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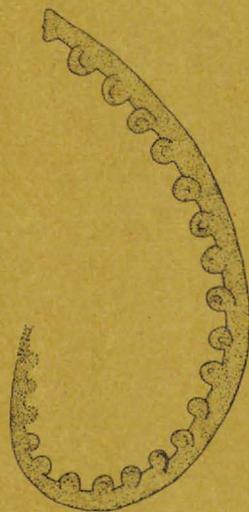
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Bulletin No. 142

Silurian graptolites from Washington Land,
western North Greenland

by

Merete Bjerreskov



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GRØNLANDS GEOLOGISKE UNDERSØGELSE
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Silurian graptolites from Washington Land,
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Merete Bjerreskov

1981

Abstract

Fifty-six graptolite species and subspecies are described from the Silurian sediments of Washington Land and Hall Land, western North Greenland. The graptolite faunas indicate the following ages and zones: Middle Llandovery, the *argenteus* and *convolutus* Zones; Upper Llandovery, the *turriculatus* and *spiralis* Zones; probably the Llandovery to Wenlock transition; Lower Wenlock, the *riccartonensis* Zone; Uppermost Wenlock (?) and Lower Ludlow. The bulk of the graptolite species are well known, but some new minor morphological grades are recognised. Four new species and one new subspecies – *Pseudoclimacograptus* (*Clinoclimacograptus*)? *washingtoni*, *Plectograptus*? *intermedius*, *Monograptus kochi*, *Monograptus teichertii*, and *Monograptus bjerringus schucherti* – are erected. *P. (C.)? washingtoni* and *P.? intermedius* possess morphological characters which are referable to more than one previously described subgenus and genus. The retiolitid fills a gap in the known record of the retiolitids.

Author's address:

Institute of Historical Geology and Palaeontology
University of Copenhagen
Øster Voldgade 10
DK-1350 Copenhagen K.

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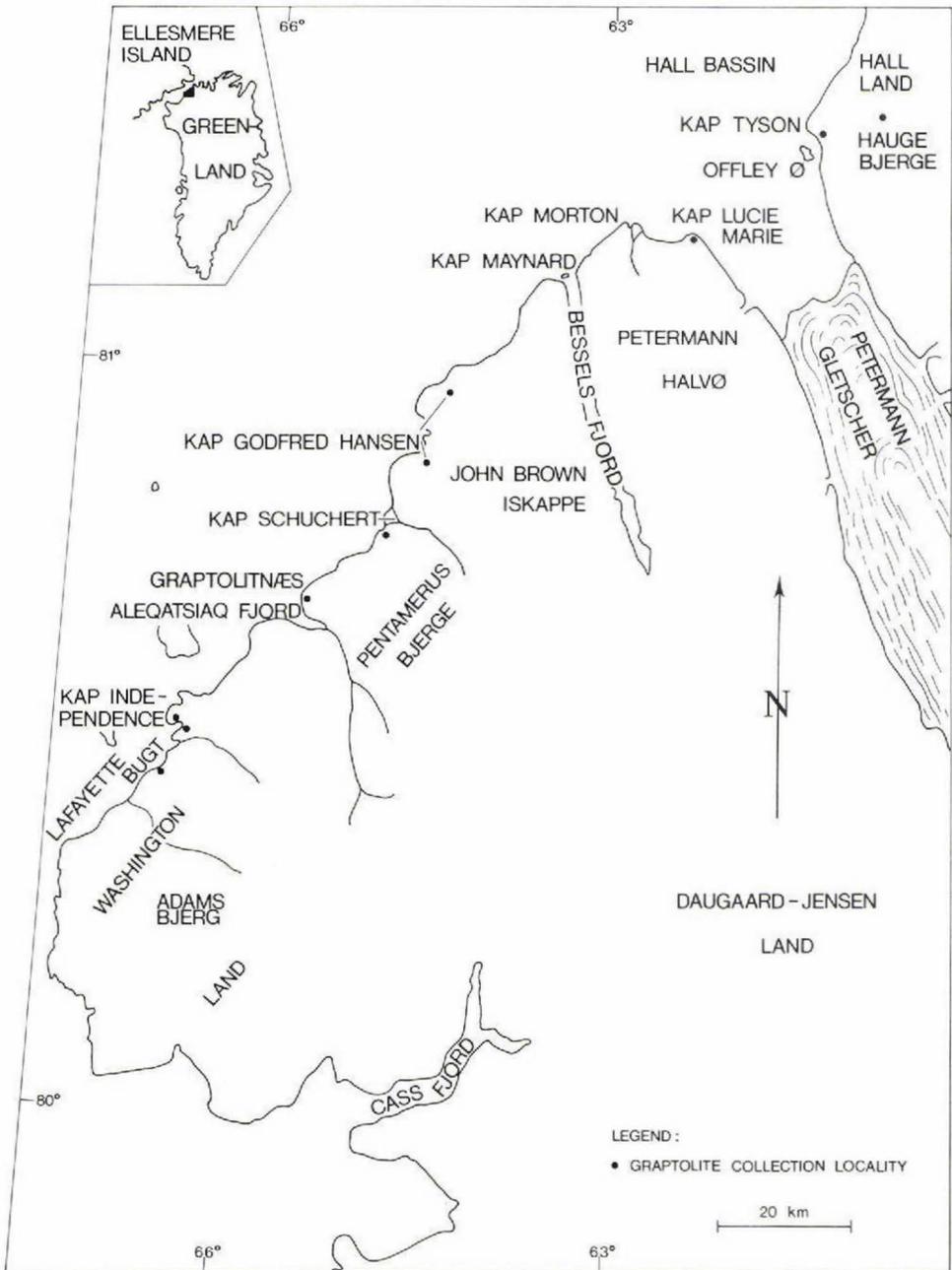


Fig. 1. Locality map of Washington Land and western Hall Land. (After Hurst, 1980, fig. 1).

INTRODUCTION

Silurian graptolites of Middle Llandovery to Lower Ludlow Age are described from the following localities in Washington land, western North Greenland (fig. 1): Kap Independence, Graptolitnæs, 'Kap Schuchert' (2 km south of Kap Schuchert), Kap Godfred Hansen and Kap Lucie Marie. In addition graptolites from Kap Tyson, western Hall Land are also included in the study.

The graptolites were collected by J. M. Hurst in the summers of 1976 and 1977, during regional reconnaissance of the Silurian rocks.

A small collection of Silurian graptolites collected by Lauge Koch during an expedition to Washington Land between 1916 and 1918 is also described. In addition the graptolite material, collected by Lauge Koch, from Kap Schuchert and listed and figured in Poulsen (1934), has been reexamined.

Prior to the present study information about Silurian graptolites from Washington Land was sparse. Koch (1920, 1925) listed a few species and Poulsen (1934) listed and figured a small fauna from Kap Schuchert which he referred to the *convolutus* Zone. In 1966 B. S. Norford collected graptolites in Washington Land, which were identified by D. E. Jackson and listed in Norford (1972). The graptolites, which were found at 'Kap Schuchert' and Kap Tyson, indicated the *turriculatus* Zone (or lower), the *spiralis* Zone (Llandovery) and probably also the Lower Wenlock. In addition Berry *et al.* (1974) reported a few graptolites from the margin of the North Greenland fold belt of western Hall Land to be of Pridoli and earliest Devonian Age. H. Jaeger later reported these as being exclusively of Pridoli Age (personal communication in Surlyk *et al.*, 1980).

The investigated material represents 56 graptolite species and subspecies, of which five species and subspecies are new. The graptolites are generally not tectonically compressed, and occur mainly in a flattened state in shales and mudstones. Occasionally lime mudstones and calcarenites contain well preserved specimens in full relief. A large portion of the graptolites are badly preserved as incomplete carbon films with indistinct structures. For this reason about ten species or subspecies, which cannot be safely assigned to known species, are not described as new.

The majority of the graptolites described here are very similar to established species. However, there are minor morphological variations from those earlier reported, especially in the rhabdosome proportions. In particular the slender monoclimalids develop many different forms during the Llandovery to Wenlock transition, and these are difficult to place among the earlier described species. Thecal structures are generally obscure and add no additional information to the already known detailed thecal morphology.

LIST OF GRAPTOLITES

The position of the major part of the samples is shown in fig. 2 and fig. 3 (see also Hurst, 1980).

GGU sample 216767, Kap Independence, Lafayette Bugt Formation:
Pseudoclimacograptus (Metaclimacograptus) hughesi
Monoclimacis? ?renularis
Monoclimacis sp.
Monograptus ?deci piens
Monograptus lobiferus lobiferus

Age: Middle Llandovery – *convolutus* Zone

GGU sample 216775, Kap Independence, Lafayette Bugt Formation:
Callograptus ?pulchellus
Monograptus ?flemingii

Age: Upper Wenlock?

GGU sample 216778, Kap Independence, Lafayette Bugt Formation:
Climacograptus sp.
Monograptus sp. 2

Age: Middle Llandovery

GGU sample 216780, Kap Independence, Lafayette Bugt Formation:
Glyptograptus (Pseudoglyptograptus) sp.
Monoclimacis? crenularis
Pristiograptus regularis regularis
Monograptus sp. 3
Rastrites sp.

Age: Middle Llandovery – *convolutus* Zone

GGU sample 216781, Kap Independence, Lafayette Bugt Formation:
Monoclimacis sp.

Age: Llandovery?

GGU sample 216783, Kap Independence, Lafayette Bugt Formation:
Retiolites geinitzianus angustidens
Stomatograptus grandis grandis
Monoclimacis crenulata sensu Elles & Wood (1911)
Monograptus spiralis spiralis

Age: Upper Llandovery – *spiralis* Zone

GGU sample 216784, Kap Independence, Lafayette Bugt Formation:
Stomatograptus grandis grandis
?Monoclimacis (not described)
Monograptus spiralis spiralis

Age: Upper Llandovery – *spiralis* Zone

GGU sample 216789, Kap Independence, Lafayette Bugt Formation:
Pristiograptus dubius ?ludlowensis

Age: Lower Ludlow?

GGU sample 216811, Kap Independence, Lafayette Bugt Formation:
Petalograptus ?conicus
Monograptus exiguus s.l.
Monograptus exiguus primulus
Monograptus planus
Monograptus aff. *M. proteus*
Monograptus rickardsi n. ssp.
Monograptus turriculatus

Age: Upper Llandovery – *turriculatus* Zone

GGU sample 216812, South of Kap Independence, Lafayette Bugt Formation:
Monoclimacis vomerina ssp. 1
Monograptus priodon
Monograptus spiralis spiralis

Age: Upper Llandovery – *spiralis* Zone

GGU sample 216839, Kap Schuchert, Cape Schuchert Formation:
Pseudoclimacograptus (Clinoclimacograptus)? washingtoni n. sp.
Petalograptus minor
Pribylograptus ?leptothea
Monograptus argenteus
Monograptus kochi n. sp.
Monograptus teichertii n. sp.

