

THE OTTAWA NATURALIST.

VOL. XX.

OTTAWA, AUGUST, 1906.

No. 5

THE SPECIES OF BOTRYOCRINUS.

By F. A. BATHER, British Museum (Nat. Hist.), London, S.W., England.

Twelve years have passed since the first publication of a statement that *Botryocrinus* occurs in America 'Crin. Gotland,' *Svensk. Vet.-Akad. Handl.*, XXV. No. 2, pp. 103-105; 1893. Although two of the determinations there made have been accepted by such well-known palaeontologists as Dr. J. F. Whiteaves and Dr. Stuart Weller, the facts appear to be still unrecognized by some American writers on fossil crinoids. It may therefore be useful to consider the generic position and the specific independence of the alleged American forms more fully than heretofore.

Comparison of the American species, rightly or wrongly referred to *Botryocrinus*, with the species found in Europe and Australia is rendered difficult by the fact that the diagnoses of the latter were based mainly on the characters of the arm-structure and partly on those of the stem-structure, whereas the former species are represented only by dorsal cups. It has, therefore, been necessary to re-study the dorsal cups of the European and Australian species and to prepare diagnoses founded on those elements alone. While the European and Australian species are not readily distinguished *inter se* upon these grounds, the dorsal cups of the American species fortunately present more points of difference.

My thanks are due to Dr. Whiteaves for kindly lending me the unique specimen of his *Homocrinus crassus*, of which a plaster cast is now preserved in the British Museum; also to Mr. F. Chapman of Melbourne for sending a wax squeeze of his *Botryocrinus longibrachiatus* to the same museum. A re-examination of this and other material contained in the British Museum has

greatly helped the revision of the diagnoses. I am further specially indebted to Professor H. C. Bumpus for the loan of the holotype of *Cyathocrinus nucleus*.

The contractions and symbols used in this paper are those adopted in Part III.—The Echinoderma—of "A Treatise on Zoology", edited by E. Ray Lankester (London, 1900; see p. 143). The terminology of the type-material follows the recent revision by C. Schuchert & S. S. Buckman (see *Science* [n s], XXI, p. 899; 9 June, 1905; *Ann. Mag. Nat. Hist.* [7], XVI, p. 102; July, 1905; and Introduction to 'Catalogue of the type and figured specimens of fossils ' *Bull. U. S. National Mus.*, LIII, Pt I; Sept. 1905). References to previous literature are confined to passages of systematic importance, and, for the sake of brevity, the plate and figure numbers are usually omitted.

SWEDISH SPECIES.

Botryocrinus ramosissimus.

Botryocrinus ramosissimus, Angelin, 1878, 'Iconogr. Crin. Suec.' p. 24.

Botryocrinus corallum, Angelin, 1878, op. cit. p. 24.

Botryocrinus ramosissimus, Bather, 1893, 'Crin. Gotland'. *Svensk Vet.-Akad. Handl.*, XXV, No. 2, p. 117.

Dorsal cup a wide cone, with straight sides, except for a slight projection of RR towards the facet. Height of cup (11. mm.), 100; width at base, 56; width at summit, 139. IBB and BB wider than high. RR not higher than wide. Arm-facet .63 of R. x supports 3 or more tube-plates. Proximal columnal obscurely pentagonal.

Lower Ludlovian, Lindström's bed *f*, Gotland.

Cotypes of *B. ramosissimus* and *B. corallum* in Riksmuseum, Stockholm. As lectotype of *B. ramosissimus*, should be taken the specimen lettered *b* (Crin. Gotland, p. 117).

Botryocrinus cucurbitaceus.

Sicyocrinus cucurbitaceus, Angelin, 1878, 'Iconogr. Crin. Suec'. p. 23, 24.

Botryocrinus cucurbitaceus, Bather, 1893, 'Crin. Gotland,' *Svensk. Vet.-Akad. Handl.* XXV, No. 2, p. 120. Et locc. ibi citt.

Dorsal cup a wide cone, with straight sides except for a very slight projection of RR towards the facet. Height of cup (5. 9

mm), 100 ; width at base, 50 ; width at summit, 118. IBB much wider than high. BB and RR about as high as wide. Arm-facet .62 of R. α supports 3 tube-plates. Proximal columnal pentagonal.

Lower Wenlockian, Lindström's bed c, Gotland

Of the two cotypes one is lost ; the other, which should be regarded as lectotype, is in Riksmuseum, Stockholm, lettered a (Crin. Gotland, p. 121).

