NORTH AMERICAN GRAPTOLITES:

NEW SPECIES AND VERTICAL RANGE.[1]

PREFACE.

No general revision of American graptolites has been attempted since the termination of Hall's classic labors some thirty years ago, and one based on the lines of recent taxonomic progress is badly needed. The present paper is a preliminary attempt at such a zoölogic and geologic revision.

The tables showing the vertical range of species are, to a considerable extent, based on my own determinations. This reservation is necessary, as many of the ranges assigned to species are incorrect, the result of erroneous identification. In this matter I am glad to find myself in general accord with Ami,[2] almost the only American observer who has studied extensively the graptolites in the light of recent foreign work.

A word as to the somewhat numerous changes made in the synonymy. Most of them are in accordance with general graptolite consensus. Most of the remainder are explicable on the ground of priority. In a previous paper[3] I followed general consensus rather than attempt the necessary thorough overhauling of the synonymy, reserving the latter until such time as I could publish more extensively the reasons for the requisite changes. Now, however, it seems best to enforce priority rigidly, and to this end the original spelling has been followed in all cases. Reasons for deviation from current usage are given in brief, but in a paper of this compass it is of course not possible to give the evidence in extenso.

No attempt has here been made to determine accurately the

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[2] Bull. Geol. Soc. Amer., II., pp. 477–502, Plate XX.

[3] Ann. Rep. Geol. Surv. Ark. for 1890 (1892), III., pp. 401–418, Plate IX.

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zoölogic limits of the group, as this paper being rather geologic than zoölogic, the aim has been to include every species of graptolite (as the word is generally understood), reported from American strata, with the proper generic reference and the ascertained range. Only species in good standing are, however, given, and such forms as *Nereograpsus*, which are no longer regarded by any one as graptolites, are omitted.

Finally, all new species here described will be fully illustrated in a future publication of the U. S. Geological Survey. The authority for each new species is appended to it.

I. DESCRIPTIONS OF GENERA AND SPECIES.

PHYLLOGRAPTUS HALL, 1858.

Rep. Progr. Geol. Surv. Can. for 1857, pp. 135, 137. Type, *P. typus* Hall.

Phyllograptus ? cambrensis Walcott, sp. nov.

"*Diplograptus simplex* (Emmons)" Walcott, 1886, Bull. 30, U. S. Geol. Surv., pp. 92–93, Plate XI., Figs. 4, 4*a*; "*Phyllograptus simplex* (Emmons)" Walcott, 1889, Amer. Jour. Sci., XXXVIII., p. 388.

The synonymic relations of this species are very complex. For the present it is sufficient that it is neither *Fucoides simplex* Emmons, 1844 (*Taconic System*, p. 27, Plate V., Fig. 1), nor *Diplograpsus secalinus* (Eaton) Emmons, 1856 (*American Geology*, I., Part II., p. 104, Plate I., Fig. 11).

BRYOGRAPTUS LAPWORTH, 1880.

Ann. and Mag. Nat. Hist., V., p. 164. Type, *B. kjerulfi* Lapw.

Bryograptus ? multiramosus Gurley, sp. nov.

Polypary round-triangular in outline; length and breadth each 20^{mm}. Proximal extremity bearing a sicula 1^{mm} long. Branches numerous, dividing dichotomously, one being five times divided (including sicular division). Thecæ 30 to 35 in 25^{mm}, forming cylindrical tubes, free for one-half their length or a little less, pustuliferous. Virgula not seen.

Horizon and locality.—Several specimens on some pieces of Upper Cambrian shale from Matanné, Canada, sent by Sir J. William Dawson to the National Museum.

DICHOGRAPSUS SALTER, 1863.

Quart. Jour. Geol. Soc. London, XIX., p. 139. Type, *D sedgwickii* Salter.

Dichograpsus remotus Gurley, sp. nov.

Only a single specimen seen. Branches very narrow, having a length of 25 to 35^{mm} between successive points of division, the latter apparently becom-

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ing progressively more remote from one another. Thecæ not well shown, about 25 in 25^{mm}. The main characteristic of this species is the remoteness of the points of bifurcation and the small size of the branches.

Horizon and locality.—Calciferous shales (zone with *Dichograpsus flexilis*, etc.), Point Levis, Canada.

Dichograpsus abnormis (Hall).

Herrmann[1] regards this species as simply an "abnormal" specimen of *D. rigidus*. I am unable to agree with this view, the species apparently being well characterized.

TETRAGRAPSUS SALTER, 1863.

Quart. Jour. Geol. Soc. London, XIX., p. 140. Type *T. crucialis* Salter.

Tetragrapsus acanthonotus Gurley, sp. nov. Plate IV., Figs. 1, 1*a*.

Width of branches from apex of thecæ to virgula, 2.5–3^{mm}. Dorsal margins at intervals of from 1 to 3 thecæ (generally opposite every other theca) bearing spines 1^{mm} or less in length, which are integumentary processes, not connected with the virgula. Thecæ 17 to 20 in 25^{mm}, slightly curved with the upper lip produced into a rather acute denticle. Line of aperture concave, inclined (on distal side) to virgula about 120°.

Horizon and locality.—Calciferous shales about one and one-quarter miles N. N. W. of the East Railway Station, at Point Levis, Canada, opposite the iron foundry.

Recognizable at a glance by its spinose dorsal margin. The generic reference is made from a single small specimen seen.

DIDYMOGRAPSUS MCCOY, 1851.

Brit. Palæozoic Fossils, p. 9.

Didymograpsus bipunctatus Gurley, sp. nov. Plate V., Figs. 7, 7*a*.

Sicula slender, short. Branches diverging from sicula at an angle of 110°, very slender, with an undulating dorsal margin, each undulation corresponding to a theca. Thecæ about 65 in 25^{mm}, curved, equally wide throughout, with the apertural margin straight, and retrotruncate. Between each pair of thecæ are two "pustules" (one at base of proximal theca, the other near its distal end), appearing as though joined by an elevated line. Owing to the close proximity of the series of elevated lines, the specimens, viewed in some directions, appear to possess a continuous undulating raised line.

Horizon and locality.—On a slab of Calciferous shale in a small collection from one mile N.W. of the East Railway Station, Point Levis, Canada. A dozen specimens, mostly small or immature, were seen.

[1] Nyt Mag. f. Naturvid, 1885, XXIX., p. 210.

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From all species of the genus except two or three, this species is distin guished by its small size. From the remainder by the undulating dorsal mar-- gin and the double series of " pustules."

Didymograpsus perflexus Gurley sp. nov.

Branches diverging from a minute sicula at a variable angle, probably from 225° to 270°, variously directed subsequently from post mortem deflection, gradually widening from their origin to a maximum width of 3^{mm}. Maximum length observed (in a specimen whose width showed that it was situated far to the proximal side of other fragments, and that it could not have been near the sicula) 17^{cm}. Coenosarcal canal narrow, occupying not more than one-quarter or one-fifth of the extreme width of the branch. Thecæ 20 to 25 in 25^{mm}, almost or quite straight, very wide in proportion to their length, little wider (one-quarter or thereabouts) at aperture than at base; inclined to axis of branch about 30°; apertural margin straight, destitute of spines, obliquely directed,

Horizon and locality.—Upper Calciferous shales, Summit, Nev.

This species presents itself under very many aspects, so many in fact that I have several times suspected that two species were present. Subsequent study has, however, led to the conclusion that probably all these forms are to be referred to differences in preservation conditions, that is that they are preservation facies. To start with the angle of divergence varies within very wide limits, being at one extreme about two, and at the other about three right angles. Several intermediate positions are present. The true angle was probably nearer the upper than the lower limit, the lowering resulting from subsequent (post mortem) bending of the slender polypary. This seems not unreasonable especially when the inclination of the thecæ in some specimens is less than the average, and these same thecæ have every appearance of having been compressed backward against the virgula. Such pressure naturally tends to diminish the angle of divergence, measured as the latter is on the dorsal side. These two conditions (diminished angle and flattening of thecæ) were not, however, observed on the same specimen. The inclination of the thecæ to the virgula (measured of course, on the distal side), seems to increase slowly, those on the distal portion being somewhat more erect. They are also slightly more numerous in a given space. Upon each theca at the distal corner remote from the virgula, is a circular pustule-like body which may have been an orifice in the lateral wall.

This form probably approaches *D. nicholsoni* Lapw., and *D. suecicus* Tullb., more nearly than any others. The thecæ here are rather regularly 22 to 24 in 25^{mm} as opposed to 25 to 30 (average 26) in the same space, in Lapworth's species. Also *D. nicholsoni* differs in the somewhat rigid branch with a uniform width of about $1^{mm}.25$, and the concave thecal mouth usually prolonged into a denticle. With *D. suecicus* its affinities would seem even

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closer, but in that species we have somewhat crooked thecæ, twice or one and one-half times as wide at mouth as at base, with the somewhat concave mouth often bearing a denticle.

Didymograpsus geminus (Hisinger).

(Miller's North American Geology and Palæontology, 1889, p. 186, Fig. 169.)

Concerning this form, it may be remarked (1) that Hisinger's *geminus* (*Lethaea Suecica*, Suppl. 2, 1840, p. 5, Part XXXVIII., Fig. 3) is a synonym for *D. murchisoni* Beck (Murchison's *Silurian System*, Part II., 1839, p. 694, Plate XXVI. Fig. 4); (2) that *D. murchisoni* is not known to be American (except as *var. furcillatus* Lapw.; see p. $\frac{1}{m}$); and (3) that the original of Miller's figure is Carruther's mal-identification (in Murchison's *Siluria*, 4 ed., 1867, Plate IV., Fig. 8) as *D. geminus* His., of *D. patulus* Hall.

Didymograpsus hirundo Salter, 1863.

Quar. Jour. Geol. Soc. London, XIX., p. 137, Fig. 13.

Graptolithus constrictus Hall, 1865, Can. Org. Rem., Dec. II., p. 76, Plate I., Figs. 23–27.

This species is very largely represented in collections from the main Point. Levis zone. The supposed constriction of the theca mentioned by Hall is clearly an illusion, due to the intervention of a thin film of shale which covers one theca along the furrow produced by the overlapping apertural margin of the next proximal theca. This produces an appearance as though the distal theca were interrupted and contracted to receive the next proximal one. Specimens in relief show the thecæ uncontracted.

Didymograpsus convexus Gurley, sp. nov. Plate V., Fig. 8.

Branches slender, in distal portion 1^{mm} wide, diverging from a small sicula with an upwardly concave-rounded curve, including between them (on the dorsal side, of course) an angle of about 265^{c}. Thecæ 20 to 22 in 25^{mm}, inclined to axis of branch 25° to 30°, widest at mouth, with a straight, apertural margin; the last making (on the distal side) an angle with the virgula of 105° to 110°; thecæ free for one-half their length.

Only two specimens were seen, but the aspect is such that they cannot be referred to *D. serratulus* or any other described species. Possibly it may be the proximal portion of *D. sagitticaulis*, but nearly fifty years have passed since the discovery of that species without the finding of any specimens long enough to connect the distal and proximal parts; hence the necessity for two names, at least pending the proof of such a connection which may be long delayed.

This species may be recognized by the broadly rounded curve at the base.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

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Didymograptus sagitticaulis Gurley, sp. nov.

Graptolithus sagittarius (His.) Hall, Pal. N. Y., 1847, I., p. 272, t. 74, Fig. 1; "*Graptolithus sagittarius* Hall (non-His.)," etc., of subsequent writers; *Didymograptus sagittarius* Hall, Lapworth, 1886, Trans. Roy. Soc. Can., V., Sect. IV., pp. 180–181, 183–184.

This name is proposed to clear the synonymy. No name has ever been given to this species, that under which it has gone being derived merely from the erroneous identification of it with Hisinger's species. Very possibly the species is a distal fragment of one of the others in the same beds, but if so, it is so far distal that the chances of connecting it with the proximal portion are rather small, in the meantime it is important that it have a name in good standing, especially as, being a very common form, it occurs in nearly every list of species from the Lower *Dicellograpsus* zone, and usually appears under some clumsy explanatory circumlocution.

Horizon and locality.—Lower *Dicellograpsus* zone.

STEPHANOGRAPTUS GEINITZ, 1866.

Neues Jahrb. für Mineral., 1866, p. 124. Type, *S. gracilis* (Hall).

This generic name takes precedence of *Helicograptus* Nicholson,[1] and *Coenograptus* Hall,[2] both of which were founded upon the same species (*Graptolithus gracilis* Hall).

Stephanograptus crassicaulis Gurley, sp. nov.