Age: Middle Llandovery – *argenteus* Zone

GGU sample 216846, Kap Schuchert, Cape Schuchert Formation:

Pristiograptus bjerringus schucherti n. ssp.
? *Monograptus turriculatus*

Age: Upper Llandovery – *turriculatus* Zone

GGU sample 216851, Kap Schuchert, Lafayette Bugt Formation:

Monograptus priodon

Age: Upper Llandovery?

GGU sample 242832, Kap Lucie Marie, Offley Island Formation:

Monoclimacis vomerina ssp. 2
Monograptus sp. 1

Age: Upper Llandovery?

GGU sample 242838, Kap Lucie Marie, Kap Lucie Marie Formation:

Retiolites geinitzianus angustidens
Stomatograptus grandis grandis
Monoclimacis aff. *M. linnarssoni*
Monoclimacis ?*vomerina*
Monograptus praecedens
Monograptus priodon

Age: Upper Llandovery – *spiralis* Zone

GGU sample 242839, Kap Lucie Marie, Kap Lucie Marie Formation:

Retiolites geinitzianus angustidens
Stomatograptus grandis grandis
Monoclimacis aff. *M. linnarssoni*
Monoclimacis ?*vomerina*
Monograptus praecedens
Monograptus priodon

Age: Upper Llandovery – *spiralis* Zone

GGU sample 242840, Kap Lucie Marie, loose material, Kap Lucie Marie Formation:

Retiolites geinitzianus angustidens
Monoclimacis ?*vomerina*
Monograptus priodon
Monograptus ?*spiralis*

Age: Upper Llandovery – *spiralis* Zone

GGU sample 242900 Kap Tyson, Lafayette Bugt Formation:

Retiolites geinitzianus angustidens
Monoclimacis ?*crenulata sensu* Elles & Wood (1911)
Monograptus ?*parapriodon*

Age: Upper Llandovery – *spiralis* Zone

GGU sample 242917, Kap Godfred Hansen, Lafayette Bugt Formation:

Stomatograptus grandis grandis
Monograptus priodon
Monograptus sp. 4

Age: Upper Llandovery – *spiralis* Zone

GGU sample 242918, Kap Godfred Hansen, Lafayette Bugt Formation:

Dictyonema aff. *D. polymorphum*
Retiolites geinitzianus angustidens
Monoclimacis vomerina s.l.
Monograptus priodon
Cyrtograptus sp.

Barrandeograptus ?*pulchellus*

Age: Upper Llandovery – *spiralis* Zone

Graptolites from Lauge Koch collection

Sample 101.1, Kap Tyson, Lafayette Bugt Formation:
Monograptus priodon

Age: Upper Llandovery – Lower Wenlock

Sample 101.2, Kap Tyson, Lafayette Bugt Formation:
Monoclimacis aff. *M. linnarssoni*

Age: Upper Llandovery – Lower Wenlock

Sample 101.3, Kap Tyson, Lafayette Bugt Formation:
Monograptus cf. *M. dextrorsus*

Age: Upper Llandovery – Lower Wenlock

Sample 101.4, Kap Tyson, Lafayette Bugt Formation:
Stomatograptus grandis grandis
Monoclimacis aff. *M. linnarssoni*

Age: Upper Llandovery – *spiralis* Zone

Sample E.1, Graptolitprofillet (north), Kap Independence, Lafayette Bugt Formation:

Dictyonema sp. 1
Pristiograptus regularis ?*regularis*
Monograptus ?*barrande*
Monograptus planus
Monograptus turriculatus

Age: Upper Llandovery – *turriculatus* Zone

Sample E.2, Graptolitprofillet, Kap Independence, Lafayette Bugt Formation:

Dictyonema sp. 2
Monograptus turriculatus

Age: Upper Llandovery – *turriculatus* Zone

Sample E.5, Graptolitprofillet, Kap Independence, Lafayette Bugt Formation:

Retiolites geinitzianus angustidens
Monoclimacis vomerina s.l.
Monograptus priodon
Monograptus spiralis spiralis

Age: Upper Llandovery – *spiralis* Zone

Sample E. 6, Graptolitprofillet, Kap Independence, Lafayette Bugt Formation:

Retiolitid (not described)
Monograptus priodon

Age: Upper Llandovery – Lower Wenlock

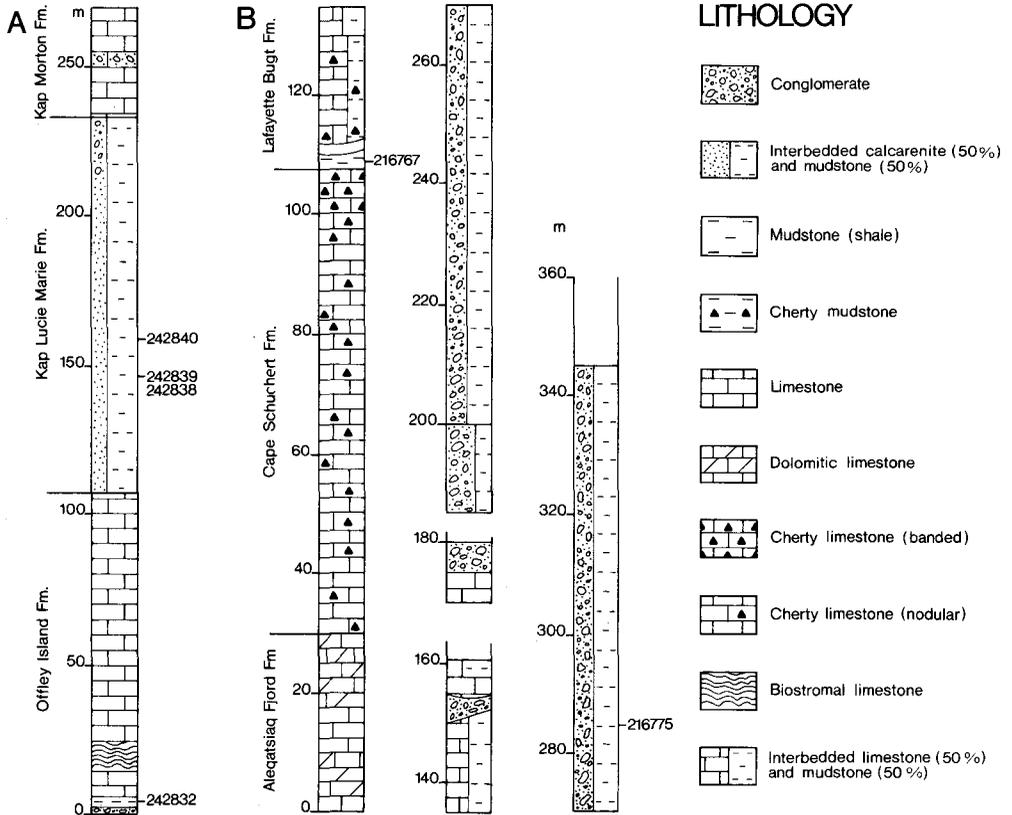


Fig. 2. Generalised stratigraphic sections in which graptolites occur. A – section from Kap Lucie Marie (Hurst, 1980, fig. 46). B – section from Kap Independence (Hurst, 1980, fig. 58). C - section from Kap Schuchert (Hurst, 1980, fig. 59). D - section from Kap Independence (Hurst, 1980, fig. 61). E - section

Sample E.7, Graptolitprofil, Kap Independence, Lafayette Bugt Formation:

Monograptus aff. *M. speciosus*

Age: Upper Llandovery?

Sample E.9, Graptolitprofil, Kap Independence, Lafayette Bugt Formation:

Monograptus spiralis spiralis

Age: Upper Llandovery – *spiralis* Zone

Sample E.11, Graptolitprofil, Kap Independence, Lafayette Bugt Formation:

Retiolites geinitzianus angustidens

Monograptus priodon

Monograptus spiralis spiralis

Cyrtograptus n. sp.

Age: Upper Llandovery – *spiralis* Zone

Sample E.12, Graptolitprofil, Kap Independence, Lafayette Bugt Formation:

Retiolites geinitzianus angustidens

Monograptus priodon

Age: Upper Llandovery – *spiralis* Zone

Sample E.13, Graptolitprofil, Kap Independence, Lafayette Bugt Formation:

Stomatograptus grandis grandis

Age: Upper Llandovery – *spiralis* Zone

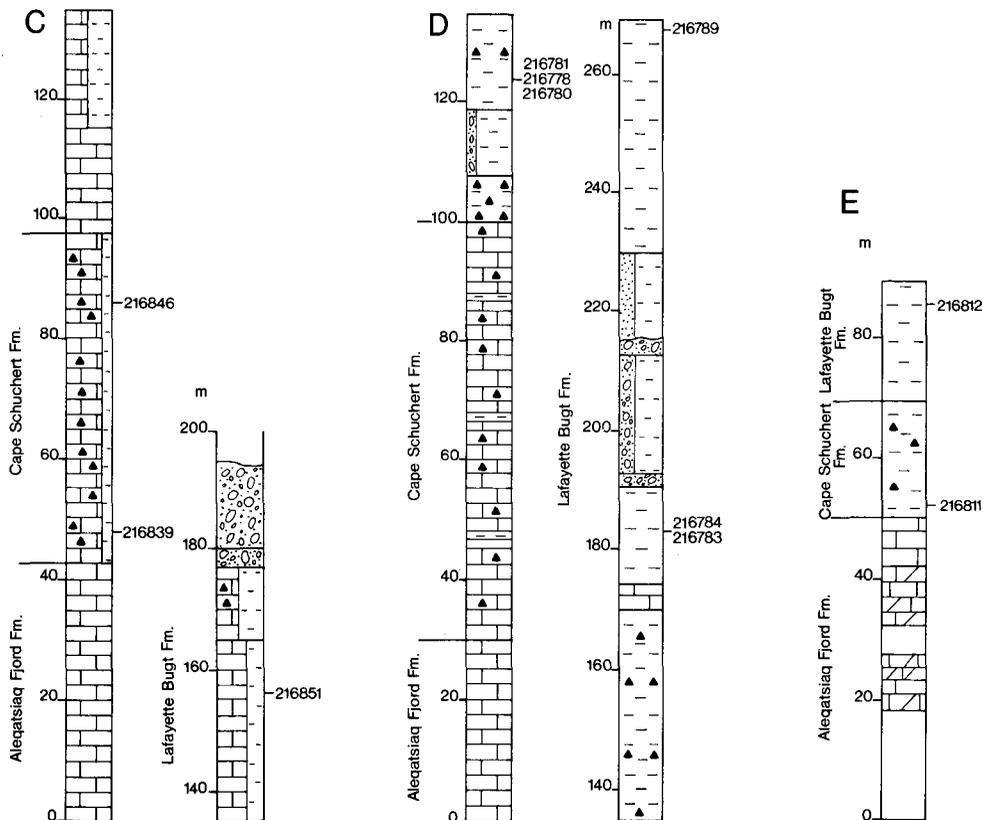
Sample F.1, Graptolitnäs, 220 m above sea level, Lafayette Bugt Formation:

Plectograptus ?intermedius n. sp.

