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XII.—*The Lower Palæozoic Crinoids of Bohemia.*

By F. A. BATHER, M.A., F.G.S.

THE latest volume of 'The Silurian System of Bohemia' * is welcome indeed to students of Palæozoic geology and palæontology, and more than welcome to the worker on Crinoids. The account of the rich and varied Cystid fauna, published 13 years ago, had given us hope that the unwearied efforts of Barrande might have garnered up a fairly rich harvest of Crinoids, while the known differences between this province and that of North-west Europe led us to expect considerable novelty. The eminence and experience of the senior author and the intelligent zeal of his collaborator were further warrant for pleasurable anticipation. We knew that no pains were being spared in looking up the literature, while some valuable papers by Dr. Jahn indicated that the statements of horizon and locality were being placed on a sure basis. If, after all, disappointment be our dole, this is due to many causes, for most of which the authors are in no way responsible. In the first place, the material is neither rich nor well preserved: the many-plated calyces are often crushed and their plates disarranged; they are covered to a deplorable extent by "an extremely hard, irremovable limestone matrix"; several specimens that might have been interesting are represented by mere ochreous powder. Then the vast majority of forms come from one stratum alone, namely reef-like bands of limestone that form a transition between the beds e1 and e2 (about equivalent to our Woolhope Limestone): the first fauna (Cambrian) furnishes no crinoid remains; the second fauna (Ordovician) includes a few indeterminable columns chiefly from d4 and d5, and two species of a new genus, *Caleidocrinus*, from d4 (about equal to Middle Bala); the third fauna (Silurian s. str.) yields a very few stem-fragments from e1, rather more from e2, along with recognizable specimens of *Scyphocrinus* and of the new genera *Bohemicocrinus*, *Carolicrinus*, and *Laubeocrinus*, all which, except the last, occur more abundantly in the underlying transition beds; f1 contains a few doubtful remains, and f2 yields *Beyrichocrinus humilis*, gen. et sp. nov., as well as a

* 'Système Silurien du centre de la Bohême,' par Joachim Barrande. 1^{re} partie: Recherches Paléontologiques. Continuation éditée par le Musée Bohême. Vol. vii. Classe des Echinodermes. 2^e partie: Famille des Crinoïdes. Par le Prof. Dr. W. Waagen et le Dr. J. Jahn. Traduit par A. S. Oudin. vi and 216 pp., 40 pls. numbered xl-lxxix. Prague (Dec. 1899).

doubtful *Ichthyocrinus* and a few undetermined fragments; **G** and **H** are barren of crinoids, except for rare fragments in **g1**, **g2**, and **h1**. From this it is clear that the crinoids of Bohemia could not be made by anyone to throw much light on the general evolution of crinoids or on the succession of faunas in the Bohemian basin.

The next obstacle with which the authors have had to contend is "piété pour la mémoire de Barrande." This praiseworthy sentiment has caused them to follow with marvellous success the monumental style of the great 'Système Silurien,' and the arrangement which necessitates numerous chapters after the model of the notorious one on Snakes in Iceland. It is no doubt the same piety that has induced them to publish 25 plates by a pitiable person called Langhans. Concerning these plates the authors themselves write: "most of the drawings are more or less defective . . . many are so ill executed that they give not the faintest idea of the original; &c. &c." Worse than this, the majority of the specimens misrepresented on these plates are themselves obscure fragments, to which Barrande, doubtless for his own convenience, had casually attached manuscript names "au point de vue scientifique . . . nullement justifiés." And yet "respect for his memory" is supposed to be shown by the retention and publication of all these provisional names. It is useless for the authors to say, as they do on p. 139: "nous déclinons toute responsabilité sur la question de leur admissibilité." Here, unfortunately, are the names, and they have to be reckoned with. As our knowledge of the Bohemian crinoids increases, what dissensions will there not be among systematists as to the value of these names! What hideous confusion, wrangling, and waste of time! For all of it those who have published the names will be responsible.

In this article the drawings by Langhans will be ignored; difficulties enough will confront us in reconciling the artistic representations by Swoboda with the outlines thoughtfully annexed on the thin covering-papers and with the diagrams in the text. For example, the first question that arises is as to the position of the small basal in *Beyrichocrinus*. Plate 59, fig. 4 shows no basal smaller than the two others; the covering outline places it in the left posterior interradius; the diagram on p. 12 (our Fig. 1) shows it in the left anterior interradius; fig. 1, on p. 13, has it in a position that is different but not more precisely determinable. A point of equal importance, especially considering the authors' doubt as to the monocyclic nature of this same base, is the orientation of the lobes of the axial canal as seen in the base of the cup.

