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VOLUME IV

GEOLOGY AND PALEONTOLOGY

BY

B. K. EMERSON, CHARLES PALACHE,
WILLIAM H. DALL, E. O. ULRICH,
and F. H. KNOWLTON

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ALASKA

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FOSSILS AND AGE OF THE YAKUTAT FORMATION

DESCRIPTION OF COLLECTIONS MADE CHIEFLY NEAR KADIAK, ALASKA

BY EDWARD OSCAR ULRICH

DISTRIBUTION

THE collections here described and discussed are from three principal localities: Woody Island, Pogibshi Island, and the shore of Russell Fiord near Hidden Glacier. Pogibshi Island lies close to the village of Kadiak, being separated from the much larger Kadiak Island by the narrow strait constituting Kadiak Harbor. Woody Island is a few miles distant, Woody and Pogibshi being members of a group of low islands constituted wholly of slate. The Hidden Glacier locality is nearly 500 miles to the eastward. A fourth locality, about 300 miles northeast of Kadiak, is indefinite in position, being represented only by a specimen from the back of Columbia Glacier, Prince William Sound. These four localities are correlated by means of a fossil species of definite character, *Terebellina palachei*, common to them all. At one locality, that near Hidden Glacier, the containing formation has

received a name, having been called Yakutat by Russell in 1891.[1] This name, therefore, applies to the strata at all the localities.[2]

AGE

All that could hitherto be said concerning the age of the slate of the vicinity of Kadiak was that it is older than the Cenozoic, and that it is unconformably overlain, in some instances at least, by strata of early Miocene or Oligocene age. As it has an aspect denoting considerably greater age than the unquestionable Jurassic rocks underlying the Cenozoic deposits at other points along the southern coast of the peninsula, and as the only mollusk found in it was believed to be of the genus *Posidonomya*, whose known range does not extend above the Jurassic, both Dall and Hyatt suggested that the age of the slates is Triassic or older.

Dall says of them,[3] referring particularly to the exposures studied by him on Woody Island: "The fossils found are very few; one, apparently a *Posidonomya*, the only bivalve; a singular organism like a flattened *Dentalium*, but probably a worm tube; and an alga which Professor Knowlton identifies with Eichwald's *Chondrites heeri* were the most conspicuous. It is not improbable that these slates are of Triassic age, but a final determination will require more prolonged study."

In the same report, page 907, Hyatt says of the supposed *Posidonomya*, which had been referred to him and which is described in this paper as *Inoceramya concentrica*, "I should think it might be Triassic or older, but there is no solid basis for this opinion."

The quoted opinions were influenced perhaps by Fisch-

[1] An expedition to Mount St. Elias, Alaska, by Israel C. Russell: Nat. Geog. Mag., vol. III, p. 167. 1891.

[2] The statements in this paragraph, as well as other data concerning formations and localities, are on the authority of Mr. Gilbert.

[3] Report on coal and lignite of Alaska, by W. H. Dall: 17th Ann. Rept. U. S. Geol. Survey, Pt. I, p. 872. 1897.

er's identification of the Triassic *Monotis salinaria* among fossils collected by Penart from the eastern point of the peninsula at Cold Bay, Alaska. Also by the fossils collected on the southern side of the peninsula of Katmai and near the bay, reported on by Grewingk in 1850.[1] These fossils were from two horizons, one with *Ammonites wosnessenskii*, *A. biplex*, and *Belemnites paxillosus?*, the other containing a *Unio* that was somewhat doubtfully identified with *U. liassinus*.

The fossils studied and described on the following pages are referred to twelve genera and eighteen species. Thirteen of the species and seven of the genera are regarded as new, and all of the species, save the tubicolous worm and the pelecypod, are of that difficult and usually very unsatisfactory class commonly called 'fucoids.' Still, since both the worm tubes and the bivalves belong to undescribed genera, we are obliged to rely chiefly upon the evidence afforded by these supposed marine plants.

We are well aware that paleontologists are of two minds concerning the nature and origin of the majority of the fucoids, but we have not the time, nor is this the proper place, to discuss the questions. Still we may say in passing that we believe many of them are really marine plants, and that the most of the others are more than mere trails or burrows or water marks. Some of them, again, are almost certainly of the nature of sponges. It is to be understood, however, that when we speak of them as marine plants it is not because we believe they are, as a whole, of that nature, but only to obviate the frequent qualification of the words flora and plant by either a question mark or the word 'supposed.'

Following the Cambrian, in which the impressions

[1] Beitrag zur Kenntniss der orographischen und geognostischen Beschaffenheit der Nord-West-Küste Amerikas mit den anliegenden Inseln, von C. Grewingk: Verhandl. Russ. k. mineral. Gesell. zu St. Petersburg, Jahrg. 1848–1849, pp. 121, 344–347, published in 1850.

simulating some of the later fucoids, though insufficiently studied to justify a decision concerning their nature, are perhaps chiefly referable to trails of Crustacea and to inorganic causes, the American Paleozoic rocks contain but three or four notable horizons for fucoids. The first of these comprises the Frankfort and Lorraine divisions of the Cincinnati series, the second the Medina and Clinton rocks, constituting the basal members of the Silurian, the third the shaly sandstones of the Boston Group of the Lower Carboniferous of northern Arkansas. Fucoids occur in most of the other Paleozoic formations, but in the three horizons mentioned they are more abundant and much more varied in character than in any of the other divisions. Of these other divisions the Erie and Waverly shale in America and the probably nearly corresponding beds in Europe from which Ludwig and others have descibed many forms, may be mentioned as ranking next among Paleozoic formations to the Cincinnati, Medina, and Boston rocks in affording fucoids in abundance and variety.

The strata of the Coal Measures, Permian and Trias apparently everywhere are strikingly poor in fucoids, but when we reach the Lias we meet with a wealth of forms in Europe rivaling, if not exceeding, the representation in any Paleozoic horizon. In the upper Jura and middle Cretaceous they are again inconspicuous, but in the central European deposits of Eocene age, especially the Flysch of Switzerland, they occur once more in great abundance.

One of the most striking features of these successive marine floras is the extraordinary uniformity of expression running through them all. This is particularly noticeable when we compare the Ordovician types with those found in the Lias and, in a less degree, with those in the Eocene Flysch. It is true each of these horizons is distinguished by its peculiar forms, but the others, among them the

commonest, are often very similar. Thus the Ordovician *Arthraria*, *Bythotrephis*, *Paleophycus*, *Rauffella*, and certain undescribed forms, have, respectively, their corresponding types in *Fucoides moeschi* Heer, *Chondrites*, *Cylindrites*, *Cancellophycus*, and *Palæodictyon* of the Lias. One might say that this similarity in expression argues for an inorganic origin of these reappearing types. But this assertion would not be warranted, since, aside from the types peculiar to each fucoid horizon, the reappearing types are represented in each horizon by sets of species distinguishable by minor peculiarities from those of the corresponding type in another horizon; and if we could compare in these extinct marine floras the fructification and other features that are considered important in classifying recent algæ, the apparently close resemblances between the successive floras would probably resolve themselves into mere family likenesses.

