

**Article XVI.—ON NEW FORMS OF MARINE ALGÆ
FROM THE TRENTON LIMESTONE, WITH
OBSERVATIONS ON BUTHOGRAPTUS LAXUS
HALL.**

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PLATE XI.

In 1861 Prof. Hall¹ described what he evidently supposed to be a graptolitic body, from shales of the age of the Trenton limestones of New York, found at Platteville, Wisconsin, under the name *Buthograptus*, giving the species *B. laxus* as the type; and in the 'Canadian Organic Remains,' Decade II, on page 49, he mentions it again as "doubtfully" referable to the Graptolitidæ. In the next paragraph he speaks of an associated form having a general resemblance to *Dendrograptus*, and says "without farther knowledge, I refer these fossils, with hesitation, to the genus *Oldhamia* (*O. fruticosa* Hall)."

In working over the fossils described in the 'Report of Progress' of the Wisconsin Geological Survey for 1861, the types of most of which are the property of the Museum, for illustration in the Museum publications, I have become convinced that these remains are not of Graptolitic origin, but are true MARINE ALGÆ.

These bodies are found preserved on surfaces of a brown carbonaceous shale, and are seen on the surface as black lines. When examined under a sufficiently strong glass they are found to be composed of a black, coaly matter, having the lustre and fracture of anthracite, the carbonaceous character of the shale being undoubtedly derived from this source, as there are but few other organic remains found in the same layers with them.

Buthograptus consists of a midrib, flattened as seen on the shale, which gives origin to a series of short, slender, slightly curved pinnules on either edge, somewhat closely arranged, and presents a feather-like aspect as it lies on the rock. There are no definite serratures or cells on either the midrib or on the lateral pinnules, but along the line of the midrib may sometimes be seen a series

¹ Rep. Prog. Geol. Surv. Wis., 1861, pp. 18 and 19.

of dots or punctures which were supposed to represent the apertures of cells, analagous to those of Graptolites, but which now prove to be only depressions in its surface. When the stipe is placed under a sufficiently strong lens it is readily seen that the lateral pinnules are not a part of the central stipe, but are separate organs articulated by a club-shaped end to the central stipe; and it is the imprints of these club-like ends that has produced the punctures that in the description of *Buthograptus* are described as "oval spots marking the form and place of the cellules." No positive evidence has as yet been detected of articulations in the midrib or central stipe, and no really negative proof can be shown. The pinnules where perfectly preserved increase in width outwardly, from just above the club-shaped attachment to nearly twice that width near their extremity, and are rounded or obtusely pointed at the outer end.

The absence of proper cells, taken in connection with the other features above mentioned, led me not only to question the animal origin of *Buthograptus*, but to examine critically the so-called *Oldhamia fruticosa* Hall, which is associated with it, and on placing them under a sufficiently high magnifying power the Algous characteristics were at once detected in their mode of growth and in the jointed bifurcations of the branches. This has led me to the conclusion that they are both of vegetable origin and belong to the true articulated marine Algæ. This was to me a somewhat astonishing result, as I can find no record of any *articulated* marine Algæ described from Palæozoic rocks.

Among the living forms of marine Algæ on the Florida coast and elsewhere we have a form known as *Caulerpa plumaris*, which to the naked eye is so exactly a counterpart of *Buthograptus laxus* that a figure of one would answer equally well for that of the other, but when examined more carefully it is seen that in the living form the lateral pinnules are simply ramifications from the central axis or stipe, while in *Buthograptus* they are articulated pinnules which by maceration were readily separated from the central axis, as is plainly seen in the fossil specimens. The form of *Buthograptus* when living was most probably plumose with a cylindrical axis from which a series of pinnules arose on two opposite sides, not quite opposite to each

other at their origin but slightly alternating. These pinnules were probably cylindrical and somewhat club-shaped or enlarging outwardly, and attached to the axis by the knob-like inner end. In the shale, by compression, these rounded parts are all flattened, so there is little left beyond the brown staining on the rock from the carbonaceous material of the plant substance.

The name *Buthograptus* (or *Bythograptus*, as written by several authors) is a misnomer and misleading, as the termination "graptus" seems to ally it with the Graptolitidæ, which we now see to be incorrect. Such a name as *Bythocladus* would be much more appropriate.

Referring again to the supposed *Oldhamia*, I find but little similarity between it and the true *Oldhamia antiqua* Forbes, which occurs fossil in the Cambrian of England, and is the type and only species of the genus, the other species formerly included having been removed under the name *Murchisonites radiatus*. The *Oldhamia antiqua* has been considered by some authors as a Nullipore, by others as a Sertularian; the first a vegetable, the other an animal. The mode of growth seen in these Trenton forms positively indicates their vegetable character.