The lobation is doubtless peculiar, but in every figure it is represented differently, so that one can only enquire whether the lobes are radial or interrarial: they are clearly radial in one drawing, clearly interrarial in another, and not clearly anything in the rest. The text throws no light on the matter, unless the following sentences may suggest a solution of the riddle: "Ce genre n'est représenté que par un fragment de la couronne" (p. 12); "sous cette dénomination, nous comprenons le calice et les bras, abstraction faite de la tige" (p. 3); "la base est . . . presque entièrement cachée par la tige" (p. 13); "les exemplaires [note plural!] du genre *Beyrichocrinus* étaient munis d'une tige" (p. 15). But the apparent contradiction is probably due to an ambiguity introduced by the translator—another obstacle in the path of the authors. Whether due to the imperfection of the specimens or the carelessness of the artists, such discrepancies are only too numerous.

The Crinoidea of the Lower Palæozoic rocks of Bohemia, as presented in this volume, may be divided into three classes: (i.) *Incertæ sedis*; (ii.) *Scyphocrinus* species and varieties; (iii.) eight new species, distributed among seven new genera. If this statement can be substantiated, then the authors are to be congratulated on having at least fulfilled our dream of novelty. But their caution and candour are so manifest that they will be the first to admit the rather unsatisfactory foundations for some of these genera. Let us examine them in order, the order being first by geological periods and then alphabetical—a final Barrandeian touch. The absence of a strict systematic arrangement and the doubt that surrounds many of the genera have prevented our authors from drawing up diagnoses. In attempting to abstract the salient features, I hope to be pardoned if I use the terminology elsewhere employed by me*.

* The old-fashioned terminology retained by Messrs. Waagen and Jahn for the arm-structures obscures their homologies in Camerate Crinoids. The term *pièces brachiales* is due to L. de Koninck, who applied it solely to the fixed arm-ossicles, while he called the free arm-ossicles *articles brachiaux*. Since the present authors restrict the term *brachialia* to the free ossicles, they should not translate it by *pièces brachiales* (p. 5). A similar error as to *articles brachiaux* occurs on p. 17 of Wachsmuth and Springer's "Crinoidea Camerata." The term *route* (vault) connotes a structure now admitted by all to be imaginary; while the terms *trompe* (proboscis) and *canal nourricier* (alimentary canal) are equally misleading. The well-known term *cirri*, though introduced on p. 9, is replaced in practice by the term *vrilles* (tendrils), which is no gain. Again, the term *calyx* is defined on p. 3 in the sense in which it has been used by Wachsmuth and Springer and others: "the employment of the word *calyx* to designate that part which is only the dorsal

Beyrichocrinus humilis, the sole species of the genus, comes from the limestone f 2 of Koněprus*. Only the cup is preserved (Fig. 1). It consists of the following primary

Fig. 1.—Analysis of the cup of *Beyrichocrinus humilis*, outlines copied from Waagen and Jahn, and about twice nat. size. Interbrachials (iIBr) and anals are shaded from right to left; intersecundibrachs (iIBr) from left to right; intertertibrachs vertically.

elements: 3 basals, 2 large and 1 small; 5 radials, which appear to abut laterally by short sides, except in the posterior interradius; 2 fixed primibrachs in each ray, the first being hexagonal except in the right and left posterior rays; 2 fixed secundibrachs in each half-ray; 2–4 fixed tertibrachs, of which the last is axillary and bore the free quartibrachs. The secondary elements of the cup are: 5–10 interbrachials arranged in 4–6 horizontal zones, the proximal interbrachial resting on the steep shoulders of two adjacent radials and coming very near to the basals; in the wider anal interradius are about 14 interbrachials (anals), of which the

cup is an abuse.” It is therefore perplexing to find the authors persistently using the term in the sense they here deny to it. The fact is that the word *calyx* has so often been used for the dorsal cup, that our attempts to define it otherwise seem bound to fail. The adoption of the term *theca*, as used by Haeckel, for the whole case or test containing the central organs of the animal, seems the most rational escape from the difficulty.

The symbols and terminology of the present paper differ but slightly from those explained in the Ann. & Mag. Nat. Hist. ser. 6, vol. ix. p. 57, Jan. 1892. The nomenclature and classification follow Part III., The Echinodermata, of ‘A Treatise on Zoology,’ edited by E. Ray Lankester: London, 1900.

* Oddly enough, the authors have adopted for the Bohemian names a spelling different from that hitherto employed in the ‘Système Silurien.’ Their reasons, though not given, are probably good enough to warrant me following them in this article.

proximal rests, though by a very short side, on the base, while it supports 3 plates above; the intersecundibrachs are at least 2, but are small and obscure; the existence of intertibrachs is doubtful. The authors profess not to know whether the base was monocyclic or dicyclic. But, since no camerate crinoid has yet been described in which infrabasals are associated with fused basals, we are justified in placing *Beyrichocrinus* among *Monocyclica* Camerata. Therein it falls apparently into the Suborder Batocrinoidea, and the family Periechocrinidæ, although we do not know whether it possessed the biserial free arms characteristic of the latter. Many obscure genera have been referred to this family, mostly as supposed synonyms of *Periechocrinus*. Whether *Beyrichocrinus* may be identical with any of these, is a question for the future. It appears allied to *Periechocrinus*, but the cup is rounded as in *Megistocrinus*; its most distinctive characters are the wedge shape of the proximal anal, and the absence of a distinct median vertical row of anals.