Specimen resembling one-half of *S. gracilis* but with a much thicker main curved stem and branches, the former measuring from 0.50 to $0^{mm}.75$. in thickness, the latter in the distal portions attaining a width of 1^{mm}. The branches are given off from the main stem at first at a right angle, but with each succeeding branch the divergence becomes less. The thecæ on the distal portion of the branches measure 20 in 25^{mm}.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

This species differs from all other of the genus in its very stout polypary. Though only one-half of the polypary has been seen, the generic reference seems hardly open to doubt so much does the habit of the species resemble that of *S. gracilis*.

Stephanograptus exilis Lapworth, sp. nov.

Polypary bilaterally symmetric, consisting of two simple (or compound) monoprionidian branches about 40^{mm} long, diverging in opposite directions from the center of a minute radicular bar; branches bearing thecæ of type of those of *S. gracilis* Hall. Width of branches at origin about $0^{mm}.17$, proceding outward at first horizontally (180°), the deflection increasing, however,

[1] Ann. and Mag. Nat. Hist. 1868, II., p. 23.

[2] Twentieth Rep. N. Y. St. Cab. Nat Hist., 1868, p. 179.

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at end of first theca to 240°; branches continued in a gentle, flexuous curve to their extremities, averaging in width about $0^{mm}.5$. Thecæ 30 or 32 in 25^{mm}; adnate to the coenosarcal canal, with straight or very slightly convex margins and slightly inclined apertural edge.

The affinities of this form are distinctly with *S. pertenuis* Lapworth and its associates, *S. explanatus* and *S. nitidulus*. From all these, however, it differs in absence of secondary branches and in general form of polypary.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N Y.

To the above description I may add that some specimens indicate that the primary branches give origin to secondary ones, probably from the athecaphorous margin.

AZYGOGRAPTUS NICHOLSON, 1875.

Ann. and Mag. Nat. Hist., XVI., p. 269. Type, *A. lapworthi* Nich.

Azygograptus? walcotti Lapworth, sp. nov.

Polypary unilateral, monoprionidian, consisting of a single flexuous and simple compressed branch proceeding almost horizontally from the side of an inconspicuous sicula, 50 to 75^{mm} in length, in average diameter about 0.5^{mm}. Thecæ 16 in 25^{mm}, without overlap, consisting of conical tubes, increasing slightly in diameter throughout, adnate to the coenosarcal canal, with straight or slightly convex ventral margins. Apertural margin a little inclined and projecting from the ventral margin for a distance equal to about one-half the diameter of the polypary and transgressing upon the periderm for a similar distance. Denticle almost rectangular; excavations and interspaces shallow and inconspicuous.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

This form has all the appearance of belonging to the curious genus *Azygograptus*. Two specimens occur in the collection. One lacks the proximal part; in the other there is evidence of the unilateral nature of the polypary and of the presence of the sicula. Further research may show that it belongs to the bilateral genus *Leptograptus*, but in any case it is a new and undescribed form of the family. If it actually belong to *Azygograptus*, this is the first specimen of the genus on the American side of the Atlantic, and there is special appropriateness in its dedication to Mr. Walcott, whose recent researches have done so much to elucidate the sequence and fossils of the strata in which it occurs.

LEPTOGRAPTUS LAPWORTH, 1873.

Geol. Mag. London, X, p. 558. Type, *L. flaccidus* (Hall).

Leptograptus? macrotheca Gurley, sp. nov.

Known only in the form of a fragment of a branch. Thecæ long, curved, slender, finally becoming nearly perpendicular to the branch but slightly

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inclined distalwards; apertural margin straight; proximal margin concave, not uniformly, but with a bluntly rounded angle. Thecæ 16–17 in 25mm. Branch including thecæ 1mm wide, of which the coenosarcal canal occupies about two-sevenths.

Horizon and locality.—Calciferous shales, Point Levis, Canada.

DICELLOGRAPSUS HOPKINSON, 1871.

Geol. Mag., VIII., p. 20. Type, *D. elegans* (Carruthers).

Dicellograpsus intortus[1] *polythecatus* Gurley, var nov.

A species occurs at Stockport which presents a close resemblance to Lapworth's species but shows some important differences, at least from his published description and figures. These differences are sufficient to justify its provisional varietal separation, although it is possible that they may be due to the structure being more perfectly shown by the Stockport specimens. It resembles Lapworth's species, in the mode of growth, character of thecæ and dimensions of the branches. Like that species the present form is also a Norman's Kill (= Glenkiln) form. The thecæ are uniformly 32 in 25mm. The first six or eight bear spines almost as long as the thecæ. But the most important difference is that the mode of growth is exactly the same as that exemplified by *Dicranograptus furcatus* (Hall), that is to say, the thecæ are present alternately on the outer and inner margins of the branches, and the latter cross alternately over and under, showing a growth in opposite-turning spirals. Lapworth's figures indeed not only do not show this feature but on the contrary show the opposite condition. Nevertheless the conformity of type is so close that I suspect that this omission is an error, and that the British form, as well as the American, has the spiral mode of growth.

Where the proximal portion of the polypary is absent the appearance may resemble somewhat that of *Dicranograptus furcatus* (Hall) under similar conditions. The latter species has, however, much thicker branches (1mm as against 0.6mm for the present form), the thecæ are much coarser and are *all* provided with strong spines. The loops are also more elongate and narrow.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

Dicellograpsus gurleyi Lapworth, sp. nov.

Branches from 25mm to 100mm long, slender, gently concave distally; diverging immediately from sicula at an angle of 270°, which slowly decreases to a general angle of 240°; width at origin about 0.5mm; maximum diameter 1.25mm in adult parts of polypary. Thecæ averaging about 24 to 26 in 25mm. without overlap, compressed proximally to form a deep excavation; ventral margin straight for first three-fourths of its length; convex in last fourth, Distal portion of theca of the rounded type found in the genus, isolated and

[1] *Dicellograpsus intortus* Lapworth, was described in Ann. and Mag. Nat. Hist. 1880, V., p. 161, Plate XIX., Figs. 19 a–c.

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introverted, opening well within ventral margin of the polypary, the free portions occupying about one-fifth of entire length of theca. Excavation distinct, deeply curved, occupying about one-third of transverse diameter of polypary, the interspaces taking up less than one-fifth of the ventral margin.

This form certainly belongs to a group of Dicellograpsi comprising besides it three species as yet undescribed. All these forms agree in having thecæ of the same general type, with very short, isolated distal portion and small introversion; but they differ in size, length, and angle of divergence of the branches, and in the proportion of their thecæ. They are, however, all of the same geological age, and it is not outside the limits of possibility that they may be local representative forms of one and the same species.

The whole group is intimately related to the group typified by *D. forchhammeri* (Geinitz), into which it passes by almost insensible gradations.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

Dicellograpsus elegans (Carr).

Specimens occur in our Lower *Dicellograpsus* zone which agree in every respect with Carruther's species except that they show 24 to 28 thecæ in 25^{mm}, while Carruther's and also Lapworth's figures show but 20 to 22.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

Dicranograptus Hall, 1865.

Can. Org. Rem., Dec. II., p. 112. Type, *D. ramosus* (Hall).

Besides *D. furcatus* two types of this genus occur in American strata, viz., *D. nicholsoni*, Hopk., with a very short proximal portion bearing very few thecæ (*ad plurimum* 8 or 9) and *D. ramosus* (Hall), with a much larger proximal portion bearing nearly twice as many thecæ (usually 15 or thereabouts).

Of *D. nicholsoni* 5 (perhaps ultimately reducible to 4) fairly well marked varieties occur which present a gradation from the non-spinose var. *arkansasensis* with an angle of 135° to 90° through *D. nicholsoni* (angle 80° to 70°) to the smaller angled spinose forms *whitianus* and *parvangulus* and finally to var. *diapason* with converging branches.

D. ramosus presents 2 varieties, the typical form with a stout polypary, occurring in the Lower *Dicellograpsus* zone and a much more slender variety occurring in the Upper *Dicellograpsus* zone at Magog.

Dicranograptus furcatus (Hall).

This species presents a very peculiar structure. In the compressed state it consists of several elliptic loops. The thecæ begin on the proximal, diprionidian portion, and are continued on the *outer* side of the *lower* half of the first loop. At the middle of the loop they become scalariform and on its *upper* half occupy the *inner* margin of the branch. Traced upward, on to the next loop, they are seen to be (owing to the recurving of the branch toward the median

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line) again on the *outer* side, and the same phenomenon is repeated with each loop. Thus the thecæ are always on the *outer* margin on the *lower*, and on the *inner* margin on the *upper* half of each loop. Further between the two branches at their points of crossing a film of shale can frequently be seen, the branches lying in the shale at slightly different levels. Also the branches always cross alternately over and under. All this is easily and only explicable upon the supposition that the branches originally grew *spirally* upward, each describing an oppositely directed curve. Compression would then produce the successive ellipses with the thecæ directed alternately outward and inward. This mode of growth in a continual spiral seems, as far as I can judge from Lapworth's figures of the species, to be exhibited by his *Dicellograpsus caduceus* and *D. ziczac*.

Relative to its generic affinities it has been referred to both *Dicellograpsus* and to *Dicranograptus*. Having early noted the presence of the thecæ on the concavity of the first curve and the specimens not being the best, I thought it possibly a *Dicellograpsus* of the *caduceus* type, in which the first loop was closed. Better specimens, however, seem to show conclusively that the branches are united as in *Dicranograptus*. This portion is very short and like several other species it presents in this respect an approximation to *Dicellograpsus*.

Horizon and locality.—Lower *Dicellograpsus* zone (of which it is one of the most characteristic species) near Stockport, Columbia county, N. Y.

Dicranograptus nicholsoni Hopkinson.

Geol. Mag., VII., 1870, p. 357, Plate XVI., Fig. 3.

This species occurs in the Utica under a form which Professor Lapworth informs me does not differ from the typical.

Dicranograptus nicholsoni arkansasensis Gurley, 1892.

Dicranograptus arkansasensis, Ann. Rep. Geol. Surv. Ark., for 1890, III., pp. 416–7, Plate IX., Figs. 1, 2.

Proximal portion 9^{mm} long; branches diverging at an angle of 90° to 130°, curving upward at a short distance from their origin so as to include a smaller angle; thecæ 20 in the space of 25^{mm}; non-spinose.

Horizon and locality.—Lower *Dicellograpsus* zone, Arkansas.

Dicranograptus nicholsoni whitianus (Miller), 1883.

Graptolithus (*Climacograptus*) *ramulus* White (preoc.), 1874, Prelim. Rep. Invt. Fossils, p. 13; *ib.*, White, 1875, Rep. Wheeler Survey, IV., Part I., p. 62, Plate IV., Figs. 3*a–e*; *Graptolithus whitianus* Miller, 1883, Cat. Amer. Pal. Foss., 2d ed., p. 269; *Dicranograptus ramulus* Herrman, 1886, Nyt Mag. f. Naturvidensk., XXIX.

This form differs from the typical *D. nicholsoni* of the Utica in the smaller

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angle (35° or 40° against 70° to 80° in the Utica specimens) and in the presence of short, rigid spines on the thecæ of the stem and on practically all those of the branches. In the latter features lies its chief difference from var. *parvangulus* Gurley. I should add that a careful examination of the type specimen shows the proximal portion to be longer than shown in White's figure, at least six thecæ being visible.

Dicranograptus nicholsoni parvangulus Gurley.

(*D. nicholsoni* Lapw., 1876, Armstrong, Young & Robertson's Cat. West. Scot. Foss., pp. 6–9, Plate III., Fig. 79; *ib.*, Lapw., 1877, Ann. Rep. and Proc. Belfast Nat. Field Club, I., p. 141, Plate VII., Fig. 2.)

Dicranograptus nicholsoni parvangulus Gurley, 1892.

Ann. Rep. Geol. Surv. Ark. for 1890, III., p. 417.

In the Stockport collection several examples of this variety occur which permit of the following description: Proximal portion about 6^{mm} long; at base 1^{mm}, and immediately below bifurcation 1.5^{mm} wide; with eight or nine thecæ, each with a short, sharp, horizontal spine; branches 1^{mm} wide, diverging at an angle of 35° or 40° (or thereabouts), often bending very slightly towards one another immediately after the division, thus producing a slightly rounded, bulging appearance. Thecæ forming bent tubes, as in *D. nicholsoni* proper; as nearly as possible 24 in 25^{mm}; those on the proximal portion and the first few on the branches above the bifurcation spiniferous. On the branches not more than three spiniferous thecæ were seen.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y., and in Arkansas; Upper *Dicellograpsus* zone, Magog, Canada.

