Canada
Department of Mines

Hon. CHARLES STEWART, Minister
CHARLES CAMSELL, Deputy Minister

Geological Survey

W. H. COLLINS, Director

Bulletin No. 49

GEOLOGICAL SERIES, No. 48 — MARCH 15, 1928.

CONTRIBUTIONS TO CANADIAN PALÆONTOLOGY

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1928

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CONTENTS

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THE SYSTEMATIC POSITION OF THE FOSSIL BIRD CYPHORNIS MAGNUS

By Alexander Wetmore

Illustration

The avian fossil *Cyphornis magnus* was described by Cope[1] in 1894 from a fragmentary metatarsus from Vancouver island. Its systematic position has been somewhat uncertain. In the original description Cope compared this species mainly with the totipalmate birds, particularly with the genus *Pelecanus*, but adduced relationships to other groups. His final statement reads[2] "we may suspect real affinities with the Steganopodes, combined with affinities to more primitive birds with a simple hypotarsal structure." His comparisons with modern pelicans have led to the inclusion of *Cyphornis magnus* in the family Pelecanidae in the fossil list of the third edition of the A. O. U. Check-list[3]. The species is also discussed as a pelican by L. H. Miller in a review of the fossil birds of the Pacific coast.[4]

The type of *Cyphornis* is in the collection of the National Museum of Canada. During the A. O. U. convention in Ottawa, in October, 1926, through the kindness of Mr. W. H. Collins, Acting Director of the Museum, and Mr. E. M. Kindle, Chief of the Division of Palæontology, I was able to examine this type and was given permission to bring it to the U. S. National Museum in Washington for careful study and comparison with material in the large collection of skeletons of birds there available. The results of these studies have been of considerable interest.

From the records of the Canadian Geological Survey it appears that the type of *Cyphornis magnus*, Cat. No. 6323, was collected at Carmanah point, Vancouver island, in the strait of Juan de Fuca. The formation is marked as "Tertiary (Eocene-Oligocene)." On the margin of the volume containing Cope's original description in the library of the Geological Survey of Canada there is the following annotation in pencil: "This bone from Carmanah point, Vancouver I. sent by Capt. Jacques of Victoria. G.W.D." The letters following the statement are indistinct, but Mr. Kindle believes them to be G. W. D., the initials of Dr. Dawson.

The geological horizon from which this fossil originates is, unfortunately, uncertain. J. C. Merriam[5], on basis of material collected by Dr. C. F. Newcombe of Victoria, has placed a fauna exposed at Carmanah point in the Miocene, from its close similarity to the Astoria Miocene as studied by Conrad.

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[1] Jour. Acad. Nat. Sci., Philadelphia, ser. 2, vol. 9, pp. 449-452 (May 31, 1894).
[2] Loc. cit., p. 451.
[3] Check-list of North American Birds, 3rd ed., 1910, p. 381.
[4] Miller, L. H.: Univ. Calif. Pub. Geol., vol. 7, pp. 65, 66, 67 (Oct. 12, 1912).
[5] Univ. Calif. Bull., Dept. Geol., vol. 2, pp. 101-108 (Dec., 1896).

The map of southern Vancouver island published by the Geological Survey, Canada,[1] indicates Carmanah point to represent Tertiary beds which are grouped under the name of "Sooke and Carmanah formations." Concerning fossils from the Sooke formation and the "so-called Carmanah formation" at Carmanah point, Charles E. Weaver states:[2]

"The presence of *Aturia angustata* certainly indicates that the Sooke is older than Upper Miocene.

The faunas occurring in the vicinity of Carmanah point do not appear to differ greatly from those at Sooke bay. It is possible that they may be slightly older.

The Sooke formation from such evidence as is available is probably the equivalent of the upper portion of the Lower Miocene of Washington. The Carmanah beds may be in part contemporaneous and in part Middle Lower Miocene."

The Sooke and Carmanah formations were, according to Clapp, deposited chiefly near a steep mountainous shore, and Arnold[3] in a discussion of the marine Oligocene of the Pacific coast of North America in a generalized map shows Oligocene deposits at the spot in question, though there is no statement of exposure of such strata at this definite locality and the map is too small for local detail.

The most that may be said at present is that *Cyphornis* is seemingly of Tertiary origin, and that it is probably Miocene, since the cavity of the shaft is filled with bluish grey matrix of a character that suggests deposits cited by Merriam (page 102) from data supplied by Newcombe. The question can perhaps be settled definitely by examination of this included matrix when the section exposed at Carmanah point has been carefully studied, so that the age of the elements exposed is certainly known.

The type (*See* Figure 1) is the proximal portion of a left metatarsus, and probably represents a little less than one-fourth of that bone. It is well fossilized and varies in colour from light to very dark brown. The lower end shows a clean, sharp fracture that is not worn, so that the entire specimen may have been available at the time of collecting if search had been made for it. Though considerably broken there is sufficient character in the specimen to permit appreciation of its original form.

Wear and breakage in this type have been especially severe on the various crests and surfaces of the proximal articular surface. In outline, viewed from above the bone represents a truncated triangle, with the base in front and the cut-off point behind; the intercondylar tubercle, badly worn away, projects well above the general level of the head, and apparently had a more or less pointed form; the outer glenoid facet has been completely broken away; the inner glenoid surface, of which the outer margin is missing, was narrow, smoothly convexly rounded, ascending the side of the intercondylar tubercle behind and sloping abruptly down in front, with the articular surface extending on front of bone below level of base of tubercle; in this lower projection it is concave in outline from side to side; the posterior portion of the head, behind the facets and tubercle, is depressed so that there is a distinct but irregular transverse groove across the head of the bone, bounding proximally the portion of the shaft supporting the hypotarsal crests. On the anterior surface is a broad, shallow

[1] Clapp, C. H.: Mem. 96 (1917).
[2] Ibid., p. 339.
[3] Bull. Geol. Soc. Am., vol. 29, pp. 297-308 (1918).

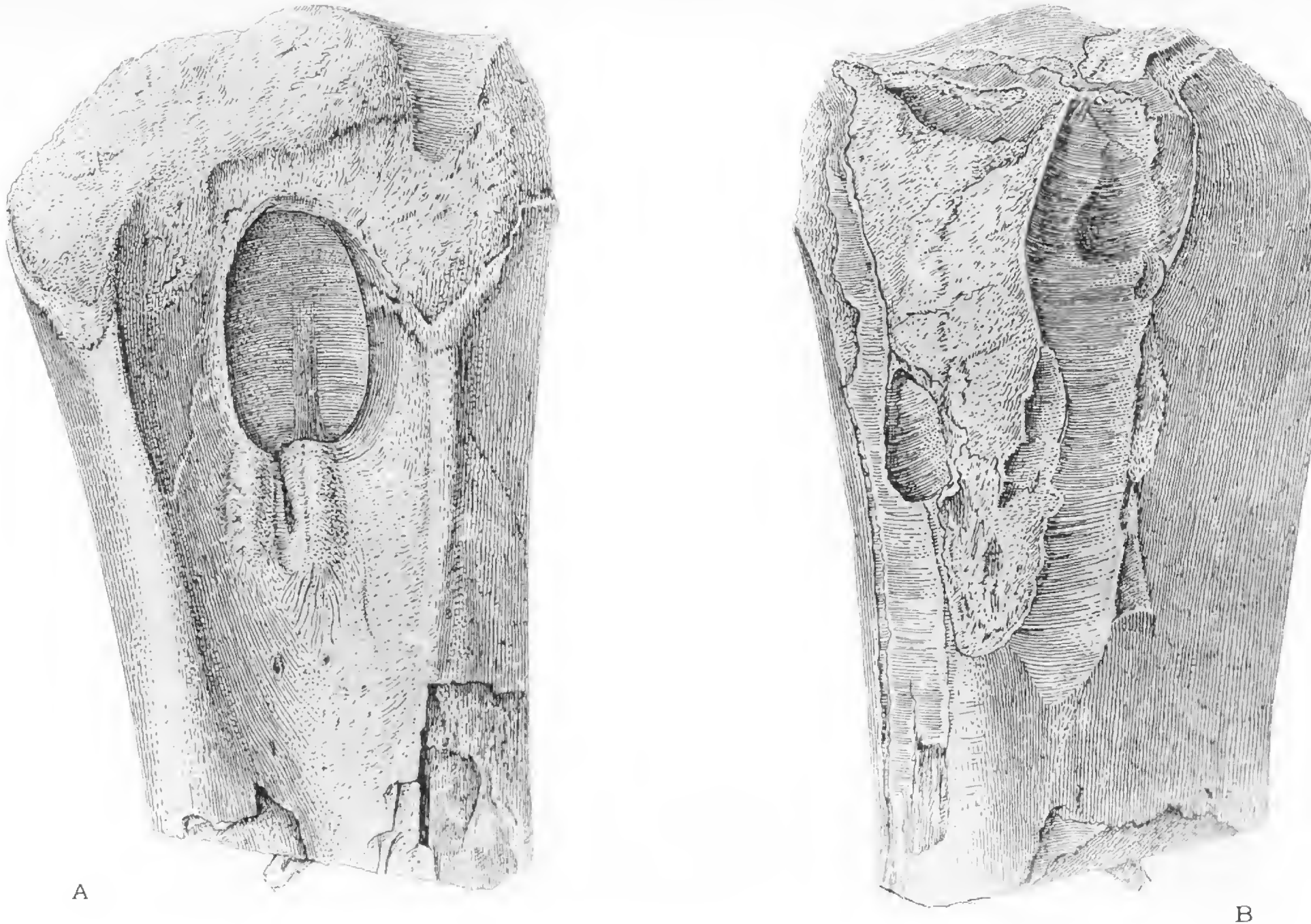

Figure 1. Upper end of metatarsus of *Cyphornis magnus* Cope. Type specimen. Twice natural size. A: anterior view; B: posterior view

groove with evenly raised margins on either side and a large, deep excavation immediately under the head marking a pneumatic foramen. This foramen is undercut beneath the head above and on the outer side, and has an abrupt but sloping wall on its inner face and below. At its bottom there is a trace of a median septum dividing it longitudinally in two sections. The tubercle for attachment of the tibialis anticus lies at the centre of the anterior groove at the lower margin of this foramen. There is a second tubercle for tendinal attachment on the outer wall separated by a narrow but distinct sulcus from the tubercle just described. External to the pneumatic foramen is a relatively broad, shallow groove with sharply crested margins. The external face of the head is broad and smooth, slightly convexly rounded for its anterior half and then changing to a faintly concave line toward the base of the talon. The inner face also is broad with a somewhat more angular surface that in general has a slight convex outline. The hypotarsal crests are missing, so that their former position is indicated merely by broken surfaces of bone. The outer crest of the talon had a long and very narrow base, extending proximally to the transverse groove on the articular surface, and distally to a level equal to that of the lower margin of the tibialis anticus tendon. It is separated from the line of the inner crest by a shallow groove, at the anterior end of which is a large pit that apparently led into the pneumatic centre of the shaft. The base for the inner crest was much broader, and was approximately as long as the outer crest. It was broader in front and narrowed behind and had a foramen entering the centre of the base on the outer side. The outer face of the base is marked by a broad, shallow, longitudinal groove. It would appear that the outer crest was high and blade-like and the inner broad, probably low and flattened, and perhaps divided by a groove into two portions. The shaft below the talon on the posterior surface in outline is irregularly rounded. The shaft was thin walled and highly pneumatic.

The specimen has the following dimensions: transverse breadth of head at level of upper margin of pneumatic foramen, 36·7 mm.; transverse breadth of shaft at lower end of fragment, 24·8 mm.; breadth of anterior pneumatic foramen, 10·8 mm.

On careful comparison with pertinent modern birds it is easily apparent that *Cyphornis* is most closely allied to the Pelecanidae. The anterior aspect of the bone in particular closely resembles that of *Pelecanus onocrotalus* and *P. erythrorhynchos*. There is the same general form, the deeply excavated pneumatic foramen, and also the highly pneumatic character of the bone. In the anterior face, *Cyphornis* differs mainly in the higher, longer ridge on its internal border and the broader space separating the intercondylar tubercle from the pit below.

In size *Cyphornis* was more than twice as large as the largest of pelicans, so that it was a giant in its order, standing perhaps 6 feet in height. Cope has remarked that if it had the ability to fly it represents the largest known flying bird in the New World. Its dimensions may be appreciated when it is known that in the largest specimen of *Pelecanus onocrotalus* at hand the transverse breadth of the metatarsus taken at the same level as in *Cyphornis* is only 25·6 mm.

Though the general form of the posterior face of the fossil is similar to that of *Pelecanus*, the crests must have been quite different in arrangement. In the pelicans the inner crest of the hypotarsus is long, and is supported on a comparatively broad, strong base. The outer crest is much reduced, as it is only slightly more than one-third as long as the inner, and rises only slightly above the centre of its stronger brother. In *Cyphornis*, as has been indicated, the crests are broken away, but from the surfaces left we may adduce that the two parts of the hypotarsus were more or less similar in length, with the inner supported on a comparatively narrow base, and the outer much broader and heavier. The condition is strongly reminiscent of the arrangement in the Sulidae where the outer crest is double, and though only a little more than half as high is about three-fourths the length of the inner. The transverse groove above the proximal end of the hypotarsus, so well marked in *Cyphornis*, though very faintly developed in the pelicans, is also indicated in the Sulidae. In the cormorant-anhinga branch of the totipalmate birds the inner crest of the hypotarsus is high and blade-like with a narrow base, and the outer crest is greatly reduced.