Bohemiacrinus (why not *Bohemiacrinus*?) is established for two imperfect cups, both assigned to one new species, *B. pulvereus*. The trivial name, taken from a manuscript

Fig. 2.—Analysis of the cup of *Bohemiacrinus pulvereus*, outlines copied from Waagen and Jahn, a little over nat. size. Shading as in fig. 1. The small plates at the angles of some of the interbrachials are described by the authors as accessory plates; they do not occur in the only other specimen known.

label by Barrande, is consistently spelled *pulverens*—a manifest misprint of familiar nature. One specimen comes from the white limestone, e2 of Kosor, the other from black limestone transitional between e1 and e2, near Dvorce. The

authors refer their genus to the family Actinocrinidæ as defined by Zittel in 1879. There is, however, nothing in the part preserved (Fig. 2) to prevent its assignment to the family Carpocrinidæ founded by the same authority; and, to speak even more precisely, there is no particular reason why these cups should not belong to a *Carpocrinus* or *Desmidocrinus*. The authors indeed say that "*Bohemiocrinus* is distinguished from all other genera of crinoids described down to this day, by the characteristic conformation of the two radii on each side of the anal interradius, as well as by the structure of the latter and of the other interradii." When this was written the authors were doubtless unacquainted with the structure of the cup in *Barrandeocrinus*, since that was first published by Wachmuth and Springer in May 1897. The same peculiarities are emphasized in that genus; and yet the structure of the cup alone would scarcely justify the removal of *Barrandeocrinus* from *Carpocrinus*. It is highly improbable that *Bohemiocrinus* possessed the remarkable arms of *Barrandeocrinus*; therefore, though the name *Bohemiocrinus* may be a convenient way of expressing the imperfect nature of the known specimens, there seems reason to think that it may ultimately prove a synonym of *Carpocrinus* or *Desmidocrinus*. *Eucalyptocrinus*, *Corymbocrinus* (= *Clonocrinus*, Quenst.), and *Dolatocrinus* have no anal resting on the base, and it is not clear why they should have been dragged into comparison.

Carolicrinus is based on a crown and an arm-fragment from the black limestone (e1-2) of Karlstein (whence the name), and another arm-fragment from the white limestone, e2, near Lochkov. These are all placed in a new species, *C. Barrandei*. This species is a many-plated camerate crinoid not unlike *Scyphocrinus*, with which it is associated in the rocks; but the biserial arrangement of the brachials would alone justify its severance therefrom. Unfortunately the authors, impressed by the general resemblance to *Scyphocrinus*, have not thought it necessary to compare *Carolicrinus* with genera foreign to Bohemia. The imperfection of the base also is held to excuse them from discussing the systematic position of the genus. The authors believe that there were three basals, two large and one small, the latter being in the posterior interradius (strange position!); and they will not admit that the proximal anal rested on the base. At the same time they "cannot quite guarantee the correctness of the explanation just given." The published figures do not help one even to the bare facts of the case, so that an attempt at any other interpretation is out of the

question. But such facts as are undisputed all indicate that this is nothing but a large species of *Abacocrinus*, although that genus has 4 basals and a proximal anal resting on the base.

Laubeocrinus Barrandei is a new genus and species based on an incomplete cup provided with 3 millimetres of stem, from the white limestone, e 2, of Lochkov (Fig. 3). No attempt

Fig. 3.—Analysis of the cup of *Laubeocrinus Barrandei*, outlines copied from Waagen and Jahn, nat. size. Shading as in fig. 1.

is made by the authors to determine the systematic position of this genus. The peculiarities of the specimen are, indeed, such that they might be considered individual abnormalities; but if that had been the opinion of Messrs. Waagen and Jahn, they would scarcely have based a new genus on them. "It is," they say, "impossible to determine if the base is monocyclic or dicyclic"; but since the basals are 4, not 5, we have every reason to believe that it is what it appears to be, namely, one of the *Monocyclica Camerata*. The fused basals are the right posterior and right anterior. The proximal anal rests on the base; but instead of the posterior basal being widened and truncated to support it, the left posterior basal is widened to occupy the whole of the left posterior radius, and so to come into contact with the anal. Both of these features are without parallel in accepted genera. Considered by itself, the base is like that of *Compsocrinus* or *Abacocrinus* (members of the family *Xenocrinidae*), but in them the larger basals are posterior and anterior. The remaining portions of the cup might belong to any typical *Actinocrinoid*. The anal area differs from that of the *Xenocrinidae*, and, indeed, of all known *Batocrinoidea*, in the presence of only two plates in the second row. *Phillipsoocrinus*, M'Coy, is believed by Wachsmuth and Springer to have been based on an abnormal specimen of *Actinocrinus*, and it is noteworthy that the peculiarity is similar to that of *Laubeocrinus*, though still more abnormal.