BRITISH SPECIES.

Botryocrinus ramosus.

Botryocrinus ramosus, Bather, 1891, *Ann. Mag. Nat. Hist.* (6) VII, p. 394.

Dorsal cup incompletely known, apparently a wide cone, with plates slightly rounded and RR not conspicuously projecting. Height (? 10. mm), 100 ; width at base, ? 60 ; width at summit, 115. IBB uncertain. BB slightly higher than wide. RR wider than high. Arm-facet .9 of R. α supports one tube-plate. Proximal columnal unknown.

Upper Wenlockian, Upper Wenlock Limestone, Dudley.

Holotype in British Museum, No. 57217.

Botryocrinus decadactylus.

Cyathocrinus (sp. 2) *decadactylus*, Salter, 1873, 'Cat. Cambr. Sil. Foss. Cambridge,' p. 123.

Cyathocrinus (sp. 3) *quindecimalis*, Salter, 1873, op. cit., p. 124.

Botryocrinus decadactylus, Bather, 1891, *Ann. Mag. Nat. Hist.* (6) VII, p. 395.

Dorsal cup elegant, rapidly widening above in a concavo-convex curve. The plates show slight traces of axial folding, and RR project slightly. Height of cup (6.5 mm.), 100 ; width at base, 51 ; width at summit, 128. All plates wider than high. Arm-facet from .48 to .85 of R. α supports 3 tube-plates. Proximal columnal obscurely pentagonal.

Upper Wenlockian, Upper Wenlock Limestone, Dudley.

The specimens to which Salter attached his MS. names are in the Sedgwick Museum, Cambridge, England, numbered a/494 and a/495 respectively ; but since they do not show the characters even of the genus, it seems better to select from among

the numerous other specimens described by me, British Museum No. E1419 as lectotype, regarding the Cambridge specimens as chirotypes.

Botryocrinus pinnulatus.

Botryocrinus pinnulatus, Bather, 1891, *Ann. Mag. Nat. Hist.* (6), VII, p. 402; also 1892, ser. cit. IX p. 192.

Dorsal cup widens rapidly above with a concave curve. The plates show traces of axial folding, and RR project markedly. Height of cup (8.5 mm.), 100; width at base, 42-47; width at summit, 129. IBB wider than high. BB as high as wide. RR wider than high. Arm-facet less than .5 of R. α supports 3 tube-plates. Proximal columnal pentagonal or quinquelobate.

Upper Wenlockian, Upper or Thin Wenlock Limestone, Dudley.

Holotype in Dudley Museum. The heautotype of the second reference (supra) has recently been acquired for the British Museum (No. E 14081).

In the original description of the holotype the measurements of height of cup, and of width at its summit appear inconsistent with the figure, and it seems probable that they were interchanged.

Botryocrinus quinquelobus.

Cyathocrinus quinquangularis Phillips, Salter, 1875, 'Cat. Cambr. Sil. Foss. Cambridge,' p. 123.

Botryocrinus quinquelobus, Bather, 1892, *Ann. Mag. Nat. Hist.* (6), X, p. 189.

Dorsal cup elegant, widening above, with a slightly concavo-convex curve, RR projecting very slightly. Height of cup (6.25 mm.), 100; width at base, 48; width at summit, circa 160. IBB not higher than wide. BB and RR wider than high. Arm-facet about .66 of R. α unknown. Proximal columnal quinquelobate.

Upper Wenlockian, Upper Wenlock Limestone, Dudley.

Two cotypes in Sedgwick Museum, Cambridge, England, No. a7435. No. 1 of my description is hereby selected as lectotype.

AUSTRALIAN SPECIES.

Botryocrinus longibrachiatus.

Botryocrinus longibrachiatus, F. Chapman, 1903, *Proc. R. Soc. Victoria* (n.s.) XV, p. 108.

Dorsal cup conical, with straight sides, the plates slightly rounded, RR projecting very slightly if at all. Height (7.2 mm), 100; width at base, 44; width at summit, 125. IBB and BB slightly higher than wide. RR about as high as wide. Arm-facet not more than .5 of R. α rather wide and apparently supporting 3 tube plates. Proximal columnal quinquelobate.

Silurian, Brunswick, Victoria.

Three cotypes in National Museum, Melbourne, No. 390—392. Of these, No. 390, shown in Chapman's pl. xviii, f. 6, should be taken as lectotype. Plastotype in British Museum, No. E7130.