Monograptus riccartonensis

Monograptid (not described)

Age: Lower Wenlock – *riccartonensis* Zone



from 10 km south of Kap Independence (pers. comm. Hurst, 1980). 216767–242840 are GGU sample numbers.

Sample F.2, Graptolitnæs, 220 m above sea level, Lafayette Bugt Formation:
Monograptus riccartonensis

Age: Lower Wenlock – *riccartonensis* Zone

Sample F.3, Graptolitnæs, 220 m above sea level, Lafayette Bugt Formation:
Pristiograptus cf. *P. jaegeri*

Age: Lower Wenlock?

Sample F.4, Graptolitnæs, 340 m above sea level, Lafayette Bugt Formation:
Bohemograptus bohemicus bohemicus

Age: Lower Ludlow

Sample I.1, Kap Tyson, 240 m above sea level, Lafayette Bugt Formation:
Monoclimacis aff. *M. linnarssoni*
Monograptus cf. *M. dextrorsus*

Age: Upper Llandovery – Lower Wenlock?

Sample I.6, Kap Tyson, 300 m above sea level, Lafayette Bugt Formation:
Monograptus pridon
Monograptus cf. *M. dextrorsus*

Age: Upper Llandovery – Lower Wenlock?

STRATIGRAPHY

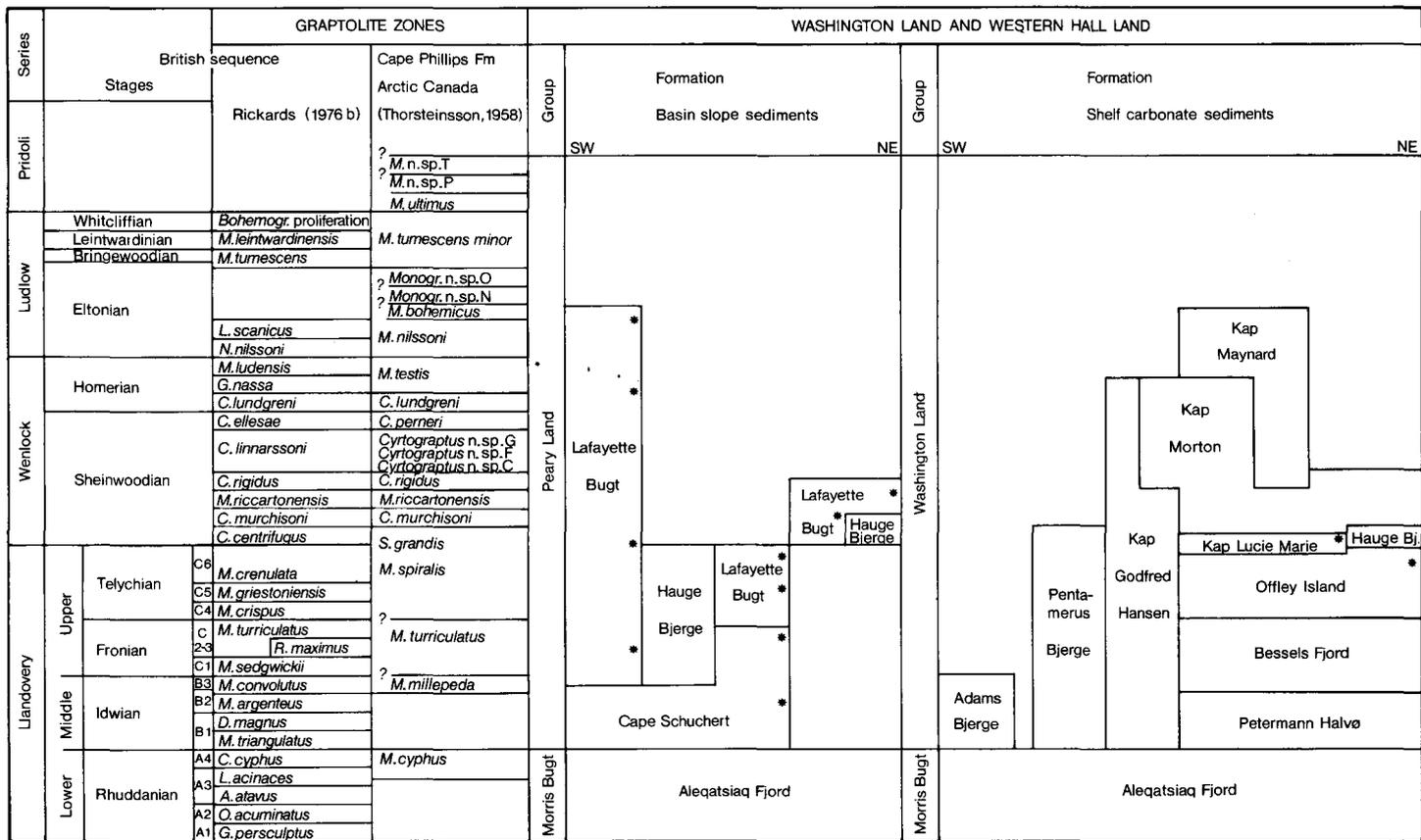
The first comprehensive description of the Silurian rocks of Washington Land was given by Koch (1920, 1925). Poulsen (1934) followed Koch's stratigraphy when listing a graptolite fauna from Kap Schuchert. The stratigraphic scheme was not revised until after the investigations of Allaart (1966), Kerr (1967), Norford (1967, 1972) and Dawes (1971). These authors demonstrated that the Silurian strata of Washington Land developed complicated facies changes in association with large carbonate buildups.

Recently the investigations of Hurst in 1976 and 1977, during the mapping of Washington Land, have shed further light on the depositional environments of the Silurian strata (Hurst, 1980). He revised the earlier stratigraphic nomenclature and erected a new lithostratigraphic scheme. The Silurian was divided into two groups corresponding to different depositional environments (fig. 3). These included the Washington Land Group for the Silurian platform carbonate sediments and the Peary Land Group to which basin slope rocks were assigned. In the hinge between the platform and slope complicated facies changes occur.

In the Washington Land Group, the following formations have yielded graptolites (Hurst, 1980): Offley Island Formation comprising shallow platform biostromes, Late Llandovery Age; and Kap Lucie Marie Formation, including offshore to slope calcarenites and shales, Late Llandovery Age. The Peary Land Group was divided into two formations both of which yielded graptolite faunas. The Cape Schuchert Formation, which consists of calcarenites, cherts and black limestones indicating a slope environment, is of Middle to early Late Llandovery Age. The Lafayette Bugt is of Middle Llandovery to Ludlow Age and consists of shale and conglomerates, also deposited in a slope environment.

No graptolites from the Lower Llandovery have been observed. The oldest are from the Middle Llandovery *argenteus* Zone and *convolutus* Zone (according to the British zonation scheme). These together with the *turriculatus* Zone of the Upper Llandovery are present in the two formations deposited on the slope. In the Lafayette Bugt Formation the Upper Llandovery *spiralis* Zone is well developed. The lowermost Wenlock is possibly present. In the platform to slope transition rocks of the Kap Lucie Marie Formation the *spiralis* Zone is present. This is the only graptolite zone known in this facies. The extensive *spiralis* Zone and the lack of the *crispus* and *griestoniensis* Zones of the British zonation scheme is in accord with the Silurian graptolite sequences of the Cape Phillips Formation of Arctic Canada (Thorsteinsson, 1958), and the Cordillera sequences from the Yukon to British Columbia (Jackson & Lenz, 1962 and Lenz, 1979). The *spiralis* Zone is also reported from central Nevada (Berry & Murphy, 1975).

The *Cyrtograptus sakmaricus* – *Cyrtograptus laqueus* level, which recently has been established as an individual zone in the topmost Llandovery in the Cordillera



* OCCURRENCE OF GRAPTOLITES

Fig. 3. Silurian stratigraphy of Washington Land and western Hall Land showing the distribution of graptolite occurrences (Based on Hurst, 1980, tables 1 and 2, pl. 1). The Aleqatsiaq Formation is the uppermost formation of the Morris Bugt Group and is principally Ordovician.

and Arctic parts of North America (e.g. Lenz, 1979), has not been recognised in Washington Land. In other places all over North Greenland this zone can be easily recognised (observed by the author in the collections of J. M. Hurst, F. Surlyk and J. S. Peel). At present the collections with a *spiralis* fauna without the large cyrtograptids are all referred to the *spiralis* Zone. The *sakmaricus* – *laqueus* level cannot safely be shown without the index species or *Cyrtograptus lapworthi*, which also indicates the uppermost Llandovery (e.g. Bjerreskov, 1975).

Wenlock graptolites are only known from slope environments. Very few Wenlock graptolites indicating precise stratigraphic horizons are known, but further collecting may show a complete Wenlock succession (Hurst, 1980). A few graptolite specimens in the Lauge Koch collection most probably represent the *riccartonensis* Zone and one slab with *M. ?flemingii* apparently indicates the Upper Wenlock. The material is too small for proper comparison with the Wenlock graptolites from northern Arctic Canada (Lenz, 1978). The occurrence of *B. bohemicus bohemicus* and *P. dubius ?ludlowensis* may indicate the Lower Ludlow. *B. bohemicus* apparently has a shorter range in Arctic Canada than Europe (Thorsteinsson, 1958; Jackson & Lenz, 1962) and may indicate a level around the *scanicus–nilssoni* to *bohemicus* Zones in the Lower Ludlow.

SYSTEMATIC DESCRIPTIONS

The generic terminology employed here is mainly based on Bulman (1970). The genera constituting the family Monograptidae are currently under discussion and in addition to those listed in Bulman (1970) the well defined genera, *Pribylograptus* and *Bohemograptus* (Urbanek, 1970 and Rickards, 1976a) are also considered representative of the family. Morphological descriptions are based on the terminology of Bulman (1970).

All figured specimens and the Lauge Koch collection are deposited in the Geological Museum, Copenhagen; other GGU specimens are retained in the Geological Survey of Greenland.

Family DENDROGRAPTIDAE Roemer in Frech, 1897

Genus *Dictyonema* Hall, 1851

Type species. Subsequent designation. Miller, 1889, p. 185; *Gorgonia? retiformis* Hall, 1843, p. 115, fig. 1; from the Silurian of New York State, U.S.A.

Diagnosis. See Bulman, 1970, V38.

Dictyonema aff. *D. polymorphum* Ruedemann, 1908

Plate 5, fig. 2

Material. 1 specimen, nearly flattened; GGU 242918, Kap Godfred Hansen, Lafayette Bugt Formation.

Description. Conical rhabdosome, in flattened state of preservation and with flabellate appearance. Stipe length approximately 1.5 cm and distally the rhabdosome is 1.4 cm wide. The basal part is present, but no root or disc was observed.