Coming to a more detailed comparison of the Yakutat fucoids with those characterizing the various horizons mentioned, we find that they indicate some post-Paleozoic time, for the branching forms are of *Chondrites* and *Palæodictyon*, and not *Bythotrephis;* and the reticulated species is of *Cancellophycus*, and not *Rauffella;* while the new generic types are so far quite unknown in any of the Paleozoic fucoid horizons. Forms of the true *Helminthopsis* type also are so far unknown in Paleozoic rocks, but *Helminthoida*, though apparently restricted to the Eocene in Europe, has recently been discovered in two Lower Carboniferous horizons in Arkansas and Texas, and possibly is represented among the Silurian forms referred to *Crossopodia* McCoy *e. g.*, *C. scotica* Nicholson (? McCoy).

Now, according to the evidence of its fucoids, and assuming, of course, that we are not dealing with a new horizon, the slate of Kadiak must be referred to either the

lower Jurassic (Lias) or to the Eocene. Considering the evidence from the side of the genera represented at Kadiak, and their geologic distribution in Europe, it points perhaps quite as strongly to the Eocene as to the Lias. Thus *Helminthoida* occurs there only in the Eocene, but *Helminthopsis* belongs to the upper Lias ; *Palæodictyon* is more characteristic of the Eocene Flysch than of the Jura, but the reverse is true of *Cancellophycus*, while *Chondrites* is about equally common in the upper Lias and the Flysch. Taking this generic evidence alone into account, the question of age could not be determined ; but when we extend the comparison to specific alliances, and take into account the fact, already noted, that *Helminthoida* occurs in America as low as the Lower Carboniferous, the case clears up very materially.

None of the Kadiak species of *Helminthoida* are specifically identical with any of the described European species. On the other hand, *H. subcrassa*, *H. abnormis*, and *H. vaga* compare quite as closely with the unpublished Lower Carboniferous species and with the figure of the Silurian *Crossopodia scotica* published by Nicholson and Ethridge in their Monograph of the Silurian Fossils of the Girvan District in Ayrshire, as with the Eocene *H. crassa* Schafhäutl.

We describe two species of *Palæodictyon*, and both are identified with Swiss Eocene forms figured by Heer, though the larger one of the two Kadiak species has seemed to us to require separation as a variety. In these two fucoids we have the only specific evidence upon which the age of the Yakutat slate might be determined as Eocene. But carefully analyzed it turns out that even here the evidence is scarcely satisfactory, and certainly not conclusive. In the first place both *P. magnum* and *P. singulare* occur also in rocks that have been, probably erroneously, referred to the Lias. Next, at least one of

our species is not strictly the same as its European representative, *P. magnum*. Then Heer describes one insufficiently illustrated species from undoubted Liassic rocks, which is very close to *P. singulare*, and to which we might have referred the smaller of the two Kadiak species had the illustrations of the older species been as copious as those of the younger one. Finally, the specific characters of *Palæodictyon* are so vague and variable, and with the general simplicity of the fossilized plant so few, that specific identifications necessarily are more or less doubtful. Indeed, we have seen black inosculating films in the Waverly shales of Kentucky and certain Carboniferous shales in Texas that we are really at a loss to distinguish from the Eocene species figured by Heer or from the Kadiak species.

The direct evidence for the upper Liassic age of the slates under consideration is the presence in them of four European species characterizing that age, namely, *Chondrites divaricatus* F.-O., *C. alpestris* Heer, *Helminthopsis magna* H. and *H. ? labyrinthica* H. The latter genus so far is reported only from the Lias, but *Chondrites* ranges from the Lias, and possibly from the Trias, on to the Tertiary, so that the genus can be used only in determining the lower limit. The species, however, seem to be sufficiently characteristic and defined to justify considerable reliance on their evidence.

Besides the fucoids the only fossils afforded by the Kadiak localities are (1) numerous shells of a tubicolar worm and (2) several casts of a pelecypod shell. The evidence of these fossils is purely inferential, but so far as it goes it corroborates that of the upper Liassic species mentioned in the foregoing paragraph. The worm tubes, to which we have applied the name *Terebellina palachei*, compare in form with the Ordovician genus *Serpulites*, but in being composed of cemented grains of sand they

agree with *Terebella*, a living genus whose oldest known species occurs in the Liassic. The relationship being on the one hand to an Ordovician type and on the other to a Jurassic and living genus, we infer that the period of its existence must have been at some intermediate time; and since the latter relationship is doubtless the more intimate it is, especially in view of the other evidence, justifiable to assume that this period was post-Paleozoic.

The pelecypod has been called *Inoceramya concentrica*. The generic name is intended to suggest the supposed relationship of the new type, the general expression of the shell being very like that of a large *Posidonomya*, a well-marked late Paleozoic and early Mesozoic genus, and from which we believe it originated, while the vertical ligamentary pits of the hinge plate ally it to *Inoceramus*, a highly characteristic Cretaceous genus. It is just such a form as might be expected to have given rise to the last genus; while, on the other hand, its derivation from *Posidonomya* is scarcely to be questioned. Assuming that *Inoceramya* is really a connecting link between *Posidonomya* and *Inoceramus*, it is fair to assume further that it existed some time near the extinction of the earlier of those genera and before the later one attained its typical characteristics; *i. e.*, about early Jurassic or Liassic time.

After weighing, as we have, the evidence of all its known fossils, no other decision seems justifiable than that the slate of the Yakutat series is of Liassic age.

DESCRIPTIONS OF SPECIES

VERMES

Suborder TUBICOLA

Genus **Terebellina** gen. nov.

Long, subcylindrical, gently curved and rather thick-walled tubes, acuminate below; surface obscurely striated transversely. Tubes composed of cemented minute siliceous grains.

The general aspect of the tubular fossils for which the above generic name is proposed is greatly like that of the Ordovician *Serpulites dissolutus* Billings. On closer comparison, however, their respective compositions prove to be wholly different, the Ordovician fossils having a glossy, phosphatic or chitinous shell resembling that of a *Lingula*, while the Alaskan tubes under consideration are composed chiefly of quartz and feldspar grains, with an occasional shred of colorless mica. Thin sections show that their constituents are essentially the same as those of the arenaceous shale in which they are found, the main difference being that the grains are of more uniform and larger average size in the tubes than in the matrix.

In having a shell composed of cemented sand grains *Terebellina* suggests Cuvier's *Terebella*, a genus of tubicolous worms living in the present seas but recognized also in the Liassic and Upper Jurassic of Germany. The tubes of *Terebella*, however, are more irregular in their growth and, so far as we could learn, are always composed of coarser grains; and the latter differ further in being calcareous instead of siliceous. Possibly the last difference has no structural significance and is due solely to the mineralogical character of the sand grains available to the worm in building its tubular investment. Whether this is true or not, we believe the affinities of the new genus are nearer *Terebella* than either *Serpula* or *Serpulites*.

Terebellina palachei sp. nov.

pl. xi, figs. 1–7.