We find then that *Cyphornis magnus* though strongly pelican-like in its characters shows certain affinities to the Sulidae and more distantly to the Phalacrocoracidae and Anhingidae. Although similar to the Pelecanidae, it is so different as to warrant its segregation in a distinct family, to be known as the Cyphornithidae.

In this connexion there must be considered also *Palaeochenöides mioceanus* Shufeldt[1] described from the lower end of a left femur, from Miocene deposits near the source of Stono river, South Carolina. Though Dr. Shufeldt considered this an anserine bird I have shown[2] that it is properly a species of the order Pelecaniformes (known formerly as the Steganopodes). After careful study of the type my conclusion as to the affinities of *Palaeochenöides mioceanus* in the paper just cited (page 557) was as follows:

"Should more of the skeleton become known, it may eventually be placed in a separate family. If we may venture to base theory on this one fragment, *Palaeochenöides* was a pelican-like bird somewhat larger than *Pelecanus erythrorhynchos* or *P. onocrotalus*, as the portion of the femur representing it seems to indicate that the bone in its entirety was somewhat larger and heavier than the femur in these two species. In its appearance this bone seems, too, to show certain resemblances to the Sulidae and remotely to the Anhingidae and Phalacrocoracidae. Hence, while *Palaeochenöides* will stand as a milepost in the line of descent of the pelicans, it brings down to us suggestions of generalized development indicating ancient relationships of pelicans to gannets and more remotely to the cormorant-anhinga branch of the totipalmates."

The affinities of *Palaeochenöides mioceanus* are thus so similar to those adduced for *Cyphornis* that I have no hesitance in including it in the family *Cyphornithidae.*

The arrangement will be as follows:

Family, CYPHORNITHIDAE

Genus, *Cyphornis* Cope

Cyphornis magnus Cope, Jour. Acad. Nat. Sci., Philadelphia, ser. 2, vol. 9, p. 451 (May 31, 1894). (Tertiary, probably Miocene of Vancouver island.)

Genus, *Palaeochenöides* Shufeldt

Palaeochenöides mioceanus Shufeldt, Geol. Mag., N.S., dec. 6, vol. 3, p. 347, Pl. 15 (August, 1916). (Miocene of South Carolina.)

[1] Geol. Mag., N.S., dec. 4, vol. 3, p. 347, Pl. 15 (August, 1916).
[2] Jour. Geol., vol. 25, pp. 555-557, fig. 1 (September-October, 1917).

DENDROCYSTIS IN NORTH AMERICA[1]

By F. A. Bather

Illustration

Messrs. A. O. Thomas and H. S. Ladd[2] have recently published a careful description of *Iowacystis sagittaria* n.g. et. sp. from the Fort Atkinson limestone of the Middle Maquoketa series at the old Fort Atkinson quarry, Winneshiek county, Iowa. The Maquoketa beds are generally referred to the middle of the Richmondian (Upper Ordovician of some authors, Lowest Silurian of others) and probably correspond to the upper part of Marr's Ashgillian in Great Britain.

Iowacystis is referred by the authors to the Anomalocystidae, though they admit that certain characters "are foreign to that family," and add that "Foerste suggests relationship to the Mitrocystidae or Lagynocystidae." It is, however, plain that the species is a *Dendrocystis*, and, thus considered, it may be diagnosed as follows:

Dendrocystis sagittaria (Thomas and Ladd)

A *Dendrocystis* with thecal outline sub-triangular, width at base nearly equal to thecal height; thecal lobes descending slightly below stem-attachment; sides slightly convex, marginals more developed on reverse side, 3 lateral, 1 apical, and 2 basal, and between the last on each side is a basal or adcolumnal plate; these frame about 40 irregular plates on obverse side, with greatest diameters from 1·5 to 4·5 mm., and 6 plates on reverse side, with greatest diameters from 3 mm. to 6·5 mm., 5 of which are symmetrically arranged. Most of the plates show obscure axial folds or ridges. Length of brachiole unknown; width at base about 1·2 mm. [?]. Length of stem uncertain, but at least twice thecal height; section throughout elongate-elliptical; distal region of short subalternate dimeres; median region of alternate dimeres, with height about twice breadth, and some intercalated plates; proximal region short, of narrow flanged dimeres forming about eight rings, with no smaller plates.

Dendrocystis sagittaria occurs at about the same horizon as *D. scotica*, but it is the end (so far as known) of a different line of evolution. The European line leading from *D. barrandei* to *D. scotica* shows a gradual increase in bilateral symmetry, with the brachiole moved to one side and counterbalanced by an antibrachial process.[3] Starting again from *D. barrandei*, we must suppose an American line, in which an expanded bilateral symmetry continued to affect the proximal region, but was replaced in the distal (adoral) region by the more central position of the brachiole and the median apical (i.e. adoral) marginal.

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[1] Published by permission of the Trustees of the British Museum.
[2] Univ. Iowa Stud. Nat. Hist., XI, No. 8, pp. 6-10 (June, 1926).
[3] *See* Bather, 1913: "Caradoc. Cyst. Girvan." Trans. Roy. Soc. Edinburgh, XLIX, ii, p. 374.

The departure in outline from *D. barrandei* is very slight, but there were other changes.

The marginals became more pronounced, more regular, and fewer, thus constituting a more obvious frame.

A slight decrease in number of somatic plates is to be observed in *D. scotica*, but along the American line this decrease has proceeded more rapidly, reaching what must be almost an extreme on the reverse side of *D. sagittaria*.

With the enlargement of the plates is naturally connected a development of axial folding and ridging. Traces of similar folding have already been described in *D. sedgwicki*[1].

The evolution of the stem also has proceeded along a line somewhat different from that of the European forms. The median and distal regions of the stem consist of alternating dimeres, which become shorter in the median region and are occasionally accompanied by intercalated plates.[2] On the whole these parts of the stem are nearer the stage of the Middle Ordovician *D. sedgwicki* than of the more flattened Upper Ordovician *D. scotica*. The proximal region of the stem, on the other hand, has progressed further in the direction of flanged rings (7 or 8 in all) than in any other completely known *Dendrocystis*. The proximal ossicle of the median series fits into the lowest of these rings, and reminds one of the conical reducing piece in *Cothurnocystis*, *Ceratocystis*, and other genera (the styloconus of Jaekel). So far as the stem is concerned, the intermediate stage between *D. sagittaria* and *D. barrandei* is provided by the Trenton Limestone fossil which E. Billings (1859) named *Syringocrinus paradoxicus*, and which I referred to *Dendrocystis* in 1913 (par. 155).

Some new morphological features are described by Messrs. Thomas and Ladd. To our knowledge of the brachiole itself, they unfortunately do not add; but they show that, with the reduction of the somatic plates, three of them have become more definitely associated with the brachiole than have any of the adbrachial plates in the European species.[3] One of these three might also be compared to the radial of a crinoid, and it would be interesting to see if it shows any trace of an articular facet for the brachiole. What is an important observation is that these plates bound a groove opening into the theca. The brachiole appears to be attached to the lower or proximal end of this groove. This is additional confirmation, if such were required, of my interpretation of this structure as a brachiole (1899, 1900, and 1913, par. Nos. 71, 72).

Another of these three plates—that on the left when the theca is viewed on the obverse face—is "thick and the adapical [i.e. adoral] part of its surface is elevated into a pointed cone directed outward and upward; in the apex of the cone is a small depression, evidently a pore, thought to be the gonopore" (page 8). "On the flanks of the ..... cone ..... are a number of tiny pustules which have the appearance of being perforated; their purpose is unknown" (page 10). This is very suggestive of a madreporite bearing a gonopore. Hitherto no such openings have been observed in any Heterostelea other than the pores detected by Jaekel (1919) on

[1]Bather, 1913, par. No. 49.
[2]Cf. Bather, 1913, par. Nos. 82, 83.
[3]Bather, 1913, par. No. 61.

marginals 2 of *Mitrocystis*.[1] I did, however, suggest in 1913 (par. No. 80) that a hydropore would be found in *Dendrocystis* in the position where Messrs. Thomas and Ladd have now found an opening, and I actually described and figured a similar rounded projection in *D. scotica* and mentioned its occurrence in an unnamed species from Hérault (1913, par. Nos. 80, 136). This independent confirmation in *D. sagittaria* is, therefore, most gratifying.

Enough has been said to show that this species falls into its true place as a *Dendrocystis*, and that the resemblance to certain Anomalocystidae lies solely in the triangular outline, the exaggeration of the marginals, and the reduction in number of the body plates. This is a clear case of parallel evolution, but hardly close enough to be called convergence. It has no bearing on the relations between Dendrocystidae and Anomalocystidae, since it occurs in both at the end of the series not at the beginning.

It will be noted that the larger somatic plates are on the reverse side, which, on my explanation of the mode of life, was that towards the sea-floor, whereas the obverse or uppermost side retains the smaller plates and the flexibility which they permit (Bather, 1913, par. No. 585).

Dendrocystis (?) *paradoxica* Billings

The kindness of Mr. E. M. Kindle and other friends enabled me, when visiting Ottawa in 1924, to study the original specimen of this species. It is from the Trenton limestone of Beaufort, Quebec, and is No. 1521a in the National Museum of Canada at Ottawa. Thus something can be added to the remarks previously published by me (1913, par. Nos. 155-159).

Billings (1859) figured and described the fossil as showing portions of the stem alone. His figure shows parts of all three regions, but the specimen seen by me presents only the proximal and median regions. Some part of this specimen, as well as other specimens mentioned by him, has perhaps been mislaid.

On the other hand, by cleaning the upper (adoral) part of the type specimen, I was able to expose some of the proximal plates of the theca. All those seen may be called somatic plates. They are thin and quite small; most are polygonal and irregular, but a few are hexagonal, with a diameter of 1·25 mm. On the left side of the specimen are one or two of the latter still in contact, but the other plates that remain are irregularly scattered, those between them having disappeared.

The columnals of the proximal region are flanged rings formed of dimeres, and are very low or thin, as indicated in Billings' figure, which represents the transverse ridges on the dimeres; but they are more numerous than shown by Billings.

The columnals of the median region differ in some respects from those of any other described species of *Dendrocystis*, and the points, which are not clear in Billings' figure, are brought out in the accompanying sketch

[1] *See* Bather: Palaeont. Zeitschr., VII, p. 13 (May, 1925).

(Figure 2). The dimeres on the left side of the specimen are much shorter than those on the right side, about 3 on the left corresponding to 2 on the right, but they vary in individual height. They are about twice as wide as those on the right, and their width is generally greater than their

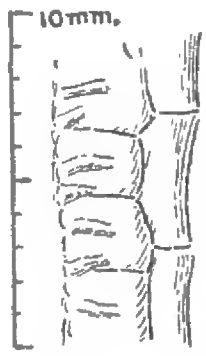

Figure 2. *Dendrocystis (?) paradoxica* Billings.

height. They bear irregular transverse ridges, some on or across the sutures, as though connecting the ossicles, others half-way up the ossicle. The latter merge into the transverse ridges of the proximal region. The dimeres on the right are about three times higher than wide, and their outer edge is markedly concave.

It is not easy to understand why there should be this great difference between the two sides of the stem in the median region and, in the absence of the theca, any suggestion would lack corroborative evidence.

The specific distinctness of this form is accentuated by the facts now described, but its reference to *Dendrocystis*, though still probable, is not placed beyond doubt. If the discovery of further specimens were eventually to prove this species certainly congeneric with the genotype *Dendrocystis sedgwicki*, there would arise the question of adopting the prior name *Syringocrinus*. In my opinion such a change of name would be unfortunate and ridiculous. It must be clearly understood that from neither the description nor the figure of Billings, nor even from the holotype as now elucidated, can the generic position be inferred with certainty. *Syringocrinus* has never been diagnosed, and the generic name should not be considered available.

NEW DEVONIAN CEPHALOPODA FROM NOVA SCOTIA

By A. F. Foerste

Illustration

The material studied was embedded in three blocks of coarse and very hard sandstone from Bear River district, 2 miles northwest of Clementsvale, southwestern Nova Scotia. These contained a considerable number of cephalopods, preserved partly in the form of casts of the interior of the conch and partly in the form of hollow cavities, the conchs having completely weathered away. The hollow cavities, or moulds of the exterior of the conchs, usually show the sutures of the septa distinctly. It is evident from the lithological character of the rock, and the abundant pelecypod fauna enclosed in it that all three chunks came from the same horizon. The associated fauna, according to E. M. Kindle, indicates this to be a Lower Devonian horizon.