Vletavicrinus, a name derived from the ancient appellation of the river Moldau, on which lies Dvorce, is based on a unique specimen from the black limestone (e1-2) of that locality. The specimen is an almost perfect crown, to which 47 millim. of stem remain attached. It forms the type of a new species, *V. Haueri*. The crinoid (Fig. 4) is a Camerate,

Fig. 4.—Analysis of the type of *Vletavicrinus Haueri*, outlines copied from Waagen and Jahn, nat. size. Shading as in fig. 1. The portions of arms that surmount the anals are intended as repetitions of the arm-branches drawn also in the adjoining rays; the object doubtless was to show the relations of the pinnules, but the chief result is to prove the inaccuracy of the diagram.

but whether monocyclic or dicyclic is uncertain, since the base is almost entirely hidden by the stem. Each ray contains 2 fixed primibrachs, and the fixed secundibrachs in each half-ray are said to be 7 or 8 (a number which each of the five figures chooses its own way of contradicting), the last of these being axillary. The left posterior interradius, as cleaned from matrix by the authors, exhibits a proximal interbrachial resting on the shoulders of the radials, and supporting two parallel rows of interbrachials, which gradually become smaller and more irregular and pass into the tegmen. Fifteen plates in all are exposed in this interradius. The posterior interradius shows over 30 plates, which seem to have passed up into an anal tube. The proximal anal rests on the base, and is followed by a single plate which supports two parallel rows of irregular plates, 5 in each row, followed by smaller plates. Rather large intersecundibrachs are visible in the right and left posterior rays, arranged as in the diagram, and succeeded by smaller and less regular plates. The arms,

which are free from the secundaxil, may branch at least twice more, *i. e.* up to quintibrachs, and are composed of low uniserial brachials bearing closely set pinnules. Unfortunately the authors attach so little importance to the mode of arm-branching that they have passed over without comment the very different appearances drawn by Mr. Swoboda in two identical views of the single specimen. One gathers only that the branching was not a regular dichotomy. It is also regrettable that the relation of the pinnules to the brachials is to be learned from neither description nor figures, the latter being discrepant in this important point also. We are told that immediately after each bifurcation the fine pinnules form a solid pavement, but we are not told whether any of these apparently united pinnules form part of the cup-wall; nor, what is far more important, is it stated if more than one pinnule is borne by each brachial. Whenever the whole base is not exposed as in a diagram, Messrs. Waagen and Jahn seem to think that they are absolved from any attempt to relegate the specimen to its place in the system. Had they likewise refrained from weighting such a specimen with a new generic name, their avoidance of responsibility would have been more readily excused. When, however, they go so far, we may demand to have such details as it is obvious could be learned from the specimen, without being forced "to wait for more abundant material." The facts vouchsafed to us do, all the same, permit some inference. The families of Dicyclica Camerata, as at present known, afford no place for *Vletavicrinus*. Its reference to Monocyclica Camerata is more than consistent with the small amount of base that is visible. If placed in this Order, the relations of its proximal anal prevent admission to the Melocrinoidea, while the number of secundibrachs, if nothing else, keeps it out of Actinocrinoidea. The disposition of the anals, though not that typical of the Batocrinoidea, is not absolutely discordant therewith, and it is in that Suborder that it seems to find its nearest allies. If the brachials do bear more than one pinnule apiece, if, in other words, they are compound structures, one would place the genus near *Carpocrinus*. In any case it might provisionally be placed in the Carpocrinidæ. Our conclusion, then, is similar to that reached in the case of *Bohemiocrinus*, from the same horizon and locality; and we now remember that the anals of that genus have an arrangement almost identical with that of the present specimen. Comparison of the descriptions reveals many minor resemblances, so many, indeed, that one is impelled to ask why

Vletavicrinus is not the same as *Bohemicocrinus*, even if *V. Haueri* be not a synonym of *B. pulvereus* itself.

The last of the alleged new genera from the black limestone, e 1-2, is based on an ill-preserved cup from Dvorce, and is now called *Zenkericrinus melocrinoides*. It is the *Xenocrinus* mentioned by name only on p. 416 of Dr. Jahn's "Beiträge zur Stratigraphie und Tektonik der mittelböhmischen Silurformation"*. The authors refer it to the Melocrinidæ, to which family, even in its latest and most restricted sense, it certainly belongs. They say that "it is nearest to *Melocrinus*, from which, however, it differs in many essential features." This opinion also is well founded; but the authors seem unaware that the genus *Mariacrinus*, Hall, is distinguished from *Melocrinus* by those same features. There is nothing to prevent the relegation of the present specimen to *Mariacrinus*.

Fig. 5.—*Caleidocrinus multiramus*. Proximal portions of stem and crown, seen from alleged right posterior radius; the supplementary plates of the alleged posterior interradius are in two vertical rows, those of the other are in a single row. This is fig. 28 a of Waagen and Jahn, and is said to be "grossi"; but not a single measurement is given throughout the account of this genus. The block has been kindly lent by Dr. Anton Fritsch, on behalf of the Barrande Committee.

In the second fauna the only representative of the Crinoidea is a new genus, *Caleidocrinus*, based on impressions in the "schistes de grauwacke," d 4, of Háj Hill, near Zahořan.