Tube long and narrow, subcylindrical, expanding very gradually from the acuminate lower extremity; about two-thirds of the diameter is taken up by the central hollow. In the majority of the specimens the greatest diameter does not exceed 2.3 mm., and some of these must have had a length of over 15 cm. A number of fragments, however, have a diameter of from 3.5 mm. to 4.5 mm., but as the collection affords no satisfactory intermediate sizes we are not prepared to say positively that these larger fragments belong to the same species. The surface of most of the specimens presents no markings save a few widely separated constrictions and annulations, and more numerous transverse furrows or slits that seem to be due to weathering. On a few of the better preserved fragments, however, the surface exhibits more or less obscure and closely arranged transverse striæ.

As preserved, the specimens nearly always present clear evidence of compression, the tube being in most cases cracked lengthwise. As a rule the slabs of slightly arenaceous slate or shale on and in which

the tubes occur contain no other evidence of either animal or vegetable remains.

Dr. W. H. Dall collected the first specimens of this fossil, and mentions it in his Report on Coal and Lignite of Alaska (Seventeenth Annual Report United States Geological Survey, Part I, page 872). He speaks of it as "a singular organism like a flattened *Dentalium*, but probably a worm tube."

Named for Dr. Charles Palache, one of the geologists of the Expedition.

Localities.—Most of the specimens are from Pogibshi Island, opposite the village of Kadiak. Others came from near Hidden Glacier, at Russell Fiord of Yakutat Bay, and from Woody Island, near the station of the North American Commercial Company, while a single example was secured from a boulder in the moraine of Columbia Glacier, Prince William Sound.

Collectors.—W. H. Dall, G. K. Gilbert, B. K. Emerson, Charles Palache.

MOLLUSCA

PELECYPODA

Genus **Inoceramya** gen. nov.

Shell resembling that of a *Posidonomya*, apparently equivalve, thin, compressed, concentrically waved; hinge margin straight, long, edentulous, but bearing on its central part several small but long vertical ligamentary pits, and behind these, possibly to the end of the hinge, numerous shorter and gradually diminishing pits; post-cardinal region compressed, obtusely wing-like, distinguished externally from the concentrically waved body of the valve by finer and somewhat differently directed striation and internally by a rib-like thickening extending obliquely backward from the beaks toward the middle of the dorsal half of the posterior margin; anterior part of hinge unknown; beaks subcentral, not large.

The systematic position of this genus may be said to be intermediate between *Posidonomya* Bronn and *Inoceramus* Sowerby, though it has certain characters not possessed by either of the two genera mentioned. From the former it is distinguished by having ligamentary pits; from the latter by the absence of the prismatic inner shell layer that is so highly characteristic of Sowerby's genus, and in having the hinge plate wider and the ligamentary pits longer in the region of the beaks. Continuing the comparison, we find that the characters pertaining to the wing-like post-cardinal region of the new genus are not present in either of the old genera.

Considering the importance of the genus as a probable connecting link between the Paleozoic and early Mesozoic *Posidonomya* and the chiefly Middle and Upper Cretaceous genus *Inoceramus*, it is unfortunate that the material upon which the new genus is founded is not more complete and better preserved. Still, by careful preparation it has been made to show sufficient characters to give us a fairly good idea of the shell that left the impressions.

Inoceramya concentrica sp. nov.

Pl. XII, figs. 1, 2; Pl. XIII, fig. 1.

Shell broad-ovate, slightly oblique, with the hinge margin long and straight; anterior cardinal margin probably nearly rectangular, post-cardinal margin sharply rounded and forming a wider angle; anterior and ventral portions of outline nearly semicircular. Valves depressed convex; beaks small, situated anterior to the center; umbonal ridge inconspicuous. Surface concentrically waved, the average width of the undulations increasing with age from 1 mm. or 2 mm. on the umbones to 4 mm. or 5 mm. on the central and ventral parts of adult shells. The concentric undulations do not cross the compressed elongate triangular posterior wing, but cease along a line separating the wing from the body of the valve. The wing itself is marked by much finer and rather obscure striæ. Hinge plate wide just beneath the beaks, where a specimen broken off at this point (see pl. XII, fig. 2) shows two long vertical ligamentary pits and behind these a series of shorter and gradually diminishing pits that may be traced beyond the middle of the distance to the post-cardinal extremity. Immediately beneath this pitted margin there is a narrow depression, becoming obsolete posteriorly, and beneath this the heavy, posteriorly widening interior rib marking the separation of the wing from the body of the shell. This begins just behind the beak and dies out as it widens, becoming quite obsolete before reaching the posterior margin. Muscular scars and pallial line not observed.

Dr. W. H. Dall, who discovered the specimens above described, refers to the species as 'apparently a *Posidonomya*' in his Report on Coal and Lignite of Alaska (page 872 of the Seventeenth Annual Report of the United States Geological Survey). Though we have shown already, in our remarks on the new genus that we have believed it necessary to establish for their reception, why they should not be referred to *Posidonomya*, we may repeat that besides the ligamentary pits, which are absent in true species of that genus, the internal rib in

the post-cardinal region of *I. concentrica* constitutes another feature so far unknown in *Posidonomya*.

Locality.—Woody Island, Kadiak, on the shore facing Chiniak Bay, Alaska.

Collector.—W. H. Dall.

FUCOIDES

Genus **Chondrites** Sternberg.

Chondrites divaricatus Fischer-Ooster.

Pl. XVI, figs. 1, 2.

Chondrites divaricatus FISCHER-OOSTER, Foss. Fucoiden, p. 45, 1858.—HEER, Flora Foss. Helvetiæ, p. 107, taf. XLI, figs. 6, 7, and taf. XLII, figs. 11, 12, 1877.

Two specimens in the material gathered at Kadiak Island appear to fall within the limits of this species. They occur as delicate, slightly glossy, black, widely divaricating ramulets in an arenaceous slate. The branching stems have a width of from 0.45 mm. to 0.6 mm., and divide both dichotomously and pinnately at frequent though variable intervals. The lateral divisions are short and not appreciably thickened at their extremities.

In one of the two specimens the stems are a trifle thinner and the divisions more abundant than in the other. This approaches *C. intricatus* (Brongniart) Heer, a common Eocene fossil in Switzerland and elsewhere in Europe, yet not near enough to justify its separation from *C. divaricatus*. The latter is not uncommon in the Upper Lias of central Europe.

Locality.—Pogibshi Island opposite the village of Kadiak, Alaska.

Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Chondrites alpestris Heer.

Pl. XVIII, fig. 4.

Chondrites alpestris HEER, Flora Foss. Helvetiæ, p. 109, taf. XLII, figs. 13–16, 1877.

Plant cæspitose, apparently not spreading in one plane but giving off branches in all directions; divisions very frequent, diverging very slightly, oftener dichotomous than pinnate; branches varying from 0.5 mm. to 1.0 mm. in width, apparently terminating obtusely.

C. alpestris is so strikingly different from nearly all the other species of this prolific genus, and at the same time is signalized by such obvious peculiarities, that we have no doubt concerning the close relations, if not the identity, of the Alaskan specimen here described

and figured with the Swiss Upper Liassic types of the species. Our specimen is a hollow mold of the exterior in a slaty sandstone.

