen. Many sutures between brachials are dentate and in one brachial that is somewhat replaced the distal facet is exposed and shows short striae alternating with shallow depressions. These structures undoubtedly correspond to similar ones on the proximal facet of the succeeding brachial. The type of articulation so was sympletic.

Such articulation has been found between the second and third, and third and fourth tertibrachs of the right fixed ramule in the anterior radius, were it is obvious that the sutures are dentate. Further indications of articulation of the brachials leading to the fixed ramule are absent.

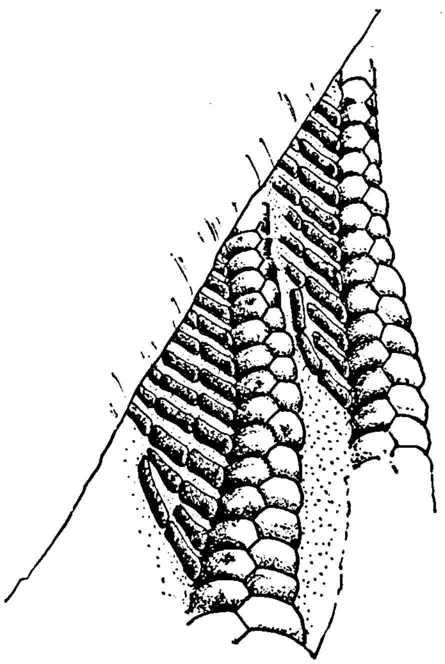

Fig. 2. Second and third left ramules of right ramus in ant. radius of spec. 97955, showing pinnules.

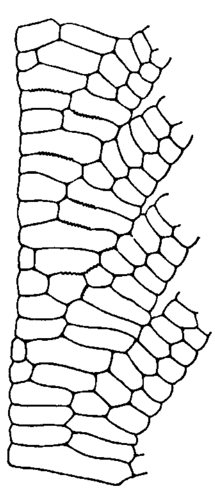

Fig. 3. Enlarged drawing of portion of left ramus in l. ant. radius of specimen no. 97955, showing dentate sutures.

Articulation of brachial plates in the main arm was certainly possible, not only in the free part but even in the fixed part. Sutures between IIAxx and the succeeding brachials are dentate. The fixed brachials of the right ramus in the ant. radius show their dentate sutures perfectly. In many places in the free arms dentate sutures have been observed. In textfig. 3 they are indicated only in those spots were no doubt can arise as to their existence. The figure — taken from the right arm of the ant. radius — shows that articulation between brachials of the ramules and those of the main arms was possible as well.

Concluding we can state that arms were able to move and even the ramules could do so in relation to the arms.

T e g m e n. The tegmen is not exposed.

S t e m. The specimen described here above has no stem attached to it. The other specimens from the same locality have well preserved stems. A fragment of one of these stems was sectioned and figured in textfig. 4. The stem is slightly oval in transverse section; its largest diameter 8 mm. It is pierced by a rather wide, deeply pentalobate axial canal of about 4 mm width, measured from lobe to lobe. The height of the rim in nodular plates is about 0.8 mm. In an external view the stem appears to be composed of rather thick columnals of one and the same order. A longitudinal section of a part of the stem reveals however that this is not true. The stem in fact is composed of a series of nodals and internodals. The nodals are but slightly thicker than internodals but to the exterior they form a thick rim around the plates. The subsequent rims of nodular plates as a rule are in contact, so obscuring the intercalated series of most times three internodal plates. The rims are at external surfaces provided with short tubercles.