In very many of the marine Algæ, the stems, branches and branchlets have a peculiar jointed structure, very much like that of a Cactus, with an expansion at the upper end of the joints, the divisions being two, three, or more. This structure is very beautifully shown on some specimens of the one called *Oldhamia fruticosa* by Prof. Hall, especially on the terminal branches. (See Plate XI, Figs. 7 and 8.) Two other forms are found on the same shales, one having long slender stipes with numerous branches, long and filiform, which are joined to the principal stipe by a knob-like end, which is rather set upon the stem than joined to it. These differ entirely from the first-mentioned species, but were included with it in the article in the 'Canadian Decade.' None of them have been positively seen bearing other than the fine filiform branches. A third form occurs which has a strong middle stem, jointed, and having whorls of very fine hair-like pinnules at each joint, and much resembles some species of the genus *Wrangelia*, or perhaps more like *Dasycladus* among our living forms of Algæ.

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The occurrence and detection of marine Algæ of a character so very similar to our living forms in rocks of the age of the Trenton limestones of New York, I take to be a matter of some interest and of more than passing importance, as all the various forms of marine plants and sea weeds hitherto described, so far as I am aware, have been so entirely devoid of positive or definite structure, that it is often uncertain whether they may not be the results of worm burrows, tracks or trails of molluscous animals, or phenomena resulting from inorganic causes. But here we have unmistakable structure, as far as external form goes, to guide us in their determination.

Following are descriptions of the new forms here given.

Callithamnopsis,¹ New Genus.

Frond articulate, branched, branches opposite in pairs, or in whorls near the upper end of the joints, and composed of single joints between bifurcations. Type, *C. fruticosa*, Hall's sp. Geological position in the Trenton period.

Callithamnopsis fruticosa.

PLATE XI, FIGS. 4-8.

Oldhamia fruticosa Hall, Can. Org. Rem. Decade II, p. 50. Name only.

Frond consisting of thin filiform stems more or less distinctly jointed, with slender thread-like branches of half or less than half the width of the main stem, the extremities more or less bulbous where they unite with the stem or outer divisions. Outer divisions two or three, or in some cases four or more, diverging at an angle of about thirty degrees from each other, the branches being slightly curved; the whole having the appearance of a densely branched bush in miniature. Stipes and branches with parallel margins.

In some cases the terminal branches only of a frond will be found forming a group together, when they are likely to present the appearance of whorls of many branches from their overlapping and interference one with another, and so present a variety of forms. In one case, what seems to be a main stem with many branches attached, shows the upper terminal point of the stem broad and rounded at the extremity, like a young growing shoot. In some cases the outer branches are short and the bifurcations quite close together, while in others they are long and very slender and the bifurcations quite distant. I have thought these last might possibly be specifically distinct from the type specimen of *C. fruticosa*, but after further study they seem to be connected by intermediate forms enough to unite them as one and the same.

Geological Formation and Locality.—In dark brown or chocolate-colored shales of the Trenton Group, at Platteville, Wisconsin.

¹ *Callithamnion*, a genus of Algæ, and ὀφίς, resemblance.

One peculiar feature noticed by Prof. Hall of some of these bodies, which he referred to *Oldhamia fruticosa*, is that of two of the stems being twisted together like stems of a vine growing and intertwining as if for mutual strength and support. Many of these slender thread-like stems are seen to have this feature. These are long slender stipes sometimes having numerous more slender ramifications. These differ entirely from the one mentioned above under the name *Callithamnopsis*, and cannot well be placed under that genus. So far as seen no true bifurcations, like the terminal parts of that one, have been detected. The branches are attached to the main stipe by a clavate or bulbous base as in that one, but instead of having numerous jointed divisions are simple and hair-like in their extension. This form I shall designate only by specific name, leaving it provisionally under the name *Chætomorpha*, one of our living genera, and give it the specific name *prima* with the following diagnosis.

***Chætomorpha ? prima*, n. sp.**

PLATE XI, FIGS. 9 AND 10.

Slender hair-like plants with continuous stems (*i. e.* not articulated), having numerous more slender filiform branches of extreme tenuity but without known bifurcations or divisions; branches attached to the main stipe or stem by bulbous bases or discs, easily separated. Bifurcations of the main stem uncertain. Stems frequently intertwining.

Geological Position and Locality.—On shales of the age of the Trenton group of New York at Platteville, Wisconsin, associated with the *Buthograptus laxus* Hall and *Callithamnopsis fruticosa*.