Locality.— Pogibshi Island, opposite the village of Kadiak, Alaska.
Collectors.— G. K. Gilbert, B. K. Emerson, Charles Palache.

Genus **Palæodictyon** Heer.

Palæodictyon magnum laxum subsp. nov.

PL. XV, fig. 1.

Cfr. *Palæodictyon magnum* HEER, Flora Foss. Helvetiæ, p. 160, taf. LXIV, fig. 9, 1877.

The remains of this plant appear as glossy, flat, irregularly convoluted, rarely inosculating bands 2 mm. to 3 mm. wide, on fresh surfaces of a dark slate. The bands evidently are mere fragments that originally may have been connected to form a very loose and irregularly meshed network.

At first sight we were inclined to refer these Alaska specimens to Heer's *P. magnum* without qualification, they being perhaps sufficiently like certain portions of the figure published by Heer of this Eocene (Flysch) species to justify their identification. Closer comparisons, however, satisfied us that the growth of the Alaskan form was more irregular and very loosely reticulated, so that it seems advisable to distinguish it as a subspecies at least.

Locality.— Woody Island, near the village of Kadiak, Alaska.
Collector.— W. H. Dall.

Palæodictyon singulare Heer.

PL. XV, fig. 2.

Palæodictyon singulare HEER, Urwelt der Schweiz, p. 245, taf. X, fig. 10, 1865,—and Flora Foss. Helvetiæ, p. 160, taf. XLIII, fig. 21, taf. LXIV. figs. 5–8, 1877.

This delicate form is associated with *P. magnum* var. *laxum*, but will be distinguished at a glance by its smaller size and much closer intertwinings. The bands usually are a trifle less than 1 mm. wide and but rarely exceed that width, and they bend in and out and over oue another so rapidly that they appear to form a close but always very irregular network.

This form has seemed to us to agree too well with some of Heer's figures of *P. singulare* to be distinguished even as a variety. In Switzerland the species occurs, sometimes in association with *P. mag-*

num and *P. textum*, in the shales of the Flysch formation, generally regarded as of Eocene age, and possibly also in the Liassic.[1]

Locality. — Woody Island, Kadiak.

Collector. — W. H. Dall.

Genus **Arthrodendron** gen. nov.

Plant ramose, bushy, the branches constricted at regular intervals and probably consisting each of a series of rounded or ovate, flattened (originally inflated) joints; surface of joints minutely granopunctate.

This marine plant may have some relation to *Cymopolia* Lamouroux and *Corallina* Linn., but instead of a thick calcareous incrustation the joints appear to have had a leathery carbonaceous cover that, in consequence of the compression the plants have suffered in common with the mud in which they were entombed, is now thickened around the edge of each joint and more or less wrinkled in the flattened space inclosed by the marginal rim. The substance of the plant, which is believed to have been carbonaceous, because of its dull polish and dark color, is readily distinguished from the grayish-black shale in which the specimens are embedded.

The jointed or beaded character of the branches, coupled with their carbonaceous composition, recalls an Eocene (Flysch) species from Switzerland that Heer refers to the recent genus *Hormosira* Harvey. In the fossils before us, however, the joints appear to be of one kind only, whereas in *Hormosira* two sets — one narrow and sterile, the other wider, subglobular, and fertile — are distinguishable.

Arthrodendron diffusum sp. nov.

Pl. XIV, figs. 1–3.

Branches moniliform, springing from a central point and spreading outwardly and upwardly so as to form a loose bush-like mass as much as 15 cm. in diameter; divisions dichotomous, at intervals varying from 6 mm. to over 20 mm. Joints subelliptical, the lower half usually a little narrower than the upper half, 4 mm. to 6 mm. in length and from 2.2 mm. to 2.8 mm. in width; surface usually glossy and smooth, but where the preservation is more favorable is covered by minute granules and punctæ.

[1] Both *P. singulare* and *P. textum* were identified by Heer in rocks, formerly at least, referred to the Lias. In the Flora Fossilis Helvetiæ, however, he doubts the Liassic age of the beds, and seems to favor the view of Escher, who had previously suggested that they belong to the Eocene. Whether this later view has been substantiated by more recent investigations we can not say.

Locality.—Pogibshi Island, opposite the village of Kadiak, Alaska.
Collector.—G. K. Gilbert.

Genus **Cancellophycus** Saporta.

Cancellophycus rhombicum sp. nov.

PL. XX, fig. 1.

Of this fossil the collections before us contain only the specimen figured on pl. XX. It lies on the flat surface of a block of slate and probably represents only a part of an originally much larger expansion. That this was ever sack-like in form, as is believed of the typical species of *Cancellophycus*, is very doubtful. Instead, the evidence of the specimen all tends toward proving that it was originally a large, simple, flabelliform expansion. This probable difference in growth might justify another generic arrangement, but as some at least of the species referred to the genus by Saporta indicate a similar habit of growth, and as the general structure agrees very well with that of the species in mind, notably *C. reticulare* Sap., it seems best, for the present at least, to refer the Alaskan species to the same genus.

The surface of the specimens is covered with branching and interwoven knotted ribs and threads, leaving, according to the degree of regularity in which they cross or unite with one another, either elongate shapeless meshes or more or less regularly rhomboidal ones. Along the lower edge the ribs are very much stronger, and here the bifurcations are numerous, the size of the branching threads being soon reduced to an average thickness of less than 0.5 mm. The meshes exhibit a fine longitudinal striation.

C. rhombicum seems to be closely related to *C. reticulare* Saporta,[1] from the Lower Oolite of the Jurassic of France. It may be distinguished, however, at once by the much greater delicacy of its ribs and smaller rhomboidal meshes.

Locality.—Pogibshi Island, opposite the village of Kadiak.
Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Retiphycus hexagonale gen. et sp. nov.

PL. XVIII, fig. 5.

Plant? forming retiform expansions of unknown dimensions; meshes somewhat irregularly hexagonal, averaging six in 25 mm.; separating walls about 1.0 mm. thick, rounded.

The composition of this fossil seems to be precisely as in the other 'fucoids' found at Kadiak, and if the latter are to be regarded as

[1] Pal. Franc., 2° ser., Veg., T. I, p. 142, pls. 7 et 8, fig. 1, 1873.

remains of marine algæ it is fair to assume that this also is of that nature. There may be recent algæ with which it might be compared, but we know of none reticulated like this one among the fossil forms.

Locality.—Pogibshi Island opposite the village of Kadiak, Alaska.

Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Genus **Gyrodendron** gen. nov.

Plant consisting of apparently solid cylindrical stems, bifurcating one or more times, and enrolled in one plane so as to form one or perhaps two volutions; inner extremity somewhat acuminate, outer ends obtuse.

In the absence of any characters beyond the mere form we must place this peculiar type with such other supposed remains of algæ as *Cylindrites*, *Helminthoida* and *Helminthopsis*, from all of which it is at once distinguished by its spiral habit of growth. Whether the stems were originally solid or hollow can not be decided now. As preserved, their composition is generally quite different from that of the matrix in which they are embedded.