* Jahrb. d. k. k. geol. Reichsanst. Wien, xlii. pp. 397-462, Feb. 1893 (not 1892).

Several specimens were distributed by Barrande under the manuscript name, *Echinoencrinites multiramus*. The present authors place it in or near the Taxocrinidæ of Angelin, which is as much as to say that it belongs to the Flexibilia Impinnata. It is of interest as being older than any Flexible genus hitherto known, and the interest is enhanced when we see how its structure accords with its age in the eyes of the evolutionist (Fig. 5). The Flexibilia Impinnata of the Silurian rocks fall into four main groups, which may provisionally be regarded as families and named Ichthyocrinidæ, Taxocrinidæ, Calpiocrinidæ, and Sagenocrinidæ. The two latter are clearly more specialized than the two former and have a larger proportion of representatives in later rocks. Both Ichthyocrinidæ and Taxocrinidæ have isotomous arms, which may abut, and in some Ichthyocrinidæ even interlock, by their sides. Taxocrinidæ have a few interbrachials, of which the proximal is the largest; their anals form a well-defined vertical series resting on the posterior basal. The Ichthyocrinidæ have no interbrachials, and their simplest genus, *Ichthyocrinus*, has no anals. Now *Caleidocrinus* resembles *Ichthyocrinus* in the absence of anals from the radial circlet and in the isotomy of its arms, which are, as in that genus, sometimes inrolled at their distal ends; but it resembles the Taxocrinidæ in the presence of interbrachials with occasional intersecundibrachs, which, however, are all very small and irregular. The authors believe themselves able to distinguish an anal interradius by the presence of 3 vertical rows of interbrachials instead of 2. But since these interbrachials lay in a flexible integument, a greater or less expansion of the arms would of itself expose more or fewer interbrachials. However this may be, we have in *Caleidocrinus* a genus that approaches the common ancestor of *Ichthyocrinus* and *Taxocrinus*, although an important point of divergence, and one by no means primitive, lies in the minuteness of the basals. All the specimens except one are assigned to *C. multiramus*, which has two primibrachs. The remaining specimen, having 3 primibrachs, is made another species, *C. Barrandei*. The authors' argument is not without force, but "the possibility that more abundant material of the two species may disclose yet other distinctive characters" seems to me far from the probability.

We return to the consideration of those members of the third fauna which are referred either with doubt or certainty to genera previously known. The first is called *Calpiocrinus? bohemicus*, or sometimes *Calpiocrinus??? bohemicus* (Fig. 6). The latter mode of expression is preferable, for, as the authors

fully recognize, their own interpretation of the fragment does not agree with Angelin's diagnosis of his genus. Their interpretation is that the fragment represents the lower portion of a cup, consisting of 3 basals, 5 radials, each followed by about two thirds of a broken primibrach, and 5 large inter-radials, all but one reaching from the basals to the same level

Fig. 6.—The so-called *Calpiocrinus* ??? *bohemicus*, after Waagen and Jahn, pl. lix. figs. 7, 8, 9; $\times \frac{1}{4}$ diam. *a*, “calice incomplet, vu d'en bas,” but from above if regarded as a root. *b*, from the side, in what W. & J. consider the normal position, but upside down if it be a root. *c*, “vu d'en haut,” but showing the surface of attachment to the sea-floor if a root.

as the broken top of the first primibrachs. It is admitted that all the plates are extremely irregular. This point, however, need not be laboured, for a glance at Mr. Swoboda's drawing of the alleged upper surface (pl. lix. fig. 9; our Fig. 6 *c*) is enough to suggest—nay, to force upon one—a very different interpretation. The published figures having failed us so constantly, it may seem the height of rashness to take their evidence in opposition to the opinion of two eminent naturalists who have devoted so many years to the study of these fossils. But no human being could have drawn that figure 9 without having either before him or in his mind's eye the root of some stalked Echinoderm. Here is faithfully represented the flat surface of adhesion to the sea-floor, with grooves, like those of *Lichenocrinus* and other genera, radiating from the central cavity. Within that cavity are shown what the authors themselves describe as “écailles nombreuses, imbriquées, ornées de côtes fines longitudinales, et traversées par un grand nombre de petits canaux radiaires.” This is no description of the thecal cavity of any fossil crinoid, but is perfectly intelligible in the light of certain roots well known to geologists in North America. As for an appearance of pentamerous symmetry in the outer plating,

that also is so far from unusual that it has recently led an American palæontologist to make the remark (extraordinarily exaggerated no doubt) that "the root of crinoids appears to be the counterpart of the calyx in type of symmetry." Should this interpretation commend itself to Dr. Jahn, he will be able to discuss it in that future volume which is to deal with Loboliths and other crinoid roots.

An imperfect crown from the white limestone, f2, near Koněprus was labelled by Barrande "*Lecanocrinus bohemicus*," but Messrs. Waagen and Jahn incline to place it in *Ichthyocrinus*, to which it certainly presents a closer resemblance.