The present diagnosis differs in some respects from the account given by Mr. Chapman, being based on the excellent wax squeeze which he so kindly sent. From this it appears that the plates were somewhat disarranged, and that the specimen was flattened, thus appearing wider above than it really was. Mr. Chapman only measured to half-millimetres, but measurement with sliding callipers and a vernier gives: Height, 7.2 mm.; width at base, 3.2 mm.; width at summit, 10 mm. In calculating the proportions for the diagnosis I have reduced the last measurement to 9 mm.; it may have been even less. Thus the proportions and form of the cup do not so closely resemble *B. quinquelobus* as would appear from the published figures. It was, Mr. Chapman has informed me, mainly this supposed resemblance which led him to refer the species to *Botryocrinus* notwithstanding the apparent invisibility in both species of structures definitely diagnostic of the genus. Examination of the wax squeeze, however, convinces me that those structures are after all to be seen in *B. longibrachiatus*. Chapman's pl. xviii, f. 6, is in fact viewed from the left posterior radius, l. post. R being the middle of the three plates in the uppermost circlet, the plate on its right hand being α , the plate below it on the right being post. B., and the small plate, of which a portion is seen to the right between post. B and α , being RA. The edge of r. post. R is seen to the right of α .

Mr. Chapman presumably interpreted α , which he nowhere mentions, as a radial; but the present identification, when once made, [is] so obvious that only two facts need be adduced in its support. First, the heptagonal outline of the plate here called post.B. Second, the contrast between the conspicuous arm-facets on l. post. and l. ant. RR, and the absence of any such excavation on α . Above α , in the angle between it and the proximal IBr. of r. post. arm, are a few small plates (apparently not the ones alluded to and figured as tegminal plates by Mr. Chapman), and one of these seems to be folded at its edges as is so usual in the tube-plates of this genus. The arm-facet, neither mentioned nor very exactly drawn by Mr. Chapman, appears to have had straight, rather steeply sloping sides, ending in a deep axial canal, which has broken through to the front of the plate (compare the account of the ventral groove and axial canal in *B. crassus*). It is not easy to understand the true shape and proportions of the facet; but the narrowness of the primibrachs indicates that its width can scarcely have been half that of the radial.

AMERICAN SPECIES.

Botryocrinus nucleus.

Dendrocrinus nucleus, Hall, 1876, *Rep. N. Y. State Mus. Nat. Hist.* XXVIII, Documentary Edit., explan. pl. xv, ff. 7-9.

Cyathocrinus nucleus, Hall, 1879, op. cit., Museum Edit., p. 136.

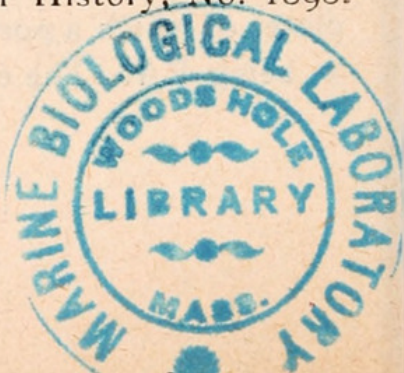
Homocrinus nucleus, Wachsmuth & Springer, 1886, 'Revision of Palaeocrinoidea', III, p. 220, *Proc. Acad. Nat. Sci. Philadelphia*, 1886, p. 144.

Botryocrinus nucleus, Bather, 1893, 'Crin. Gotland', *Svensk. Vet.-Akad. Handl.* XXV, No. 2, p. 104.

Dorsal cup with straight sides up to the RR, which project markedly towards the arm-facet. Slight trace of axial folding on BB. Height of cup (8-11.5 mm.), 100; width at base, 43; width at summit, 125-130. IBB low, much wider than high. BB wider than high. RR higher than wide. Arm-facet more than .66 of R. α supports 1 tube-plate. Proximal columnal circular, with tendency to quinquelobation.

Upper Wenlockian, Niagara shales of Waldron, Ind.

Holotype, American Museum of Natural History, No. 1898. Plastotype in British Museum, No. E14075.



It should be noted that the holotype is a young specimen, and that, according to Hall, it, or at least the figures of it, "do not fairly represent the species." Therefore the specimens on which Hall based his diagnosis and description should be more important than the specimen figured. Unfortunately they are not to be found in the American Museum of Natural History, and I have had to rely on Hall's description and on the little holotype which Professor H. C. Bumpus most kindly entrusted to me for examination. Its chief measurements are: Height of cup to top of RR, 3.6 mm.; width at base, 1.7 mm.; width at summit, 5 mm.