Professor Lapworth (letter, 1890) remarks the difference between this form and *D. nicholsoni*, saying that this, the Glenkiln (= Lower *Dicellograpsus* zone) form, has a smaller angle and spinose proximal thecæ. *D. nichclsoni* proper is not found below the Utica. This variety, on the contrary, ranges through both the Lower and the Upper *Dicellograpsus* zones but apparently not into the Utica.

Since publishing this variety, I have noticed its extremely close resemblance to *D. whitianus* Miller. Indeed the latter form appears to differ from the present one only in having all of the thecæ on the branches spinose. I might at this time unite the two forms were it not that var. *whitianus* rests upon a single specimen from a very far distant locality, and it is possible that further collections in Nevada may show the distinctive characters of *whitianus* to be sub-constant. Finally it may be noted that none of the eastern, or of the Arkansas specimens show any decided approximation to the condition found in *whitianus*.

Dicranograptus nicholsoni diapason Gurley, var. nov.

Proximal portion with three minute spines at base; measuring from base

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to notch between branches five (sometimes as much as 6mm), showing below the level of the notch, at most seven (usually six, sometimes five) thecæ ; width of proximal portion 1.25 to 1.50mm ; branches, in the compressed condition, 1 to 1.25mm wide; diverging at an angle of 45° (sometimes slightly less) to 50°, with a very gentle inward curve which brings them into parallelism, or even approximates them still further. Thecæ forming bent tubes with the tip introverted, 24 or 25 in 25mm ; some of them (probably all on basal portion ; material here uncertain) bearing an acute spine.

This variety is a well-marked one. In form the most characteristic specimens approach closely *D. ziczac minimus* Lapw., but our form is at least twice as large as Lapworth's, and besides *D. ziczac* appears not to occur in our strata. From the characteristic calliper-shape as a basis, the variety shades into var. *parvangulus*, which has the branches straighter and continually divergent.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

Climacograptus Hall, 1865.

Can. Org. Rem., Dec. 2, p. 3. Type *C. bicornis* (Hall).

Climacograptus antiquus Lapworth sp. nov.

(*Climacograptus antiquus*, Geol. Mag., 1873, X, p. 134, *nomen nudum; C. cælatus*, Lapworth, 1876, in Armstrong, Young & Robertson's Cat. West. Scot. Foss., p. 6, Plate I., Fig. 56; *ib.*, Lapworth, 1877, Ann. Rep. and Proc. Belfast Nat. Field Club, I, Part IV., p. 139, Plate VI., Fig. 39; *ib.* Lapworth, 1886, Trans. Roy. Soc. Can. for 1886, V. Sect. IV, p. 178. Synonymy *fide* Lapworth, letter.)

This being the first publication of the synonymy which establishes the species, it is to be regarded as a new one dating from this publication.

Climacograptus caudatus Lapworth,[1] 1876.

Climacograptus caudatus, in Armstrong, Young & Robertson's Cat. West. Scot. Foss., p. 6, Plate II., Fig. 48; *ib.*, Lapworth, 1880, Ann. and Mag. Nat. Hist., VI., p. 22.

Polypary attaining, in one proximally ("distally") incomplete specimen, a length (exclusive of prolonged virgula), of 80mm. Maximum breadth, attained at proximal ("distal") extremity, 2.25mm. Polypary increasing gradually in width, nearly the full width being attained by the middle of the polypary, so that the widening is less rapid from that point to the proximal ("distal") extremity, which latter is abruptly cut off. Distal ("proximal") extremity marked by extension of virgula. Lateral spines not seen (conditions of specimens unsatisfactory.) Virgula about 0.75mm wide, prolonged

[1] For remarks on the present form and *C. caudatus laticaulis* see next page.

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both proximally and distally for about 25^{mm} without very obvious decrease in size. Theca 16 to 20 in 25^{mm}, appearing to form bent tubes.

Horizon and locality.—Upper *Dicellograpsus* zone, Magog, Canada.

Climacograptus caudatus laticaulis Gurley, var. nov.

(*Climacograptus caudatus* Lapworth, 1877, Ann. Rep. and Proc. Belfast Nat. Field Club, I, Part IV., p. 138, Plate VI., Fig. 34.)

Polypary reaching a length of 60^{mm} or somewhat more; usually shorter; maximum width attained at extreme proximal ("distal") extremity, usually 3.5^{mm} or a little more. Outline of polypary obtriangular, continuously widening from the rather blunt, 1^{mm} wide distal ("proximal") extremity to the abruptly truncated proximal ("distal") extremity. Distal ("proximal") extremity marked by two rather small lateral spines and further by the prolonged virgula. Virgula strap-like, prolonged both proximally and distally at least 25^{mm} without any evidence of termination. In the distal ("proximal") direction, the diminution in size in the distance mentioned is apparent, while in the proximal ("distal") direction, it is very slight. The broad strap-like virgula forms a conspicuous ridge-like elevation along the median line, of one lateral face, appearing less distinct on the other. Thecæ 22–26 in 25^{mm}, apparently with the outer wall concave-indented below, and rectangular above. Excavation indenting polypary for about one-third of its width, not at right angles but inclined (on distal side, of course) about 75° to virgula. Young individuals (with a length much less than maximum for the species) have, nevertheless, attained nearly the maximum width.

Horizon and locality.—Upper *Dicellograpsus* zone, Magog, Canada.

I at first had a great deal of trouble with the preceding two forms. The first light on the subject was obtained by noticing that to my two forms corresponded respectively the two figured at different times by Lapworth under the name of *Climacograptus caudatus*. That they are at least varietally distinct there is no doubt. For Lapworth's *caudatus* of 1876 (which of course remains the *caudatus*) is about 2^{mm}.75 (possibly 3^{mm} *ad maximu*) wide, has only 18 thecæ in 25^{mm}, and a more attenuated polypary which enlarges much more slowly; while the *caudatus* of 1877 (var. *laticaulis*) is 3^{mm} wide (probably, judging from my specimens, *ad minimum*), and has 24–26 thecæ and a more widely obtriangular polypary. Further in var. *laticaulis* the virgula is very stout and strap-like, recalling that of *Diplograpsis foliaceus*. Correlated with these differences in theca-numbers and polypary width, is the different proportions of the "denticles." In *caudatus* rhombic, with the ventral and apertural margins about equal, in var. *laticaulis* they are considerably wider than long. It is possible that the forms are entirely distinct, but the material consisting merely of flattened films is not satisfactory on this point.

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Climacograptus oligotheca Gurley, sp. nov.

Polypary acutely isosceles-triangular, long and slender, widening very slowly; distal ("proximal") extremity bearing two short lateral spines. Virgula stout, occupying about one-sixth width of polypary, greatly prolonged proximally and distally, the distal ("proximal") extension sometimes consisting merely of a short triangular process, sometimes of a virgular extension terminating in a vesicular dilatation, but generally forming a straight broadly filiform process which may be traced for some distance without evidence of termination. No vesicle or "disk" visible at end of proximal ("distal") prolongation. Length, 11^{cm} or less; width about 2^{mm}. Ventral margins straight, interrupted by notches corresponding to the thecal mouths. Thecæ 12 to 14 in 25^{mm}.

Horizon and locality.—Upper *Dicellograpsus* zone, Magog, Canada.

This species is readily recognized by the proximal and distal extension of the virgula, and by its straight parallel sides incised by a series of straight notches at comparatively distant intervals. It is most closely allied to *C. antiquus*, but is usually longer and has but 12 to 14 thecæ in 25^{mm}, while *C. antiquus* has (by measurement on Lapworth's figure) 20 in the same space.

Climacograptus caelatus Lapworth, 1875.

Quart. Jour. Geol. Soc. London, XXXI., p. 655, Plate XXXV., Fig. 8; *not ib.*, Lapworth, 1876 (see *C. antiquus*).

The principal interest in our specimens attaches to the "disk" which forms the proximal ("distal") termination of the virgula. This body is an obtriangulat-cordate leaflet, bilaterally symmetrical, and traversed medianly by the virgula. Some appearances suggest that it may possibly consist of two superposed elliptic leaflets. It is sometimes at a distance from, sometimes close to, or in actual contact with the proximal ("distal") end of the polypary. From the (apparent) dilatations of the virgula seen in *D. vesiculosus* Nich., *D. palmeus* (Barr.), and *D. trifidus* Gurley, it differs markedly in its distinct bilateral symmetry, and flat leaf-like appearance. This "disk" is present in a large proportion of the specimens.

Horizon and locality.—Upper Calciferous, Summit, Nevada. Identified by Professor Lapworth from specimens sent him.

Climacograptus kamptotheca Gurley, sp. nov.

Polypary pretty uniformly $1^{mm}.5$ broad and 35 to 40^{mm} long; distally ("proximally") tapering gradually for about length of last 7 or 8 thecæ to the narrow rounded extremity; maintaining its full width to the proximal ("distal") extremity which is abruptly truncated. Virgula straight or slightly zigzagged, prolonged distally ("proximally") as a straight needle-like process, 2 or 3^{mm} long; and proximally ("distally") as a filiform extension which in one specimen extends 12^{mm} without terminating in any "disk."

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Thecæ cylindrical, at first directed perpendicularly outward from virgula, then deflected through nearly 90° so as to become directed proximally ("distally") and almost parallel with virgula, and at the same time to make a small angle with the plane of the shale-section (rising up from or sinking down into the rock); pretty uniformly 24 to 26 in 25^{mm}; apparently without any overlap.

Horizon and locality.—Upper *Dicellograpsus* zone, Magog, Canada.

Easily recognized, in connection with the dimensions, by the superficial outline which shows a series of rather squarish thecal outlines distinctly alternating on the two sides.

Climacograptus phyllophorus Gurley, sp. nov. Plate IV., Figs. 4–6.

(*Climacograptus parvus* Hall, 1865, Can. Org. Rem., Dec. 2, p. 57; *nomen nudum.*)

Polypary gradually widening from distal ("proximal") extremity, attaining its full width in the length of 6 to 8 thecæ; ventral margins above this point parallel. Length, exclusive of proximally ("distally") prolonged virgula, 10 to 30^{mm} (usually about 20^{mm}); maximum width, $1^{mm}.5$ to 2^{mm}; distal ("proximal") extremity narrow and abrupt, with two short lateral spines; and an extension of virgula for 2 to 6^{mm}. Proximal ("distal") extremity abrupt, showing a prolongation of the virgula which terminates in a "disk," varying in shape (apparently with age) from narrowly lanceolate to broadly elliptic, 6 to 10^{mm} long, and 1 to 3^{mm} broad. Thecæ 30 to 36 in 25^{mm}, short, perpendicular, apertural margins concave, the excavation nearly horizontal (slightly inclined distalward), occupying nearly one-third of width of the polypary.

Horizon and locality.—Lower *Dicellograpsus* zone (of which it is one of the most characteristic species), Stockport, N. Y.

This species was identified by a comparison with Hall's types in the American Museum of Natural History in New York City. It is very distinct from *C. bicornis* and *C. typicalis*, differing from the former in the absence of the three prominent spines and the disk developed around them, and from the latter by the constantly prolonged virgula.[1] It is also much smaller than either *bicornis* or *typicalis*. The species which it most closely resembles is *C. scalaris* (L. = *normalis* Lapworth), and for this form it has been mistaken (as it easily might be, and formerly was by me) by Ami.

The chief interest in the species lies in the "disk." This has the form of and strikingly resembles an elliptic pinnate-veined leaflet, a resemblance heightened by the likeness of the virgula to the midrib, and the presence of several obscure, obliquely directed fibers running from it on either side out-

[1] If, as would naturally be expected, *C. typicalis* has a proximally ("distally") extended virgula, it never (within my experience) shows it on the shale, and for practical diagnosis this absence is all-sufficient.

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wards and proximalwards. An exactly similar but differently-shaped appendage is constant in *C. caelatus* from Nevada, and probably it is equally constant in *C. phyllophorus*, though here the longer, more slender virgula is more frequently broken. This appendage appears to differ from that found in such species as *Diplograpsis vesiculosus* Nich., in being accurately bilaterally symmetrical, and in being plainly traversed by and not forming (as apparently is the case in *D. vesiculosus*) a dilatation of the virgula.

DIPLOGRAPSIS McCOY, 1850.

Ann. and Mag. Nat. Hist., VI., pp. 270–2. Type. *D. pristis* Hisinger.

Diplograpsis stenosus Gurley, sp. nov.

Polypary long and very slender, when complete probably measuring in the majority of cases about 50^{mm} or somewhat more; breadth 1 to 1.5^{mm}, the latter figure being rarely exceeded. Polypary very gradually widening from near its distal ("proximal") end. Sicula and extreme distal ("proximal") end of polypary unknown. Virgula usually obscure, frequently invisible, apparently not distally prolonged. Thecæ about 20 in 25^{mm}, straight, free for one-half of their length, inclined to virgula 25° to 30°; apertural margin probably perpendicular to virgula.