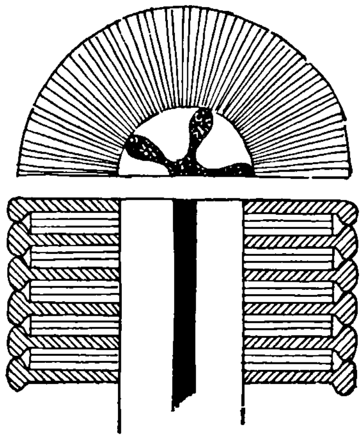

Fig. 4. Longitudinal section of stemfragment of spec. 97956: *Rhipidocrinus sp.*

Affinities and systematic position. Some very well preserved cups of *Rhipidocrinus crenatus* from the Eifel, stored in the Rijksmuseum van Geologie en Mineralogie at Leiden (Holland), could been studied in order to compare them with the newly found specimens from Pelm and to trace the real generic affinities of *Rhipidocrinus.*

It was found that the position of basals and radials is not very constant. All radials may intervene completely between the basals so coming in contact with infrabasal circlet. But on the contrary, all basals may be in lateral contact so that basals and radials are arranged in two different circles.

Textfig. 5 shows a morphological series of several different arrangements of radials and basals in *R. crenatus* specimens. The first stage clearly shows affinity to Zygodiplobathrina, where radials and basals alternate in one and the same circle of ten plates, whereas the last stage is typical for Eudiplobathrina, where radials and basals alternate in two different circles [1]).

[1]) Perhaps it is better to avoid the term *superposition* (as used by Ubaghs, 1950, p. 120, 121), when it is meant to indicate that radials and basals are arranged in two different circles. Radials and basals never are in true superposition as can be thought to exist between R and IBr 1. RR and BB always alternate in position.

The second and third drawing indicate clearly that transitional forms occur. This series proves that a fundamental difference between the two modes of basal organisation in diplobathrids does not occur. Ubaghs (op. cit.) was right when he concluded that alternation and the so called "superposition" of radials and basals are not morphologically irreducible organisation types. Fundamentally only a dicyclic type of basal organisation exists. Variation in this type should not be overestimated. Similar things are known from such forms as *Griphocrinus, Lyriocrinus* and *Atactocrinus* among eudiplobathrids, when the lateral contact of the radials ventral from the basals is concerned. In these genera the first interbrachials may be in contact with basals or may not, so that a variable number of radials are in lateral contact with the others. These features are found among several species of the above mentioned genera. Kirk (1945, p. 351) stated already that these characters "can be overemphasized and must be considered in combination with other

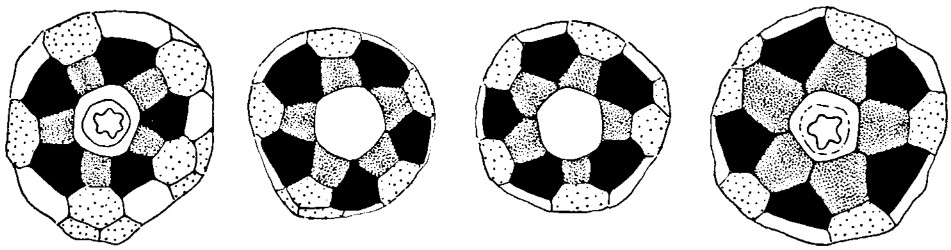

Fig. 5. Arrangements of basal parts of four *Rhipidocrinus crenatus* specimens from the Eifel (Germany). From left to right numbers 97560, 97561, 97562 and 97563, stored in the Rijksmuseum voor geologie at Leiden (Holland).

structural features and the stage of evolution of the group". All this indicates that diplobathrid morphology does not deals with certain strict limits between several well characterized groups but — in fact — with all possible transition forms between the different "stages" of diplobathrid morphology (Zygodiplothrina, Reteocrinicae, Dimerocriniticae).

With regard to the armstructure of *Rhipidocrinus* it must be stated that this structure is quite unusual among dicyclic camerates. As a rule the arms of typical rhodocrinitids are biserial, whereas in *Rhipidocrinus* they are monoserial and provided with pinnulated ramules. The only known structure to which they have to be compared are the arms of *Trybliocrinus*.