The stipes are slightly flexuous and 0.35–0.4 mm wide at maximum, but generally their width is 0.25 mm. There are approximately 12 stipes per 10 mm, measured transversely in the distal part, and about 6–8 bifurcations within 1 cm of the branch. The bifurcations are right of each other distally, and the dissepiments are perpendicular or inclined at 45° to the stipes. Occasionally the branches are infilled with pyrite displaying a fibrous structure, but distinct thecal structures have not been observed.

Remarks. This specimen is smaller than previously described individuals, but it is similar to specimens with slender stipes described by Schrock (1928). The maximum width of the stipes (in figs 10b and 10d of Schrock, 1928) is 0.5 mm. The meshes approximate to a circular shape, rather than oblong, and have some resemblance to those in *Desmograptus*.

D. polymorphum was reported from the Lower Ludlow Missisnewa Shale of Yorktown, Indiana (Schrock, 1928 and Erdtmann, 1976). The present specimen is, however, associated with *R. geinitzianus angustidens*, *M. vomerina*, and *M. priodon* indicating an age of latest Llandovery and/or earliest Wenlock.

Dictyonema sp. 1

Plate 5, fig. 3

Material. At least 2 fragmentary specimens; Lauge Koch collection: E.1, Kap Independence, Lafayette Bugt Formation.

Description. The specimens are incomplete, preserved as relief casts. The stipes are about 2–3 cm long and the distal width of the conical rhabdosome is approximately 2 cm. The stipes are subparallel, 0.1–0.15 mm wide, and number 8 per 5 mm transversely. They bifurcate 2–3 times, at angles of about 45°. The very slender dissepiments are 0.05 mm wide, only 1–2 per 5 mm, but this value may be larger. The thecae have not been observed.

Remarks. The very slender nature of the stipes and their frequency per 10 mm precludes assignment of these specimens to earlier described species. However, as the material is incomplete with no information concerning shape and dimension of the rhabdosome, nor the proximal parts, it is not considered appropriate to erect a new species. *Dictyonema* sp. 1 is associated with a graptolite fauna indicating the *turriculatus* Zone.

Dictyonema sp. 2.

Plate 5, figs 1, 5

Material. 3 fragmentary, flattened specimens; Lauge Koch collection: E.2, Kap Independence, Lafayette Bugt Formation.

Description. As the rhabdosomes are incomplete, the shape and dimensions cannot be discerned. The longest stipes are nearly 3 cm in length. They are subparallel, 0.25–0.35 mm wide, and number 14 per 10 mm transversely. Bifurcations occur every 5–6 mm and at angles of 30°–40°. The dissepiments are 0.1–0.2 mm wide and number 2–4 per 5 mm. The thecae are so indistinct that their shape and spacing number cannot be distinguished.

Remarks. *Dictyonema* sp. 2 is similar to *Dictyonema obpyriforme* Gurley (cf. Ruedemann, 1947), but is distinguished by the wider spaced stipes. The material from Greenland is too incomplete to allow closer comparison with previously described species.

Dictyonema sp. 2 is associated with a *turriculatus* zonal assemblage.

Genus *Callograptus* Hall, 1865

Type species. *Callograptus elegans* SD Miller 1889, p. 175; Hall, 1865, p. 133; from the Ordovician of Quebec, Canada.

Diagnosis. See Bulman, 1970, V38.

Callograptus ?pulchellus Schrock, 1928

Plate 5, figs 4, 6

Material. 3 flattened specimens; GGU 216775, sec. 1, Kap Independence, Lafayette Bugt Formation.

Description. One specimen has a basal root at least 1.5 mm long and about 0.5 mm wide. The stipes originate from the root and bifurcate, forming a dendritic bush-like rhabdosome with subparallel stipes. The largest specimen is 1.5 cm long and 2 cm wide distally.

The stipes are approximately 0.35 mm wide proximally and 0.25 mm in the distal part. Bifurcations occur 1–2.5 mm from each other, and the space between the stipes is about 1–1.5 mm wide. Transverse dissepiments are occasionally seen.

Remarks. The present specimens are only slightly dissimilar to those described by Schrock (1928). The Greenland material has more frequent bifurcations, in comparison with the 2 to 3 mm frequency described by Schrock (1928). The proximal part of the stipes are slightly wider (0.45 mm) than reported by Schrock (1928). The species was reported by Schrock (1928) and Erdtmann (1976) from the Lower Ludlow, Missisinea Shale of Indiana, U.S.A.

In Wahsington Land *C. ?pulchellus* is associated with *M. ?flemingii*, perhaps indicating a stratigraphic level in the Upper Wenlock.

Family DIPLOGRAPTIDAE Lapworth, 1873
Genus *Climacograptus* Hall, 1865

Type species. Original designation *Graptolithus bicornis* Hall, 1847, p. 268, pl. 73, fig. 2; from the Upper Ordovician of New York State, U.S.A.

Diagnosis. See Bulman, 1970, V125.

Climacograptus sp.

Plate 1, figs 1, 2

Material: 5 flattened specimens; GGU 216778, sec. 2, Kap Independence, Lafayette Bugt Formation.

Description: The largest specimen is 2.5 cm long. The width increases from 0.5 mm proximally to a mesial maximum width of 1.8 mm, distally decreasing to 1.65 mm.

The thecae are climacograptid and alternate, numbering 6 per 5 mm proximally and 9 per 10 mm in the mesial part of the rhabdosome. The apertures occupy about 1/4 of the width of the rhabdosome, and 1/3 of the length of the supragenicular walls.

In one specimen (plate 1, fig. 2) there is a vague indication of the sicula, 0.7 mm long.

Remarks. The specimens are too wide to be referred to *Climacograptus normalis* Lapworth, which obtains a maximum width of 1.4 mm (e.g. Hutt, 1974). *C. sp.* is too slender for reference to *Climacograptus rectangularis* (M'Coy) or to *Climacograptus medius* Törnquist. *C. sp.* is associated with indeterminable monograptids and occurs in a sample, possibly referable to the *convolutus* Zone, as it is found 5 m above GGU sample 216780 (Hurst, 1980), which indicates the *convolutus* Zone.

Genus *Pseudoclimacograptus* Přibyl, emend. Bulman & Rickards, 1968

Type species. Original designation. *Climacograptus Scharenbergi* Lapworth, 1876, pl. 2, fig. 55; from the Upper Ordovician of Scotland.

Subgenus *Pseudoclimacograptus* (*Metaclimacograptus*) Bulman & Rickards, 1968.

Type species. Original designation. *Diplograptus Hughesi* Nicholson, 1869, p. 235, pl. 11, figs 9, 10; from the Llandovery of the Lake District, England.

Diagnosis. See Bulman, 1970, V126.

Pseudoclimacograptus (Metaclimacograptus) hughesi (Nicholson, 1869)

Plate 1, fig. 9

1869 *Diplograptus Hughesi*; Nicholson, p. 235, pl. 11, figs 9, 10.1975 *Pseudoclimacograptus (Metaclimacograptus) hughesi* (Nicholson, 1869); Hutt, p. 22, pl. 2, figs 6, 7, 13, 14 (see for further references).*Material.* 4 flattened, badly preserved specimens; GGU 216767, sec. 1, Kap Independence, Lafayette Bugt Formation.*Description.* The rhabdosomes attain a length of 7 mm, and are prolonged distally with a virgula up to 2 mm in length.

The specimens have only vague indications of introverted thecal apertures and undulating septa. In one specimen the thecal aperture excavations occupy 1/4 of the width of the rhabdosome. The thecae number 6–7.5 per 5 mm. The sicula has not been observed.

Remarks. The dimensions of the present specimens conform to the specimens described by Bulman & Rickards (1968) and Hutt (1974). The species is separated from *Pseudoclimacograptus (Metaclimacograptus) undulatus* (Kurck) (cf. Bjerreskov, 1975) by the more widely spread thecae and greater width. The present material is referred to *P. (M.) hughesi* mainly because of the dimensions of the rhabdosome, as the thecal structures are indistinct.Earlier *P. (M.) hughesi* was reported from the *acinaces* to *argenteus* Zones, but in Washington Land it is associated with a characteristic *convolutus* fauna.?Subgenus *Pseudoclimacograptus (Clinoclimacograptus)* Bulman & Rickards, 1968*Pseudoclimacograptus (Clinoclimacograptus)? washingtoni* n. sp.

Plate 1, figs 3, 4

1934 *Climacograptus scalaris* (Hisinger) var. *normalis* Lapworth; Poulsen, pp. 9–10, pl. 1, figs 2,3.*Material.* More than 300 specimens, preserved flattened, or in full relief. Most are in low relief; GGU 216839, Kap Schuchert, Cape Schuchert Formation. Lauge Koch collection: G.1-G.5 (G.1 = MGUH 3222), Kap Schuchert Formation.*Horizon.* The *argenteus* Zone, Llandovery.*Holotype.* Specimen MGUH 15190, GGU sample 216839, plate 4, fig. 1, Llandovery of Kap Schuchert, Cape Schuchert Formation.*Diagnosis.* Clinoclimacograptid? with introverted thecal apertures. The rhabdosome length is 3 cm and width from 0.5 mm proximally to a maximum of 1.9 mm

distally (flattened); thecal number 7.5 in the proximal 5 mm and 11 per 10 mm distally. Median septum slightly undulating proximally.

Description. The largest specimen obtains a length of about 3 cm. Full relief specimens have a round stipe. The rhabdosomes have a 1 mm long slender virgella, and occasionally a virgula up to 1.5 mm long has been observed. The median septum originates at the base of the aperture of $th2^1$ and is undulating in the proximal end. The width of the rhabdosome increases from 0.5 mm at $th1^1$, 0.8 mm at $th5^1$, 1.25 mm at $th10^1$ and is 1.5 mm at the level of $th20^1$ in specimens with low relief. In full relief specimens the width is 1.25 mm at a level around $th15^1$. The maximum distal width is 1.9 mm in flattened specimens.

The thecae have supragenicular walls which are curved and slightly concavo-convex. The apertural openings alternate and appear introverted, the excavations occupying 1/4 of the width of the rhabdosome proximally and 1/5 of the width distally. In scalariform view they are oblong, without any ventral lateral processes. The thecae overlap for about 1/3 of their length which at the level of the tenth thecal pair is 1.5 mm. The proximal thecae number 7.5 over 5 mm, and distally the thecal spacing is 10.5 in 10 mm. The sicular length has not been observed.

Remarks. The graptolite is most similar to *Pseudoclimacograptus* (*Clinoclimacograptus*) *retroversus* Bulman & Rickards, but is separated by the slightly more slender proximal part and wider distal end. No eversion of the dorsal thecal walls has been seen, and the median septum originates from the aperture of $th2^1$, and is not complete as in *P. (C.) retroversus*. *P. (C.)? washingtoni* is an intermediate between *Metaclimacograptus* and *Clinoclimacograptus*, having introverted thecae as *Metaclimacograptus*, but no hoods, and a slightly undulating median septum as in *Clinoclimacograptus*. Flattened specimens cannot be distinguished from *Climacograptus*.