All of the cephalopods in the material appear to belong to the genus *Ormoceras* Stokes. This genus, typified by *Ormoceras bayfieldi* Stokes, is readily differentiated from typical *Actinoceras* Bronn, typified by *Actinoceras bigsbyi* Bronn, by its relatively much shorter septal necks.

Three new species of *Ormoceras* are present. One of these, *Ormoceras kindlei*, is characterized by its long septal necks. In the other two—*O. novascoticus* and *O. brevicameratus*—the septal necks are distinctly shorter. These two species are distinguished from each other by differences in their rate of enlargement, the apical angle of *Ormoceras brevicameratum* being considerably greater than in either of the other two species.

All of the cephalopods here studied present elliptical cross-sections, and more or less oblique sutures of septa, which have probably resulted from distortion of the conch after death. Only *Ormoceras brevicameratum* presents distinct evidence of transverse striations.

Species of *Ormoceras* occur both in Silurian and Devonian strata, but since none of the previously known forms is strictly comparable with these new species from Nova Scotia, the latter do not serve to indicate the horizon of their fauna.

Ormoceras kindlei sp. nov.

Figure 3, A, A′, and C

Specimen 175 mm. in length, enlarging from a maximum diameter of 20 mm. at its base to 28 mm. at a point 75 mm. farther up, indicating an apical angle of about 6 degrees. At a point where the maximum diameter is estimated at 31·7 mm., the minimum diameter of the conch is 25·5 mm. Four and a half cameræ occur in a length equal to the maximum diameter of the conch at the top of the series of cameræ counted where this diameter is estimated at 28 mm. At this point the concavity of the

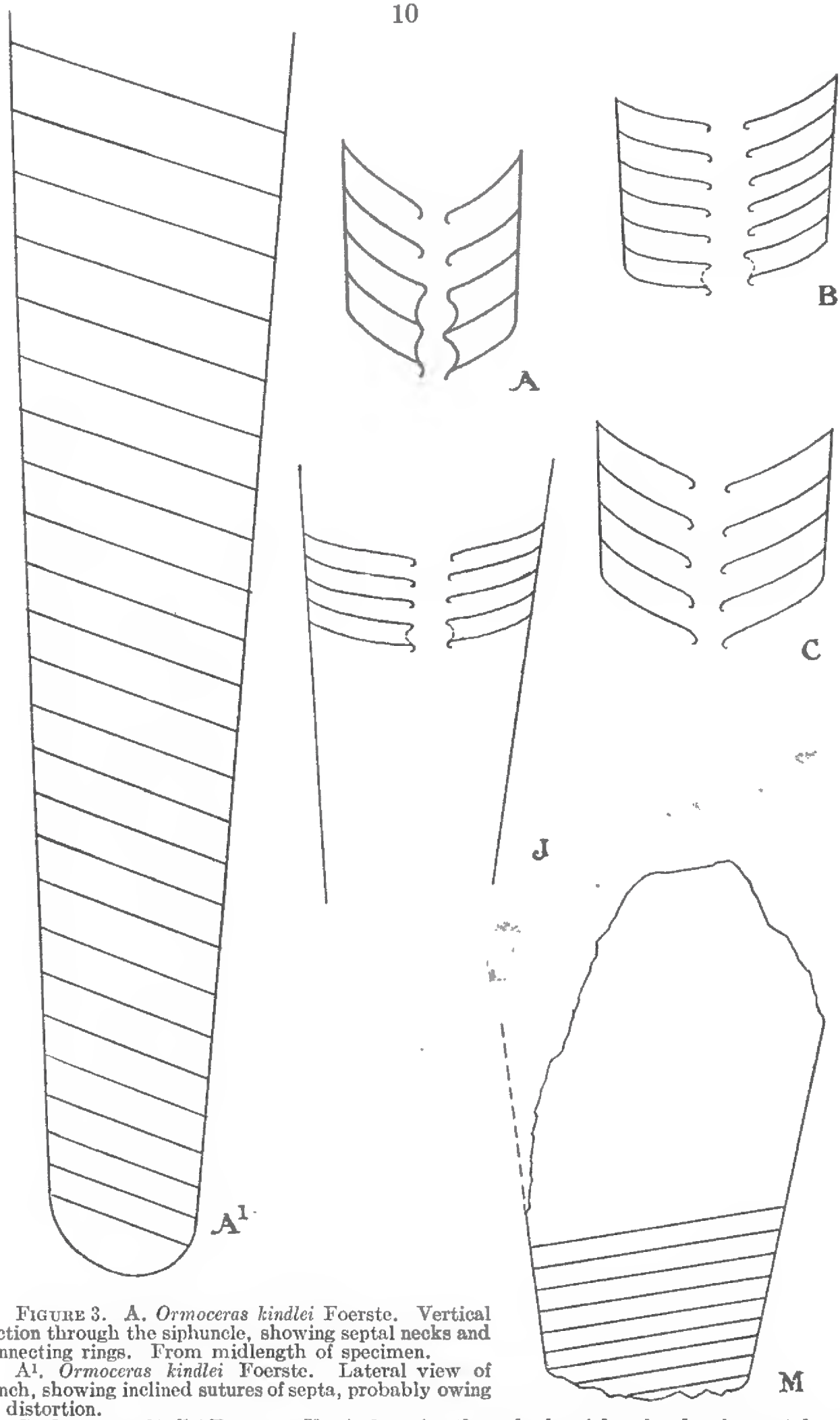

FIGURE 3. A. *Ormoceras kindlei* Foerste. Vertical section through the siphuncle, showing septal necks and connecting rings. From midlength of specimen.

A1. *Ormoceras kindlei* Foerste. Lateral view of conch, showing inclined sutures of septa, probably owing to distortion.

C. *Ormoceras kindlei* Foerste. Vertical section through the siphuncle, showing septal necks.

B. *Ormoceras novascoticus* Foerste. Vertical section through the siphuncle, showing septal necks and probable form of connecting ring.

J. *Ormoceras brevicameratum* Foerste. Vertical section through the siphuncle, showing septal necks and probable form of connecting ring.

M. *Ormoceras brevicameratum* Foerste. Lateral view of conch, showing inclined sutures of septa, probably owing to distortion.

septa equals 6·5 mm. The location of the siphuncle is central or slightly ventrad of the centre. At the septal neck it contracts to a diameter varying from 2·5 mm. to 3 mm. The length of the septal neck varies from 1·1 mm. to 1·3 mm., the height of the enclosing cameræ varying from 5 to 6 mm. The maximum diameter of the nummuloidal segments of the siphuncle, within the cameræ, is somewhere near 5·5 mm., the maximum diameter of the conch at this point being 28 mm. The siphuncle formerly was filled with calcareous deposits, which, in vertical section, enclosed the septal necks in lunate form, successive lunate deposits meeting slightly above midheight of the cameræ, as in typical Actinoceroids. The surface of the conch, as far as known, was smooth.

Named in honour of E. M. Kindle, in recognition of his notable contributions to Canadian geology.

Remarks. Specimen No. 7978 (A). At present the sutures of the septa incline at an angle of 70 degrees with the vertical axis of the conch in a direction parallel to the longer lateral axis of the latter. From this it is assumed that the inclination of the septa is due to distortion subsequent to the death of the animal. The downward curvature of the septa is greater on one side of the siphuncle than on the other, in a direction parallel to the shorter lateral axis of the conch. This, also, may be due to distortion, but that is not so certain.

Specimen No. 7978a (C). Specimen having its base still embedded in the rock,with a length of 90 mm. exposed, of which the upper 4 cameræ are free and have been sectioned through the siphuncle, vertically. The diameter here is estimated at 32 mm. About 6 cameræ occupy a length equal to this diameter. The location of the siphuncle is central, and the diameter of its septal neck is 3·5 mm. The length of the septal neck in the only camera within which it is clearly exposed is at least 1·5 mm. Since the lower margins of these necks curve strongly outward, the connecting rings are assumed to have been nummuloidal. The rate of expansion of the conch is at least 6 degrees.

Locality and Horizon. Two miles northwest of Clementsvale, N.S. Lower Devonian.

Types. Nos. 7978, a, National Museum of Canada.

Ormoceras novascoticum sp. nov.

Figure 3, B

Specimen 85 mm. in length. Near the top of the specimen its maximum diameter is 29 mm., and its minimum diameter is 23·5 mm. The rate of enlargement of the conch cannot be determined with accuracy, but it equals at least 5 degrees in the direction of the minimum diameter. About 7·5 cameræ occur in a length equal to the maximum diameter of the conch. The location of the siphuncle is central. The diameter of the septal necks varies from 3·3 to 4 mm. where the maximum diameter of the conch varies from 26 to 29 mm. The cast of the interior of the passage of the siphuncle through the septum equals 2·75 mm., where the diameter of the septal neck is 3·6 mm. Possibly this is due to the former

presence here of a calcareous deposit lining the inner surface of the septal neck. The length of the septal neck is about 0·6 mm. The surface of the shell, apparently, was smooth.

Remarks. Specimen No. 7979 (B). This specimen is distinguished from typical *Ormoceras kindlei* by its distinctly shorter septal necks. The strongly outward curved lower margins of the septal necks indicate the presence of nummuloidal connecting rings, probably at least 5·5 mm. in diameter at mid-height.

A second specimen, about 70 mm. in length, is still embedded in the rock, weathered so as to show a vertical section through a part of the conch. Six cameræ occur in a length equal to the diameter of the conch. The septal necks are 3 mm. in diameter where the diameter of the conch is 23 mm. These septal necks are very short, as in typical *Ormoceras novascoticum.* The nummuloid character of the segments of the siphuncle is indicated at the base of the cast of the interior of the specimen. Specimen No. 7979a, National Museum of Canada.

A third specimen is about 55 mm. in length along one side of the strongly distorted specimen. Diameter 36 mm. About 7 cameræ occur in a length corresponding to this diameter. The septal necks are 3 mm. in diameter, and apparently are as short as in typical *Ormoceras novascoticum.* Specimen No. 7979b, National Museum of Canada.

Locality and Horizon. Two miles northwest of Clementsvale, N.S. Lower Devonian.

Types. Nos. 7979, a, b, National Museum of Canada.

Ormoceras brevicameratum sp. nov.

Figure 3, J and M

Specimen about 60 mm. in length. In its present condition its cross-section is elliptical. About 22 mm. above its base its maximum diameter is 35 mm. and its minimum diameter 23 mm. Its apical angle parallel to its maximum diameter is about 13 degrees. Beneath the point where its maximum diameter is 34·5 mm., there are 7 cameræ in a length of 19 mm.; from this it is estimated that there were at least 13 cameræ in a length equal to the maximum diameter of the conch, when this diameter is measured at 31 mm. in length. The surface of the shell is ornamented by transverse striæ, varying from 8·5 to 11 in a length of 5 mm.

Remarks. Specimen 7980a (M). This specimen differs from the preceding two species in its greater apical angle and in the relatively greater number of its cameræ in a length equal to the diameter of the conch. Moreover, the surface of the shell is striated transversely.

A second specimen is 45 mm. in length, enlarging from a maximum diameter of 18 mm. at its base to 25 mm. at a point 33 mm. farther up, indicating an apical angle of 12 degrees in this direction. Where the maximum diameter is 25 mm., the minimum diameter is 18 mm. Eleven cameræ occur in a length equal to the maximum diameter of the conch. This specimen is a cavity left in the rock by the removal of the conch by weathering.

A third specimen is parallel to the second in the rock and within 3 mm. of the latter. At the top of the specimen the casts of the interiors of 4 cameræ still are partly preserved. At the lowest of these cameræ the maximum diameter is 29 mm. and the minimum diameter is 21 mm. Twelve cameræ occur in a length equal to the maximum diameter of the conch. The concavity of the septa is moderate. The siphuncle is central in location. The maximum diameter of its septal neck is 4 mm. and its minimum diameter is 2·8 mm. where the maximum diameter of the conch is 32 mm. The length of the septal neck is about 0·6 mm., and its lower margin curves strongly outward, indicating a nummuloidal form of connecting ring. The passage of the siphuncle through the septum is narrowed to 2·6 by 1·8 mm., probably owing to a calcareous deposit lining the interior of the septal neck, as in other Actinoceroids. Specimen No. 7980 (J), National Museum of Canada.

Locality and Horizon. Two miles northwest of Clementsvale, N.S. Lower Devonian.

Types. Nos. 7980a, National Museum of Canada.

THE OCCURRENCE AND CORRELATION OF A DEVONIAN FAUNA FROM PEACE RIVER, ALBERTA

By E. M. Kindle

CONTENTS

Illustrations

STRATIGRAPHIC RELATIONS

The Devonian fauna which occurs along lower Peace river at Peace point, above the gypsum cliffs in both banks of the stream, presents some noteworthy features both from the viewpoint of correlation and manner of occurrence.

Precambrian Base

The schistose and granitic rocks of Precambrian age which are so conspicuous along Slave river, above and below the mouth of the Peace, are represented only by a few low, rounded island knobs on the lower 25 miles of Peace river. With the exception of these low granitic islands no consolidated beds outcrop along the lower 80 miles of the Peace. Above the islands for nearly 50 miles the Palæozoic rocks are concealed along the river by a heavy mantle of river and lacustrine deposits.