Textfig. 6 gives an impression of how a proximal arm portion in a young *Trybliocrinus* cup is composed. Compared with *Rhipidocrinus* (see fig. 1, p. 253) it appears that in both genera a stout main arm trunk exists, provided at both sides with pinnulated ramules, placed in alternating order. The first ramule may be fixed to the dorsal cup, but at least comes directly from one of the two series of fixed brachials. In *Rhipidocrinus* it comes from IIAx and becomes free after six or seven pairs of fixed brachials, whereas in *Trybliocrinus* it comes from IAx but becomes free after many fixed brachials. Textfig. 7 gives an impression how this first ramule was fixed to the cup. In the central part of the drawing the larger opening for the food groove of the main arm trunk can be seen. Below this opening the distal facets of some fixed brachials are observed. The opening is surrounded by irregularly arranged smaller tegmen plates. It is noted that the food grove in *Trybliocrinus* is roofed by a rather competent structure of plates, leading directly to the tegmen plates. So the central opening communicates with an elongated depression that once — at least partly — was filled in by the ambulacral plates forming the cover of the food groove.

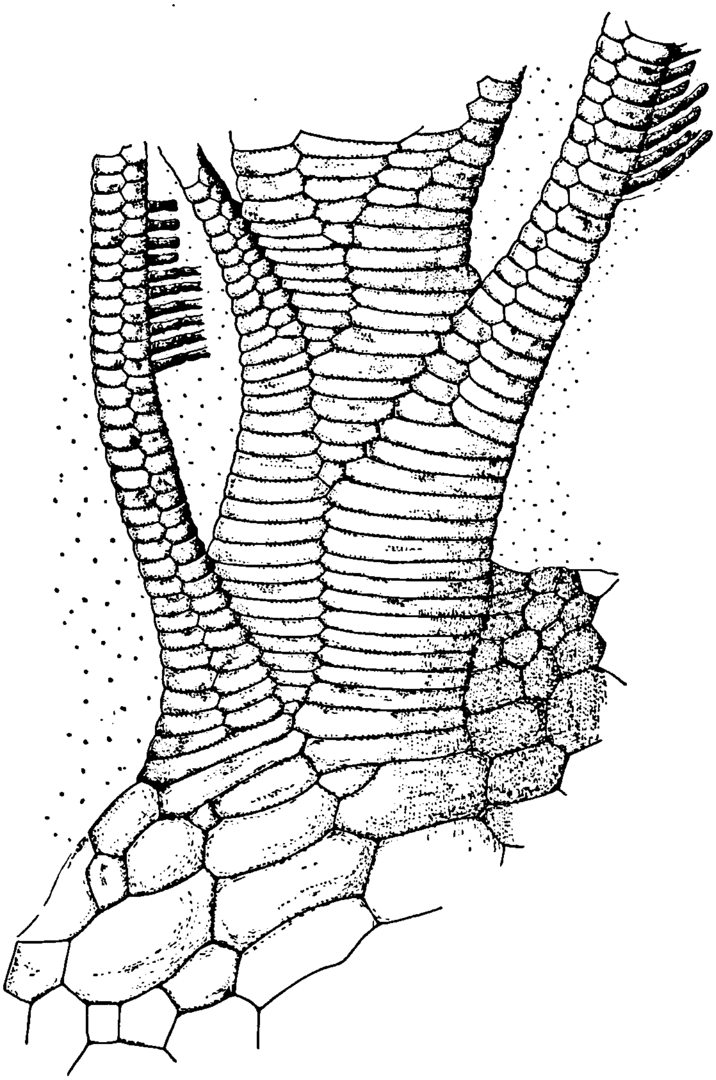

Fig. 6. Proximal portion of arm in young specimen of *Trybliocrinus Flatheanus* (specimen of the Instituto geológico y minero de España) coming from Lower Devonian deposits at Arnao, near Avilés in Asturias (Spain).