Neither the description nor the figures of Hall indicate distinctly that this species is a *Botryocrinus*; indeed he himself says that it is "a true *Cyathocrinus* in structure". Hall, however, as has been previously pointed out (Wachsmuth & Springer, 'Revision' I, p. 82; Bather, 'Brit. Foss. Crin. VIII, *Cyathocrinus*', *Ann. Mag. Nat. Hist.* (6), IX, p. 206; 1892), "extended the diagnosis of *Cyathocrinus* to include forms with a small quadrangular radianal". Such a plate is shown in Hall's fig. 7, but in the actual specimen it is so obscure that one looks for confirmatory evidence. If such a plate were present the posterior and right posterior basals would be heptagonal. Now Hall says of this species "subradial plates [i. e. basals] wider than high, three of them pentagonal [err. pro 'hexagonal'] and two heptagonal." Therefore there was a small quadrangular radianal. That the species is not a *Homocrinus* follows from the shape of anal x , which has a broadly excavate upper surface. The shape of the cup markedly resembles that of the Gotland species of *Botryocrinus*, and the geological age harmonises. There is therefore no reason to doubt the correctness of this reference.

Botryocrinus Polyxo.

Cyathocrinus Polyxo, Hall, 1863, *Trans. Albany Inst.* IV, p. 199. (Date of vol. 1864; author's edition issued 2 May, 1863.)

Homocrinus polyxo, Wachsmuth & Springer, 1886, 'Revision of Palaeocrinoidea', III, p. 220, *Proc. Acad. Nat. Sci. Philadelphia*, 1886, p. 144.

Botryocrinus polyxo, Bather, 1893, 'Crin. Gotland', *Svensk. Vet.-Akad. Handl.* XXV, No. 2, p. 105.

Botryocrinus polyxo, Weller, 1900, *Chicago Nat. Hist. Survey, Bulletin* IV, Part I, p. 66. Et locc. ibi citt.

Dorsal cup rather widely spreading upwards with concavo-convex curve ; plates with axial folds ; RR projecting markedly to the facet. Height of cup (19.7 mm.) 100 ; width at base, 48 ; width at summit, 132. Plates, especially IBB and RR, wider than high. Arm-facet .28 of R. x , which is very wide, supports 3 (or more ?) tube-plates. Proximal columnal quinquelobate ; IBB project beyond it.

Upper Wenlockian, Niagara shales of Waldron, Ind.

Four cotypes in American Museum of Natural History, No. 1897. These are said to be figured by Hall, *Rep. N. Y. State Mus. Nat. Hist.* XXVIII, pl. xv, ff. 10-17. But Hall there mentions five specimens. Which of them is missing ?

Since Dr. Stuart Weller has confirmed the reference of this species to *Botryocrinus*, it is unnecessary to argue the point. His description is but slightly modified from Hall's and is presumably based on the co-types, or at any rate on topotypes. But when he says that the somewhat rare specimens found in the dolomite of Bridgeport near Chicago "are indistinguishable from typical individuals from Waldron", it must be objected that his figure (pl. xiv, f. 12) by no means bears out this statement. The plates in this specimen are a little disarranged, and possibly have lost some of their outer form by solution ; but it is easy enough to see the following points of difference. The dorsal cup shows no sign of spreading upwards, but seems to have had straight sides. The absence of axial folds may possibly be due to solution ; but it is clear that the radials do not project towards the facet, which consequently has not the markedly oblique slope seen in the cotypes. Approximate proportions, based on the figure, are : height, 100 ; width at base, 45 ; width at summit, at most, 123. The plates are perhaps wider than high, but not nearly so much so as in the cotypes. The arm-facet, which appears shallow, and far from "indenting the plate to about one-fourth of its depth", is drawn as at least .46 the width of the radial. x does not appear at all wide ; and RA, which is here narrower, has its long axis passing upwards from right to left, whereas in all Hall's figures it passes upwards from left to right. In short, if there is a species of *Botryocrinus* to which one would have thought it impossible to refer

this figure, that species is *B. polyxo*. Dr. Weller may reasonably be asked for an explanation.*

Botryocrinus crassus.

Homocrinus crassus, Whiteaves, 1889, *Contrib. Canad. Pal.* 1, p. 95.