Silurian Section

About 80 miles above the mouth of Peace river the banks are bordered by cliffs of gypsum, anhydrite, and magnesian limestone. These cliffs extend, with occasional breaks, for a distance of approximately 12 miles, rising from 20 to 80 feet above the river. They are first seen in descending the river about 10 miles below the mouth of Jackfish river. At this point the cliffs exposed on the south bank are about 35 feet high and consist mainly of nearly white gypsum and anhydrite interstratified with thin bands of blue clay. At this and other points on the south side of the river where these beds were examined the gypsum cliffs are capped with Quaternary deposits. The strata of this horizon are nearly everywhere disturbed by local folds having generally a lateral extent of not more than a few hundred feet. These folds are doubtless, as stated by Camsell,[1] the

[1] Camsell, Chas.: "Salt and Gypsum Deposits of the Region Between Peace and Slave Rivers, Northern Alberta"; Geol. Surv., Canada, Sum. Rept. 1916, p. 135 (1917).

product of stresses incident to increased volume of the beds resulting from their change from anhydrite to gypsum. One of these local anticlines on the south bank forms a gothic arch of remarkable beauty and symmetry rising about 25 feet above the level of the river. At many points the stresses to which these beds have been subjected have produced a breccia. The entire face of the cliffs shows at such localities a mass of angular limestone boulders of various sizes firmly cemented together in a calcareous matrix. The appearance of the breccia is shown in Plate I, figure 1. Between these vertical belts of crushed beds lie sections in which the strata often remain horizontal and undisturbed (Plate II, figure 1). The anhydrite and gypsum which locally form boulderlike masses are shown on Plate I, figure 2. The following section is exposed on the south side of the island near the north bank of the river at the upper end of the cliffs.

Section at the Upper End of the Cliffs

	Feet
(a) Thin-bedded, drab, slightly magnesian limestone	10±
(b) White and cream-coloured anhydrite and gypsum in thin, horizontal, ribbon-like bands	50±
(c) White gypsum and anhydrite	6

Only the uppermost beds of this section appear to contain fossils, and these very sparingly. None has been found in the lower part of the section. The specimens collected have been listed as follows:

Spirifer crispus (Hisinger)
Modiolopsis sp.
Modiolopsis sp. cf. *orthonota* (Conrad)

This fauna represents a late Silurian horizon, probably the approximate equivalent of the Bertie waterlime or the Akron dolomite. The beds with the *Spirifer crispus* fauna appear to represent the youngest member of the dolomitic formation called by Cameron[1] the Fitzgerald dolomite (Plate II, figure 1). At various points on the north bank of the river the gypsum beds and associated buff-coloured, slightly magnesian limestones which furnish the fossils listed above are overlaid by a set of sharply contrasted sediments holding an entirely different fauna and lying unconformably upon the lower beds. The following section shows the two formations exposed in a single cliff section.

Section 2 Miles Below Upper End of Cliffs

	Feet
(a) Lake clay	6
(b) Glacial clay and boulders	9
(c) Blue shale and thin-bedded limestone with Devonian fossils abundant	8
(d) Grey, thin-bedded, hard, argillaceous limestone with a metallic ring, lower third brecciated	70

Devonian Beds

The foregoing section was taken at a point where the cliffs have about their maximum height and where the gypsum shales are represented chiefly by limestones. These lower beds, d, of the limestone section, show

[1] Cameron, A. E.: "Explorations in the Vicinity of Great Slave Lake"; Geol. Surv., Canada, Sum. Rept. 1917, pt. C.

the sharpest possible contrast faunally with the blue shale, c, above, not a single species being common to both. The two formations are separated by an angular unconformity which is clearly shown at a number of points along the cliffs. The basal Devonian clays may lie 75 feet above the river in one section and in another a few yards away be found in place, 50 feet lower. The cliffs show good vertical sections of cistern and well-shaped chimneys 50 to 65 feet deep filled with Devonian clay and shale rich in fossils, which evidently represent ancient caverns in the gypsiferous shales and associated limestones. The photograph (Plate II, figure 2) shows the relations existing between the two sets of unconformable beds found in these cliffs. The blue shales with thin calcareous bands overlying the Silurian beds and characterized by the fauna listed below will be called the Peace Point beds.

The beds, d, are believed to correspond in horizon to the upper beds of the Silurian limestones of Manitoba east of lakes Manitoba and Winnipegosis. Their equivalent beds in the New York section probably lie within the limits of the Cayugan group.

DEVONIAN FAUNA

The Devonian blue clay and shale (c of section, page 15), with its associated thin-bedded limestone bands which overlie the Fitzgerald beds, contain an abundance of fossils in a perfect state of preservation. The following species are from these beds. This fauna is considered to represent an early phase of the Upper Devonian fauna.

Fossils Collected at Stations 3 and 4 From the Devonian Shales of the Peace Point Section

Crinoid stems	c
Aulopora cf. *adnascens* Fenton	r
Spirorbis omphaloides Goldfuss	c
Crania sp	r
Schizophoria striatula (Schlotheim)	c
Camarotoechia sp	r
Pugnax pugnus Martin var	c
Leiorhynchus mesacostale Hall	c
Atrypa reticularis (Linn.)	a
Atrypa cf. *spinosa* Hall	r
Cyrtina hamiltonensis Hall var	r
Cyrtina billingsi Meek	c
" " var. *symmetrica* n. var	r
Spirifer tullia var. Whiteaves	c
Palaeoneila filosa (Conrad)	r
Leda cf. *diversa* (Hall)	r
Modiomorpha sp. undet	r
Leptodesma cf. *naviforme* Hall	r

Correlation of the Fauna

Comparison of this fauna with the rich Devonian fauna collected from the Peace River section at the Chutes, 150 miles above the Peace Point cliff section, shows only one species in common, the ubiquitous *Atrypa reticularis*. *Spirifer disjunctus*, which is extremely abundant in the upper Devonian faunules at the Chutes, in the Hay River section, and at other points in the late Devonian of Mackenzie River district, is unknown in the Peace Point section. The absence of this significant species suggests

for the fauna an horizon earlier than Chemung. The presence of such a species as *Pugnax pugnus*, however, points to an horizon later than Middle Devonian. The association with *P. pugnus* of *Cyrtina hamiltonensis*, *Schizophoria striatula*, *Leiorhynchus mesacostalis*, *Palaeoneilo filosa*, and *Leda* cf. *diversa* forms an assemblage comparable with many of those furnished by the Ithaca fauna of the Lower Portage. It is believed, therefore, that the fauna represents an horizon corresponding approximately to the Lower Portage horizon of the New York section.

Observations on Species

It should not be inferred from the correlation here made and the list of species on which it is based, that the Peace Point fossils are without the small differences which might be expected to distinguish them from a fauna representing so remote a region as central New York. There are differences which direct comparison with representatives of the New York fauna may yet make it advisable to treat as new species. *Pugnax pugnus* var. is represented by one or two exceptionally well-preserved shells which show on the dorsal valve very fine radiating striæ, 5 or 6 to 1 mm., and very fine concentric striæ on the ventral valve. These are not recorded in the descriptions of *P. pugnus* from Iowa or New York, and appear to represent a northern geographic variation of the Iowa and New York shells.

Cyrtina billingsi var. *symmetrica* n. var.

A well-marked variety of *C. billingsi*, represented by three or more specimens, is distinguished by a nearly or quite symmetrical ventral valve the beak showing practically no deflexion to the right or left. The sinus and fold are rather less well defined than in *Cyrtina billingsi*.

Types. Nos. 5593, National Museum of Canada.

Cyrtina hamiltonensis var.

A single small specimen with a highly granulose surface marked by about 12 plications on each valve is here considered a variety of *C. hamiltonensis*. Additional material showing the same peculiarities, if found in the future, may justify treating this form as a new species.

Spirifer tullia var. Whiteaves

The three specimens studied appear to be intermediate between *S. tullia* and the variety figured by Whiteaves, having fewer plications than the former and more than the latter, but apparently closer to Whiteaves' variety than Hall's species.

Many of the shells of *Schizophoria striatula* are perforated by the trails of a boring organism, probably a sponge, which are generally about $\frac{1}{3}$ mm. in diameter. These in some cases penetrate the shell at a sharp angle, but more frequently trench the surface in zigzag courses. Shells which are conspicuously marked with these borings are commonly much wave and water-worn, having escaped covering by sediments for a sufficiently long period to provide opportunity for these parasitic organisms

to become established. Other shells in the fauna appear to be free of these parasitic creatures. The largest specimen of *S. striatula* has a length of 33 and width of 36 mm.

Relations of the Peace Point and Fort Simpson Shale Fauna

The position in the New York section of the Ithaca fauna with which this Peace Point fauna is correlated was long misunderstood. James Hall first correlated it with the Chemung, where it remained until H. S. Williams showed by the study of a series of east-west sections across New York state that the Ithaca fauna was the eastern or inshore equivalent of the Portage fauna of western New York. The writer considers the Peace Point fauna to have precisely the same relationship to the Simpson shale[1] fauna of Mackenzie valley that the Ithaca fauna bears to the New York Portage. The occurrence of this fauna in the easternmost of the Palæozoic exposures of the Peace River section and the location of all the known sections of the Simpson shale far to the westward of the eastern margin of Devonian sediments are in harmony with the inference that the Simpson shale and Peace Point faunas were contemporaneous western and eastern faunas of the same early Upper Devonian sea in which the temperature differed along more or less parallel north and south belts or in discontinuous areas near the eastern Devonian sea border. A comparable example of discontinuous distribution on the Atlantic coast of Canada is the *Venus mercenaria* fauna of Northumberland strait, which comprises an assemblage of molluscs fundamentally different from that found elsewhere in the gulf of St. Lawrence. The Northumberland Strait colony, which includes such southern species as *Ostrea virginica* and *Venus mercenaria*, is separated from the northeastern border of the New England zone of the Acadian fauna by the deep basin of the bay of Fundy and the Atlantic coast waters of northern Nova Scotia. The reason for this isolation becomes apparent on examination of a bathymetric chart of the waters of the Maritime Provinces. The whole of Prince Edward Island and Northumberland strait lie inside the 20-fathom line, and much of the broad strait has a depth of 10 fathoms or less. On the southeastern coast of Nova Scotia, however, the 20-fathom line approaches in many places to within one-half mile of the coast, and there is everywhere a narrow zone of shoal water inside the 100-fathom zone which renders it colder than the broad, shallow, warm waters of Northumberland strait. It illustrates well the fact that a zone of shallow water (if sufficiently close to and unprotected from deep waters) may serve as a faunal barrier as effectively as a land barrier.

The Peace Point Devonian fauna is believed to be related to the Simpson shale fauna in the same general way that the Northumberland Strait fauna is related to that of the adjacent parts of the gulf of St. Lawrence. The Peace Point fauna is considered to be the eastern or inshore fauna of the two and to have extended an unknown distance toward or eastward of the present western margin of the Precambrian shield in the region of Slave River valley.

[1] Kindle, E. M.: "The Discovery of a Portage Fauna in the Mackenzie River Valley"; Geol. Surv., Canada, Mus. Bull. 29, pp. 1-8, Pls. I, II (1919).

NEW JURASSIC AMMONOIDEA FROM THE FERNIE FORMATION, ALBERTA

By F. H. McLearn

Illustrations

It has been known for some time that the Fernie formation contains faunas of more than one age.[1] Two additional faunas are now recognized and can be correlated.

One is represented by an ammonite collected by James McEvoy in 1908 on Ribbon creek, a tributary of Kananaskis river, and is presumably in the Fernie, for that formation outcrops on Ribbon creek.[2] It is not known, however, at what horizon in the formation it occurs. This ammonite is described below as *Yakounites mcevoyi* n. sp. and is interesting, for *Yakounites* is in the upper Yakoun fauna at Skidegate inlet, and the fauna including it is to be correlated with the Upper Yakoun. The affinities of *Yakounites* are with *Galilaeanus* S. Buckman and other ammonoid genera of Proplanulitan age in the English Jurassic. Another fauna having affinities with those of Proplanulitan age in the English Jurassic occurs in the Fernie formation at Blairmore, but it contains macrocephalitids, not gowericeratids; it is probably not of exactly the same date. In England, faunas of Proplanulitan age are in the Kellaways clay and Kellaways rock.

The other fauna is of considerably earlier age than the foregoing and was found by J. R. Marshall on the headwaters of Sheep creek, Alberta. It occurs at the base of the Fernie formation[3] and includes the ammonoids *Stemmatoceras albertense* n. sp., *Saxitoniceras allani* n. sp., and *S. marshalli* n. sp. In Buckman's chronology the date of *Stemmatoceras* is the earlier part of the Stepheoceratan age. Faunas of this age are found in the Bajocian or Middle Inferior Oolite strata of England. Other faunas of approximately this date, including those of both Sonninian and Stepheoceratan affinities, are present in the lower Yakoun at Skidegate inlet, in the middle sedimentary division of the Hazelton group on Hudson Bay and Babine mountains, probably in the Fernie at Minnewanka lake, and at other localities.