Left of this larger opening the smaller one of the fixed ramule is seen. Similar openings could be expected in *Rhipidocrinus*. In fact we met with this feature in Schultze's fig. 1d, Pl. VII (1867). In the lower left part of his drawing a pair of larger openings flanked by two smaller openings, apparently for the reception of smaller ramules, can be distinguished. This is in complete agreement with our observations on the fixed ramules in the specimen described above. Such fixed ramules occurred in both genera.

With all these similarities between arms of *Rhipidocrinus* and *Trybliocrinus*, some difference exist as well. The most striking difference is the fact that in *Trybliocrinus* the main arm trunk is biserial arranged and comes almost horizontally from the dorsal cup, whereas in *Rhipidocrinus* it is monoserial and stands perfectly vertical. A further difference may be constituted

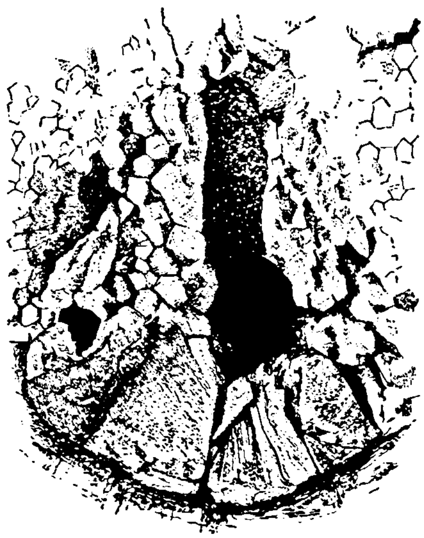

Fig. 7. Portion of ventral edge of large *Trybliocrinus Flatheanus* specimen from Arnao, near Aviles in Asturias (Spain), showing ambulacral openings of main arm trunk and fixed ramule.

by the place of the first and fixed ramule. In *Rhipidocrinus* this ramule regularly comes off at the interradial sides of the arm trunk, whereas in *Trybliocrinus* the position of the first ramule seems to be somewhat variable. A difference in the ventral parts of arms in both genera may exist as well. *Trybliocrinus* distinctly has roofed food grooves, but this character is unknown up to now from *Rhipidocrinus*. It will be worth sectioning isolated arm fragments,

In general form and structure of the dorsal cup *Rhipidocrinus* agrees rather well with typical rhodocrinitid genera. It is low globose, with flattened base; the radial series are not conspicuous and interradial areas not depressed; the posterior interradial area has supplementary plates but a median ray ridge does not occur.

For all the above mentioned reasons it appears that *Rhipidocrinus* has some affinity to Rhodocrinitidae, but on the contrary, through its basal organisation and arm-structure stands apart not only from this family but even from the whole group of dicyclic camerates. It seems rather useless now to establish a new family for it, since so many genera of diplobathrids are not very typical and as yet insufficiently known. The real affinities with those forms cannot been found for the moment. The best will be to keep *Rhipidocrinus* within the family of Rhodocrinitidae — at least provisionally and for reasons of convenience — until more data become available.

CONCLUSIONS

From the present study of *Rhipidocrinus* the following conclusions can be drawn:

1) The base of *Rhipidocrinus* cups is variably arranged. Radials may, or may not, be in contact with infrabasals. Similar phenomena are known from *Paulocrinus*. Morphologically there is some transition between eudiplobathrid and zygodiplobathrid ways of basal organisation. So fundamentally only a dicyclic type of basal organisation exists.

2) The arms of *Rhipidocrinus* as described above are of unique composition among diplobathrids. They only need to be compared with the arms of *Trybliocrinus* that are, morphologically, similar structures.

3) Through its very special arms *Rhipidocrinus* stands apart among dicyclic camerates. Through its basal organisation it has affinities both to eudiplobathrids and zygodiplobathrids. It is held within the family of the Rhodocrinitidae as a matter of convenience, until it becomes apparent how to group the very diverse forms included in that family.

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