Botryocrinus crassus, Bather, 1893, 'Crin. Gotland'. *Svensk. Vet.-Akad. Handl.*, XXV, No. 2, p. 103.

Botryocrinus crassus, Whiteaves, 1898, *Contrib. Canad. Pal.* 1, p. 375.

Dorsal cup bell-shaped, inflated near base and slightly constricted near middle of BB. RR very slightly projecting towards the facet. Height of cup (14 mm), 100; width at base, 32; width at summit, 95. IBB wider than high. BB higher than wide. RR wider than high below, but less wide than high above. Arm-facet about .66 of R. x supports at least 3 tube-plates. Proximal columnal circular.

Middle Devonian, Hamilton Group, Thedford, Ont.

Holotype in Mus. Geol. Surv. Canada at Ottawa. Platype in British Museum, No. E14060.

Redescription of the holotype (following the order of Dr. Whiteaves' original description):—

Dorsal cup somewhat bell-shaped, rather broad and sharply inflated near the base, and very slightly constricted just about the middle of the basals. Height of dorsal cup, from lower margin of infrabasals to top of radial facet, 14 mm., to bottom of facet, 12.75 mm.; maximum width of cup, 13.4 mm.; width at base, 4.5 mm. Infrabasals (IBB) pentagonal, about one half the size of the basals, and wider than high. Basals (BB) moderately large, about equal in size to the anterior radials; higher than wide; the three anterior ones hexagonal, the two posterior ones heptagonal and truncated above. Radial plate (RA) equal in size to the IBB, rhomboid (see measurements below) and resting obliquely between the two posterior BB, the right posterior radial, and the superior anal plate x . Radials (RR) pentagonal, outer surface nearly flat below, slightly raised in the middle, and above this

*Dr. Weller has been so generous with his help to me in the past, that on 6th Jan., 1806, I presumed to ask for the loan of material that would enable these doubts to be set at rest. Either my letter or his reply must have gone astray, and the publication of these remarks can no longer be delayed. 10th July, 1906.

truncated abruptly and obliquely by the facet for the arms, angle of facet with general side of cup being 135° . The facet is shallowly excavated with contour almost circular, but broader than high, width 4 mm.; height 3.1 mm.; axial canal small, ovate, marginal, its acutely pointed apex opening directly into the ventral groove, which forms an obtusely angular notch in the centre of the upper margin of the plate. Right and left posterior RR a little smaller than the rest. Superior anal plate α pentagonal, equal in size to the r. post. R. and faceted above for the reception of plates of the anal tube (vide infra). Cup-plates thick; all rounded towards the sutures, especially in the upper part of the cup; outer surface apparently smooth, but where the test is well preserved, as on post B. and ant. R, are slight traces of shagreen ornament

Measurements in millimetres :—

	Height.	Width below.	Width above.	Length of suture between plates.
IBB.....	4.	2.5	5.	3.
l. ant. B.....	8.	5.4	7.	4.5
ant. R.....	6.5	7.	6.4	4.
to bottom of facet....	4.			
r. post. R.....	5.	5.4	4.75	4.
to bottom of facet....	2.75			
anal α	4.8	4.7	3.75	{ l. side 4. r. .. 2.6

Each of the sutures bounding RA is 3 mm. long, and the plate in each direction is 3.6 mm.

Relations of the species :—

The radials slope outwards towards the facet, in the way characteristic of *Botryocrinus*. The axial canal is quite distinct from the ventral groove, though not actually separated therefrom by stereom. The sides of the ventral groove slope inwards at a wide angle, and at the same time separate from one another, so that the communication between ventral groove and axial canal becomes wider. Right posterior radial has portions of 3 or 4 rather solid covering plates. The chief point of difference between *Homocrinus* and *Botryocrinus*, so far as the dorsal cup is concerned, lies in the number of plates supported by the anal plate α . These plates are not preserved, but one can see the facets for

them on the upper surface of the plate α . There is one small, deeply grooved facet in the middle, and another rather smaller immediately to the right of this. The right and left slopes of anal α have larger curved facets, of which that on the left still bears a fragment of the succeeding tube-plate. Two small similar facets are clear on the adjacent slope of left posterior radial and one at all events is to be made out on right posterior radial. These facets are surrounded by a slightly elevated rim, so that their size and position are well defined. The arrangement of the tube-plates of the proximal row must therefore have been very like that of *Botryocrinus ramosissimus*, as figured in 'Crinoidea of Gotland' I, pl. v, fig. 164.