Gyrodendron emersoni sp. nov.

Pl. XVIII, fig. 3; Pl. XIX, figs. 1, 2.

Stems varying in thickness from 2.5 mm. to 6.0 mm., bifurcating once, twice or three times, all apparently becoming more robust with age and forming from one to one and two-thirds volutions about the acuminate inner extremity. In the larger examples the concentric curve of the outer ends of the branches is gradually lessened until they become approximately straight and appear to run off at a tangent.

This striking and easily recognized fossil is named in honor of the eminent geologist, Prof. B. K. Emerson.

Locality.—Pogibshi Island, opposite the village of Kadiak, Alaska.

Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Genus **Gilbertina** gen. nov.

Plants ? consisting of a double cord wound in a close spiral like the spring of a watch. As preserved, the fossils present the appearance of a slender coiled tube cut in half horizontally.

This remarkable fossil can at present be compared only with *Helminthoida* Schafhäutl, though we are not by any means satisfied that there is any true relationship between them. Much might be said upon the possible relations of *Gilbertina*, and also concerning other interpretations of its fossil remains, but it may all very well be post-

poned to some future occasion when we hope to discuss the 'fucoids' as a whole. For the present it will suffice to state that the spiral habit of growth is the character principally relied on in distinguishing the genus from the other unbranched fucoids. The much more robust *Cylindrites convolutus* Fischer-Ooster, from the Eocene of the Alps, also grows in a spiral manner, but in this case the spiral is formed by a single cord and not by two parallel cords.

The name is from that of the discoverer, Mr. G. K. Gilbert, who also collected most of the other fossils obtained by the geologists of the Expedition from Pogibshi Island.

Gilbertina spiralis sp. nov.

pl. XVIII, figs. 1, 2.

The spirally coiled slender stem begins with an open loop, the two ends of which soon begin to curve inward and, maintaining a nearly parallel curve with respect to each other and preceding volutions, continue until they cover a subcircular space 5 to 8 cm. in diameter. The concave spaces between the coils of the stem increase in width as growth proceeds, from about 1.2 mm. to about 2.5 mm., while the thickness of the stem itself remains nearly constant at about 1.0 mm.

Perhaps it would be nearer the truth to consider the raised coils of the fossil as matrix filling the interstices between an originally hollow and now compressed cylinder. Under this interpretation the structure at the center of the coil would necessitate the assumption that the impressions were formed by two equal but separate cylinders. This was the view that first suggested itself, but the difficulty of explaining the irregularity of the outer one or two of the raised coils exhibited by two of the specimens before us could not be satisfied except by the interpretation adopted above.

Locality.— Pogibshi Island, opposite the village of Kadiak, Alaska.
Collector.— G. K. Gilbert.

Genus **Helminthoida** Schafhäutl.

Helminthoida SCHAFHÄUTL., Geognostische Untersuch. des südbayer. Alpengebirges, p. 142, 1851.— HEER, Urwelt der Schweiz, p. 246, 1865, and Flora Foss. Helvetiæ, p. 167, 1877.

Among the problematical fossils before us are four varieties of a type that in part at least corresponds very closely with the one for which Heer proposed the name *Helminthoida*. The first and the second of these varieties may be referred to this genus without reserve, but the third and fourth varieties depart from the normal forms of the genus

in the much less regular convolution of the cord-like fossil. The trend of the variation is toward *Helminthopsis* Heer, and *Helminthoida vaga* might, with perhaps equal propriety, be referred to that genus.

Heer describes four species of *Helminthoida* from the Eocene of Switzerland, and so far as we know the genus has not been heretofore met with in older rocks.[1] One of Heer's species, *H. appendiculata*, presents a peculiarity in the appendical prolongation of the closed end of the loops, but in other respects resembles *H. vaga* of this paper. Our *H. subcrassa* and *H. exacta* may be compared with Schafhäutl's *H. crassa*, but both are distinguished by obvious differences. As to *H. abnormis*, it stands somewhat apart, yet may be compared with certain varieties of *H. labyrinthica* Heer.

Concerning the nature of these and other trail-like fossils, we are wholly satisfied of their organic origin, while the fact that they often lie *over* each other and sometimes are piled together like tangled cords, proves, we believe, conclusively that they are not trails. Considering their organic nature as established, some provisional position must be assigned to them in nature until something definite concerning their structure may be learned. In the mean time we are quite willing to follow Heer and others, who view them provisionally as marine plants, despite the fact that no corresponding algæ are known in the present seas.

Helminthoida exacta sp. nov.

Pl. XVI, fig. 5.

The remains of this supposed marine plant resemble a convoluted cord, about 1.5 mm. in thickness, folded very regularly so as to form equal, narrow, slightly curved loops about 18 mm. in depth and averaging 1.5 mm. in width. The imperfect specimens at hand indicate that as growth proceeded the successive loops increased very gradually in length.

Locality.—Pogibshi Island, opposite the village of Kadiak, Alaska.

Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Helminthoida subcrassa sp. nov.

Pl. XVI, fig. 3.

The form for which this name is proposed is represented by a

[1]Since the above was written the author has discovered two large species apparently of this genus, one in the Batesville Sandstone of the Lower Carboniferous rocks of Arkansas, the other in the somewhat younger Strawn Formation of Texas. This fact and the possible relations to *Crossopodia* are noted *ante*, page 129.

specimen composed of seven successive loops. Of these the first is >-shaped and considerably shorter and wider than the last three or four. The cord decreases in average thickness from below upward, the extreme measurements being 2.7 mm. and 2.0 mm.

Distinguished from *H. exacta* by its more robust aspect and less regular convolutions. From *H. crassa* Schafhäutl, from the Eocene of Switzerland, with which it agrees in size of the cord, it differs in forming much shorter loops.

Locality.—Pogibshi Island, opposite the village of Kadiak, Alaska.

Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Helminthoida abnormis sp. nov.

Pl. XVI, fig. 4.

In this species the windings of the cord, which often appears to be crimpled and here and there knotted, and varies from 1.2 mm. to nearly 2.0 mm. in thickness, form very irregular and unequal loops. The latter, however, can scarcely be called vagrant, since, despite their irregularity, they seem to be confined to a space of nearly definite width.

Distinguished from the preceding species by the irregular intertwining of the cord and its slightly knotted and crimpled character. The same peculiarities separate it from all of Heer's species, among which the usually much more delicate *H. labyrinthica* presents perhaps more points of resemblance than any other known species.

Locality.—Pogibshi Island, opposite the village of Kadiak, Alaska.

Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Helminthoida vaga sp. nov.

Pl. XVII.

In this form the cord, which averages about 2.2 mm. in diameter, forms several large and more or less irregular loops or folds and then becomes vagrant, the succeeding turns being without order and having, apparently, no relation to the preceding loops.