Horizon and locality.—Upper *Dicellograpsus* zone, Magog, Canada.

No other species of the genus possesses a polypary so slender in proportion to its length. In this respect (only in this, however) it approaches most nearly some Upper Silurian species, notably *D. tamariscus* Nich., and *D. longissimus* Kurck.

GLOSSOGRAPSUS EMMONS, 1856.

American Geology, I., Part II., p. 108. Type *G. ciliatus* Emmons.

Glossograpsus arthracanthus Gurley, sp. nov.

(*Diplograpsus ciliatus* Emmons, 1856, Am. Geol., I., Part II., pp. 105–106, Plate I., Fig. 19.)

"Straight, thin and ciliated; ciliæ, bulbous and jointed or transversely marked, proceeding from the point of each serration; serrations unequal, the intervening smaller serrations rounded, the larger prolonged and run into the base of the ciliæ, axis distinct.

"The specimen is imperfect, but probably, from the character of the column, it was free. The entire width of the column embracing the extended lateral ciliæ is one-fourth of an inch, the membrane is rather less than one-eighth of an inch wide, the margins appear to be dissimilar. In another specimen the end is rounded and complete, and furnished like the sides with ciliæ. Found in Augusta county, Virginia."

This form is apparently a *Glossograpsus*. The name *ciliatus* having been previously used (by Emmons, and in the same paper) for a *Glossograpsus*, the name *arthracanthus* is proposed for this form to clear synonymy. The dupli-

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cation of the "serrations" is probably due to a slightly oblique pressure causing the lower latero-ventral margin of the polypary to extend beyond the upper latero-ventral margin of the same, in such a manner that the corners of the thecal mouths alternate. I have seen this condition in *G. ciliatus* and several other graptolite species.

LOMATOCERAS BRONN, 1834.

Lomatoceras, Lethæa Geognostica, I., pp. 55–56; *Monoprion* Barrande, 1850, Grapt. de Bohême, p. 14; *Monograpsus* Geinitz, 1852, Die Graptolithen, p. 32; *Monograptus* of later writers; *Lagenograptus* Hall, 1870, 20th Rep. N. Y. St. Cab. Nat. Hist., 2 ed., p. 261. Type *L. priodon* Bronn.

There can be no question as to the clear priority of this name, though it has been asserted, reasserted and taken for granted that it was preoccupied.[1] I find no evidence of such preoccupation, at least I have searched with the aid of several entomological friends for the name as a genus of insects without success. Bronn says that his genus is "non *Lomatocera*, insectorum genus." This is not preoccupation and there is no reason why both names should not stand. Finally if for any reason *Lomatoceras* cannot stand, *Monograpsus* must still give place to Barrande's *Monoprion*, as Geinitz's alteration of the last to *Monograpsus* (to harmonize with his substitution of *Diplograpsus* for *Diprion*) preoccupied, cannot be accepted.

GLADIOLITE BARRANDE, 1850.

Grapt. de Bohême, p. 68. Syn. *Retiolites*, *ibid.*, p. 68, footnote. Type *G. geinitzianus*.

Barrande proposed *Gladiolites* as the name of the genus; merely adding that *Retiolites* could be used if *Gladiolites* were considered too near *Gladiolus*. By no rule of nomenclature can *Retiolites* have any standing (except as an unnecessary synonym). Accepted usage must therefore be rejected and *Gladiolites* restored.

Gladiolites venosus (Hall).

Pal. N. Y., 1852, II., p. 40, Plate XVII*a*, Figs. 2*a-c*.

The figure of this species given by Spencer[2] and copied from him by Miller,[3] bear no very evident resemblance to Hall's species. Moreover, after a careful examination of a fine specimen (unquestionally co-specific with Spencer's species) from the Niagara beds at Hamilton, Ontario (whence Spencer's species came), has convinced me that the reference of it to *G. venosus* (Hall), is incorrect. Whatever else it may be it is not Hall's form,

[1] Beck in Murchison's Silurian System, 1839, Part II., p. 696; Bronn, 1849, Geschichte der Natur, p. 667; Geinitz, 1852, Die Graptolithen, p. 18.

[2] Bull. Mus. Univ. State Mo., 1884, I., p. 16, Plate I., Fig. 2.

[3] North Amer. Geol. & Pal., p. 202, Fig. 214.

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as, besides other reasons, it lacks any very evident graptolitic texture or structure and has 24–26 oblique ribs as compared with (from measurements on Hall's figures) some 35–40 for *G. venosus*.

RETEOGRAPTUS HALL, 1859.

Pal. N. Y., III., p. 518. Type *R. tentaculatus* (Hall).

A specimen of *R. tentaculatus* in the American Museum of Natural History, New York City, exhibits practically the same type of structure as is seen in *R. geinitzianus* from the Lower *Dicellograpsus* zone. I have no doubt that they are congeneric. Lapworth has, however, referred *R. geinitzianus* to his *Clathrograptus*[1] (founded on *C. cuneiformis* Lapw.). If *C. cuneiformis* be, indeed, congeneric with *R. geinitzianus*, the genus *Clathrograptus* must be suppressed.

Reteograptus geinitzianus Hall, 1859.

Reteograptus geinitzianus, Pal. N. Y., III., p. 518, with fig.; *Reteograptus barrandi* Hall, 1860, 13th Rep. N. Y. St. Cab. Nat. Hist., pp. 61–62, with fig.; *Clathrograptus geinitzianus* Lapworth, 1880, Ann. and Mag. Nat. Hist., V., p. 22.

Some particularly favorable preservation-conditions occur among the Stockport specimens. They permit the following description: The polypary in this species is parallel-sided blunt-fusiform, and consists of skeleton and periderm. The skeleton shows, at and imbedded in its base a body apparently a sicula, flanked on either side by a spine which is directed obliquely upward. Two virgulas are present, each zigzagged in the basal expanding portion of the polypary, straight in the middle (parallel-sided) portion, and (?) again zigzagged in the upper contracting part. From the convex angles of the zigzagged, and at intervals from the straight portion of the virgula, a parietal ledge[2] runs in each lateral wall to the ventral margin, where it undergoes an abrupt deflection downward to the parietal ledge of the theca next below, to which it appears to connect just before (*i. e.*, at a point on the lateral surface just within the ventral margin) that ledge reaches its point of downward deflection. At the latter point a mouth ledge connects the parietal ledge with its fellow on the opposite side. These three chitinous threads (the horizontal limb of the parietal ledge, the vertical limb of the same and the mouth ledge), all meet at the point of deflection with rounded edges, and together form the rim of the mouth opening, which is thus somewhat squarish or slightly trapezoidal. I have seen nothing corresponding to the inner cross-ledges and the material furnishes no data for an opinion *pro* or *con* as to the existence of any interthecal partition planes.

[1] Geol. Mag., 1873, X., p. 559.

[2] I here follow the nomenclature of Holm (Bihang til kongl. Sv. Vet.-Akad. Handl., 1890, XVI., No. 7).

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The periderm consists of three, rarely only two,[1] longitudinal series of meshes of a subrhomboidal shape which alternate in adjacent rows, and give off from the middle points of the meshes of the outer rows (the rows along the ventral margin) short, stout spines which are the mouth ledges crushed V-shape. The relation of the three rows of peridermal meshes to the skeleton is not known. The parietal ledges form the upper and lower borders of the meshes, and are deflected inwards (*i. e.*, into the intra-polyparial space) to their virgular connection at the inner borders of the outer rows of meshes (?). The meshes are covered by a membrane which is markedly thinner in the center of the mesh.

The structure is therefore in substantial agreement with that observed by Holm in *Retiolites* and *Stomatograptus*, the latter of which, *Reteograptus*, seems particularly to resemble.

DICTYONEMA HALL, 1851.

Am. Jour. Sci., XI., p. 401. Type *D. retiforme* (Hall).

Like Mr. Holm[2] I think the taxonomic condition in this genus very unsatisfactory. While there seems no possibility of denying to *D. flabelliforme* the possession of a true sicula, certain other species are certainly non-siculate. The extraordinary vertical range is also, as Mr. Holm remarks, good reason for suspicion of the generic references. When I first studied *Desmograptus macrodictyon*, I thought Mr. Hopkinson's genus was a first step in the establishment of a natural series of cleavage planes in the genus, especially as both species occur at equivalent horizons. But on subsequently studying *D. devonicus* I found that on no characters now predicated of *Desmograptus* could this species be denied admission to it. So that we only have two wide-ranging genera instead of one such genus. Another explanation (one which has been suggested before, and one which, though I at first could not favor, I incline now to think not impossible) is that the characters (form, dimensions of mesh, thickness, etc. of branches) on which (being dependent on conditions of fossilization) we have to rely are really of very subordinate biologic value. And as Mr. Holm says there is no chance of a rational subdivision until we know more of the basal end.

Dictyonema, cf. neenah Hall.

Rep. Progr. Supt. Geol. Surv. Wisc., 1861, p. 7.

A single specimen, perhaps, referable to this species is found in the collection. It shows a considerable portion of the network, but not the proximal

[1] Several specimens show two series below and three above, the interpolated middle series being wedge-shaped (*i. e.*, narrower and less perfectly developed) below. The specimens showing the periderm are *much* larger than those showing the skeleton, and though plainly congeneric, may not be cospecific.

[2] Bih. t. k. Svensk. Akad. Handl., 1890, XVI., Afd. IV., No. 7.

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extremity. The two layers of the flattened funnel-shaped polypary are pressed almost into contact, which circumstance, together with the slightly slicken-sided condition of the specimen, renders its accurate specific description difficult. Enough, however, can be made out to state that, as flattened, the polypary is flabellate, 40^{mm} in length, and the same in breath, of a triangular shape, with the distal side of the triangle rounded. The branches of the polypary are subparallel, very gradually diverging, about 1.5^{mm} apart, forking into two branches several times in their course towards the periphery.

Horizon and locality.—Upper *Dicellograpsus* zone, Magog, Canada.

I have compared this form with the other species of the genus, and especially with those forms which approach it in vertical distribution. Only two species have heretofore been described from approximately the same horizon, viz., *D. moffatense* Lapw., and *D. neenah* Hall. With the former of these the present form needs no comparison. The latter species was described from the Trenton limestone of Wisconsin.

Dictyonema perexile Gurley, sp. nov.

Dictyonema delicatulum Dawson, 1883, Can. Nat. and Quart. Jour. Sci. X., pp. 461–3; "D. n. sp. (=*D. delicatulum* Dawson, preoccupied)" Ami, 1889, Ann. Rep. Geol. Surv. Can. for 1887, p. 117 K.).

Proposed to replace Dawson's *delicatulum*, that name having been previously used by Lapworth (Quart. Jour. Geol. Soc., London, 1881, XXXVII., p. 172.).

Dictyonema actinotum Gurley, sp. nov.

Dictyonema hamiltoniæ Hall, 1865, Can. Org. Rem., Dec. 2, p. 58; *nomen nudum*.

Specimens seen very incomplete. Branches radiating rapidly, bifurcating mostly near the base (in correspondence with their rapid radiation) rather conspicuously longitudinal-striate, 0.5–0.6^{mm} wide, 25–30 in 25^{mm}. Dissepiments rather stout, wiry, apt to be curved, transverse or slightly oblique. Meshes subquadrangular or with rounded angles. Thecæ present but indistinct. Length of mesh uncertain, perhaps 2–2.5^{mm}.

Horizon and locality.—Devonian (Hamilton formation), Kashong Creek, Cayuga county, New York. Several specimens badly preserved, but apparently of this species, occur in the Hamilton at Moscow, N. Y.

Dictyonema blairi Gurley, sp. nov.

Proximal end of polypary unknown. Branches radiating slowly, subparallel, usually scarcely but nearly 0.4^{mm}, occasionally 0.5^{mm}, *ad max.*, and arranged transversely about 20–25 in 25^{mm}. Interspaces generally about one and one-half times as wide as branches or slightly more. Dissepiments rather slender, about 0.25^{mm}, thick *ad max.* Sometimes straight. Usually more or less

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oblique. Meshes correspondingly variable in shape, from quadrangular to triangular. The shortest are about 1.25^{mm} long, and the greatest length in unbroken meshes (*i. e.*, where all the dissepiments are entire) is probably near 3^{mm}. Texture Carbonaceous. Branches rather obscurely striate, dividing at an acute, rather sharp, angle.