Acknowledgment is made to Mr. S. S. Buckman, F.G.S., for most important and helpful advice. Professor J. A. Allan of the University of Alberta, Edmonton, kindly loaned the specimen of *Stemmatoceras albertense*.

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[1] McLearn, F. H.: Geol. Surv., Canada, Sum. Rept. 1922, pt. B, p. 6 (1923).
[2] Marshall, J. R.: Personal communication.
[3] Marshall, J. R.: Personal communication.

Family, Gowericeratidae S. Buckman

Genus, *Yakounites* McLearn

Yakounites mcevoyi n. sp.

Plate IV, figures 1, 2

	Mm.	Mm.
Diameter	95	80
Height, whorl	35·6	46·5
Thickness, whorl	41	51·2
Width, umbilicus	25·8	16·9

The first measurement is taken at the anterior end of the outer whorl and the second about one-fourth whorl back. The posterior part of outer whorl is involute, anterior part shows marked umbilical enlargement; on outer whorl cone shape is from about sphaeroconic to almost scaphiticonic. Whorls are thicker than high, are somewhat flattened and convergent on the sides and rounded on the venter. There is whorl contraction at the anterior end. There is less than one-half whorl of living chamber. The venter of a part of the penultimate whorl is exposed and is rounded. The inner margin is narrow and upright and its outer edge abruptly rounded. The narrow, angular, primary ribs are curved a little, are slightly inclined, and number 29 on the outer whorl. The narrow and elevated secondary ribs number four to each primary on the posterior part of the outer whorl, and five to each primary on the anterior part. The suture line is deeply cut. ES[1] is about one-third deeper than wide and is divided on its inner side by a long accessory lobe. S1 is smaller and is divided by a long accessory lobe. L1 is longer than EL and has a long, median lobule and short, drooping lobules on either side.

This is a much smaller species than *Yakounites plenus* McLearn or *Yakounites loganianus* (Whiteaves); it has relatively somewhat lower and thinner whorls, a more abrupt umbilical enlargement, and somewhat relatively longer lobes.

The species name is given for James McEvoy.

Horizon and Locality. Collected on Ribbon creek, Kananaskis river, by James McEvoy in 1908. Presumably from the Fernie formation.

Type. National Museum of Canada, Ottawa; holotype, Cat. No. 5018.

Family, Stepheoceratidae S. Buckman

Genus, *Stemmatoceras* Mascke

Stemmatoceras albertense n. sp.

Plates V-VII

	Mm.	Mm.
Diameter	145	116·5
Height, whorl	27·2	30·2
Thickness, whorl	44·4 (43·1)	47·8* (47·2*)
Width, umbilicus	51·7	48·8
Primary ribs	38	33
Secondary ribs	118	

*Approximate.

[1]In accordance with common practice, the following symbols are used to designate lobes and saddles: ES, external saddle; S1, first lateral saddle; S2, second lateral saddle; EL, external lobe; L1, first lateral lobe; L2, second lateral lobe; Aux. I, auxiliary lobe.

Part of one side is imperfect. Perlatumbilicate, with depressed but not very thick whorls. The area inside the tubercles is narrow and divergent. The ventral area is very gently arched. The straight, primary ribs end in small conical tubercles. There are about three secondary ribs to each primary, two arising by furcation and one by intercalation. The secondary ribs are of moderate relief and curve forward a little on the venter. The living chamber is not preserved. The suture line is not deeply cut; ES is deep; S1 is much smaller than ES; S2 is smaller than S1 and much deeper than broad; L1 is as long as EL, but narrower, and is not quite symmetrical, having a long median lobule, a short outer lobule, and a yet shorter inner lobule; L2 is much shorter than L1; Aux. is narrow and inclined. The tubercle is on S1.

This species closely resembles *Stemmatoceras coronatum* (Quenstedt)[1] in general proportions, but has more ribs per whorl. The suture line of *S. coronatum* is not illustrated, so that comparison with it cannot be made.

Horizon and Locality. From the base of the Fernie formation on the headwaters of Sheep creek, Alberta.

Type. University of Alberta collections.

Family, Sphaeroceratidae S. Buckman

Genus, *Saxitoniceras* n. gen.

The inner whorls are sphaeroconic and there is umbilical enlargement on the anterior part of the outer whorl. The mouth border has in succession behind the lip, a slight elevation, a well-marked furrow, a ridge of low relief, and a scarcely defined depression. The primary ribs are rather broad and slightly inclined. The suture line is not deeply cut. L2 is broad. This genus differs from *Chondroceras* Mascke[2] in a two-ridged, at the most, not a three-ridged, mouth border, broader primary ribs, not markedly inclined forward at the anterior end, and a simpler, less deeply cut suture line. It differs from *Defonticeras* McLearn of the lower Yakoun fauna in its simpler suture line, not so lobed or deeply cut, shorter and wider L1, and the less abrupt umbilical enlargement. Genotype, *Saxitoniceras allani*, n. sp.

Saxitoniceras allani n. sp.

Plate VIII, figures 1, 2

	Mm.	Mm.
Diameter	43	36·4
Height, whorl	41·8	50·6
Thickness, whorl	55·8	56·3
Width, umbilicus	19	13·7

The first measurement is taken near the anterior end and the second nearly one-half whorl back. The maximum diameter is 45 mm. The inner whorls are sphaeroconic and there is umbilical enlargement on the anterior part of the outer whorl. Whorls fairly well rounded except for a little flattening on the sides, and somewhat contracted at the anterior

[1] Ammon. Schwab. Jura, Pl. 66, fig. 11 (1887).
[2] The writer is indebted to S. S. Buckman for the generic characters of *Chondroceras*.

end. Behind the lip there is in succession a slight elevation, a well-defined furrow, a low ridge, and a scarcely defined depression. The living chamber is about three-fourths of a whorl. The primary ribs are short, rather broad, low, rounded, slightly inclined, and number 17 on the outer whorl. The secondary ribs are straight across the venter, two bifurcate from each primary, and in addition there is one intercalated secondary to each primary. The suture line is little cut. ES and S1 are both deep and about equal, S1 being a little narrower than ES. S2 is small. L1 is shorter than EL, has a long, narrow median lobule and a short, narrow lobule on either side; it is nearly as broad as S1. L2 is broad.

The species name is given for Professor J. A. Allan.

Horizon and Locality. At the base of the Fernie formation on the headwaters of Sheep creek, Alberta.

Type. National Museum of Canada, Ottawa; holotype, Cat. No. 9021.

Saxitoniceras marshalli n. sp.

Plate VIII, figures 3, 4

	Mm.	Mm.
Diameter	49·2	42
Height, whorl	43	48·8
Thickness, whorl	77	
Width, umbilicus	22·3	14·2

The specimen is a little distorted and is imperfect. The maximum diameter cannot be measured owing to imperfection of the anterior end. The first measurement is taken about one-eighth of a whorl back from the anterior end and the second one-half whorl back. The inner whorls are sphaeroconic and there is umbilical enlargement on about the anterior half of the outer whorl. The whorls are depressed, being much thicker than high. A very narrow inner part of the lateral area is somewhat flattened; the ventral area is broad and well arched. Not enough of the mouth border is preserved to describe. The primary ribs are little inclined, are of moderate thickness, and have considerable relief, but at the anterior end of the outer whorl are broad, low, and rounded. The secondary ribs are about three to each primary, are very little inclined on the sides, but are straight across the venter.

The suture line is rather simple. S1 is somewhat smaller than ES. L1 appears to be a little stronger than EL. L2 is broad.

Compared with *Saxitoniceras allani* n. sp. this species is a little larger, has much thicker whorls, and differs in details of the suture line. *Stephanoceras zirkeli* Steinmann[1] from Caracoles, Chile, has a larger umbilicus, compared with that of the inner whorls of *S. marshalli*, has narrower and more elevated primary ribs, and shows no umbilical enlargement. The suture line is not illustrated and no comparison can be made with it. It is probably not of the same genus as *S. marshalli*.

The species name is given for J. R. Marshall.

Horizon and Locality. At the base of the Fernie formation on the headwaters of Sheep creek, Alberta.

Type. National Museum of Canada, Ottawa; holotype, Cat. No. 9022.

[1] Neues Jahr. Min. Geol. Pal., Beil.-band, I, p. 269, Pl. 12, figs. 5, 5a.

UPPER CRETACEOUS PLANTS FROM STIKINE RIVER, CASSIAR DISTRICT, B.C.

By W. A. Bell

CONTENTS

The plants were collected by F. A. Kerr of the Geological Survey, Canada, from a locality on Stikine river, three-fourths of a mile from the mouth of Carlson creek.

DESCRIPTION OF SPECIES

Asplenium dicksonioides Heer

The specimens of this form are all sterile fragments that agree closely with those figured by Heer.[1]

Aspidiophyllum trilobatum Lesquereux

Plate IX, figures 1, 2

Description. Only the basal portion of two specimens are represented. There are 3 strong principal nerves, the two lateral diverging from the midrib at an angle of 45 degrees to 60 degrees, and only slightly less prominent than the median one. Laterals provided with parallel secondaries, the lowest of which branch again. The primary laterals are attached about 1 cm. above the base of the leaf. The peltate basal lobe is not completely preserved. It is provided with at least three pairs of downwardly directed secondaries from the midrib. Tertiary veins, well-defined transverse arches. The second lateral pair of primary veins begin 2·3 cm. above the basal pair and are sub-opposite or alternating.

Remarks. Regardless of the fragmentary nature of these leaves, the characters of *A. trilobatum* are so pronounced in them that no doubt is held as to their specific identity.

Types. Plesiotypes, 167, 168; National Museum of Canada, Ottawa.

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[1] Flora Fossilis Arctica, vol. 3, Abt. 2, Pl. 1, figs. 1-5 (1874).

Protophyllum stikinensis n.sp.

Plate X, figure 2

Description. Leaf blade, entire, with smooth or undulate margin, apex unknown; lower border, narrowly rounded and subpeltate. Median vein, straight; primary laterals, inclined about 25 degrees to midrib, and nearly as prominent, slightly curved upwards, somewhat flexuous in their course distally, craspedodromous, terminating at top margin; basal laterals opposite, and inserted about 5 mm. above the base of the leaf, provided each with about 8 secondaries on the lower side. The basal one of the latter curves slightly downwards in its course and is camptodromous; the remaining secondaries of this series, of which the upper at least are craspedodromous, curve slightly upwards and are somewhat flexuous distally. The second pair of laterals are subopposite and distant 2·6 cm. above the basal pair to which they are subparallel. A third pair of laterals is partly exposed, distant 2·5 cm. from the second pair, and opposite one another. Below the insertion of the basal laterals there are 3 pairs of camptodromous veinlets given off directly from the midrib, of which the lowest pair is approximately horizontal. Tertiary veins, transverse, regular, generally simple, rather distant, slightly arched upwards.

Remarks. This species is quite distinct from other American species of *Protophyllum.*

Types. Holotype, 166; National Museum of Canada, Ottawa.

Platanus uniformis n.sp.

Plate XI

Description. Leaf blade, entire, somewhat longer than broad, evenly but not deeply dentate; lower margin nearly a right angle; top margin broadly rounded and with abruptly acute apex; petiole at least 2·5 cm. in length. Median vein straight; primary laterals inclined at 30 degrees to 35 degrees to midrib and only a little less prominent, nearly straight or somewhat curved upwards, craspedodromous, terminating in marginal teeth. Basal laterals opposite and inserted several mm. above the base of the leaf, each furnished with 6 to 8 craspedodromous secondaries on lower side, the latter simple or with one or two branches that end in marginal teeth. Remaining laterals consist of 4 or 5 pairs, subopposite or alternate, each with 0 to 3 secondary nerves on lower side ending in teeth. Tertiary veins transverse, remarkably regular, generally simple, arched upwards.

Remarks. At first sight this leaf was confused with *Protophyllum stikinensis* on account of the similarity in the venation, but the lateral veins in *Platanus uniformis* are not so upright and are not so distantly spaced. The tertiary veins too form a closer pattern. Moreover, the margin of *Protophyllum stikinensis* is smooth and the basal end subpeltate. *P. uniformis* resembles somewhat in its venation *Platanus marginata* (Lesquereux) Heer as well as certain variants of *P. guillelimae* Heer.

Types. Cotypes, 185, 185a; National Museum of Canada, Ottawa.

Populus kerri n. sp.

Plate XII

Description. Leaf subcircular, membranous, entire. Primary nerves 3 in number, the laterals opposite and set at 50 degrees to 60 degrees to the midrib. These veins are strong proximally, but fade distally on approaching the margin. The median nerve is nearly straight and runs to the margin; the two laterals and the secondaries are camptodromous. The laterals are straight and unbranched for about three-fifths of their length; beyond they become faint, branched, and follow a zigzag course. Four or five secondaries alternate on each side of midrib, set at a very wide angle to the latter, but curving upward; branching is rare and only distally. A pair of secondary basilar veins lie below the primary laterals.