To the long-known genus *Scyphocrinus* are devoted no less than sixty-three pages and nearly twenty-two plates, not to mention those on which are described and figured the numerous fragments probably belonging to it. The more one appreciates the thoroughness of this piece of work, the more one regrets that its wonderful array of detail is unprovided with a summary in the form of diagnoses of the genus and its species. There is a key to the latter, but it has proved incomplete and inapplicable in practice. For the generic diagnosis the reader is referred to the description by Zenker (1833), which, he is told, "forme une diagnose générale fort exacte." Even had Zenker given a diagnosis, it would have been framed in accord with the knowledge of his time, and would have required revision after the discovery of hundreds of genera unknown to him, some of them closely allied to *Scyphocrinus*. Merely to learn that the present authors refer *Scyphocrinus* to the Melocrinidæ (which they nowhere define) one has to hunt back from p. 73 to p. 11. But such is the vast plan to which they will be faithful at all costs!

The Melocrinidæ belong to that division of Monocyclica Camerata which has the radials in contact all round. They are distinguished by having 4 basals; in each half-ray 2-5, occasionally more, fixed secundibrachs, which support 2 or 4 main rami, giving off pinnules or pinnulate ramuli; numerous and usually definite interbrachials, intersecundibrachs, and anals; a tegmen of numerous, small, and irregular plates; a stem circular in section. The known genera are *Scyphocrinus*, *Mariacrinus*, *Melocrinus*, and *Ctenocrinus*; and of these the oldest and, in some respects, least specialized is *Scyphocrinus*.

Scyphocrinus may be diagnosed as a Melocrinid with a large number of interbrachials, anals, and intersecundibrachs, varying both in number and arrangement within a single

species or even a single individual; with the anal area distinguished only, and that slightly, by its greater width and greater number of plates; with arms bifurcating fairly regularly from 3 to 5 times (possibly more), and composed of simple brachials, which in the free portions are pinnulate and either uniserial (especially in the proximal region) or alternating (especially in the distal region), but not biserial in any authentic specimen; with both the primibrachs, all the secundibrachs, which are numerous, and the more proximal tertibrachs loosely joined to those of adjacent rays by a pavement or network of plates.

A very careful study of a large number of specimens belonging to this variable genus has led the authors to separate them, according to the ornament of the cup-plates and especially the interbrachial network, into the following species and varieties, which form a closely connected series: *Scyphocrinus subornatus*; *S. excavatus*, var. *Zenonis*, var. *Schlotheimi*, var. *typica*, var. *Schroeteri*; *S. decoratus*. Except *S. excavatus*, all these names are new; the name *S. subornatus* is indeed ascribed to Barrande, but apparently only on manuscript evidence. One misses the familiar *S. elegans*, Zenker; but this yields to the name *Pentacrinites excavatus*, which Schlotheim in 1820 applied to pl. iv. fig. 2 of J. S. Schroeter's 'Vollständige Einleitung &c.,' 1778, in which work the honour of original discovery is ascribed to F. Zeno, Professor at Prague University. The case is, however, no clearer than usual with these old names. It is admitted that the details given by Schroeter and Schlotheim do not indicate definitely any one even of the species, much less one of the varieties, distinguished by the present authors. The name *excavatus* has by no previous writer been resuscitated or applied to *Scyphocrinus*. One would therefore be inclined to let it rest and to adopt *S. elegans*, Zenker, did not Messrs. Waagen and Jahn assert their inability to find in either figures or description of Zenker the characters absolutely necessary for any decision as to which of their species may claim the name *elegans*. Since, moreover, not one of the numerous writers on this genus has attempted to give precision to the specific name, the way seems clear for the present authors to exercise their free choice. Therefore they make the loosely defined *elegans* a synonym of the loosely defined *excavatus*, and adopt the older term for their largest species. The chief objection to this proceeding is that one can after all determine the species to which Zenker applied the name *S. elegans*. In the very words of the volume before us: "l'espèce de Zenker diffère notablement

des Crinoïdes du Silurien de la Bohême, désignés par Barrande sous le nom de *Scyph. subornatus*, et par nous, sous le noms de *Scyph. decoratus* et *Scyph. excavatus*, var. *Zenonis*. Cependant la description de *Scyphocr. elegans* Zenker convient parfaitement à la plupart des spécimens que nous rangeons dans trois variétés nouvelles: *Scyph. excavatus* var. *typ.*, var. *Schlotheimi*, et var. *Schröteri*; il y a même une concordance remarquable entre les spécimens et les figures données par Zenker." Briefly then: *Scyphocrinus excavatus* Waagen and Jahn, non *Schlotheim*, is identical, even in its var. *typica*, with *S. elegans*, Zenker. It seems a pity that our authors did not draw the obvious conclusion, and so preserve a name in universal use. Had they chosen, "par respect pour la mémoire de" *Schlotheim*, to give the name *excavatus* to their new species *S. decoratus*, none could have said them nay. However, for the sake of concord, let us accept the action which the authors themselves have seen fit to base on their profound research.