Resembles somewhat *D. gracile* Hall, but the branches are a little more slender and the interspaces a little wider, and especially the number of branches transversely in this species is less (20–25 as against 25–30 in *D. gracile*). I am indebted to Mr. Charles Schuchert for having drawn my attention to this species.

Horizon and locality.—Lower Carboniferous (Choteau limestone), Sedalia, Mo. Collected by and dedicated to Mr. R. A. Blair, of Sedalia.

DESMOGRAPTUS HOPKINSON, 1875.

Quar. Jour. Geol. Soc., London, XXXI., p. 668. Type, *D. cancellatum* Hopk.

Desmograptus macrodictyum Gurley, sp. nov.

Polypary subparallel, rather abruptly widening from a non-siculate, fibrous, root-like base; branches thick, almost straight, longitudinally striate, bifurcating quite regularly; bifurcations evenly rounded, the dividing branches curving into parallelism and coalescing prior to redivision. Thecal mouths pressed against the stem, appearing as rounded or transversely oval elevations, about 36 in 25^{mm}. Meshes very long in proportion to their width, formed only by the coalescence of the branches, true dissepiments being entirely absent.

Horizon and locality.—Calciferous shales, Point Levis, Canada.

This species differs decidely from all species of *Dictyonema* except *D. cancellatum* Hopk., for which its author proposed (as a subgenus) *Desmograptus*, saying:

"The most distinctive characteristic is that the meshes or interspaces are chiefly formed by the branches coalescing and dividing by virtue of their curvilinear direction, being connected by transverse filaments only here and there where not sufficiently undulated to be brought quite into contact, and not being connected at all where the undulations do not bring the branches into tolerably close proximity to each other."

In the species here described no dissepiments are anywhere visible, the division of branches appearing to take place mostly at regular intervals, a series of divisions extending across the whole width of the polypary at the same level. I regard *Desmograptus* as entitled to full generic rank if, as I think, *D macrodictyum* belongs to it.

From all species it is distinguished by the entire absence of dissepiments; from *D. cancellatum* in particular by the straight branches, the greatly elongated meshes and the generally stouter structure.

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Desmograptus devonicus Gurley, sp. nov.

(*Dictyonema cadens* Hall, 1865, Can. Org. Rem., Dec. 2, p. 58; *nomen nudum*).

Polypary very irregular in its mode of growth; scarcely a true dissepiment present. Branches dividing and re-fusing irregularly, leaving round-elliptic or round-quadrangular (the prevailing type) meshes. The irregularity renders an accurate count of the branches difficult, but there seem to be about 12–15 in 25^{mm}. The thickness varies considerably, though most of the branches measure 1^{mm}, or nearly that. Longitudinally, there are about six or seven meshes in 25^{mm}.

Horizon and locality.—Devonian (Hamilton formation), Moscow, N. Y.

DENDROGRAPTUS HALL, 1862.

Rep. Geol, Surv., Wisc., I., p. 21. Type, *D. hallianus* (Prout).

Dendrograptus unilateralis Gurley, sp. nov.

Portion of polypary seen, 35^{mm} in length, by 12^{mm} in breadth. Branches in the single specimen seen, diverging mostly (entirely?) to one side, whence results a one-sided appearance; varying in thickness from 0.25^{mm} to 0.50^{mm}, mostly approaching the latter size; given off at rather distant intervals, at a variable angle (roughly approximating 60°), very soon curving toward or into parallelism with the parent stem. Thecæ unknown.

The specimen consists of a slightly weathered, flattened film. Obscure indications of thecæ were seen, but they were too obscure to permit of detailed description.

Horizon and locality.—Upper *Dicellograpsus* zone, Magog, Canada.

Dendrograptus arundinaceus (Hall), 1847.[1]

Graptolithus arundinaceus, Pal. N. Y., I., Plate LXXIV. Fig. 8.

No description of this species has been published. Hall's figure gives as much information as would a description of the same specimen, which, of course, is a mere fragment. I was able, however, to make out the distinctness from it of the Dendrograpti subsequently published.

Horizon and locality.—The type specimen (the only one) in the American. Museum of Natural History, New York City, was collected from the Utica shale, at Turin, Lewis county, N. Y.

Dendograptus, cf. serpens Hopkinson.

Quart. Jour. Geol. Soc., London, XXXI., 1875, p. 665, Plate XXXVII., Fig. 3

A single specimen referable to this genus in the Summit, Nevada, collection seems most nearly related to Hopkinson's species. It consists of an

[1] Overlooked entirely by cataloguers, which is not surprising considering its entire absence from both text and index.

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exceedingly tangled maze of branches, most of which are of extreme tenuity, and cross and recross one another in inextricable confusion. A few larger branches are seen curving around and among the smaller. No thecæ were observed, although certain indistinct crenulations may represent these structures. Sicula and terminations, both proximal and distal, unknown.

Horizon and locality.—Upper Calciferous, Summit, Nevada.

CARYOCARIS SALTER, 1863.

Quart. Jour. Geol. Soc., London, XIX., p. 139. Type, *C. wrightii.*

This genus, referred by its author to the Crustacea, was defined as follows:

"A long pod-shaped, bivalved carapace (with distinct hinge-pits), rounded anteriorly, subtruncate behind, and with the back and front subparallel. The surface is smooth, or with only oblique wrinkles near the margins, but with no parallel lines of structure. Body? Telson and appendages?

"All I know of this pretty little Crustacean, an inch long and rather more than a third of an inch wide, is contained in the above note. I was fortunate enough to find the tubercles (Huxley found them also in *Ceratiocaris*), which I suppose indicate teeth, and corresponding pits at each end of a short hinge-fulcrum.

"The shelly carapace is solid for its size; it appears to have a good deal of lime in its composition. The genus is evidently distinct, though so little is known of the entire form.

"Everywhere in the Skiddaw Slate district. I have named it after Mr. Bryce M. Wright."

It may be re-defined as follows: Polypary bilaterally symmetrical; proximal portion possibly thecaphorous; distal portion consisting of one (two?) median and two lateral appendages. Lateral appendages symmetrically disposed with reference to median line of polypary, apparently inserted on proximal portion through the medium of an elliptic body ("tubercles" of Salter); median appendage bilaterally symmetrical overlying superposed adjacent margins of lateral appendages. Texture yellowish-translucent, gauzy, resembling the wings of insects.

The above description is based upon American specimens of the type species, the other species being known only in the form of the lateral appendages. The substance of the polypary does not differ much from that of the Diplograpses in the same beds. In texture it resembles *Dawsonia* more nearly than any other genus, and the resemblance is increased by the presence of a marginal filament. At present, however, there is nothing to show that *Dawsonia* actually represents the lateral appendages of species of this genus, and the relationship of the two genera may be summed up as follows: The Dawsonias are certainly comparable, as regards texture and general appear-

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ance to the lateral appendages found in *Caryocaris*, but to them only. Had these structures stood alone without evidence of further organization, I should probably have referred them to *Dawsonia*. But although a majority of these appendages are found isolated, in *C. oblongus* all of the few specimens obtained, and in the other two species, a not inconsiderable number of specimens are found paired in such a way as to leave no doubt that this is their normal condition, and their separation a result of decomposition. Further in several (of course very exceptional, but evidently so only as being exceptionally favorable preservation-conditions) specimens of *C. wrightii* I have seen these symmetrically paired lateral appendages attached to the distal end of a single median proximal portion on which I believed thecæ could perhaps be traced. It seems very doubtful indeed whether the future will show similar organization in any species at present referred to *Dawsonia*.

It is needless to add (as Professor Lapworth points out) that this is not, as Salter supposed, a Crustacean, but from its resemblance to *Dawsonia* appears to be a graptolite.

Caryocaris wrightii Salter, 1863. Plate V., Figs. 1, 2.

Quart. Jour. Geol. Soc., London, XIX., p. 139, Fig. 15.

Polypary, consisting of a proximal portion, two lateral and one (two?) median appendages. Proximal portion acutely triangular, 9^{mm} long, 3^{mm} wide *ad max.* (at insertion of lateral appendages). Condition of thecæ uncertain. Lateral appendages round-triangular, obliquely truncated superiorly by the superior margin, 7^{mm} long, 2.5 to 3^{mm} wide *ad max.* (at point of divergence of adjacent margins), apex proximally directed, apparently inserted upon the proximal portion through the medium of the "tubercle" which lies just within the outer margin; outer margin almost straight, bordered by a single filament which is interrupted by openings which appear to be continued into the substance of the appendage; superior margin slightly convex, running downward and inward, finally overlapping (or underlapping) the corresponding margin of the opposite appendage, furnished with a row of cîlia-like processes; inferior margins curving downward and outward around the "tubercle" to join the outer margin at the proximal extremity. Median appendage somewhat shorter than lateral, the superposed adjacent margins of which it overlies) acutely isosceles-triangular, symmetrical with reference to median line of polypary, the equal sides almost straight, the apex projecting in the notch left by the diverging superior margins of the lateral appendages.

Horizon and locality.—Upper Calciferous, Summit, Nevada.

The specimens occur only as flattened films, a condition unfavorable for the determination of structure. The symmetrical disposition of the lateral appendages would seem to imply a similar symmetrical structure in the

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proximal portion of the polypary. Possibly a second median appendage may underlie (as the first overlies) the notch left by the diverging adjacent margins of the lateral appendages.

This species is much less common than *C. curvilatus*. I have not as yet seen it in the Point Levis shales. The lateral appendages differ from those of *C. curvilatus* in their smaller size, triangular shape and in the single marginal filament, interrupted at intervals.

Caryocaris oblongus Gurley, sp. nov. Plate IV., Fig. 2.

Species known only in the form of the lateral appendages. These are roundish-oblong, about 15^{mm} long and about 3^{mm} wide, showing near the proximal part a discolored spot which probably represents the "tubercle." Appendages superposed as in the other species of the genus. Substance thinner, presenting no evidence of structure. Filaments absent. No trace of median appendages.

Horizon and locality.—Calciferous shales, Point Levis, Canada.

This species is distinguished from the other two by its regularly oblong shape. There is no evidence that it represents a developmental stage of *C. curvilatus*.

Caryocarus curvilatus Gurley, sp. nov. Plate IV., Fig. 3; Plate V., Fig. 3.

Species known only in the form of the lateral appendages. These are broadly elliptic in outline, 20 to 30^{mm} long; 10^{mm} wide, more or less; with one margin convex, bordered by half a dozen horse-hair-like filaments which run parallel converging toward the ends, enclosing a ribbon-like space which is obscurely transverse-striate (merely transverse-wrinkled?); superior margin with two acute processes between which extends a row of cîlia-like processes; outer margin bordered by a single filament.

Horizon and locality.—Upper Calciferous, Summit, Nevada; Calciferous, Point Levis, Canada.

This species presents very perplexing varieties of facies from differences in the amount and direction of pressure, and perhaps differences of age. Thus the width may be only one-third the natural, greatly altering the appearance of the species. But most difficult to decipher are the complicated foldings and refoldings of the marginal filaments; usually, however, these retain their parallelism. This latter fact implies that they were united by a thin membrane. The frequent foldings, however, show that they were either free except at one end, or (more probably, perhaps) that the uniting material was so thin as to offer no resistance to flexion.

Although the number of specimens are very numerous (forming more than one-half of the whole number of graptolite specimens from Nevada), I have not seen one specimen possessing the proximal portion. Several have,

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however, been seen with the appendages overlapping, both in the Nevada and in the Point Levis specimens.

The lateral appendages of this species differ from those of *C. wrightii* and *C. oblongus* in their much larger size, usually more rotund shape, and in the multiple marginal filaments.

Dawsonia Nicholson, 1873.

Ann. and Mag. Nat. Hist., XI., p. 139. Type, *D. acuminata* Nich.

Dawsonia monodon Gurley, sp. nov. Plate V., Fig. 4.

Polypary somewhat rhomboidal in outline; 10 to 14^{mm} long, 3 to 5^{mm} wide *ad max.;* apex drawn out to a tapering mucro; dentate margin gently curving from apex to the blunter extremity, interrupted at junction of upper with middle third by a small acute tooth; non-dentate border obtusely isosceles-triangular joined near its lower end by a groove that has run close beside and parallel to it; proximal extremity rounded.

Horizon and locality.—Calciferous shales, Point Levis, Canada.

Easily recognizable by the single tooth and its (for the genus) large size.

Dawsonia tridens Gurley, sp. nov. Plate V., Fig. 5.