P. (C.)? washingtoni is associated with a fauna indicating the *argenteus* Zone, and may be a forerunner of *P. (C.) retroversus*.

Genus *Glyptograptus* Lapworth, 1873

Type species. Original designation. *Diplograpsus tamariscus* Nicholson, 1868, p. 526, pl. 19, figs 10–13; from the Llandovery of Scotland.

Diagnosis. See Hutt, 1974, p. 24.

Subgenus *Glyptograptus* (*Pseudoglyptograptus*) Bulman & Rickards, 1968.

Type species. Original designation. *Glyptograptus* (*Pseudoglyptograptus*) *vas* Bulman & Rickards, 1968, p. 13; from the Llandovery of Cross Fell, Northern England.

Diagnosis. See Hutt, 1974, p. 29.

Glyptograptus (Pseudoglyptograptus) sp.

Plate 1, figs 6, 7

Material. 10 flattened specimens; GGU 216780, Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosome obtains a length of about 3 cm, and is prolonged with a virgula up to 2 cm in length, and occasionally with a short slender virgella. The width increases from 1 mm proximally to 1.5 mm at th5¹, 1.65 mm at th10¹, and to 1.8 mm at th15¹. The maximum distal width is 1.9 mm.

The thecae generally have a climacograptid appearance, with nearly straight supragenicular walls and well developed genicula. Occasionally the supragenicular walls are slightly concavo-convex, especially in the proximal end, where the apertures appear slightly introverted, as the ventral apertural rims have small lateral processes. The distal extent of thecae with processes is not known. The median septum originates at the aperture of th1² and appears to be nearly straight. The thecae number 7 in the proximal 5 mm, and 12 over the proximal 10 mm; distally 5 thecae occur in 5 mm. The sicula has not been observed.

Remarks. The assignment of these specimens to *Pseudoglyptograptus* is doubtful, as all the specimens are flattened, and the real thecal structures are difficult to discern, but they generally have a simple climacograptid appearance. However, the specimens appear to be rather similar to *Pseudoglyptograptus* sp. 1 and sp. 2 (Rickards, 1972). *G. (P.)* sp. is separated from *P.* sp. 1 by the longer distal width, and from *P.* sp. 2 by the apparently fewer thecae with ventral apertural processes.

In the present material *G. (P.)* sp. is associated with a *convolutus* fauna.

Genus *Petalograptus* Suess, 1851

Type species. Subsequent designation. Lapworth, 1873; *Prionotus folium* Hisinger, 1837, p. 114, pl. 35, fig. 8; from the Llandovery of Sweden.

Diagnosis. See Bulman, 1970, V126.

Petalograptus minor Elles, 1897

Plate 1, fig. 5

1897 *Petalograptus minor* sp. nov.; Elles, p. 201, pl. 14, figs 17–21.

1942 *Petalolithus minor* (Elles, 1897); Bouček & Příbyl, pp. 5–6, pl. 1, fig. 3, text-figs 1f–g.

1974 *Petalograptus minor* Elles, 1897; Hutt, p. 39, pl. 10, figs 2, 7–10 (see for further references).

1977 *Petalograptus minor* Elles; Carter & Churkin, p. 27, pl. 3, fig. 10.

Material. About 10 specimens, preserved flattened or with low relief; GGU 216839, sec. 4, Kap Schuchert, Cape Schuchert Formation. Lauge Koch collection: 2 relief specimens; G.4, Kap Schuchert, Cape Schuchert Formation.

Description. The largest specimen is 7.5 mm long and the width of the rhabdosome increases from 1 mm at th1¹ to a maximum of 3.8 mm at th5¹, decreasing distally to 3.6 mm. The median septum, which originates from the base of th3¹, appears incomplete.

The thecal tubes are inclined at 40°–50° to the axis of the rhabdosome, and they number 7.5 over the proximal 5 mm. The overlap increases from half the thecal length proximally to almost complete overlap in the distal part of the rhabdosome.

The sicula has not been clearly observed, but may reach to about the level of th3¹ - th4¹, and has a length of 1.3 to 1.8 mm.

Remarks. The present specimens are similar to those described by Hutt (1974). Of particular note is the fact that both sets of specimens have a larger rhabdosome width than the 2.5 mm given by Elles & Wood (1908).

P. minor has been reported from the *triangulatus* to *convolutus* Zones (Hutt, 1974 and Carter & Churkin, 1977). In the present material *P. minor* is associated with *P. ?leptothea* and *M. argenteus*, indicating the *argenteus* Zone.

Petalograptus ?conicus Bouček, 1932

Plate 1, fig. 8

Material. 1 flattened specimen; GGU 216811, sec. 3, South of Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosome is 1 cm long and with 15 pairs of thecae. The width of the rhabdosome at th1¹ is 1.5 mm, at th5¹ 2.5 mm, increasing to a maximum of 3 mm at th8¹. Distally the width decreases to 2 mm. The rhabdosome is prolonged with a 1 cm long virgula.

The thecae are slender tubes with parallel walls and the proximal thecae are inclined at 60° to the axis of the rhabdosome, the distal thecae are inclined at about 30°–40°. The thecae are at least 4 times as long as wide, and they number 15 per 10 mm. The sicula is 1 mm long.

Remarks. The specimen has closer set thecae and a larger width than *Petalograptus palmeus palmeus* (Barrande) which obtains a width of 2.0–2.5 mm and has 10–13 thecae per 10 mm. *P. ?conicus* is also wider than *Petalograptus hispanicus* (Haberfelner) being 2 mm wide and with 11–12 thecae per 10 mm. Thus, the present specimen appears to be most similar in dimensions to *P. conicus*, but until additional material has been studied it is only tentatively referred to this species. All three above-mentioned species have been reported from the *linnaei* Zone (Bouček & Přibyl, 1941). *P. ?conicus* is here associated with a graptolite fauna representing the *turriculatus* Zone.

Family RETIOLITIDAE Lapworth, 1873
 Subfamily RETIOLITINAE Lapworth, 1873
 (nom. transl. Bouček & Münch, 1952 (ex. Retiolitidae Lapworth, 1873)).
 Genus *Retiolites* Barrande, 1850

Type species. By monotypy. *Gladiolites Geinitzianus* Barrande, 1850, p. 69, pl. 4, figs 16–19, 24, 33; from the Lower Silurian of Bohemia.

Diagnosis. See Bulman, 1970, V128.

Retiolites geinitzianus angustidens Elles & Wood, 1908

Plate 6, fig. 1

1908 *Retiolites (Gladiograptus) Geinitzianus* Barrande, Var. *angustidens* nov.; Elles & Wood, p. 338, pl. 34, figs 9a-c.

1944 *Retiolites* (Ret.) *geinitzianus angustidens* Elles & Wood; Bouček & Münch, p. 37, figs 11a-e, 12b-e, pl. 2, figs 1–4.

1975 *Retiolites geinitzianus angustidens* Elles & Wood, 1908; Bjerreskov, pp. 38–39, pl. 5, figs D-E, table 3.

1976 *Retiolites angustidens* (Elles & Wood), 1908; Golikov, pp. 28–29, pl. 2, figs 6, 7, 9–12.

Material. Approximately 60 specimens. 7 specimens; GGU 216783, sec. 2, Kap Independence, Lafayette Bugt Formation. 1 specimen; GGU 242838, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. 13 flattened specimens; GGU 242839, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. Approximately 30 relief fragments; GGU 242840, loose blocks, Kap Lucie Marie, Kap Lucie Marie Formation. 4 flattened specimens; GGU 242900, Kap Tyson, Lafayette Bugt Formation. 1 flattened specimen; GGU 242918, Kap Godfred Hansen, Lafayette Bugt Formation. Lauge Koch collection: 2 fragments; E.5, Kap Independence, Lafayette Bugt Formation. 1 fragment; E.11, Kap Independence, Lafayette Bugt Formation. 2 flattened specimens; E.12, Kap Independence, Lafayette Bugt Formation.

Description. The largest specimen is about 3 cm in length. The initial width is 1–1.1 mm, increasing distally to a maximum width of 2.5 mm. One proximal specimen is prolonged with a 4 mm long virgula. In the reticulum there are about 7–9 meshes per millimetre. The thecae do not differ from previously described specimens of the species and they number 7 over the proximal 5 mm and 12 per 10 mm in the distal part of the rhabdosome.

Remarks. *R. geinitzianus angustidens* occurs frequently in the Washington Land material and is similar to earlier described specimens of this subspecies. The graptolite is indicative of the uppermost Llandovery to lowermost Wenlock.

Genus *Stomatograptus* Tullberg, 1883

Type species. Original designation. *Retiolites grandis* Suess, 1851, p. 99; from the Silurian of Bohemia.

Diagnosis. See Bulman, 1970, V130.

Stomatograptus grandis grandis (Suess, 1851)

Plate 5, fig. 7

1851 *Retiolites grandis*; Suess, p. 15, pl. 7, fig. 2.

1944 *Retiolites (Stomatograptus) grandis grandis* (Suess); Bouček & Münch, p. 49, fig. 15c, figs 16a-c, pl. 3, figs 7-8.

1975 *Stomatograptus grandis grandis* (Suess, 1851); Bjerreskov, pp. 39-40, pl. 5, fig. 1.

1978 *Stomatograptus grandis* (Suess); Wang, p. 309, pl. 3, figs 3-4.

Material. Approximately 20 specimens. 2 specimens; GGU 216783, sec. 2, Kap Independence, Lafayette Bugt Formation. 1 specimen; GGU 216784, sec. 2, Kap Independence, Lafayette Bugt Formation. 1 specimen; GGU 242838, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. 3 specimens; GGU 242839, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. 1 specimen; GGU 242917, Kap Godfred Hansen, Lafayette Bugt Formation. Lauge Koch collection: 3 specimens; E.13, Kap Independence, Lafayette Bugt Formation. 10 fragmentary relief specimens; 101.4, Kap Tyson, Lafayette Bugt Formation.

Description. The rhabdosome is straight with a maximum length of 7 cm. The width of the rhabdosome (in flattened specimens) increases quickly in the proximal end. At the first thecal pair the width is 1.2 mm, the tenth pair 2.9 mm, the twentieth pair 3.5 mm, and the thirtieth pair 4.0 mm. The maximum width obtained distally is 5.5 mm. In a few specimens the median row of pores was observed, and about 5-6 pores per 10 mm occur in the mesial part of the rhabdosome.

The thecae are inclined at 50°-55° to the axis of the rhabdosome; the proximal thecae are 0.45 mm wide, the distal thecae are 0.85 mm wide and about 3 mm long. They number 13-14 over the proximal 10 mm and distally the number decreases to 9 per 10 mm.