Fragments of this species appear to be abundant, but, on account of the large size and straggling habit of growth, good and approximately entire specimens are likely to prove rare. Compared with other species of the genus, and especially those found with it in Alaska, it is distinguished at once by its large size and vagrant habit. Small fragments might be confounded with *Helminthopsis ? labyrinthica* Heer, but with more complete examples this is not likely to occur.

Locality.—Pogibshi Island, opposite the village of Kadiak, Alaska.

Collectors.—G. K. Gilbert, B. K. Emerson, Charles Palache.

Genus **Helminthopsis** Heer.

Helminthopsis magna Heer.

Pl. XXI, figs. 1, 2.

Helminthopsis magna HEER, Flora Foss. Helvetiæ, p. 116, taf. XLVII, figs. 1, 2, 1877.

Fucoid originally cylindrical and tubular, now flattened, several feet in length, 12 mm. to 25 mm. in width, the edges thickened, forming serpentine convolutions over the surface of slabs of arenaceous slate. The larger of the two specimens before us exhibits distinct transverse wrinkles, while on portions of the smaller specimen longitudinal lines as well as obscure transverse undulations may be discerned.

Heer described the surface of his specimens as smooth, and the thickened margins of the compressed tubes are heavier in his figures than in the Alaska specimens under consideration. Despite these differences we believe the latter belong, if not strictly to the same species, at least to one so near the Swiss Upper Liassic form that we are not at present warranted in separating it. Possibly the differences are due to faulty observation or to the less favorable preservation of Heer's originals. However, this point may turn out, it is certain his figures look very much like our specimens.

Locality.—Pogibshi Island opposite the village of Kadiak (? also Woody Island), Alaska.

Collector.—G. K. Gilbert.

Helminthopsis? labyrinthica Heer.

Pl. XX, figs. 2, 3.

Helminthopsis labyrinthica HEER, Flora Foss. Helvetiæ, taf. XLVII, figs. 3–5, 1877.

This fossil consists of simple, smooth, cylindrical, stony cords 1.8 mm. to 2.5 mm. in thickness, meandering, in the cases before us, over the surface of arenaceous slates. The stems are usually thrown into more or less irregular and unequal loops, often horseshoe-shaped, and sometimes recalling the more regularly formed loops of *Helminthoida*.

The Alaskan specimens under consideration agree so closely with Heer's figures of the Swiss Upper Liassic specimens upon which he founded the species *H. labyrinthica* that we can not doubt they belong to the same species. As to the propriety of referring the species to *Helminthopsis*, we are inclined to differ from the able author of the Flora Fossilis Helvetiæ. Considering *H. magna* as the type of the genus, *Helminthopsis* should be restricted to species having the con-

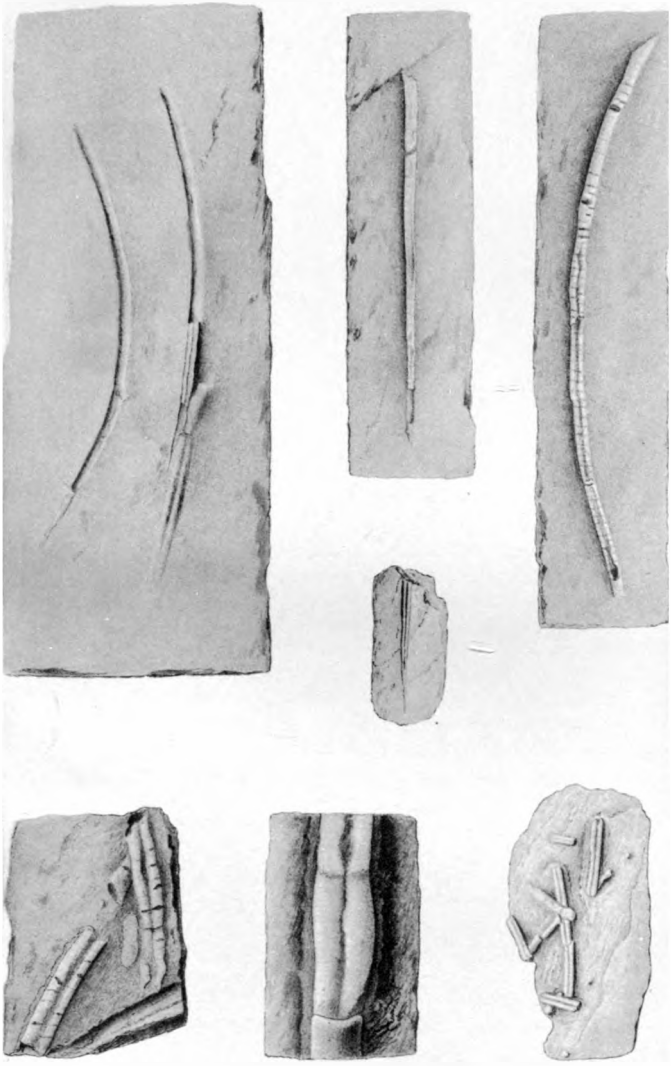
EXPLANATION OF PLATE XI

FOSSIL ANNELID TUBES FROM WOODY AND POGIBSHI ISLANDS, NEAR KADIAK VILLAGE, ALASKA

Natural size, except figure 6

FIGS. 1–7. *Terebellina palachei* gen. et sp. nov. Page 132.

1. Two curved specimens of this worm tube; incomplete and represented in part by the impression only.
2. A weathered tube, the lower half showing the interior hollow.
3 and 4. Two specimens, the first retaining the greater part, the second all of the acuminate proximal extremity.
5. A number of fragments in soft shale.
6. Portion of a specimen showing constrictions and faint transverse lines; × 5.
7. Several fragments of the large form mentioned in the description.



Frances Wieser Del. Helictype Co

YAKUTAT FORMATION, NEAR KADIAK, ALASKA

TEREBELLINA PALACHEI gen. et sp. nov.

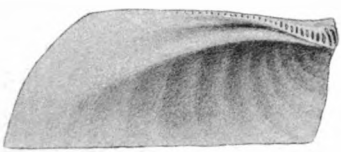
EXPLANATION OF PLATE XII

FOSSIL PELECYPOD FROM POGIBSHI ISLAND, NEAR KADIAK VILLAGE, ALASKA

FIGS. 1 and 2. *Inoceramya concentrica* gen. et sp. nov. Page 135. (See also plate XIII.)

1. Gutta percha cast of the natural mold of the exterior figured on plate XIII; restored in outline. Natural size.
2. Gutta percha cast of a natural mold of the interior (× 1.5), showing the posterior half of the hinge and the interior rib.

1



2 x 1.5

Frances Wieser Del Hellotype Co.

YAKUTAT FORMATION, WOODY ISLAND, ALASKA

INOCERAMYA CONCENTRICA gen. et sp. nov.