Among all specimens of *Botryocrinus* hitherto examined, this is the only one in which the greatest width of the cup is less than the height. This fact and the bell-shape of the cup certainly warrant the retention of the species.

Botryocrinus americanus.

Botryocrinus americanus, R. R. Rowley, 1904, Greene's 'Contrib. Indiana Palaeont.', Part XVIII, p. 184, pl. lv, ff. 12-14.

Dorsal cup spreading out rapidly from the narrow column, then ascending with approximately straight sides; all plates somewhat tumid, especially BB, which have wart-like prominences in their lower part. Height of cup (as drawn 8.1—8.6 mm.), 100; diameter of column (2.3 mm.) 27; width at bottom of BB and top of RR (circa. 9.5 mm.), 113. IBB low as seen from the side, but their length is greater than their width. BB higher than wide. RR (except perhaps the two posterior) slightly wider than high. Arm-facet more than .5 of R. Number of tube-plates supported by α uncertain. Proximal columnal circular.

Middle Devonian, Hamilton Group, near Charlestown, Ind.
Holotype in collection of G. K. Greene, New Albany, Ind.

Professor Rowley's clear description unfortunately omits a few details that would have helped to complete the present diagnosis.*

*Mr. Greene would, I am confident, have acceded to my request to borrow the holotype for examination; but, as I regret to learn from Prof. Rowley, illness has prevented him from attending to business for some months. 10th July, 1906.

The figures suggest that the arm-facet occupies the whole upper surface of the radial, but it is merely described as more than half the width. It might be possible to distinguish facets for tube-plates on the summit of x , though the phrase "its top suture on a line with the top of the radials" suggests that it only supported one plate. Though very different in shape from all other dorsal cups of *Botryocrinus*, there seems no reason to doubt Prof. Rowley's ascription of his species. After all, the characters are only an intensification of those noted in *B. crassus* from the same formation.

It should, however, be recalled that there exist other Palæozoic genera with the dorsal cup constructed as in *Botryocrinus*. The Devonian representative of such genera is *Cosmocrinus* (Jaekel, 1898, *Zeitschr. deutsch. geol. ges.*, L, Protok. p. 28). *C. Holzapfeli* Jaekel, *Poteriocrinus dilatatus* Schultze, and *Cyathocrinus ornatissimus* Hall were referred to this genus by Dr. Jaekel, and of these the first should be made genoelectotype. A good figure of the cup has been given only for *C. dilatatus*, and this, though marked with exceptionally strong axial folds, appears to have the characteristic *Botryocrinus* structure. Redescription of *C. ornatissimus* is much needed. At present it can only be said that, in the absence of direct evidence from the arms, there is no reason for referring any other American species to *Cosmocrinus*.

Cosmocrinus is a distinct side-branch of Devonian age, but perhaps the American Devonian fossils here referred to *Botryocrinus* represent a transition from that typically Silurian genus to the very similar Carboniferous *Barycrinus*. Protuberant basals, like those of *Botryocrinus americanus*, are seen in *Barycrinus stellatus*, *B. bullatus*, *B. subtumidus*, *B. mammatus*, and others. Perhaps indeed *Botryocrinus americanus* is really a *Barycrinus*. And perhaps *Botryocrinus* itself should be merged in that genus. Fifteen years have passed since I expressed my inability to distinguish between *Botryocrinus*, *Barycrinus*, and *Vasocrinus*, and since I "thought it better simply to describe the long-known genus *Botryocrinus* as fully as possible, with the aid of new material, and to leave to the American palæontologists the task of comparing it afresh with these other more particularly American genera." All that American palæontologists have done in the matter since then has been to accept without discussion my reference of certain American species to *Botryocrinus*. May we not hope for an independent study of this question from one of the many careful workers who are now turning their attention to the fossil crinoids of North America?



Bather, Francis Arthur. 1906. "The Species of Botryocrinus." *The Ottawa naturalist* 20(5), 93–104.

View This Item Online: <https://www.biodiversitylibrary.org/item/18017>

Permalink: <https://www.biodiversitylibrary.org/partpdf/368960>

Holding Institution

MBLWHOI Library

Sponsored by

MBLWHOI Library

Copyright & Reuse

Copyright Status: Public domain. The BHL considers that this work is no longer under copyright protection.

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.