Remarks. The present specimens are very similar to *S. grandis grandis* described by Bouček & Münch (1944). Specimens from Sweden (Tullberg, 1883) and from Bornholm (Bjerreskov, 1975) possess longer rhabdosomes (9 cm) and a larger distal width (7 mm), but in all other aspects they are identical to the present material.

S. grandis grandis is a characteristic species for the *spiralis/crenulata* Zones of the uppermost Llandovery. Similarly in the Washington Land material the species is associated with a graptolite fauna indicative of this stratigraphic level.

Subfamily PLECTOGRAPTINAE Bouček & Münch, 1952

Genus *Plectograptus* Moberg & Törnquist, 1909

Type species. *Retiolites macilentus* Törnquist, 1887, p. 491: from the Lower Ludlow of Germany.

Plectograptus? intermedius n. sp.

Plate 1, figs 10, 11

Material. 20 flattened specimens, mainly proximal parts; Lauge Koch collection: F.1, Graptolitnæs, Lafayette Bugt Formation.

Horizon. The *riccartonensis* Zone, Wenlock.

Holotype. Specimen MGUH 15262, plate 1, fig. 11, Lauge Koch collection: F.1, Graptolitnæs, Lafayette Bugt Formation.

Diagnosis. Retiolitid with open clathrial meshes, proximally well developed reticulum diminishing distally, and an incorporated lateral virgula.

Description. The largest rhabdosome is 1.3 cm long and the width increases from 1.5 mm proximally to 2.5 mm at the level of the first thecal pair, and this width is maintained distally. Proximally the reticulum is well developed and it reduces distally from the level of the fifth thecal pair. Prior to the fifth thecal pair the clathria are indistinct, but distally they appear to attain the open subhexagonal meshes characteristic of *Plectograptus*. The virgula, which is incorporated in the lateral wall, becomes more distinct and stout towards the distal part of the rhabdosome.

The thecae are not clearly seen, but appear to be inclined at 45° to the axis of the rhabdosome. The lower apertural lists do not appear to be greatly arched, and generally only the upper ones were observed. The thecae number 6.5 to 7 in the proximal 5 mm, and distally 5 per 5 mm.

Remarks. The new species is recognised from other plectograptids by the well developed reticulum proximally, with an incorporated virgula. The specimens most resemble *Plectograptus praemacilentus* Bouček & Münch (Bouček & Münch, 1952). However, *P.? intermedius* has a distally extended reticulum, and the subhexagonal meshes in the clathria become distinct only towards the distal part. The rhabdosomes are slightly wider. The 45° inclination of the thecae together with the well developed virgula separates the species from *Plectograptus(?) textor* Bouček & Münch, which is reported from a level around the *rigidus* Zone (Bouček & Münch, 1952).

The specimens occur with *M. riccartonensis*, apparently indicating the lower Wenlock. Previously no retiolitids have been recorded from this stratigraphic level (Rickards *et al.*, 1977). The morphology of *P.? intermedius* may indicate that there is virtually a straight evolutionary line from *P.? intermedius* to *P. praemacilentus* in the Upper Wenlock, with the virgula becoming free in the younger forms. This may leave *P. (?) textor* in a separate lineage, not a progenitor to the 'real' *Plectograptus* forms.

P.? *intermedius* possibly belongs to a new genus, representing a transition between the Retiolitinae and the Plectograptinae. However, the small amount of material together with the poor preservation of the proximal ends does not permit analysis of the ontogenetic development of the species thus precluding erection of a new genus. At present the specimens are referred to *Plectograptus?* due to the similarity with *P. praemacilentus*.

Family MONOGRAPTIDAE Lapworth, 1873

Genus *Monoclimacis* Frech, 1897

Type species. Original designation; *Graptolithus vomerinus* Nicholson, 1872, emend. Lapworth; from the Coniston Flags of Northern England.

Diagnosis. See Bulman, 1970, V134.

Monoclimacis? *crenularis* Lapworth, 1880

Plate 2, figs 1, 2

1880 *Monograptus crenularis* sp. nov.; Lapworth, p. 153, pl. 4, figs 10a-e.

1975 *Monoclimacis?* *crenularis* (Lapworth, 1880); Hutt, pp. 56–57, pl. 9, figs 8–10, text-fig. 14, figs 1, 2 (see for further references).

Material. 8 flattened specimens; GGU 216780, sec. 2, Kap Independence, Lafayette Bugt Formation. 1 flattened fragment, possibly referable to *M.?* *crenularis*; GGU 216767, Kap Independence, Lafayette Bugt Formation.

Description. The material only comprises fragments, and the sicula and extreme proximal ends are not known. The longest fragment is 8 cm. In the proximal end the rhabdosomes are slightly curved dorsally, becoming straight distally. The most proximal part is 0.25 mm wide increasing to 1.25 mm wide in the most distal parts.

In the Greenland specimens as many as 8 proximal thecae with small hooks were observed. These hooks occupy 1/3 of the width of the rhabdosome, disappearing distally, and the thecae show well developed genicula and semicircular apertures with genicular hoods. Distally the thecal apertures occupy about 1/4 of the width of the rhabdosome and 1/4 of the thecal height. The thecae are about 1.25 mm long and overlap, although the extent cannot be clearly distinguished. The most proximal thecae number 5.5 in 5 mm and distally the number falls to 4.5 per 5 mm.

In GGU sample 216767 (plate 2, fig. 2) a fragment is 0.6 cm long and dorsally curved. It is possibly a proximal part of a rhabdosome, with the width increasing from 0.5 mm to 0.9 mm. The thecae are elongated and slender, apparently with small hooks. The width of the thecal tubes is 0.25 mm, and the overlap may be 1/3 of the thecal height. 6 thecae occur in 5 mm.

Remarks. The specimens are similar to material described earlier, except that they may obtain a slightly larger distal width (1.25 mm) compared to the specimen illustrated in Elles & Wood (1911, pl. 41, fig. 7c), which is 1 mm wide. Hutt (1974) reports a width of 0.75 mm, for full relief specimens.

The specimen in GGU sample 216767 resembles *M. argenteus* but has slightly closer set thecae in the proximal end. It has the same dimensions and thecal number per cm as *M. ? crenularis*. However, the badly preserved thecal structures do not allow observation of the geniculum, and the thecal hoods could be true hooks instead of hook shaped genicular hoods which are reported from this species by Rickards (1968) and Hutt (1974). As the distal part of the rhabdosome is missing, the fragment is only tentatively referred to *M. ? crenularis*.

Earlier reports place *M. ? crenularis* in the *convolutus* Zone, which is also the case with the present material.

Monoclimacis crenulata sensu Elles & Wood, 1911

Plate 2, fig. 3

1911 *Monograptus vomerinus* (Nicholson Var. *crenulatus* (Törnquist); Elles & Wood, pp. 412–413, text-figs 278a–c, pl. 41, figs 4a–d.

? 1940 *Monoclimacis crenulata* (Törnquist); Přibyl, p. 6, pl. 2, figs 17, 18.

Material. 1 proximal and 3 distal fragments, all flattened; GGU 216783; sec. 2, Kap Independence, Lafayette Bugt Formation.

In addition about 10 flattened fragments; GGU 242900, Kap Tyson, Lafayette Bugt Formation, may be referred to *M. crenulata sensu* Elles & Wood.

Description. The rhabdosomes in sample GGU 216783 are straight throughout, the longest fragment is 11 cm and the maximum distal width 1.8 mm. In the proximal portion of the specimen the width increases from 0.5 mm at th1, to 0.65 mm at th5, to 0.75 mm at th7.

The thecae are of the *Monoclimacis* type. They number 6 in 5 mm proximally and in distal specimens there are 7.5–8 thecae per 10 mm.

The sicula is 1.25 mm long and the apex nearly reaches to the middle of th2. Th1 originates 0.2 mm from the aperture of the sicula and has a recurved closely adpressed apertural part.

In sample GGU 242900 the maximum length of the fragments is 6 cm, and all the specimens are straight. Only one badly preserved proximal part has been observed, and the sicula has not been seen. The most proximal theca is 0.4 mm wide, and the width increases over 10 thecae to 1.0 mm. The maximum width is 1.9 mm.

The thecae are of the *Monoclimacis* type, but they have poorly developed genicula. Whether the proximal thecae are hooked or the thecae are uniform throughout the stipe has not been observed. The distal thecae are 1.2 mm long,

they overlap for 2/3 of their length and are inclined at 30° to the rhabdosome. The distal width of the tubes is 0.4 mm. The thecae number 6 per 5 mm proximally and distally 4 per 5 mm.

Remarks. The Washington Land material only differs from *M. crenulata sensu* Elles & Wood in having a 0.75 mm shorter sicula.

Monoclimacis crenulata (Törnquist) described by Törnquist (1881 and 1892) has a 2 mm long sicula and no prominent hooked proximal thecae, features very similar to those of *M. vomerina vomerina*.

M. crenulata sensu Elles & Wood in Washington Land, GGU sample 216783, is associated with a graptolite fauna indicating the uppermost Llandovery and conforming precisely to earlier range reports for the species.

In GGU sample 242900 the specimens show some similarity to *M. vomerina?* in GGU samples 242838 and 242839, but they have a more slender proximal part and longer distal thecae. The graptolites are most like *M. crenulata sensu* Elles & Wood (1911) and *M. aff. crenulatus sensu* Elles & Wood described by Bjerreskov (1975) with regard to rhabdosome and thecal morphology. However, the present specimens are only tentatively referred to this species as the proximal end with the sicula has not been seen. The specimens are associated with *R. geinitzianus angustidens* and *M. ?parapriodon* most probably indicating the uppermost Llandovery.

Monoclimacis aff. *M. linnarssoni* (Tullberg, 1883)

Plate 2, figs 4, 5

Material. About 40 flattened specimens; GGU 242838 and 242839, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. Lauge Koch collection: 10 relief specimens; 101.2, Kap Tyson. 4 relief specimens; 101.4, Kap Tyson. 30 relief fragments; I.1, Kap Tyson, all from Lafayette Bugt Formation.

Description. The rhabdosomes are straight, and the largest specimen is 6 cm long. In unflattened specimens the width increases from 0.3 mm proximally (0.4 mm in flattened specimens) to 0.5 mm at th5 and 0.65 mm at th10; the maximum distal width is 0.8 mm.

The thecae are of the *Monoclimacis* type with ventrally facing apertures. In flattened specimens small dorsally prolonged thecal walls or genicular hoods are observable. In the flattened specimens the apertures occupy 1/3 of the width of the rhabdosome and 1/4 of the height of the thecae. In relief specimens the interthecal walls are inclined at about 10°–20° to the axis of the rhabdosome, and are slightly sigmoidal in both ends. Distally the thecae overlap for half their length. Proximally the thecae number 5–5.5 in 5 mm and distally the number is 9.5–10 per 10 mm.

Among flattened specimens with proximal ends, the sicula is 1.5 mm long and the apex reaches to the aperture of th1. Th1 is 1.1 mm long and originates 0.33 mm from the aperture of the sicula.