EXPLANATION OF PLATE XIII

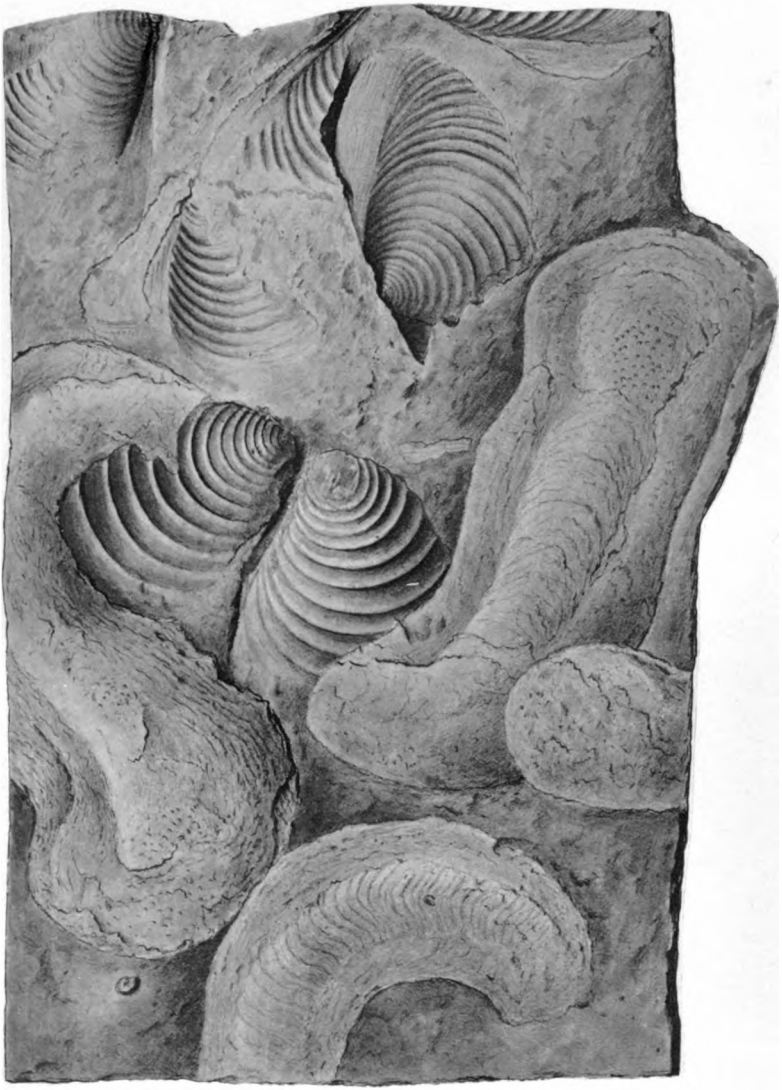
FOSSILS FROM WOODY ISLAND, NEAR KADIAK VILLAGE, ALASKA
Natural size

FIG. 1. *Inoceramya concentrica* gen. et sp. nov. Page 135. (See also plate XII.)

Portion of a large slab containing the impressions of both interior and exterior surfaces of imperfect valves upon which this species and genus are found.

2. *Myelophycus curvatum* gen. et sp. nov. Page 145.

Three specimens of this fucoid greatly compressed. The lower specimen is weathered so as to expose the edges and sections of the invaginated conical cups making up the interior portion.



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YAKUTAT FORMATION, WOODY ISLAND, ALASKA

1 INOCEROMYA 2 MYELOPHYCUS

EXPLANATION OF PLATE XIV

FOSSIL MARINE PLANT FROM POGIBSHI ISLAND, NEAR KADIAK VILLAGE, ALASKA

Natural size, except figure 3

FIGS. 1–3. *Arthrodendron diffusum* gen. et sp. nov. Page 138.

1. A nearly complete specimen showing the mode of growth and the beaded or jointed character of the branches.
2. Several fragments on another piece of shale.
3. One of the flattened elliptical joints of the preceding specimen (× 9), showing surface markings.

Frances Wisser Del. Heliotype Co.

YAKUTAT FORMATION, POGIBSHI ISLAND, ALASKA

ARTHRODENDRON DIFFUSUM gen. et sp. nov.

EXPLANATION OF PLATE XV

FOSSIL FUCOIDS FROM WOODY ISLAND, NEAR KADIAK, ALASKA
Four-fifths natural size

The greater part of a slab of slate nearly covered with two species of *Palæodictyon* described on page 137. The larger form (1) is *P. magnum laxum* sp. nov., the smaller (2) *P. singulare* Heer.

Frances Wieser Del. Heliotype Co.

YAKUTAT FORMATION, WOODY ISLAND, ALASKA

PALÆODICTYON

EXPLANATION OF PLATE XVI

FOSSIL FUCOIDS FROM POGIBSHI, NEAR KADIAK, ALASKA
Natural size

FIGS. 1 and 2. *Chondrites divaricatus* Fischer-Ooster. Page 136.

1. A specimen having more delicate branches than usual.
2. A specimen agreeing very nearly with the normal form of the species.

3. *Helminthoida subcrassa* sp. nov. Page 142.

View of the specimen described.

4. *Helminthoida abnormis* sp. nov. Page 143.

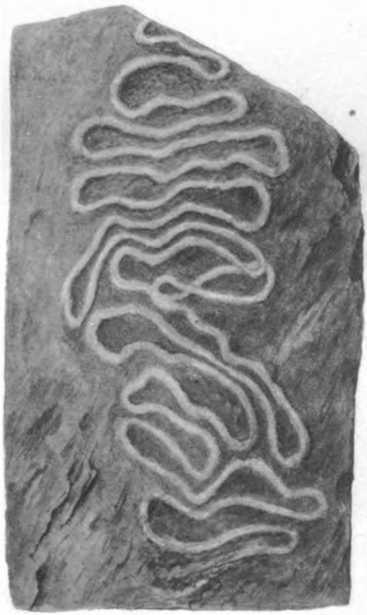
The greater part of the specimen chiefly consulted in drawing up the description of this species. It is somewhat weathered and the nodular character of the cord is best shown on the portion not included in the figure.

5. *Helminthoida exacta* sp. nov. Page 142.

One of the two specimens upon which this species is founded.

1

3



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YAKUTAT FORMATION, POGIBSHI ISLAND, ALASKA

1, 2 CHONDRITES 3, 4, 5 HELMINTHOIDA

EXPLANATION OF PLATE XVII

FOSSIL FUCOID FROM POGIBSHI ISLAND, NEAR KADIAK VILLAGE, ALASKA

Natural size

Helminthoida vaga sp. nov. Page 143.

Surface of a slab of slate showing the irregularity of folds that is regarded as characteristic of the species.

Frances Wieser Del. Heliotype Co.

YAKUTAT FORMATION, POGIBSHI ISLAND, ALASKA

HELMINTHOIDA VAGA sp. nov.

EXPLANATION OF PLATE XVIII

FOSSIL FUCOIDS FROM POGIBSHI ISLAND, NEAR KADIAK VILLAGE, ALASKA

Natural size

FIGS. 1 and 2. *Gilbertina spiralis* gen. et sp. nov. Page 141.

1. The largest specimen seen. The elliptic outline probably is due to compression.
2. The smallest specimen in the collection. It is important because of the irregular folds of the outer whorls.
3. *Gyrodendron emersoni* gen. et sp. nov. Page 140. (See also plate XIX.)