Remarks. *Populus dakotana* Cockerell is veined on a somewhat similar pattern to *P. kerri*, except that the laterals are all pinnate. The leaf blade too is more cordate in outline.

Types. Holotype, 164; National Museum of Canada, Ottawa.

Myrica? sp.

Plate X, figure 1

Oblanceolate coriaceous leaves, several centimetres long, cuneate and probably decurrent at base, broad and rounded at apex, resembling *Myrica schimperi* Lesquereux. Border entire, smooth. Midrib pronounced, percurrent; secondary veins rather faint, camptodromous, alternate to subopposite, about a centimetre apart in middle of leaf.

Types. Holotype, 169. National Museum of Canada, Ottawa.

CORRELATION

Asplenium dicksonianum when used as a name for sterile shoots such as those from this locality is a form genus that has a long vertical range in the Cretaceous. *Aspidiophyllum trilobatum* has hitherto been reported from the Dakota group of Kansas and from the Raritan of the Atlantic coastal plain. As the remaining species are new nothing may be said about their range in time. On the whole the assemblage of plants, although meagre, suggests an Upper Cretaceous age, and, more probably, a Cenomanian or Turonian rather than a later age.

45722—3

A NEW CRETACEOUS CONIFER FROM THE BELLY RIVER FORMATION OF ALBERTA

By W. A. Bell

Illustration

Some fragments of sandstone with abundant remains of sterile twigs of this conifer were gathered by G. S. Hume of the Geological Survey, Canada, from sec. 16, tp. 22, range 4, W. 5th mer. They may be described as follows:

Elatocladus albertaensis Bell

Plate XIII, figures 1–3

Description. Sterile twigs, stout, clothed with long linear-lanceolate leaves in spiral arrangement. Leaves are sessile, with single prominent midribs, are straight, reflected downward, or commonly slightly falcate, not noticeably contracted, slightly decurrent at base; maximum length observed 4 cm., and maximum width 2·5 mm.

Remarks. The presence of stomatal grooves was not confirmed and the species being founded on sterile material the designation *Elatocladus* is preferable to *Cephalotaxopsis* or *Cunninghamites.*

The leaves of *Cephalotaxopsis magnifolia* Fontaine differ from the above in their distichous or pseudo-distichous habit and in their abrupt rounding to a short pedicle at the base. The leaves of *albertaensis* possessed sufficient rigidity to resist flattening to a plane during fossilization.

Specimen 199a shows two branches arising at an angle of about 40 degrees and the leaves are mostly obliquely directed. Specimen 199, representing an older stem, has longer leaves that are abruptly deflected to a horizontal position and the resemblance to *Cunninghamites pulchellus* Knolton is very close. Like the latter the upper surface of the leaf is deeply channelled above the midrib. As the deflexion and length of the leaves are variable characters the two species may be identical.

Types. Holotype, 199; paratypes, 199a, 199b; National Museum of Canada, Ottawa.

MESOZOIC PLANTS FROM THE MATTAGAMI SERIES, ONTARIO

By W. A. Bell

CONTENTS

Illustrations

INTRODUCTION

The Mattagami series outcrops in an area on the James Bay watershed. The plant material herein described was collected by F. H. McLearn, of the Geological Survey, Canada, and Professor R. J. Montgomery and R. J. Watson, of the Ontario Department of Mines, during an investigation of coal within the series. It was gathered from two localities on Mattagami river. From locality 138, on the east bank, about 1,000 feet south of the township line between Kipling and Sandborn, was gathered a single fragment of brownish grey sandstone that carried several imprints of *Nilssonia* leaves. The material from locality 136 comprised a number of small blocks of grey, carbonaceous shale loosely packed with carbonized plant remains, and containing in addition lignified fragments of stems, and chips of mineral charcoal or fusain. This material was moist on delivery and some hours afterwards was found to have flaked and disintegrated badly. Leaves, formerly clearly outlined on the surface of the shale, had dried, cracked, and shrivelled. Accordingly, a part of the material was placed in water and the clay and sand removed by panning. The plants thus obtained were studied while still damp, or after drying and coating with a solution of celluloid. Drying was carried out by immersion first in kerosene oil then in gasoline. Some specimens were treated by macerating solutions, of which Javelle water gave the best results, and cuticles obtained. This method of treatment extended and carried on with greater thoroughness would doubtless yield botanical information of great interest on account of the mid-Mesozoic age of the plants and their remarkable preservation.

The plant debris left on the removal of the mud and sand is predominantly an accumulation of conifer twigs of one species. Some parts carried in addition abundant grass-like, flexible blades comparable in appearance to the so-called *Oleandra graminaefolia*, and more rarely small fragments of ferns. The good preservation of minute foliar teeth testifies to the quiet conditions of accumulation of the mass. The environment is believed to have been that of a conifer swamp characterized by periodic floods of water and deposition practically in situ or after very short transportation into a temporary lake.

The assemblage of plants comprises, besides stems of unidentified lignified wood, the following:

Nilssonia cf. *densinerve* (Fontaine). Loc. 138.
Brachyphyllum mclearni, n. sp. Loc. 136.
Pityophyllum graminaefolium (Knowlton). Loc. 136.
Cladophlebis cf. *albertsii* (Dunker). Loc. 136.
Onychiopsis ? sp. Loc. 136.

The age of the deposit, as inferred from this assemblage, is considered to be either Upper Jurassic or early Lower Cretaceous, with preference towards the latter on account of the presence of the species *Pityophyllum graminaefolium* that is abundant and widespread in the Kootenay.

DESCRIPTION OF SPECIES

Nilssonia cf. *densinerve* (Fontaine)

Plate XIV

Fragments of two fronds. The larger fragment is an imprint of the upper surface, 13 cm. in length and 4·1 cm. in width, simple and undissected. The midrib has a median keel to which the veins, which are numerous (16 or 17 to a centimetre), may be traced, proving the attachment of the lamina to the upper surface as in *Nilssonia*. A second fragment, only partly exposed beneath the first, shows the lower surface, and the midrib, which is 3 mm. wide, stands out more prominently. The species is close to, and perhaps identical with, *N. densinerve* (Fontaine).

Brachyphyllum mclearni n. sp.

Plate XV, figures 1-11; Plate XVI, figures 1-14; Plate XVIII, figure 10

Vegetative shoots comprise small flat twigs, 1 to 7 mm. diameter, branching at acute angles, clothed with spirally arranged, acutely pointed, triangular, subrhombic, or sublanceolate, closely appressed, moderately thick, fleshy leaves. Apices of leaves, beak-like, particularly along narrow edges of stems, and rarely reflected outwards as short spines. Leaves, imbricating, except on parts of older stems, finely striate under low magnification. Cuticles from abaxial surface of leaves reveal rows of epidermal straight-walled cells, the individual cells somewhat elongated parallel to the longer leaf borders, interrupted by unevenly spaced and scattered stomata that are arranged in irregular, discontinuous rows. Individual stomata are surrounded by a ring of 4 to 6 cells.

Cones, ovate, largest 27 by 18 mm., smallest 9 by 7 mm., borne singly at the ends of small branches (diameter 1 to 2 mm.). Scales, imbricating, laterally expanded, spirally arranged, somewhat kite-shaped, with abrupt apiculate distal apices, and narrowed proximal ends.

Remarks. The presence of cones of the above type attached to vegetative shoots would seem to warrant the creation of a new genus to include this interesting species of *Brachyphyllum*. But this is deferred until some information has been gained about the seeds and vascular anatomy. Superficially the cone and its scales strongly suggest *Araucarian* affinities, and the individual scales may be compared to *Protodammara*. The cuticular characters of the leaves on the other hand are quite comparable to those of *Sequoia*, e.g. *S. sempirvirens*.

Cladophlebis cf. *albertsii* (Dunker)

Plate XVII, figures 1-11

Ultimate pinna, with midrib broadened and flattened on lower surface tapering apically to an extremely narrow, acuminate, finely toothed blade. Pinnules, alternating, or subopposite toward apex of pinna, falcate, contiguous or confluent at base, where they are broadest, minutely acuminate at apex, irregularly and finely serrate, particularly towards the apex. The pinnules decrease in size rather rapidly towards the apex of the pinna until they become mere teeth on the margins of the latter. Median vein of pinnules given off at an acute angle, pronounced. Secondary veins, obliquely directed to margin, alternating, bifurcating once about one-quarter of the distance towards the margin, rarely divided a second time. Stomata are abundant on lower surface between the veins, and are sunken beneath the surface.

Remarks. It is not possible to satisfactorily differentiate between these sterile fronds and those of *C. denticulata* (Brongniart) on the one hand and *C. albertsii* (Dunker) on the other. This is unfortunate, as *C. denticulata* is a Jurassic species and *C. albertsii* a Wealden one. Both the European species have denticulated pinnules, although these are not as common on *C. albertsii*. The Ontario species is certainly specifically distinct from *C. albertsii* Berry from the Potomac series.

Pityophyllum graminaefolium (Knowlton)

Plate XVIII, figures 1-5

Narrow, flattened, linear, simple, coriaceous, grass-like laminæ, with well-marked midrib and acuminate apex, precisely similar to descriptions of *Oleandra graminaefolia* Knowlton, except in the absence of secondary veins. Fine longitudinal striations appear under low magnification (doubtless representing sclerenchymatous tissue) and there is in addition a fine, close, transverse costation that may be due to wrinkling as a result of fossilization, although it too may represent internal thickened tissue as it is commonly more apparent on one side of a blade than on the other. A comparable ornamentation is present on some fossil conifer leaves, e.g. *Sequoia langsdorfii*, etc. The transverse costæ are flexuous and feebly branching (anastomosing?), but scarcely show the characters of veins. Their junction with the longitudinal striations has resulted in a finely

cancellated appearance. Epidermal cuticles separated by maceration are strong and thick and marked by nearly straight-walled, rectangular to quadrate, epidermal cells. No traces of stomata were observed on either surface. This remarkable circumstance considered together with our ignorance of the mode of fructification precludes any justifiable reference to the modern fern genus *Oleandra*. The presence of a thick cuticle and of abundant strengthening tissue would not suggest that the narrow blades are leaves of a water plant. But until further evidence is gathered it would be premature to speculate upon the systematic position of this interesting form. Comparisons were made with grass-like blades from Kootenay strata of western Canada referred by authors to *Oleandra graminaefolia*, and the conclusion was reached that the material is specifically identical.

Onychiopsis ? sp.

Plate XVIII, figures 6-9

Material is little more than fragments. Pinnules are small, much contracted at base, deeply cut into two or more oblique pairs of lobes. Individual lobes narrowed at base and somewhat club-shaped, except those near apex of pinnule which are acutely pointed with a broadly acute apex. One vein enters each pinnule obliquely from the midrib of the ultimate pinna and from this a single branch goes off obliquely into each lobe. The latter are single or bifid, corresponding to whether the margin of the lobe is entire or divided.

Stomata are abundant on the lower surface of a pinnule. Fructification and hence systematic position unknown.

PLATE I

FIGURE 1. Brecciated dolomitic Silurian limestone. Gypsum cliffs, lower Peace river. (Page 15.)

FIGURE 2. Silurian anhydrite and gypsum showing spheroidal weathering. Gypsum cliffs, lower Peace river. (Page 15.)

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PLATE II

FIGURE 1. Dolomitic limestone and gypsiferous shales of Upper Silurian age. Gypsum cliffs, lower Peace river. (Page 15.)

FIGURE 2. Well-shaped pocket in Silurian limestone filled with fossiliferous Devonian shale. Gypsum cliffs, lower Peace river. (Page 16.)