To the features of great morphological interest presented by *Scyphocrinus* we can here do little more than allude. It has been supposed that the peculiar network or pavement which unites the proximal portions of the arms is formed of modified ramuli; but to this conception the authors do not refer. The resemblance to fixed ramuli or pinnules, such as are known in other genera (e. g. *Uintacrinus*), is more obvious in the figures of *S. excavatus* var. *typ.* et *Schröteri* than in those of the other varieties and species, some of which represent only a solid and continuous pavement. There is no geological evidence to show which is the more primitive type, since, as the authors are careful to point out, all the varieties are contemporaneous and associated. We must turn to anatomical and comparative evidence. The arms of *Scyphocrinus* are simpler than those of other *Melocrinidæ*, and have not the ramuli of *Mariacrinus* and *Melocrinus*. Therefore the structures in question are not so likely to be modified ramuli as modified pinnules. Two statements made by the authors suggest possible arguments. They say (p. 72) "les brachiales de premier ordre [distal secundibrachs] sont en forme de croissant ou de fer à cheval. L'échancrure . . . correspond au sillon ambulacral du tronc des bras, lequel sillon passe dans la voute du calice." If branches were given off from this ventral groove to the lines of plates forming the interbrachial network, this would confirm the view that the latter were fixed pinnules. But specimens examined by me, notably a fine one apparently referable to *Scyphocrinus excavatus* var. *Schlotheimi* (Brit.

Mus. 15417), show that the supposed ventral groove cuts into the actual brachials either not at all or only to the smallest extent, but that the markedly crescentic appearance is formed by the incurving of the adjoining interbrachials or fixed pinnules (Fig. 7). This helps to explain the otherwise

Fig. 7.—*Scyphocrinus excavatus*, var. *Schlotheimi*, from British Museum specimen 15417. $\times 3$ diam. Drawn by Gilbert C. Chubb.

- a. Tertibrachs (III Br) seen from the inner side of the ray, showing their relations to the supposed fixed pinnulars ($\overline{pn}$) that occupy the intersecundibrach area. The subhexagonal outlines of the latter plates are much clearer in such a diagram, where only the sutures are accurately represented; in a shaded drawing the linear arrangement of the plates would stand out more clearly. The latter effect is suggested here by thickening the lines between the rows.
- b. The distal surface of the same set of tertibrachs, showing how the ventral groove ($v.g.$) is formed by the supposed fixed pinnulars ($\overline{pn}$). Some of these, being broken, do not show the striated sutural surface.

unintelligible, and doubtless incorrect, fig. 25 on p. 90, purporting to show some arms of *Scyphocrinus decoratus*. The other statement alluded to is that the components of the network are joined to the arms and to one another by articular surfaces. This expression, if used in its strict morphological sense, would indicate, not merely that the structures were of brachial origin, but that they had not long become incorporated in the cup. Unfortunately for the argument, the union, at least in the specimens at my disposal, is by loose suture, with a crenelated edge and probably a striated joint-surface, just like that between the primary elements of the cup. On the other hand, since this is also the mode of union between the fixed brachials, the pinnular origin of the network remains undisproved. The above-quoted statement,

that the ventral groove passes into the vault (*i. e.* tegmen), implies that the distal secundibrachs are still above the level of the tegmen. If this were so, the plates uniting them could not be ordinary interbrachials, and their pinnular origin would be as good as proved. But, since our authors profess themselves unacquainted with so much as a fragment of a tegmen referable to *Scyphocrinus*, their rather inexplicable remark may be dismissed as a vague and inaccurate generality. The tegmen, if discovered, would certainly throw light on the question, since, if it could be proved to pass into the covering plates of the arms and pinnules, and if no rigid line could be drawn between free pinnules and those which were partially or wholly united, then the arrangement would resemble that of *Uintacrinus*. But if the network were found to pass gradually into the strictly interambulacral area of the tegmen, then its plates would have to be regarded as more or less modified interbrachials. Had this problem been present to the minds of Messrs. Waagen and Jahn, they could probably have solved it from their abundant material. With the help of Mr. Gilbert C. Chubb in preparing the specimen of *S. excavatus* above alluded to, I have been able to see that the tertibrachs and proximal quartibrachs (beyond which the arms are broken away) are all fixed by small plates arranged in definite rows; that the brachials in question are wedge-shaped and alternating, just as the free brachials of any pinnuliferous arm; and that the thickened end of each brachial corresponds with a single one of the rows of plates just mentioned. In other words, the relation of the rows to the fixed tertibrachs and quartibrachs is precisely the same as that of pinnules to free brachials. It is not so easy to trace this relation in the case of the distal secundibrachs, partly because the plates are here folded and less regular; partly because the secundibrachs are not low and wedge-shaped, but are more than twice the height of the tertibrachs, and are possibly compound ossicles. In this particular specimen there appear to be 13 secundibrachs: the lower four are flat cup-plates; the fifth and sixth are irregular in shape, and the line of the ramus is hard to trace; from the seventh onward they assume the form of free brachials. It seems probable that the plates uniting the lower secundibrachs are true interbrachials, and that their simulation of ramuli or pinnules is due to their axial folding. The true resemblance to pinnules increases in the more distal region, although in this specimen, as in many others, the plates there form a flat pavement. I am convinced that the gradual passage of these lines of plates into free pinnules

could be traced in specimens that have the arms better preserved.