Polypary elliptic in outline, 3 to 4^{mm} long and 1 to 1^{mm}.5 wide, with the sharper extremity drawn out to a point; one margin bearing three acute teeth whose upper borders curve inwards, indenting the polypary and terminating in a "pustule"; opposite margin smooth, joined at a very acute angle, near its lower end, by a groove which has run downward close beside and parallel to the margin. The blunt extremity rounded, grooved for a short distance. Substance corneous, thin. The denticles can be seen to extend into the polypary whenever a thin film of shale separates the adjacent margins of successive teeth, and seem to indicate thecæ, but from the extreme tenuity of the film it is not possible to determine this point definitely.

Horizon and locality.—Calciferous shales, Point Levis, Canada.

This species is marked off from all other by the tridentate margin. In outline and size it resembles most closely *D. acuminata* Nich.

Thamnograptus Hall, 1859.

Pal. N. Y., III., p. 519. Type, *T. typus* Hall.

Thamnograptus barrandii Hall.

Rastrites barrandii[1] Hall, Pal. N. Y., III,, 1859, pp. 520–521, with Fig.; *Thamnograptus barrandii* Lapworth, 1886, Tran. Roy. Soc. Can. for 1886, V., Sec. IV., p. 178.

This is certainly, as Lapworth says, a *Thamnograptus*. A single specimen shows, scalariform-wise, the thecal mouth-openings. They occupy about

[1] The name *Rastrites barrandii* was preoccupied by Harkness (Quart. Jour. Geol.

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two-thirds the width of the stem and are in the proportion of 25 to 25^{mm}. The aspect of the stem seems to oppose the view that the thecæ project as in other genera form a coenosarcal canal. They appear rather to have been excavated out of the substance of the branch.

PHYCOGRAPTUS GURLEY, gen. nov.[1]

Polypary consisting of long, slender, flexuous stems, apparently simple, with an entire border and many-segmented contents. Each segment with a single, central pit, seemingly the mouth of a cell, the latter apparently excavated in the substance of the stem. Sicula and virgula unknown. When preserved the substance is carbonaceous. Type *P. brachymera*.

This genus forms one of a group the relation of which to the more typical graptolites is at present somewhat dubious. They are all of a carbonaceous texture and some in addition show pits, apparently the mouth-openings of a cell of some kind, but there is at present no evidence that such cell is of the theca type found in the more typical graptolites.

Phycograptus brachymera Gurley sp. nov. Plate V., Fig. 6.

Greatest length observed, 175^{mm}; width, 1^{mm}; number of segment in 25^{mm}, about 18; each segment as long as, or little longer than wide (rarely one and one-half times as long); pit large.

Horizon and locality.—Lower *Dicellograpsus* zone, Stockport, N. Y.

Phycograptus laevis (Hall).

Graptolithus laevis Hall, 1847, Pal. N. Y., I., p. 274, Plate LXXIV., Fig. 7; probably not *ib.* Süss, 1851, Haidinger's Wissensch. Abhandl., IV., p. 114, Plate IX., Fig. 6.

A careful examination of the type specimen shows that it is about 55^{mm} long,[2] uniformly about 0^{mm}.8 wide throughout. In one place a break occurs which, in the light of the other species, I incline to interpret as a segmentation, especially as the adjacent ends appear smoothly cut. Obscure traces of a median virgula-like chitinous thread are visible at intervals; no pits could be made out with certainty. The specimen is a mere film much wrinkled.

In another specimen I was able, however, to make out distinctly all the essential *Phycograptus* characters, viz., segmentation, pits, marginal grooves; and, in addition, what appeared to be traces of a central chitinous virgula-like thread.

Horizon and locality.—Utica shale, Turin, Lewis County, N. Y. Two specimens in American Museum of Natural History.

Soc., London, 1855, XI., p. 475). As, however, the species has already been referred to, and is not preoccupied in *Thamnograptus*, there is no reason why it should not stand.

[1] φυκος, sea weed; γραφω, I write.

[2] "Specimen uncovered after the figure made" (note on label).

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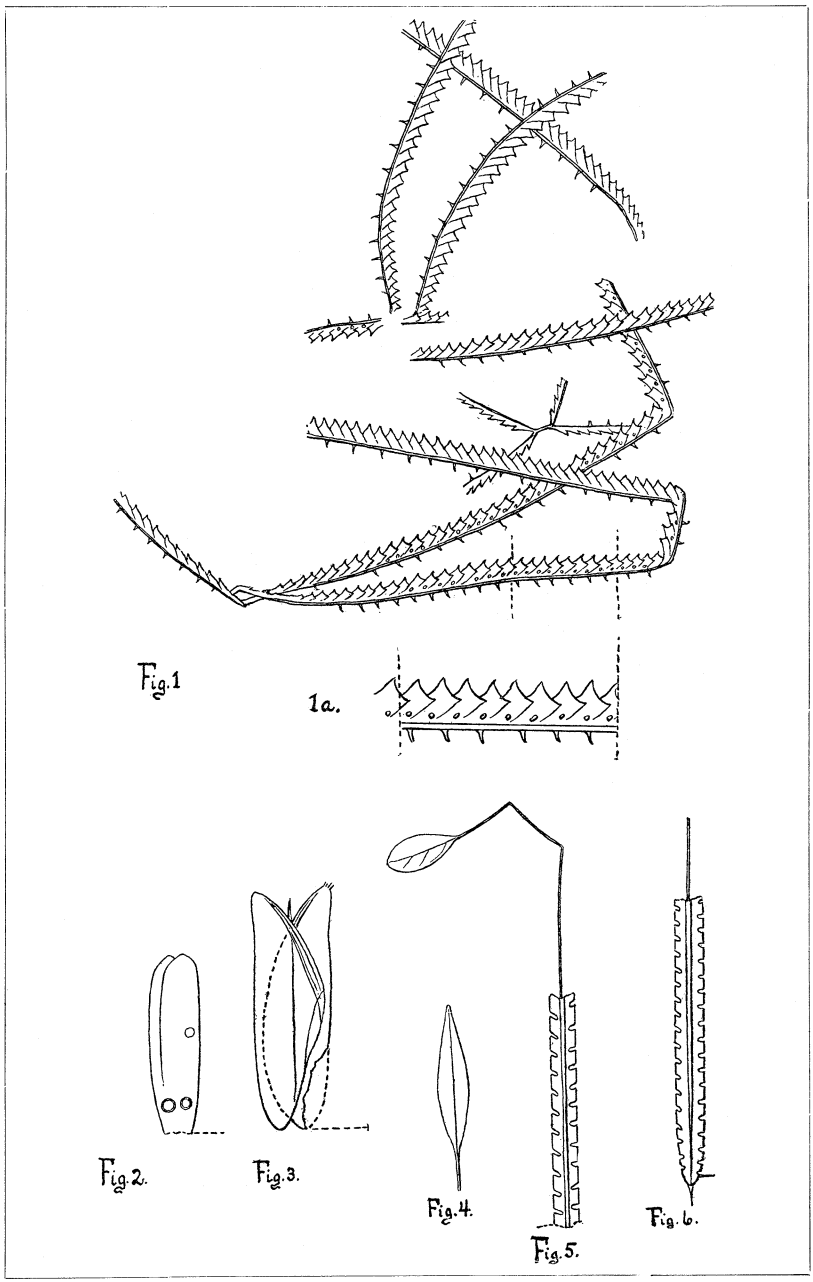

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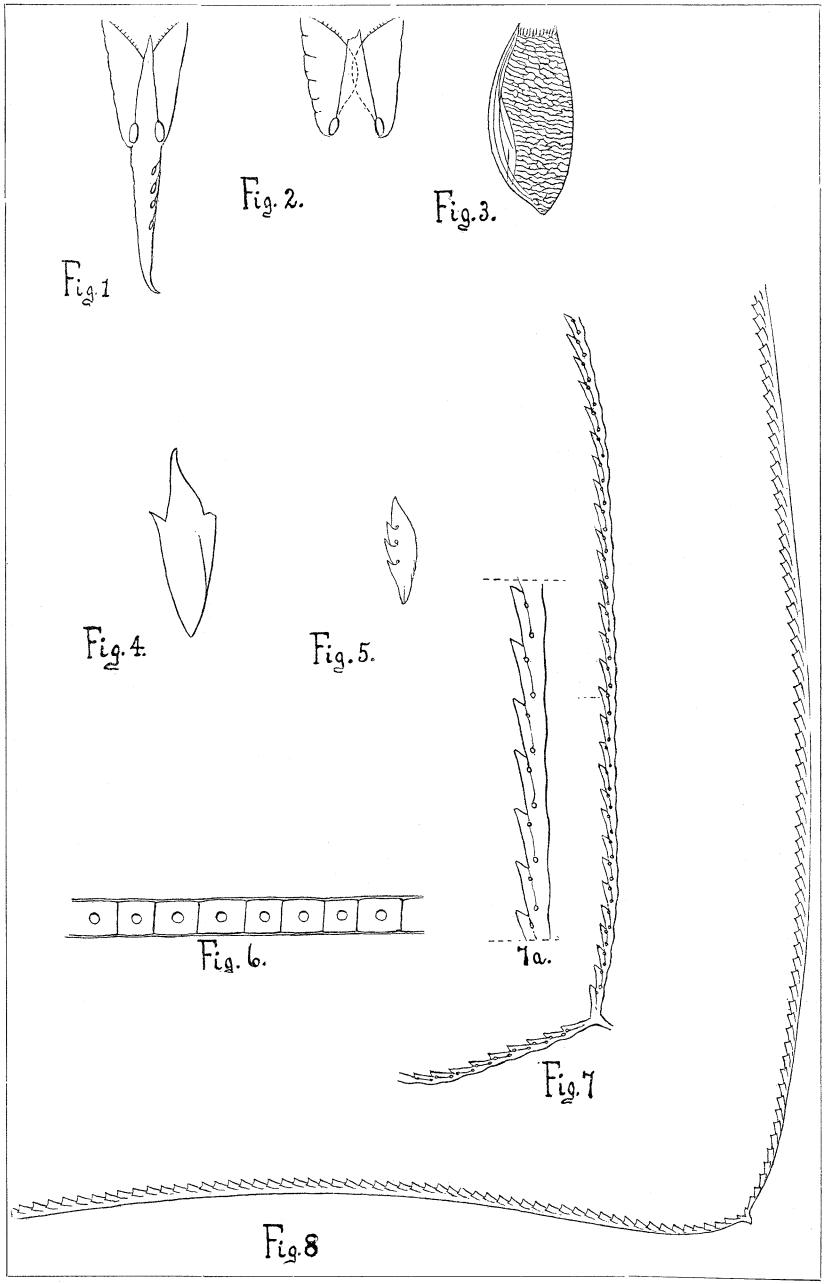

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DESCRIPTION OF FIGURES.

PLATE IV.

FIG. 1.—*Tetragrapsus acanthonotus;* nat. size, and (1*a*) × 2.

FIG. 2.—*Caryocaris oblongus*, × 2. Showing conjoined lateral appendages.

FIG. 3.—*Caryocaris curvilatus*, × 2. Showing conjoined lateral appendages.

FIG. 4.—Proximal "disk" of *Climacograptus phyllophorus;* narrow form, × 2.

FIG. 5.—*Climacograptus phyllophorus*, × 2. Showing "disk," and distal extension from it of the virgula terminating in the "polypary."

FIG. 6.—*Climacograptus phyllophorus*, × 2.

PLATE V.

FIG. 1.—*Caryocaris wrightii* Salter, × 2. Showing proximal portion, one median and two lateral appendages,

FIG. 2.—*Caryocaris wrightii*, × 2. Showing the lateral appendages, with the interrupted external, and the ciliated superior borders.

FIG. 3.—*Caryocaris curvilatus*, nat. size. Showing the outline, marginal filaments and ciliated superior border.

FIG. 4.—*Dawsonia monodon*, × $\frac{3}{2}$.

FIG. 5.—*Dawsonia tridens*, × 3. Showing the dentated border.

FIG. 6.—*Phycograptus brachymera*, × 6.

FIG. 7.—*Didymograpsus bipunctatus*, × 3. Fig. 7*a*, enlargement of thecæ, × 6.

FIG. 8.—*Didymograpsus convexus*, × $\frac{3}{2}$.

LIST OF GRAPTOLITES KNOWN FROM AMERICAN STRATA.

After some thought, I have concluded that I cannot do better than to connect this list with that given in our standard catalogue (Miller's North American Geology and Palæontology; and Supplement) as a base line. For this purpose the two lists (Miller's and mine) are given in parallel columns. Italicized genera and species are new additions to Miller's list, most of them, of course, being subsequent publications.