   A small specimen, considering that it is three times bifurcated.
4. *Chondrites alpestris* Heer. Page 136.

   View of the only specimen of this species seen. It is an empty mold of the exterior.
5. *Retiphycus hexagonale* gen. et sp. nov. Page 139.

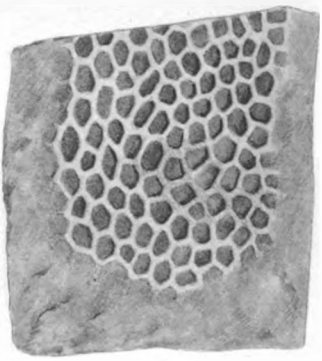
   View of the unique specimen upon which this genus and species is founded. The specimen is restored in the shaded central part of the figure.

1

3

4

2



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Frances Wieser Del. Heliotype Co.

YAKUTAT FORMATION, POGIBSHI ISLAND, ALASKA

1, 2 GILBERTINA 3 GYRODENDRON 4 CHONDRITES 5 RETIPHYCUS

EXPLANATION OF PLATE XIX

FOSSIL FUCOIDS FROM POGIBSHI ISLAND, NEAR KADIAK VILLAGE, ALASKA

Natural size

FIGS. 1 and 2. *Gyrodendron emersoni* gen. et sp. nov. Page 140. See also plate XVIII.

1. A slab containing several specimens in different stages of growth.
2. Two specimens with thicker branches, possibly belonging to another species of this remarkable genus of fucoids.

Frances Wieser Del. Heliotype Co.

YAKUTAT FORMATION, POGIBSHI ISLAND, ALASKA

GYRODENDRON EMERSONI gen. et sp. nov.

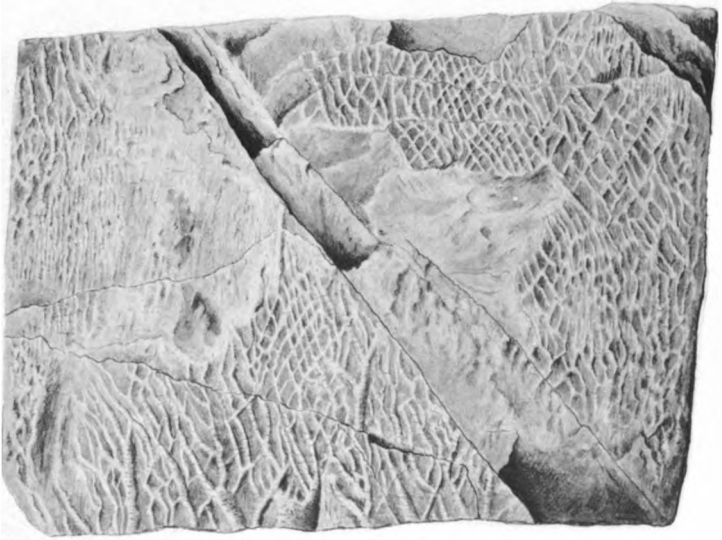
EXPLANATION OF PLATE XX

FOSSIL FUCOIDS FROM POGIBSHI ISLAND, NEAR KADIAK VILLAGE, ALASKA

Natural size

FIG. 1. *Cancellophycus rhombicum* sp. nov. Page 139.
View of the specimen described.

2 and 3. *Helminthopsis ? labyrinthica* Heer. Page 144.
Portions of two slabs with fragments of this species.



1

2

3

Frances Wieser Del. Heliotype Co.

YAKUTAT FORMATION, POGIBSHI ISLAND, ALASKA

1 CANCELLOPHYCUS 2, 3 HELMINTHOPSIS?

EXPLANATION OF PLATE XXI

FOSSIL FUCOIDS FROM POGIBSHI ISLAND, NEAR KADIAK VILLAGE, ALASKA

Natural size

FIGS. 1 and 2. *Helminthopsis magna* Heer. Page 144.

1. A small specimen of the Alaskan form of this species. The surface appears to be in a better state of preservation than on the Swiss types of the species.
2. A small portion of a slab containing a larger and wider specimen; figured to show corrugations of surface.

Frances Wieser Del. Heliotype Co.

YAKUTAT FORMATION, NEAR KADIAK, ALASKA

HELMINTHOPSIS MAGNA Heer.

voluted cylindrical stem originally hollow. *H. labyrinthica*, on the contrary, was almost certainly solid. What to do with the latter we are not prepared to say, although we have provisionally referred what we believe is a congeneric species to *Helminthoida* under the name of *H. vaga*. So far as we can see the latter is distinguished from *H. labyrinthica* only by its much longer loops and generally looser habit of growth.

Locality. — Pogibshi Island, opposite the village of Kadiak, Alaska.

Collectors. — G. K. Gilbert, B. K. Emerson, Charles Palache.

Genus **Myelophycus** gen. nov.

(*Münsteria*, part, Fischer-Ooster.)

As interpreted these supposed marine plants were simple, curved, subcylindrical or claviform masses, consisting of an outer laminated and superficially granulose integument and an inner pith-like portion made up of a succession of conical cups set one into the other.

Besides the type species next described we know of only one other form that we would refer to this genus. This was figured in 1858 by Fischer-Ooster in his paper entitled Die fossilen Fucoiden der Schweizer-Alpen (pl. XVI, fig. 5), and referred by him to *Münsteria hæssii* Sternberg. Comparing this figure with all others at hand of Sternberg's species, we find that it is clearly distinct, the *M. hæssii* of other authors being without the granulose external integument. This outer integument and the invaginated cones of the inner portion distinguish the proposed genus from *Münsteria*, *Keckia*, *Ceratophycus*, *Caulinites* and other genera having a transversely wrinkled surface.

Myelophycus curvatum sp. nov.

Pl. XIII, fig. 2.

The originally cylindrical or club-shaped masses upon which this species is founded are now greatly compressed and cover most of one surface of a slightly arenaceous slab of slate about 8 inches wide and between 12 and 13 inches long. They are from 10 cm. to 15 cm. long, strongly curved, and from 2 cm. to 4 cm. wide, the latter dimension being at one of the extremities, which as a rule is more or less expanded. The average width may be set down at about 3 cm. When the outer integument, which is thick, laminated and superficially rather coarsely granulose, is worn away, the invaginated cones of the inner structure, which takes up about half the width of the entire fossil, are exposed. When the wearing has not materially affected these, then only their straight or accidentally curved edges are seen,

but when the latter are cut away the walls of the vertically sectioned cones present a pinnate arrangement. The texture of the fossils, of whose organic nature we are thoroughly satisfied, is coarser and their color lighter than that of the black slate in which they are embedded.

Compared with *Münsteria hæssii* F.-Ooster (*non* Sternberg), the Swiss Eocene species mentioned under the generic description, *Myelophycus curvatum* is distinguished by its larger size and smaller internal cones.

Locality. — Woody Island, Kadiak, on the shore facing Chiniak Bay, Alaska. The same slab contains the types of *Inoceramya concentrica*.

Collector. — W. H. Dall.