A third species, evidently allied somewhat to the preceding, is noticed on three of the blocks which bear the other forms. It is quite distinct in structure as far as can be ascertained, presenting a dense tuft or feather-like form of about one and a half inches in length, and is composed of fine hair-like fibres of great tenuity which diverge from a central stem. On close examination they are seen to be in whorls about a tenth of an inch apart. If this is their true structure the nearest living genus would probably be *Dasycladus* or *Wrangelia*. For this form I would propose the generic name *Chætocladus*.

Chætocladus, New Genus.

Marine plants with jointed cylindrical stems giving off whorls of hair-like filaments at given distances.

Chætocladus plumula, n. sp.

PLATE XI, FIGS. II-13.

Frond probably sessile, growing in tufts of one or more plume-like stems, composed of a cylindrical axis surrounded at intervals of about a tenth of an inch, by whorls of very fine leaflets presenting a feather-like tuft of three-eighths of an inch diameter.

Formation and Locality.—In chocolate-colored shales of the Trenton group at Platteville, Wisconsin, associated with *Buthograptus laxus* and *Callithamnopsis fruticosa* Hall.

About fifteen years ago, in looking over some fragments of Trenton limestone from Middleville, N. Y., I noticed some specimens resembling Corallines, and so labeled them when placing them in the cabinet, where they have remained until now, awaiting an occasion for further notice. The specimens in question have all the characteristics of the true Corallines of the present seas, and so far as can be ascertained none in which they can be said to differ. Of course they only represent detached portions of the organism, but enough remains to show the prevailing features of the species. Nothing beyond detached joints of this form of marine Algæ has hitherto rewarded the search of Palæobotanists in any of the older geological formations. Detached plates or joints of analogous bodies have been known and described under the name *Cælotrochium* from the middle Devonian of the Eifel; and in carboniferous limestones of England other but similar bodies have been found in numbers. In the Permian rocks forms pertaining to this class of plants have been described under the generic name *Gyroporella*, while in the Upper Lias, in the Bavarian Alps, beds of limestones are said to be largely made up of *Gyroporella* and *Diplopora*. But no definitely formed organisms of the class have been noticed in the Palæozoic rocks. And it is not until we reach the more modern formations that anything very satisfactory is known of this class of organisms in a fossil state, although it is supposed that calcareous Algæ have

aided very largely in the building up of the limestones of all ages. The specimens now in hand consist of branches of from half an inch in length to one and one-fourth of an inch, with a transverse diameter of nearly one-fourth of an inch. They consist of a central or longitudinal axis which is hollow and jointed, and of whorls of lateral branches or pinnules, apparently four, possibly five in number, radiating from the central axis and forming a cylindrical body in the aggregate. The pinnules of the whorls are composed of three elements each; a first joint which diverges from the central axis gives origin to two secondary joints, while each of these supports two still smaller joints or pinnulæ. For this form I propose the generic name *Primicorallina*, with the following diagnosis:

Primicorallina, New Genus.

Articulated marine plants, consisted of elongated cylindrical fronds, composed of a central longitudinal axis, which is jointed and hollow in the fossil condition, and supports whorls of jointed pinnules from each joint; pinnules decompound. Type, *P. trentonensis*.

These remains are of course only the calcareous coating of the real plant, the vegetable portion having been lost. The joints are irregular in form but have a generally cylindrical form.

Primicorallina trentonensis, n. sp.

PLATE XI, FIGS. 14-17.

Fronds of small size, represented by cylindrical tufts of greater or less length, and of from one-sixth to one-fourth of an inch in diameter. Axis of the frond irregularly cylindrical and jointed; the joints count about thirty to the inch and are nearly twice as long as thick. Pinnules four, or perhaps five, from each joint of the axis, composed of cylindrical, oval or clavate joints; those originating on the axis are of nearly an equal length with the axial joints, and each supports two others on the outer end of very nearly or somewhat shorter length, but of less thickness; these again support each two others which are short oval in outline and of not more than half the length of the others. Bifurcations of the pinnules diverging at an angle of about thirty to thirty-five degrees to each other.

Geological Formation and Locality.—In Trenton limestone at Middleville, N. Y.

DESCRIPTION OF PLATE XI.