Acanthograptus Spencer, 1878.	Acanthograpsus Spencer, 1878.
granti Spencer, 1878.	granti Spencer, 1878.
pulcher Spencer, 1884.	pulcher Spencer, 1884.
	Amphigraptus Lapworth, 1873.[1]
	Type A. divergens.
	divergens (Hall), 1859.
	Azygograptus Nicholson, 1875.
	? *walcotti* Lapworth, sp. nov.
	Bryograptus Lapworth, 1880.
	lentus Matthew, 1895.

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	[*Bryograptus* Lapworth—*cont'd.*]
	multiramosus Gurley, sp. nov.
	patens Matthew, 1893.[6]
	spinosus (Matthew), 1893.[17]
Bythograptus Hall, 1861.	Buthograptus Hall, 1861.
laxus Hall, 1861.	laxus Hall, 1861.
Callograptus Hall, 1865.	Callograptus Hall, 1865.
elegans Hall, 1865.	elegans Hall, 1865.
granti Spencer, 1884.	granti Spencer, 1884.
minutus Spencer, 1884,	minutus Spencer, 1884.
multicaulis Spencer, 1884.	multicaulis Spencer, 1884.
niagarensis Spencer, 1878.	niagarensis Spencer, 1878.
salteri Hall, 1865.	salteri Hall, 1865.
Calyptograptus Spencer, 1878.	Calyptograpsus Spencer, 1878.
cyathiformis Spencer, 1878.	cyathiformis Spencer, 1878.
[Omitted entirely.]	*micronematodes* Spencer, 1884.
[Omitted entirely.]	*radiatus* Spencer, 1884.
subretiformis Spencer, 1878.	subretiformis Spencer, 1884.
	Caryocaris Salter, 1863.
	curvilatus Gurley, sp. nov.
	oblongus Gurley, sp. nov.
	wrightii Salter, 1863.
Cladograpsus Geinitz, 1852.	[Never properly defined; should be dropped.]
dissimilaris Emmons, 1856.	Dicranograptus dissimilaris.
inequalis Emmons, 1856.	Dicranograptus ? inequalis.
	Clathrograptus Lapworth, 1873.
	cuneiformis Lapworth, 1873.
	Clematograptus Hopkinson, 1875,[2] Type C. multifasciatus.
	multifasciatus (Hall), 1859.
Climacograptus Hall, 1865.	Climacograptus Hall, 1865.
antennarius Hall, 1863–5.	Cryptograptus antennarius.
	antiquus Lapworth, sp. nov.
bicornis Hall, 1847.	bicornis (Hall), 1847.
	peltifer Lapworth, 1876.[3]
	tridentatus Lapworth, 1876.[3]
	caelatus Lapworth, 1875.
	caudatus Lapworth, 1876.
	laticaulis Gurley, var. nov.
	confertus Lapworth, 1875.
emmonsi Walcott, 1886.	? ? emmonsi Walcott, 1886.

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[Climacograptus Hall—*cont'd.*]

parvus Hall, 1865 [not defined].

typicalis Hall, 1865.

Clonograptus Hall, 1873.
flexilis Hall, 1858.
rigidus Hall. 1858.

Coenograptus Hall, 1868. Type C. divergens.
divergens Hall, 1859.
gracilis Hall, 1847.
surcularis Hall, 1868.

Cyclograptus Spencer, 1884.
rotadentatus Spencer, 1884.

Dawsonia Nicholson, 1873.
acuminata Nicholson, 1873.
campanulata Nicholson, 1873.

rotunda Nicholson, 1873.
tenuistriata Nicholson, 1873.

Dendrograptus Hall, 1865.
[Omitted entirely.]
compactus Walcott, 1879.
dawsoni Spencer, 1884.
diffusus Hall, 1865.
divergens Hall, 1865,
dubius Miller, sp. nov.
erectus Hall, 1865.
flexuosus Hall, 1865.
frondosus Spencer, 1884.
fruticosus Hall, 1865.
gracilis Hall, 1865.

[Climacograptus Hall—*cont'd.*]
oligotheca Gurley, sp. nov.
phyllophorus Gurley, sp. nov.
scharenbergi Lapworth, 1876.[3]
typicalis Hall, 1865.
wilsoni Lapworth, 1876.[3]

Dichograpsus Salter, 1863.
Dichograpsus flexilis.
Dichograpsus rigidus.

Corynoides Nicholson, 1867.[4] Type C. calicularis.
calicularis Nicholson, 1867.[4]

Cryptograptus Lapworth, 1880.[5] Type C. tricornis (=marcidus Hall).
antennarius (Hall), 1865.
tricornis (Carruthers), 1858.[5]

Stephanograptus Geinitz, 1866. Type S. gracilis.
Amphigraptus divergens.
Stephanograptus gracilis.
Stephanograptus surcularis.

Cyclograptus Spencer, 1884.
rotadentatus, Spencer, 1884.

Dawsonia Nicholson, 1873.
acuminata Nicholson, 1873.
campanulata Nicholson, 1873.
monodon Gurley, sp. nov.
rotunda Nicholson, 1873.
tenuistriata Nicholson, 1873.
tridens Gurley, sp. nov.

Dendrograptus Hall, 1862.
arundinaceus (Hall), 1847.[6]
compactus Walcott, 1879.
dawsoni Spencer, 1884.
diffusus Hall, 1865.
divergens Hall, 1865.
dubius Miller, 1889.
erectus Hall, 1865.
flexuosus Hall, 1865.
frondosus Spencer, 1884.
fruticosus Hall, 1865.
gracilis Hall, 1865.

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[Dendrograptus Hall—*cont'd.*]	[Dendrograptus Hall—*cont'd.*]
gracillimus Lesquereux, 1877.	gracillimus (Lesquereux), 1878.
hallanus Prout, 1851.	hallianus (Prout), 1851.
novellus Hall, 1879.	novellus Hall, 1879.
prægracilis Spencer, 1884.	prægracilis Spencer, 1884.
? primordialis Matthew, 1885.	? primordialis Matthew, 1885.
ramosus Spencer, 1884.	ramosus Spencer, 1884.
	cf. *serpens* Hopkinson, 1875.[2]
simplex Walcott, 1879.	simplex Walcott, 1879.
spinosus Spencer, 1884.	spinosus Spencer, 1884.
striatus Hall, 1865.	striatus Hall, 1865.
tenuiramosus Walcott, 1979.	tenuiramosus Walcott, 1879.
	Desmograptus Hopkinson, 1875.
	devonicus Gurley, sp. nov.
	macrodictyon Gurley, sp. nov.
	Dicellograpsus Hopkinson, 1871.[7]
	anceps (Nicholson), 1867.[4]
	caduceus Lapworth, 1876.[3]
	divaricatus (Hall), 1859.
	elegans (Carruthers), 1867.[8]
	gurleyi Lapworth, sp. nov.
	intortus Lapworth, 1880.[5]
	polythecatus Gurley, sp. nov
	moffatensis (Carruthers), 1858.[9]
	rigidus Lapworth, 1880.[5]
	sextans (Hall), 1847.
Dichograptus (syn. for Graptolithus).	*Dichograpsus* Salter, 1863. Good genus.
	abnormis (Hall), 1858.
	flexilis (Hall), 1858.
	logani (Hall), 1858.
	? milesi (Hall), 1861.
	octobrachiatus (Hall), 1858.
	octonarius (Hall), 1858.
	proximatus Matthew, 1895.
	ramulus (Hall), 1865.
	remotus Gurley, sp. nov.
	rigidus (Hall), 1858.
Dicranograptus Hall, 1865.	Dicranograptus Hall, 1865.
	clingani Carruthers, 1868.[10]
	dissimilaris (Emmons), 1856.
divaricatus Hall, 1859.	Dicellograpsus divaricatus.

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[Dicranogtaptus Hall—*cont'd.*]	[Dicranograptus Hall—*cont'd.*]
furcatus Hall, 1847.	furcatus (Hall), 1847.
	? inequalis (Emmons), 1856.
	nicholsoni Hopkinson, 1870.
	arkansasensis Gurley, 1892.
	diapason Gurley, var. nov.
	parvangulus Gurley, 1892.
	whitianus Miller, 1883.
ramosus Hall, 1847.	ramosus Hall, 1847.
	rectus Hopkinson, 1872.[19]
sextans Hall, 1847.	Dicellograpsus sextans.
Dictyonema Hall, 1852.	Dictyonema Hall, 1852.
	actinotum Gurley, sp. nov.
	blairi Gurley, sp. nov,
expansum Spencer, 1884.	expansum Spencer, 1884.
fenestratum Hall, 1851.	fenestratum Hall, 1851.
	flabelliforme (Eichwald), 1840.[11]
gracile Hall, 1852.	gracile Hall, 1852.
grande Nicholson, 1873.	grande Nicholson, 1873,
	cf. *homfrayi* Hopkinson, 1875.[2]
irregulare Hall, 1865.	irregulare Hall, 1865.
murrayi Hall, 1865.	murrayi Hall, 1865.
neenah Hall, 1861.	neenah Hall, 1861.
	perexile Gurley, sp. nov.
pergracile Hall & Whitfield, '72.	pergracile Hall & Whitfield, '72.
pertenue Foerste, 1887.	pertenue Foerste, 1887.
quadrangulare Hall, 1865.	quadrangulare Hall, 1865.
retiforme Hall, 1843.	retiforme (Hall), 1843.
robustum Hall, 1865.	robustum Hall, 1865.
scalariforme Foerste, 1887.	scalariforme Foerste, 1887.
splendens Billings, 1874.	splendens Billings, 1874.
tenellum Spencer, 1878.	tenellum Spencer, 1878.
websteri Dawson, 1860.	websteri Dawson, 1860.
Didymograptus M'Coy, 1851.	Didymograpsus M'Coy, 1851.
	arcuatus (Hall), 1865.
	bifidus (Hall), 1858.
	bipunctatus Gurley, sp. nov.
caduceus Salter, 1853.	caduceus (Salter), 1853.
	convexus Gurley, sp. nov.
	euodus Lapworth, 1875.[2]
	extensus (Hall), 1858.
	extenuatus (Hall), 1865.

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[Didymograptus M'Coy—*cont'd.*]	[Didymograpsus M'Coy—*cont'd.*]
geminus Hisinger, 1840.	Not American (see p. 1/m).
	hirundo Salter, 1863.
	indentus (Hall), 1858.
	murchisoni furcillatus Lapworth, 1875.[2]
	nitidus (Hall), 1858.
	patulus (Hall), 1858.
	pennatulus (Hall), 1858.
	perflexus Gurley, sp. nov.
	serratulus (Hall), 1847.
	similis (Hall), 1865.
	cf. *superstes* Lapworth, 1876.[3]
Diplograptus M'Coy, 1854.	Diplograpsis M'Coy, 1851.
amplexicaulis Hall, 1847.	D. foliaceus.
angustifolius Hall, 1859.	angustifolius (Hall), 1859.
ciliatus Emmons, 1856.	Glossograpsus arthracanthus.
	dentatus (Brongniart), 1828.[16]
dissimilaris Emmons, 1856.	D. foliaceus.
	dubius Spencer, 1884.
	euglyphus Lapworth, 1880.[5]
foliaceous (?) Murchison, 1839.	foliaceus (Murchison), 1839.
	(=amplexicaule Hall, 1847.)
	(=dissimilaris Emmons, 1856.)
	(=laciniatus Emmons, 1856.)
	(=obliquis Emmons, 1856.)
	(=pristis Hall, 1847.)
	(=rugosus Emmons, 1856.)
	(=simplex Emmons, 1844.)
foliosus Emmons, 1856.	? foliosus Emmons, 1856.
folium Hisinger, 1837.	Not American (see p. 1/m).
hudsonicus Nicholson, 1875,	hudsonicus Nicholson, 1875.
hypniformis White, 1874.	hypniformis White, 1874.
inutilis, Hall 1865.	inutilis (Hall), 1865.
laciniatus Emmons, 1856.	D. foliaceus.
marcidus Hall, 1859.	Cryptograptus tricornis.
mucronatus Hall, 1847,	Lasiograptus mucronatus.
obliquus Emmons, 1856.	D. foliaceus.
peosta Hall, 1861.	peosta (Hall), 1861.
pristiniformis Hall, 1858.	D. dentatus.
pristis (?) Hisinger, 1837.	D. foliaceus.
putillus Hall, 1865.	putillus (Hall), 1865.

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[Diplograptus M'Coy—*cont'd.*]

rugosus Emmons, 1856.
rectangularis McCoy, 1851.
secalinus Hall, 1847.
simplex Emmons, 1844.
spinulosus Hall, 1859.

whitfieldi Hall, 1859.

Glossograptus Emmons, 1856.

ciliatus Emmons, 1856.
setaceus Emmons, 1856.