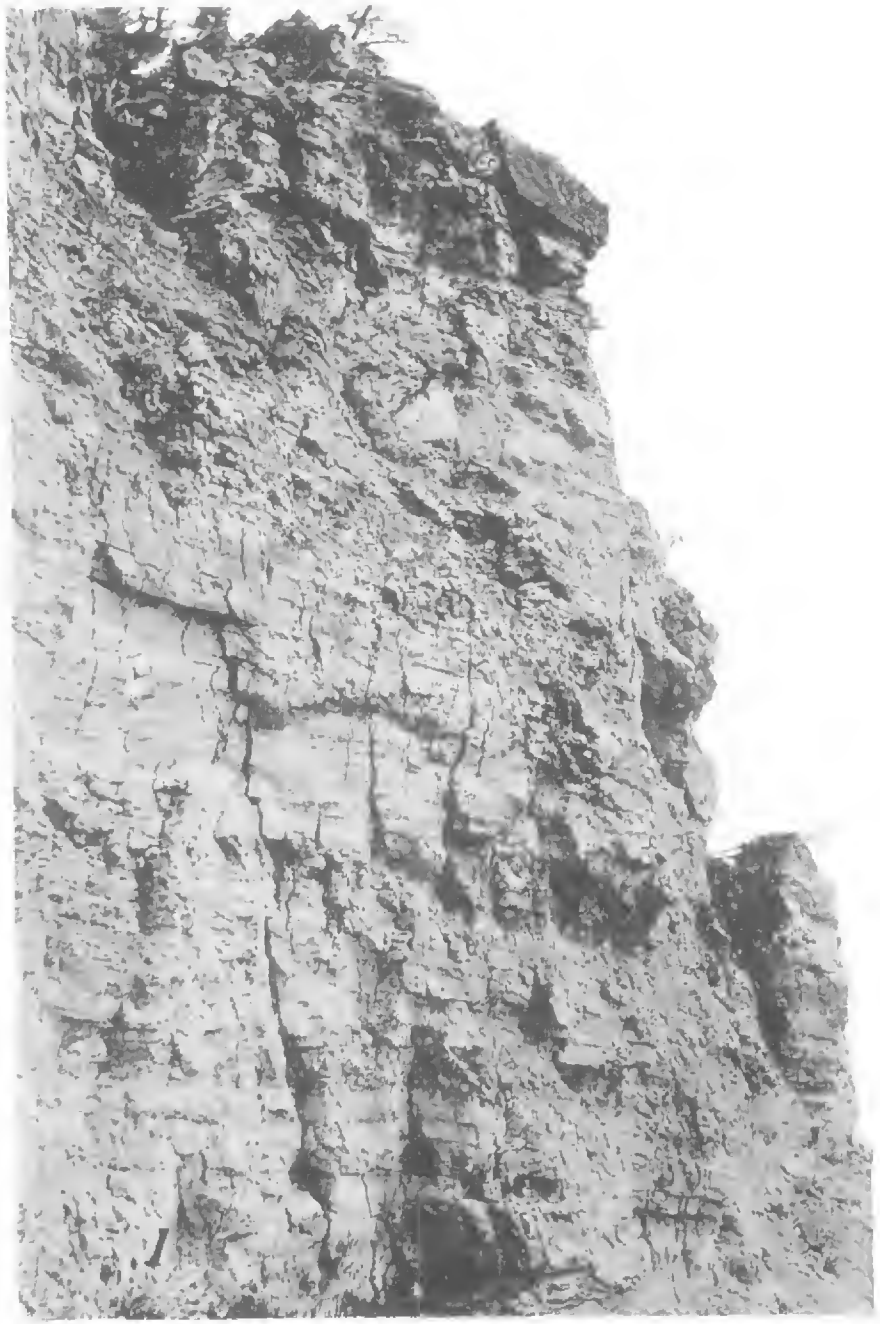
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PLATE III

Slab of Devonian limestone showing interiors and exteriors of more common fossils: X ½; from top of gypsum cliffs below Peace point. 1, *Schizophoria striatula*, interiors of dorsal and ventral valves; 2, *Cyrtina billingsi*, interior of ventral valve; 3, *Atrypa reticularis*. (Page 16.)


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PLATE IV

Yakounites mcevoyi McLearn n. sp.

FIGURE 1. Oblique view of holotype. Nat. Mus. Canada, Cat. No. 5018. (Page 20.)

FIGURE 2. Side view same specimen. (Page 20.)

Plate IV

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PLATE V

Stemmatoceras albertense McLearn n. sp.

FIGURE 1. Side view of holotype. University of Alberta collections. (Page 20.)

Plate V

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PLATE VI

Stemmatoceras albertense McLearn n. sp.

FIGURE 1. Ventral view of holotype, showing section of whorl. University of Alberta collections. (Page 20.)

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PLATE VII

Stemmatoceras albertense McLearn n. sp.

FIGURE 1. Ventral view of holotype, showing suture line. University of Alberta collections. (Page 20.)

Plate VII

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PLATE VIII

Saxitoniceras allani n. sp.

FIGURE 1. Oblique view of holotype. Nat. Mus. Canada, Cat. No. 9021. (Page 21.)
FIGURE 2. Side view same specimen. (Page 21.)

Saxitoniceras marshalli n. sp.

FIGURE 3. Ventral view of holotype. Nat. Mus. Canada, Cat. No. 9022. (Page 22.)
FIGURE 4. Side view same specimen. (Page 22.)

Plate VIII

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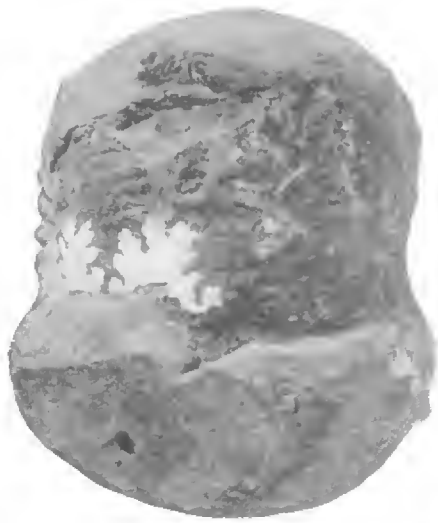

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PLATE IX

FIGURES 1, 2. *Aspidiophyllum trilobatum* Lesquereux. (Page 23.)

Plate IX

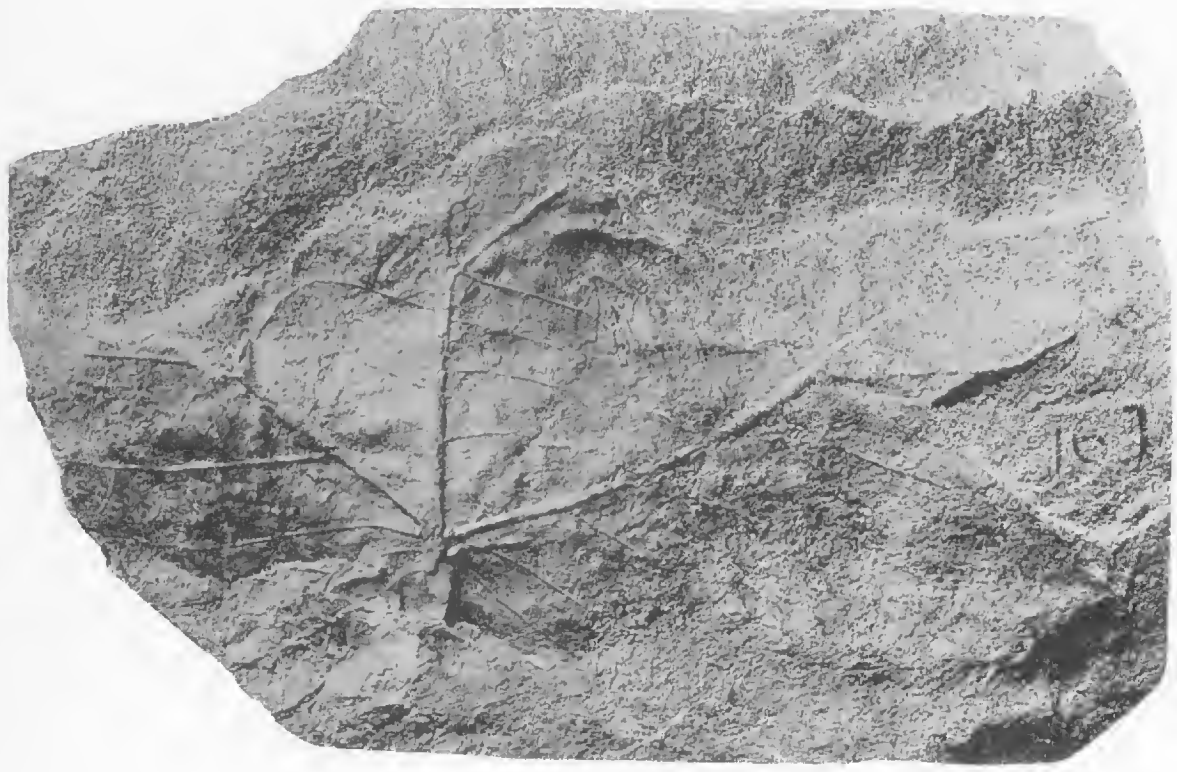

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PLATE X

FIGURE 1. *Myrica* ? sp. (Page 25.)

FIGURE 2. *Protophyllum stikinensis* Bell. (Page 24.)

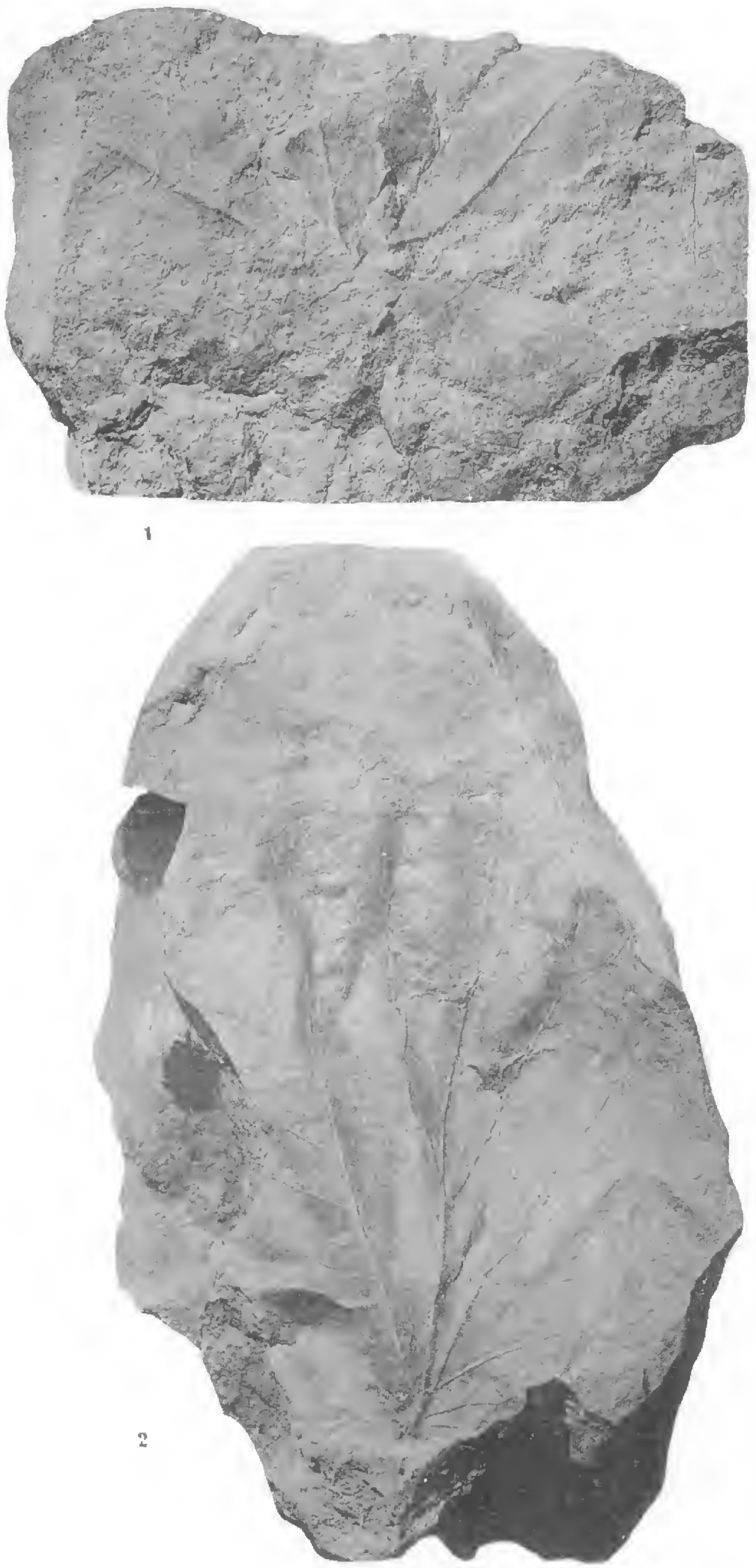

PLATE XI

Platanus uniformis Bell. (Page 24.)

PLATE XII

Populus kerri Bell. (Page 25.)