Remarks. The present specimens resemble *Monograptus linnarssoni* described by Tullberg (1883) but have slightly shorter siculae and more slender distal parts. The distal width reported earlier for *M. linnarssoni* s.l. was 1.0 mm (Přibyl, 1940) and 1.1 mm (Bjerreskov, 1975). The thecae are slightly more closely set than in the original material where the thecal count distally is 8.5 per 10 mm.

The flattened Washington Land specimens have larger apertures than those described in *M. linnarssoni* by Bjerreskov (1975).

The specimens show some affinity to *Monoclimacis sublinnarssoni* Přibyl because of their closer set thecae and the more slender rhabdosome. However, a more detailed investigation of *M. sublinnarssoni* is needed for a full comparison.

The slender rhabdosome and thecal spacing of *M. aff. M. linnarssoni* recall *M. griestoniensis*, but the two species can be easily separated by the more rapid increase in width of the former.

M. aff. M. linnarssoni is associated with *R. geinitzianus angustidens*, *S. grandis grandis* and *M. priodon*, indicating the uppermost Llandovery.

Monoclimacis vomerina s.l. (Nicholson, 1872)

Not figured

1850 *Graptolithus colonus* Barr.; Barrande, pl. 2, fig. 4.

1872 *Graptolithus vomerinus*; Nicholson, p. 53, figs 21a-c.

1910 *Monograptus vomerinus* (Nicholson); Elles & Wood, pp. 409-411, text-figs 275a-f, pl. 41, figs 1a-e, ?c.

Material. 5 flattened specimens; GGU 242918; Kap Godfred Hansen, Lafayette Bugt Formation. Lauge Koch collection: about 5 small fragments; E.5, Graptolitprofillet, Kap Independence, Lafayette Bugt Formation.

Description. Only fragments without proximal ends have been observed and the maximum length is 4.5 cm. The most proximal part is 1 mm wide and 1 cm long, and there the thecae number 4.5 per 5 mm. In the most distal fragment the thecae number 8 per 10 mm. The thecae are of *M. vomerina* type, and in the most distal fragment they are 2.5 mm long and overlap 1/2 to nearly 2/3 of their length.

Remarks. The specimens can be referred to *M. vomerina* s.l. but are too badly preserved for assignment to any subspecies.

M. vomerina is associated with *R. geinitzianus angustidens* and *M. priodon*, indicating the Upper Llandovery to Lower Wenlock.

Monoclimacis ?vomerina (Nicholson, 1872)

Plate 2, fig. 12

Material. About 10 specimens, preserved flattened or in very low relief; GGU 242838 and 242839, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. 1 fragment; GGU 242840, loose material, Kap Lucie Marie, Kap Lucie Marie Formation.

Description. The largest specimen is a distal fragment which is straight and 10 cm long. In one badly preserved proximal specimen the width of the rhabdosome increases from 0.75 mm at th1, to 1.3 mm at th10, and to 1.6 mm at th20. The maximum distal width is 2.3 mm.

The thecae are of the *vomerina* type but the genicula are not pronounced. The distal thecal tubes are 0.5–0.65 mm wide and 2 mm long. The inclination of the interthecal septum is 30°–35° in the distal part of the rhabdosome. The thecae number 11 per 10 mm in the proximal part and 8.5 per 10 mm in the distal rhabdosome.

In the proximal portion of the specimen the sicula is indistinct, about 1.25 mm long, and its apex may reach between th1 and th2.

Remarks. The specimens have less pronounced genicula and a lower inclination of the interthecal septa than generally seen in *M. vomerina*. The specimens are associated with a graptolite assemblage indicating the uppermost Llandovery.

Monoclimacis vomerina ssp. 1.

Plate 2, fig. 13

Material. About 15 specimens, all flattened; GGU 216812, sec. 3, south of Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosomes are straight and slender, with an increase in width from 0.45 mm at th1, to 0.5 mm at th5, to 0.6 mm at th10 and to 0.65 mm at th14. The maximum distal width is 1.55 mm, obtained by a 10 cm long distal fragment.

The thecae are of the *Monoclimacis* type, the 6 proximal thecae apparently have small hooks, occupying 1/3 to 1/4 of the width of the rhabdosome. In the vomerimid distal thecae the apertures occupy 1/3 of the width of the rhabdosome and 1/3 of the height of the free ventral walls. Small dorsal hoods appear to be present. The distal thecae are about 0.35 mm wide and 2 mm long and the interthecal septa are inclined at about 20° to the axis of the rhabdosome. In the proximal 5 mm the thecal count is 6.5 and over the proximal 10 mm it is 12.5. The thecae number 8 per 10 mm in the most distal portion.

The sicula is 1.3 mm long and the apex reaches slightly above the aperture of th1, which is 0.8 mm high and originates very close to the aperture of the sicula.

Remarks. The present specimens resemble *Monoclimacis crenulata* (Törnquist) but have a larger number of hooked proximal thecae, are more slender and have a less pronounced increase in width. *M. vomerina* ssp. 1 is rather similar to *Monograptus vomerinus* n. subsp. of Bjerreskov (1975), but the present specimens have closer set proximal thecae. The latter has 9.5 thecae per 10 mm.

The graptolite is separated from *M. linnarssoni* and *M. sublinnarssoni* by the wider distal part and by the presence of the hooked proximal thecae. The specimens show some affinity to *M. cf. griestoniensis* Elles & Wood which, however, on pl. 41, figs 6a and b (Elles & Wood, 1910) might be two separate species. The present specimens are distinguished from the specimen on fig. 6a by the wider proximal part and hooked proximal thecae. From fig. 6b they are distinguished by the more distant distal thecae and higher number of proximal hooks.

The present specimens are closely associated with the *vomerina* group and appear to be within a plexus with closely set proximal thecae in combination with a slow increase in width.

M. vomerina ssp. 1 is associated with *M. spiralis spiralis* indicating the uppermost Llandovery.

Monoclimacis vomerina ssp. 2

Plate 2, figs 10, 14

Material. About 60 flattened specimens; GGU 242832, sec. 5, Kap Lucie Marie, Offley Island Formation.

Description. The rhabdosome, which obtains a length of more than 6 cm, is slender, generally straight, but may occasionally be slightly flexed. The width increases from 0.45 mm at th1 to 0.65 mm at th5, to a maximum distal width of 1.4 mm.

The thecae are of the *Monoclimacis* type, with prolongation of the apertural dorsal walls in the proximal thecae. In the distal part of the rhabdosome the thecal apertures occupy 1/3 of the free ventral walls and 1/4 of the width of the rhabdosome. The intertheical septum is inclined at 20° to the axis of the rhabdosome. The distal thecae are 2 mm long. Proximally the thecae number 5.5 per 5 mm, and distally the number is 8 per 10 mm.

The sicula is 1.5 mm long and the apex reaches to the geniculum of th2. Th1 originates 0.35 mm from the aperture of the sicula and is 1.25 mm high.

Remarks. The graptolite is somewhat similar to *M. vomerina* ssp. 1 from sample GGU 216812, except that it possesses less closely set thecae, is without apertural hooks in the proximal part, and has a faster width increase of the stipe. From *M. aff. M. linnarssoni*, *M. vomerina* ssp 1 is separated by the more robust proximal end.

There are no graptolites associated with *M. vomerina* ssp. 2 indicating a precise stratigraphic level. However, from regional considerations it occurs in the uppermost Llandovery.

Monoclimacis sp.

Plate 2, figs 9, 15

Material. 3 flattened fragments; GGU 216767, sec. 1, Kap Independence, Lafayette Bugt Formation. 2 flattened fragments; GGU 216781, Kap Independence, Lafayette Bugt Formation.

Description. The fragments are straight and have a maximum length of 1.5 cm. The width is 0.5 mm throughout.

The thecae are of the *Monoclimacis* type with a pronounced geniculum and apertures with dorsal hoods and subparallel prothecal walls. The thecal overlap is 1/3 of the thecal length of 1.9 mm. The apertures appear rounded and occupy 1/3 of the width of the rhabdosome and 1/4–1/5 of the length of the supragenicular walls. The thecae number 4.5–6 per 5 mm. No proximal end with sicula has been observed.

Remarks. The specimens are very similar to *Monoclimacis* ? described by Hutt (1975). In particular the dimensions of the distal parts appear equal. However, the present specimens have straight rhabdosomes, and the species reported by Hutt is dorsally curved. *Monoclimacis* sp. is separated from *M. aff. M. linnarssoni* by a more slender rhabdosome and slightly closer set thecae. Hutt (1975) reported *Monoclimacis* from the *argenteus* Zone, but the present specimens are associated with graptolites indicating the *convolutus* Zone (in GGU sample 216767).

Genus *Pristiograptus* Jaekel, 1889

Type species. Original designation. *P. frequens* Jaekel, 1889, p. 669, pl. 28, figs 1, 2; from the Silurian of Germany.

Diagnosis. See Bulman, 1970, V134.

Pristiograptus regularis regularis (Törnquist, 1899)

Plate 2, fig. 8

1899 *Monograptus regularis* n. sp.; Törnquist, p. 7, pl. 1, figs 9–14.

1970 *Pristiograptus regularis regularis* (Törnquist, 1899); Rickards, p. 59, pl. 5, fig. 4, text-fig. 16, fig. 16.

1975 *Pristiograptus regularis regularis* (Törnquist, 1899); Hutt, pp. 58–59, pl. 11, fig. 10, pl. 12, fig. 4, text-fig. 14, fig. 7.

Material. 5 flattened specimens; GGU 216780, sec. 2, Kap Independence, Lafayette Bugt Formation. Lauge Koch collection: 1 flattened specimen; E.1, Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosome is straight and the largest specimen is 2 cm long. The width at th1 is 0.35 mm, increasing to 0.5 mm at th5 and to 0.75 at th10. The maximum distal width is 1 mm.

The thecae are straight tubes with nearly parallel walls. The distal thecae are 2 mm long, inclined at 25° to the axis of the rhabdosome, and they overlap for 1/2 of their length. Proximally the thecae number 7 per 5 mm and distally the number is 5 per 5 mm.

The sicula is 0.75 mm long and the apex reaches to the aperture of th1 which is 0.8 mm long and originates close to the aperture of sicula.

Remarks. The specimens which only include short rhabdosomes appear to be identical to the previously described *P. regularis*. *P. regularis regularis* has been reported from the upper part of the *convolutus* Zone (e.g. Törnquist, 1899; Bjerreskov, 1975) and from the *convolutus* – *sedgwickii* Zones (Hutt, 1975), whilst Rickards (1970) has extended its range into the *turriculatus* – *griestoniensis* Zones. In Washington Land, in GGU sample 216780, *P. regularis regularis* is associated with *M.?* *crenularis* and *Rastrites sp.*, referable to the *convolutus* Zone. In sample E.1 one badly preserved specimen, probably referable to *P. regularis regularis*, is associated with a *turriculatus* fauna.