Graptolithus Linnæus, 1736.

abnormis Hall, 1858.
alatus Hall, 1858.
annectans Walcott, 1879.
approximatus Nicholson, 1873.
arcuatus Hall, 1865,
bifidus Hall, 1858.
bigsbyi Hall, 1865.
bryonoides Hall, 1858.
clintonensis Hall, 1843.
constrictus Hall, 1865.
crucifer Hall, 1858,
dentatus Emmons, 1842.
denticulatus Hall, 1858.
divergens Hall, 1859.
extensus Hall, 1858.
extenuatus Hall, 1865.
flaccidus Hall, 1865.
fruticosus Hall, 1858.
gracilis Hall, 1847.
headi Hall, 1858.
indentus Hall, 1858.
laevis Hall, 1847.

[Diplograpsis M'Coy—*cont'd.*]

quadrimucronatus (Hall), 1865.
D. foliaceus.
Climacograptus rectangularis.
secalinus (Hall), 1847.
D. foliaceus.
Glossograpsus spinulosus.
trifidus Gurley, 1892.
truncatus Lapworth, 1876.[3]
whitfieldi (Hall), 1859.

Glossograpsus Emmons, 1856.
arthracanthus Gurley, sp. nov.
ciliatus Emmons, 1856.
setaceus Emmons, 1856.
spinulosus (Hall), 1859.

Goniograptus M'Coy, 1877. Type G thureaui.
thureaui selwyni Ami, 1889.

Established upon inorganic objects; should be dropped entirely.
Dichograpsus abnormis.
Tetragrapsus alatus.
Leptograptus annectans.
Tetragrapsus approximatus.
Didymograpsus arcuatus.
Didymograpsus bifidus.
Tetragrapsus bigsbyi.
Tetragrapsus serra.
Lomatoceras clintonense.
Didymograpsus hirundo.
Tetragrapsus crucifer.
Diplograpsis foliaceus.
Tetragrapsus denticulatus.
Amphigraptus divergens.
Didymograpsus extensus.
Didymograpsus extenuatus.
Leptograptus flaccidus.
Tetragrapsus fruticosus.
Stephanograptus gracilis.
Tetragrapsus headi.
Didymograpsus indentus.
Phycograptus lævis.

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[Graptolithus Linnæus—*cont'd.*]
logani Hall, 1858.
milesi Hall, 1861.
multifasciatus Hall, 1859.
nitidus Hall, 1858.
octobrachiatus Hall, 1858.
octonarius Hall, 1858.
patulus Hall, 1858.
pennatulus Hall, 1865.
quadribrachiatus Hall, 1858.
quadrimucronatus Hall, 1865.
ramulus Hall, 1865.
richardsoni Hall, 1865.
sagittarius (Linnæus) Hall, 1847.
scalaris (Linnæus) Hall, 1847.
serratulus Hall, 1847,
similis Hall, 1865.
subtenuis Hall, 1877.
whitianus Miller, 1883.

Inocaulis Hall, 1852.
anastomotica Ringueberg, 1888.
arbuscula Ulrich, 1879.
bellus Hall and Whitfield, 1875.
cervicornis Spencer, 1884.
diffusus Spencer, 1884.
divaricatus Hall, 1879.
phycoides Spencer, 1884.
plumulosus Hall, 1851.
problematicus Spencer, 1878.
ramulosus Spencer, 1884.
walkeri Spencer, 1884.

[Should be dropped entirely.]
Dichograpsus logani.
Dichograpsus milesi.
Clematograptus multifaciatus.
Didymograpsus nitidus.
Dichograpsus octobrachiatus.
Dichograpsus octonarius.
Didymograpsus patulus.
Didymograpsus pennatulus.
Tetragrapsus quadribrachiatus.
Diplograpsis quadrimucronatus.
Dichograpsus ramulus.
Holograptus ? richardsoni.
Didymograpsus sagitticaulis.
A thoroughly bad species.[20]
Didymograpsus serratulus.
Didymograpsus similis.
Leptograptus subtenuis.
Dicranograptus nicholsoni whitianus.

Holograptus Holm, 1881.[12] Type A. expansum.
? richardsoni (Hall), 1865.

Inocaulis Hall, 1851.[13]
anastomotica Ringueberg, 1888.
arbuscula Ulrich, 1879.
bellus Hall and Whitfield, 1875.
cervicornis Spencer, 1884.
diffusus Spencer, 1884.
divaricatus Hall, 1879.
phycoides Spencer, 1884.
plumulosus Hall, 185–.
? problematicus Spencer, 1878.
ramulosus Spencer, 1884.
walkeri Spencer, 1884.

Lasiograptus Lapworth, 1873.[1] Type L. costatus Lapw.
bimucronatus (Nicholson), 1869.[13]
mucronatus (Hall), 1847.

Leptograptus Lapworth, 1873.[1]
annectans (Walcott), 1879.
flaccidus (Hall), 1865.
subtenuis (Hall), 1877.

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Loganograptus Hall, 1868. Type L. headi.[14]	Dichograpsus Salter, 1863.
alatus Hall, 1858.	Tetragrapsus alatus.
crucifer Hall, 18—.	Tetragrapsus crucifer.
headi Hall, 18—.	Tetragrapsus headi.
logani Hall, 18—.	Dichograpsus logani.
octobrachiatus Hall, 18—.	Dichograpsus octobrachiatus.
	Lomatoceras Bronn, 1834.
	clintonense (Hall), 1843.
	convolutum coppingeri (Etheridge), 1878.
Megalograptus Miller, 1874.	Megalograptus Miller, 1874.
welchi Miller, 1874.	welchi Miller, 1874.
Monograptus Emmons, 1856.	(=Monograpsus Geinitz,—a synonym for Lomatoceras.)
convolutus coppingeri Etheridge, 1878.	Lomatoceras convolutum coppingeri.
elegans Emmons, 1856.	Didymograpsus ? elegans.
rectus Emmons, 1856.	Didymograpsus ? elegans.
Nemagraptus Emmons, 1856.	Nemagrapsus Emmons, 1856.
capillaris Emmons, 1856.	capilaris Emmons, 1856.
elegans Emmons, 1856.	Stephanograptus gracilis.
	Phycograptus Gurley, gen. nov.
	brachymera Gurley, sp. nov.
	lævis (Hall), 1847.
Phyllograptus Hall, 1858.	Phyllograptus Hall, 1858.
angustifolius Hall, 1858.	angustifolius Hall, 1858.
anna Hall, 1865.	anna Hall, 1865.
	? *cambrensis* Walcott, sp. nov.
dubius Spencer, 1884.	Diplograpsis dubius.
ilicifolius Hall, 1858.	ilicifolius Hall, 1858.
loringi White, 1874.	loringi White, 1874.
typus Hall, 1858.	typus Hall, 1858.
Protograptus Matthew, 1885.	Protograptus Matthew, 1885.
alatus Matthew, 1885.	alatus Matthew, 1885.
	Protovirgularia M'Coy, 1851.[15] Type P. dichotoma.
	dichotoma ? M'Coy, 1851.[15]
Ptilograptus Hall, 1865.	Ptilograptus Hall, 1865.
foliaceus Spencer, 1878.	foliaceus Spencer, 1878.
geinitzianus Hall, 1865.	geinitzianus Hall, 1865.
plumosus Hall, 1865.	plumosus Hall, 1865.

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Rastrites Barrande, 1850.	Not American.
barrandi Hall, 1856.	Thamnograptus barrandi.
Retiograptus Hall, 1865.	Reteograptus Hall, 1859.
barrandi Hall, 1860.	Reteograptus geinitzianus.
eucharis Hall, 1865.	eucharis Hall, 1865.
genitzianus Hall, 1859.	geinitzianus Hall, 1859.
tentaculatus Hall, 1858.	tentaculatus (Hall), 1858.
Retiolites Barrande, 1850.	*Gladiolites* Barrande, 1850.
ensiformis Hall, 1858.	Trigonograpsus ensiformis.
venosus Hall, 1852.	venosus (Hall), 1852.
Rhizograptus Spencer, 1878.	Rhizograpsus Spencer, 1878.
bulbosus Spencer, 1878.	bulbosus Spencer, 1878.
Straurograptus Emmons, 1856.	Staurograpsus Emmons, 1856.
dichotomus Emmons, 1856.	dichotomus Emmons, 1856.
	Stephanograptus Geinitz, 1866.
	crassicaulis Gurley, sp. nov.
	exilis Lapworth, sp. nov.
	gracilis (Hall), 1847.
	surcularis (Hall), 1868.
Tetragraptus Salter, 1863.	*Tetragrapsus* Salter, 1863. A good
"This genus is not regarded with much favor. Graptolithus bryonoides is made the typical species."	genus. Type *T. crucialis* Salter 1863.
	acanthonotus Gurley, sp. nov.
	alatus (Hall), 1858.
	approximatus Nicholson, 1873.
	bigsbyi (Hall), 1863.
	crucifer (Hall), 1858.
	denticulatus (Hall), 1858.
	fruticosus (Hall), 1858.
	headi (Hall), 1858.
	hicksi Hopkinson, 1875.[2]
	quadribrachiatus (Hall), 1858.
	serra (Brongniart), 1828.[16]
Thamnograptus Hall, 1859.	Thamnograptus Hall, 1859.
anna Hall, 1865.	anna Hall, 1865.
	barrandi (Hall), 1859.
bartonensis Spencer, 1878.	bartonensis Spencer, 1878.
capillaris Hall, 1859.	capillaris Hall, 1859.
multiformis Spencer, 1884.	? multiformis Spencer, 1884.
typus Hall, 1859.	typus Hall, 1859.
	Trigonograpsus Nicholson, 1869.[13]
	Type T. ensiformis.
	ensiformis (Hall), 1858.

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NOTES TO LIST.

References are here given to the articles in which will be found the original description of such newly introduced foreign genera and species as are not elsewhere (in connection with the tables or descriptions of species) properly cited.

[1] Geol. Mag., London, 1873, X., pp. 500–4, 555–60.

[2] Hopkinson & Lapworth, Quart. Jour. Geol. Soc., London, 1875, XXXI., pp. 631–72, Plates XXXIII–XXXVII.

[3] Lapworth, in Armstrong, Young & Robertson's Cat. West Scottish Fossils, Glascow, 1876.

[4] Geol. Mag., London, IV., pp. 107–13, Plate VII.

[5] Ann. and Mag. Nat. Hist., 1880, V., pp. 171–4.

[6] Trans. Roy. Soc. Can., X., pp. 95–100, Plate VII.

[7] Geol. Mag., VIII., pp. 20–6, 1 pl.

[8] Intellectual Observer, London, XI., p. 369, Plate II., Figs. 16*a–c*.

[9] Trans. Roy. Phys. Soc. Edinb., I., pp. 367–70.

[10] Geol. Mag., V., p. 132, Plate V., Fig. 6*a–c*.

[11] v. Baer u. Helmersens Beiträge z. Kenntn. d. russ. Reichs, St. Petersb., VIII., pp. 45–6, Plate I., Fig. 6. *Graptopora socialis*, Salter, is a synonym.

[12] Öfv. k. Sv. Vet. Akad. Förh., XXXVIII., No. 9, p. 45. Type *H. expansus*.

[13] Ann. and Mag. Nat. Hist., IV., pp. 231–42, Plate XI.

[14] *Loganograptus* is recognized by some authors. I can see in the compound forms only two fairly good genera, *Dichograpsus* and *Schizograpsus*, though a number of (mostly unispecific) genera have been proposed. The type of *Loganograptus*, however, is *L. logani*, and *headi* is a *Tetragrapsus*.

[15] British Palæozoic Fossils, pp. 3–9, Plate I*b*.

[16] Histoire des Végétaux Fossiles (4°, Paris), pp. 70–71, Plate VI, Figs. 7–12. Brongniart's *Fucoides dentatus* and *F. serra* are the (subsequently described) *Graptolithus pristiniformis* and *G. bryonoides* of Hall respectively.

[17] Trans. N. Y. Acad. Sci., 1895, pp. 262–73, Plates XLVIII., XLIX. His *Clonograpsus spinosus* of 1893 (see note 6, above) is referred to *Bryograptus*.

[18] Amer. Journ. Sci., p. 401.

[19] Geol. Mag., IX., p. 508.

[20] G. Scalaris (Linn.) Hall, 1847, Pal. N. Y., I, p. 271, Plate LXXIII., Figs. 4*a–g*. Of these figures, *a* and *b* are *Climacograptus bicornis; c* and *d* are *C. typicalis; e* and *f* are *Didymograpsus Sagitticaulis;* and *g* is *Climacograptus parvus*.

R. R. GURLEY, M. D.

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