Plate XII

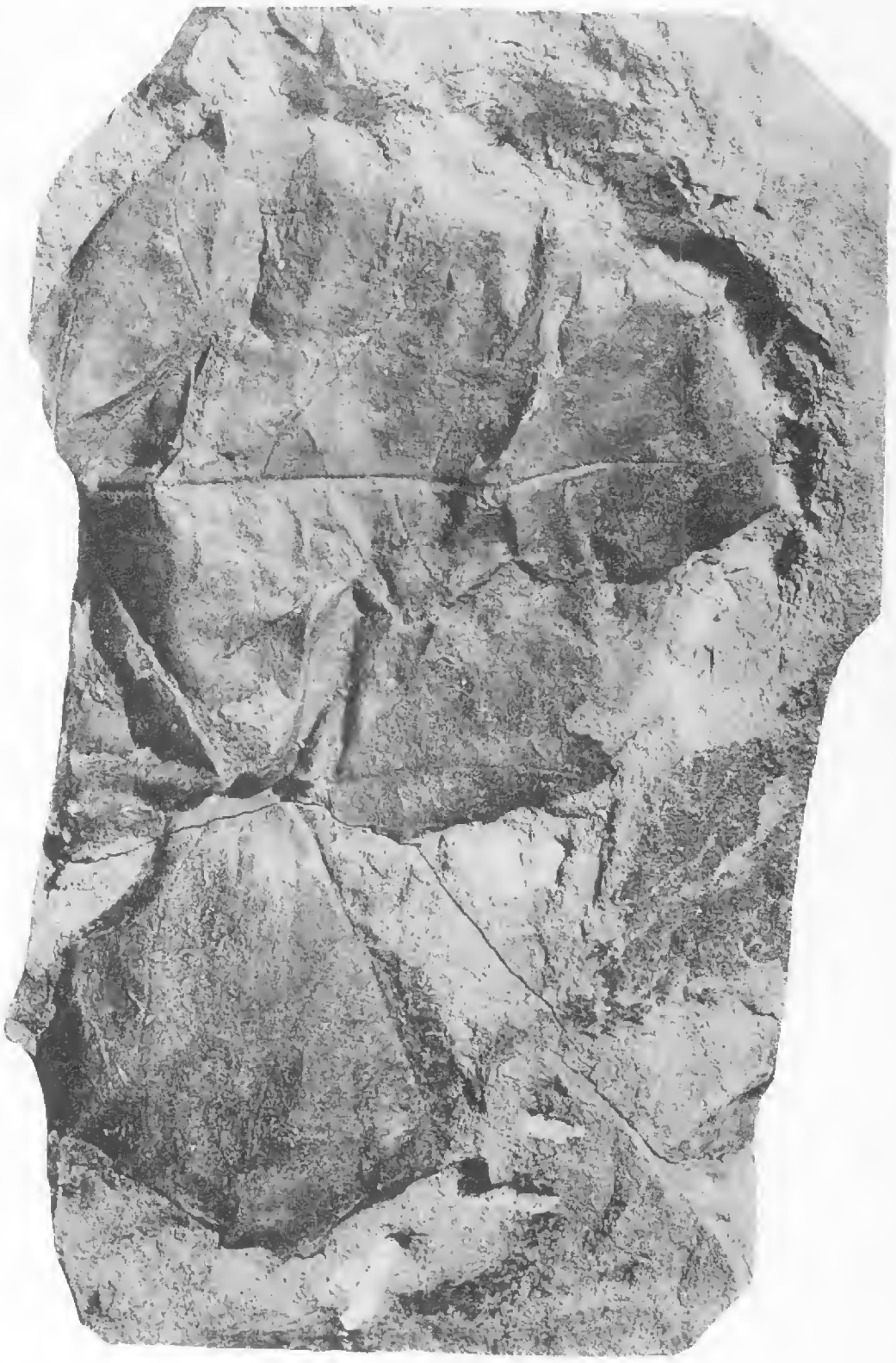

PLATE XIII

Cephalotaxopsis albertaensis Bell. (Page 26.)

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PLATE XIV

Nilssonia cf. *densinerve* (Fontaine). Holotype, specimen 194. (Page 28.)

PLATE XV

Brachyphyllum mclearni Bell. Vegetative branches. (Page 28.)

FIGURE 1. Specimen 190a, X 2.
FIGURE 2. Specimen 198e, X 2.
FIGURE 3. Specimen 174a, X 2.
FIGURE 4. Specimen 198a, X 2.
FIGURE 5. Specimen 174c, X 2.
FIGURE 6. Specimen 179a, X 2.
FIGURE 7. Specimen 171c, natural size.
FIGURE 8. Specimen 198c, natural size.
FIGURE 9. Specimen 173, X 2. *Cotype.*
FIGURE 10. Specimen 171a, natural size. *Cotype.*
FIGURE 11. Specimen 175, X 2.

Plate XV

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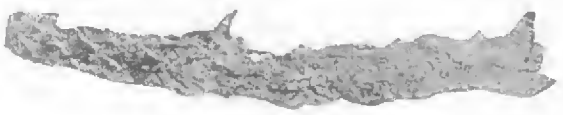

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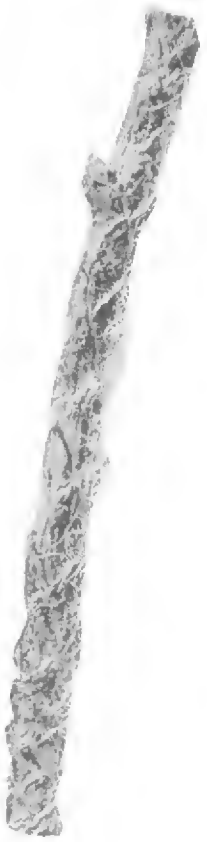

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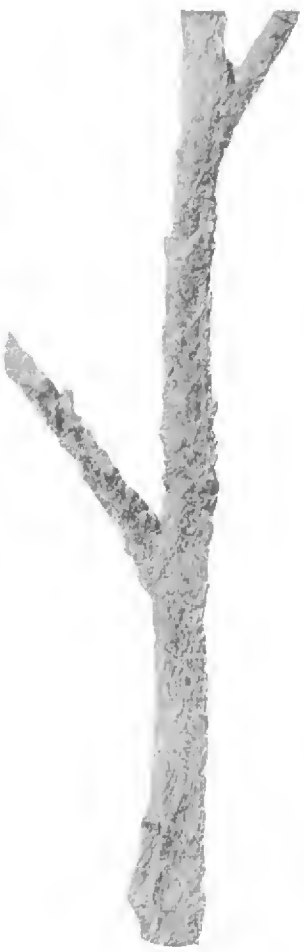

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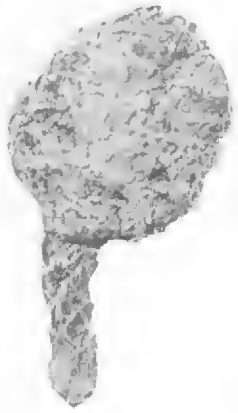
PLATE XVI

Brachyphyllum mclearni Bell. (Page 28.)

FIGURE 1. Specimen 182, X 2. Cone.
FIGURE 2. Specimen 184a, X 2. Cone.
FIGURE 3. Specimen 177a, X 2. Cone.
FIGURE 4. Specimen 177b, X 2. Cone.
FIGURE 5. Specimen 184d, X 2. Cone.
FIGURE 6. Specimen 184c, X 2. Cone.
FIGURE 7. Specimen 183, X 2. Cone.
FIGURE 8. Specimen 180d, X 2. Cone scale.
FIGURE 9. Specimen 180e, X 2. Cone scale.
FIGURE 10. Specimen 180c, X 2. Cone scale.
FIGURE 11. Specimen 185a, X 2. Cone.
FIGURE 12. Specimen 180a, X 2. Cone scale.
FIGURE 13. Specimen 185b, X 2. Cone.
FIGURE 14. Specimen 176, X 2. Vegetative branch.

Plate XVI



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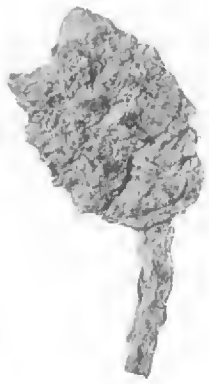

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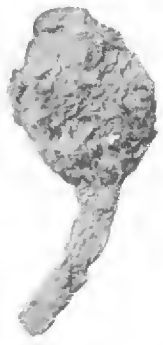

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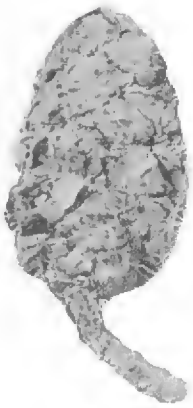

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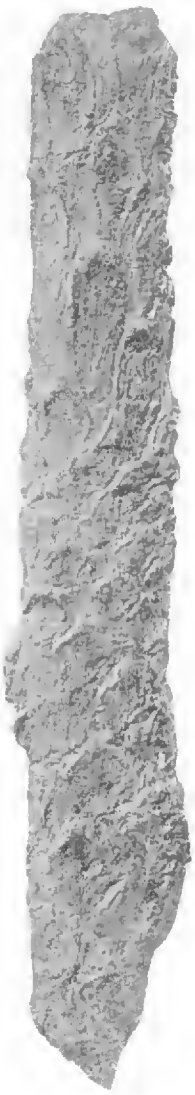

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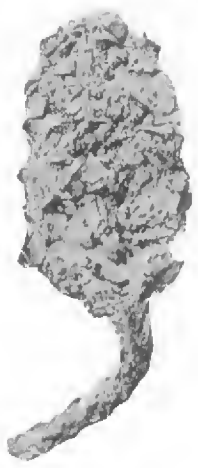

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Plate XVII

Cladophlebis cf. *albertsii* (Dunker). (Page 29.)

Figure 1. Specimen 117, X 2.
Figure 2. Specimen 116d, X 2.
Figure 3. Specimen 116b, X 2.
Figure 4. Specimen 116c, X 2.
Figure 5. Specimen 118, X 2.
Figure 6. Specimen 124b, X 2.
Figure 7. Specimen 127, X 2.
Figure 8. Specimen 120, X 2.
Figure 9. Specimen 121, X 2. Holotype.
Figure 10. Specimen 122, X 2.
Figure 11. Specimen 123, X 2.

Plate XVII

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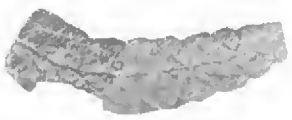

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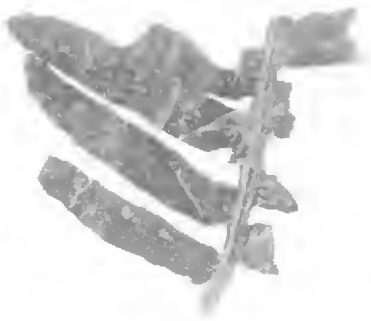

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PLATE XVIII

Pityophyllum graminaefolium (Knowlton). (Page 29.)

FIGURE 1. Specimen 147d, X 2. Plesiotype.
FIGURE 2. Specimen 154d, X 2.
FIGURE 3. Specimen 154e, X 2.
FIGURE 4. Specimen 147c, X 2.
FIGURE 5. Specimen 188, X 100. Cuticle.

Onychiopsis ? sp. (Page 30.)

FIGURE 6. Specimen 163e, X 2.
FIGURE 7. Specimen 163h, X 2.
FIGURE 8. Specimen 163b, X 2.
FIGURE 9. Specimen 163a, X 2.

Brachyphyllum mclearni Bell. (Page 28.)

FIGURE 10. Specimen 187, X 100. Cuticle with stomata.

Plate XVIII

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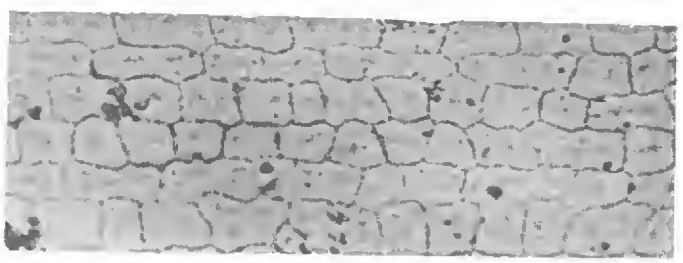

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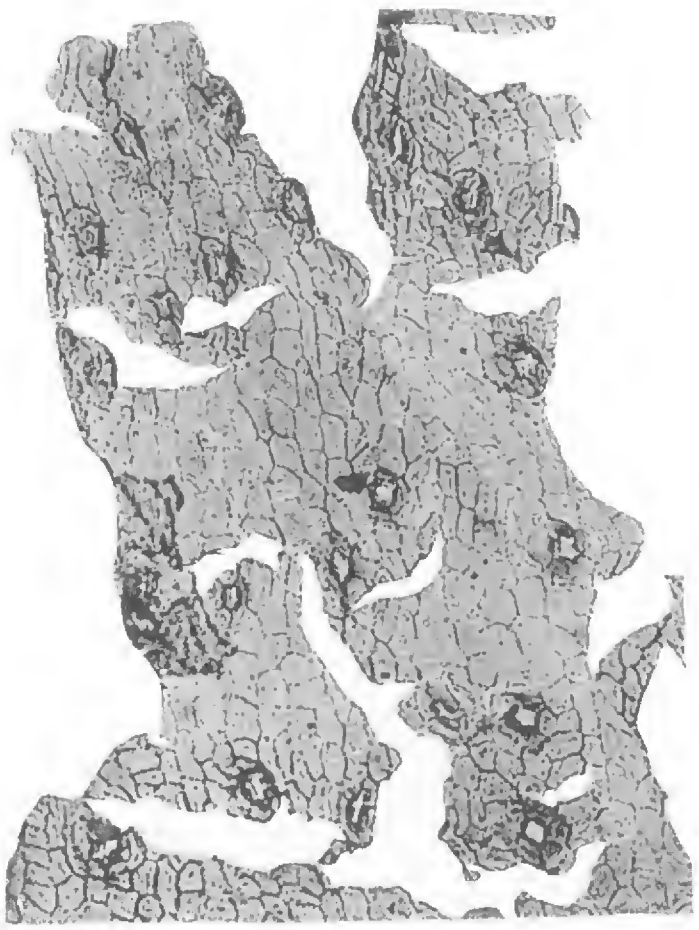

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