It is curious that, in describing some undetermined tegmina which may possibly belong to *Scyphocrinus*, the authors should twice observe that they are unable to see "l'ouverture buccale sur le fragment," especially as they most definitely refer these specimens to the Camerata of Wachsmuth and Springer or the equivalent *Hypascocrina* of Neumayr, which are characterized by the total absence of a mouth-opening. Possibly these remarkable sentences are due to the translator.

Of all the specimens of *Scyphocrinus* only four retain any of the stem, and in the most perfect of these it consists of but 7 columnals. Nevertheless there is reason to believe that the stem often attained a length of many metres. Various roots are associated with the remains of *Scyphocrinus*, but the authors do not feel justified in referring any one of these to the genus. Some of these roots sprang from the curious hollow and chambered spheroids known as Loboliths. But if these cautious palæontologists ever intend to hint that those bodies may be a part of *Scyphocrinus*, they have reserved their remarks for a future volume on roots.

Realizing the futility of discussing, on the evidence of professedly incorrect figures, those remains which the authors themselves decline to determine, we may summarize in a table (p. 120) what this analysis has brought out concerning the Palæozoic crinoid fauna of Bohemia.

It is probable that all the species are new, but they should be compared afresh with known species of the genera to which they are here referred. The genera, however, are not so strange as they seemed at first. *Bohemiocrinus* and *Caleidocrinus* may be accepted without hesitation; *Beyrichocrinus* and *Laubeocrinus* are open to slight question. But if half of the genera are new, even that is a large proportion; and since the authors believe that all records of *Scyphocrinus* outside Bohemia are insufficiently supported, five out of the eight genera may possibly be peculiar to that province.

The authors have nowhere ventured to arrange their genera in systematic order. The attempt here made, if near the truth, is rather startling. The extraordinarily large proportion of Monocyclica and the truly remarkable absence of Inadunata afford much food for reflection. But considering the rarity of crinoid-bearing beds in Bohemia, perhaps one should not lay great stress on negative evidence. Some of the doubtful remains are of rather Inadunate appearance. The absence of Monocyclic Adunata is less noteworthy, since this order did

	d 4.	d 5.	e 1.	e 1-2.	e 2.	f 1.	f 2.
MONOCYCLICA.							
INADUNATA.....							
ADUNATA.....							
CAMERATA.....							
MELOCRINOIDEA.							
Melocrinidae.....							
					1		
BATOCHINOIDEA.							
Xenocrinidae.....							
Carpocrinidae ..					1		
Periechocrinidae.					1		
					2 (♀)		
					..	..	1
ACTINOCRINOIDEA.							
Fam. incert.....					1		
DICYCLICA.							
INADUNATA.....							
FLEXIBILIA.							
IMPINNATA.							
Fam. incert.....							
Ichthyocrinidae ..							
					..	..	1
CAMERATA.....							
Total	1 or 2	0	0	6 or 7	4	0	2

8 genera.

10 or 12 sp.

not originate till Silurian times and was nowhere represented in large numbers. *Flexibilia*, too, have not hitherto been known earlier than the Wenlock Age, so that their rarity in the lower beds and the appearance of an *Ichthyocrinus* in f2 are just what one might expect. The importance of *Caleidocrinus* has already been dwelt on. The *Monocyclica Camera*-*rata*, which form the dominant assemblage, present no genus at all puzzling except *Laubeocrinus*. The others belong to widely spread families, and even the new genera among them are not so distinct as to indicate any great isolation of their life-province. Indeed, the vertical distribution of the Crinoids within the Bohemian basin, and such a curious detail as the fact that all the stem-fragments attacked by parasites (*Myzostomidæ*, the authors say) come from the one band f2, seem to show that the nature of the genera found was dependent rather on their selection by a local and temporary environment than on any wider conditions governing the migration of faunas or the evolution of orders.

Since the foregoing pages were written the senior author has passed beyond reach of criticism. I have not, for that reason, thought it necessary to modify any of my remarks, since they were never intended to depreciate the labours of those to whom we are indebted for this exhaustive account of the Lower Palæozoic Crinoids of Bohemia. It is clear that the conditions imposed on them rendered their task one of peculiar difficulty; but the volume they have produced is none the less worthy of its place in the magnificent work of Barrande.

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XIII.—ASIATIC *TORTRICIDÆ*.

By the Rt. Hon. LORD WALSHINGHAM, M.A., LL.D., F.R.S.

[Continued from vol. v. p. 490.]

CARPOSINA, H.-S.

912 (3). *Carposina niponensis*, sp. n.

Antennæ (♂) biciliate (3); dirty brownish white. *Palpi* whitish, the median joint shaded externally with fuscous, the terminal broadly annulate with fuscous at its base. *Head*