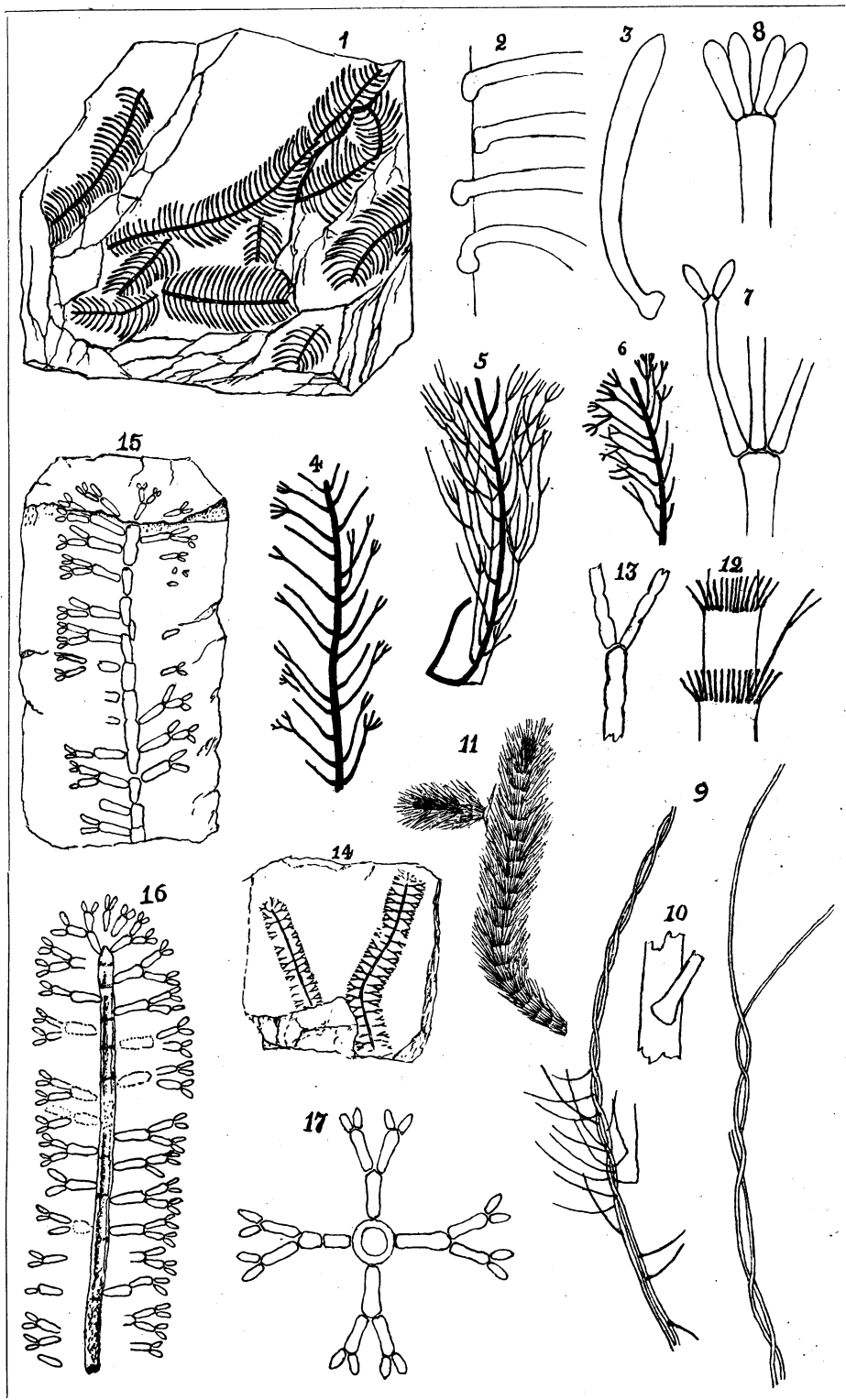
Figs. 1-3. **Buthograptus laxis** Hall. Page 351. Fig. 1, view of a block showing several stipes, nat. size. Fig. 2, an enlargement to show the manner of attachment of the pinnules. Fig. 3, a single pinnule enlarged.

Figs. 4-8. **Callithamnopsis fruticosa** Hall. Page 354. Figs. 4, 5 and 6, views of three specimens showing variations of form, enlarged 3 times. Figs. 7 and 8, further enlargements of two terminal portions of a fragment.

Figs. 9, 10. **Chætomorpha? prima** Whitf. Page 355. Fig. 9, views of two specimens each showing two stipes intertwined, one of which retains the hair-like pinnules; Figs. two diameters. Fig. 10 shows the manner in which the pinnules are attached to the stipe.

Figs. 11-13. **Chætocladus plumula** Whitf. Page 356. Fig. 11, view of a branch, nat. size, with a second branch on a lower lamina of shale. Fig. 12 shows the arrangement of the pinnules around the stem. Fig. 13, an enlargement showing a bifurcation and an apparent constricted or jointed character.

Figs. 14-17. **Primicorallina trentonensis** Whitf. Page 357. Fig. 14, fragment of shale with two stipes, nat. size. Fig. 15, enlargement 4 times of a specimen in limestone. Fig. 16, enlargement of the smaller stipe on specimen Fig. 14. Fig. 17, diagram showing a sectional view with the arrangement of pinnules around the main stem.



New Forms of Fossil Marine Algæ.