Pristiograptus bjerringus schucherti n. ssp.

Plate 2, figs 6, 16

Material. About 20 fragments, all flattened; GGU 216846, sec. 4, Kap Schuchert, Cape Schuchert Formation.

Horizon. The *turriculatus* Zone ?, Llandovery.

Holotype. Specimen MGUH 15212, GGU sample 216846, plate 2, fig. 16, Llandovery of Kap Schuchert, Cape Schuchert Formation.

Diagnosis. Rhabdosome long, straight or slightly flexed. Proximal part narrower than that of type species and with smaller increase in width. Width from 0.3 mm proximally to 2.7 mm distally. Thecae numbering 8–10 per 10 mm, distally becoming 3.5 mm long and with a 2/3 overlap.

Description. The largest fragment, which lacks the proximal end, is 10 cm long. The width increases from 0.3 mm at th1 to 0.5 mm at th5, 0.75 mm at th10, and 1.0 mm at th20. The maximum width is normally 2.5 mm, but occasionally 2.7 mm is obtained.

The thecae are typical pristiograptid, straight and with simple apertures. In the proximal part the overlap is 1/4 to 1/3 of the thecal length, and the ventral walls are inclined at 25° to the axis of the rhabdosome. In the distal part the inclination is about 30°, and here the length of the thecae increases to 3.5 mm and the overlap to about 2/3. The apertures of the distal thecae are 0.5 mm wide, and they are situated perpendicular to the axis of the thecae and occasionally appear slightly

everted. The thecae number 5–5.5 in the proximal 5 mm, and in the distal part the number decreases to 8 per 10 mm.

The sicula is 0.9 mm long and the apex reaches to the aperture of th1.

Remarks. The graptolite shows great resemblance to *Pristiograptus bjerringus bjerringus* (Bjerreskov) and to *Pristiograptus largus* (Perner). Both species are large forms contained within the *nudus*-group.

From *P. bjerringus bjerringus* the new subspecies is separated by the more slender proximal part and the more gradual increase in width. The thecae are slightly more widely spaced at 8–10 per 10 mm compared to 9–11 per 10 mm in *P. bjerringus bjerringus*. The latter also has a larger thecal overlap, amounting to 3/4 of the thecal length.

P. bjerringus schucherti can be distinguished from *P. largus* by the more slender proximal part and thecae. In *P. largus* the thecae are twice as long as wide, and are more widely spaced at 7–9 per 10 mm (Příbyl, 1943).

The present specimens are separated from *P. regularis* by the wider spaced proximal thecae and the larger distal width.

P. bjerringus schucherti is associated with badly preserved spirally coiled specimens which may represent *M. turriculatus*.

Pristiograptus dubius ?ludlowensis (Bouček, 1936)

Plate 2, figs 7, 11

Material. About 70 flattened specimens; GGU 216789, sec, 2, Kap Independence, Lafayette Bugt Formation.

Description. Maximum length of rhabdosome 2 cm. The proximal part is ventrally curved to about the level of th5, and the distal portion is straight. The width at th1 is 0.65–0.75 mm, at th5 1.2 mm, at th10 1.2–1.4 mm, and the distal maximum width is 1.8 mm.

The thecae which are of the *dubius* type are uniform throughout. The proximal thecae overlap 1/2 to 1/3 of their length and are inclined at about 20°. The distal thecae are at maximum 1.8 mm long and overlap nearly 2/3 of their length, and are inclined at about 30° to the axis of the rhabdosome. The thecal count is 11 in the proximal 10 mm.

The sicula is 1.5 mm long and the apex reaches to the level of the aperture of th2. Th1 which is 1 mm long, starts very close to the aperture of the sicula, and the free part of the th2 is 0.65 mm long.

Remarks. The material, which is mainly juvenile specimens, is tentatively referred to *P. dubius ludlowensis*. In particular, the dimensions of the rhabdosome are similar to those reported by Příbyl (1943). However, the reference to *P. dubius*

ludlowensis is slightly questionable as *P. dubius dubius* forms in the Wenlock may also be of similar dimensions (written information from H. Jaeger, 1978).

P. dubius ?ludlowensis is the only graptolite in the sample and may indicate an early Ludlow age.

Pristiograptus cf. *P. jaegeri* Holland, Rickards & Warren, 1969

Plate 2, fig. 18

Material. 1 nearly flattened specimen; Lauge Koch collection; F. 3, Graptolitnæs, Lafayette Bugt Formation.

Description. The specimen is a proximal fragment, preserved in very low relief. The stiff rhabdosome is 1.5 cm long, the width increases from 0.75 mm at th1 to 1.25 mm at th5, and to a distal width of 1.7 mm.

The thecae are pristiograptid. Th1 which originates 0.55 mm from the aperture of the sicula, is 1.5 mm long and 0.5 mm wide at the aperture. The inclination of the interthecal septa is 20°.

Towards the distal parts of the rhabdosome the thecal length increases to 2.5 mm and the overlap to 2/3 of the thecal length. The distal thecae are 0.65 mm wide and inclined at 30° to the axis of the rhabdosome. The thecal count is 5.5 in the proximal 5 mm and 4 in the distal 5 mm.

The sicula appears to be 2.2 mm long and the apex reaches to the dorsal part of the aperture of th1.

Remarks. The dimensions of the stiff rhabdosome, the thecal morphology and the sicular size are like those of *P. jaegeri*. In the present specimen the apex of the sicula only reaches to the aperture of th1, whilst in *P. jaegeri* it reaches to the aperture of th2. Further, in *P. cf. P. jaegeri* the interthecal septum is distally inclined at 40° to the axis of the stipe (Holland *et al.*, 1969).

P. jaegeri has been reported from the *lundgreni* to *nilssoni* Zones (Holland *et al.*, 1969). L. Koch indicated that the present specimen occurred in the same level as *M. riccartonensis*. It is possible that *P. cf. P. jaegeri* represents an early form of *P. jaegeri*, and evolution within the species lineage tends towards a more distal position of the apex of the sicula, from a position at the aperture of th1 to that of th2. Parallel development of this feature is also observed in the *priodon-flemingii* lineage (e.g. illustrated in Rickards *et al.*, 1977, fig. 22).

Genus *Pribylograptus* Obut & Sobolevskaya, 1966

Type species. Original designation. Obut & Sobolevskaya 1966, p. 33; *Monograptus incommodus* Törnquist, 1899, p. 11, pl. 2, figs 1–5; from the Llandovery of Sweden.

Diagnosis. Emended by Rickards (1976a).

Pribylograptus ?leptotheca (Lapworth, 1876)

Plate 2, fig. 17

Material. 1 short fragment preserved as a cast with nearly full relief (Poulsen, 1934, pl. 1, fig. 5; MGUH 3224), Lauge Koch collection: G. 4, Kap Schuchert, Cape Schuchert Formation, and 2 fragments preserved in low relief; GGU 216839, Kap Schuchert, Cape Schuchert Formation.

Description. Two specimens are apparently mesial fragments, 1 cm (MGUH 3224) and 2.5 cm long. Their width is 0.65 mm throughout.

The thecae are 2 to 3 mm long and they overlap for 2/3 of their length. They are 0.15–0.2 mm wide and inclined at 10°–15° to the rhabdosome. The apertural structures cannot be seen. The thecae number 9.5 per 10 mm.

The third fragment is possibly a more distal fragment, which is 0.8 mm wide and with thecae 2.5 mm long numbering 4 per 5 mm.

Remarks. By comparison with earlier descriptions of *P. leptotheca* (e.g. Hutt, 1975; Bjerreskov, 1975) the fragments most likely represent proximal to mesial parts of *P. leptotheca* rhabdosomes.

P. leptotheca has been reported from the *argenteus-sedgwickii* Zones by Hutt (1975), and in Greenland *P. ?leptotheca* is associated with a fauna indicating the *argenteus* Zone.

Genus *Bohemograptus* Přibyl, 1967

Type species. *Graptolithus bohemicus*, Barrande, 1850; from the Silurian of Bohemia.

Diagnosis. See Urbanek, 1970, p. 265.

Bohemograptus bohemicus bohemicus (Barrande, 1850)

Plate 3, fig. 1

1850 *Graptolithus bohemicus* Barrande; Barrande, p. 40, pl. 1, figs 15–18.

1970 *Bohemograptus bohemicus bohemicus* (Barrande, 1850); Urbanek, pp. 267–275, pl. 10, pl. 13, fig. C, pl. 20, fig. A, text-figs 10, 11 (see for further references).

Material. 5 flattened specimens; Lauge Koch collection: F.4, Graptolitnæs, Lafayette Bugt Formation.

Description. The rhabdosome is strongly curved ventrally. The largest rhabdosome (without the sicula) is about 2 cm long, and appears to be broken near the extreme proximal end. The width increases from 0.5 mm at th1, to 1.0 mm at th5, 1.2 mm at th10, and to a maximum distal width of 1.3 mm.

In the distal thecae the ventral walls are inclined at 35° and the apertures are inclined at 120° to the axis of the rhabdosome. The overlap cannot be seen. The proximal thecae number 6 per 5 mm and the distal thecae 5.5 per 5 mm.

The sicula is indistinct but appears to be 1.5 mm long with the apex at the level of the aperture of th1. The base of the protheca of th2 is 0.3 mm wide.

Remarks. The wider rhabdosome and longer sicula of *B. bohemicus bohemicus* separate it from *B. bohemicus tenuis* (Bouček) (Urbanek, 1970). However, the length of the sicula in the Greenland material overlaps the range of sicula length for the two subspecies indicated by Urbanek (1970).

B. bohemicus bohemicus is characteristic of the lower to middle Ludlow. However, the Washington Land material is not associated with other species, so a more precise stratigraphic level cannot be determined. Thorsteinsson (1958) and Jackson & Lenz (1962) noted a shorter range for this species in Arctic Canada than in Europe (e.g. Urbanek, 1970). As the Washington Land graptolite fauna appears more like the Canadian than the European, the present material might also indicate the lowermost Ludlow.

Genus *Monograptus* Geinitz, 1852 emend.

Type species. Subsequent designation. Bassler, 1915, p. 822; *Lomatoceras priodon* Bronn, 1835, p. 56, pl. 1, fig. 13; from the Silurian of Germany.

Remarks. Discussion of the genus *Monograptus* can be found in Rickards (1970), Bulman (1970), Bulman & Rickards in Bulman (1970) and Rickards *et al.* (1977).

Diagnosis. See Bulman 1970, V132.

The descriptions of the monograptid species are arranged in alphabetical order.

Monograptus argenteus (Nicholson, 1869)

Plate 3, fig. 3

1869 *Graptolites argenteus* n. sp.; Nicholson, p. 239, pl. 11, fig. 19.

1892 *Monograptus cygneus* n. sp.; Törnquist, p. 16, pl. 1, figs 28–31.

1975 *Monograptus argenteus* (Nicholson, 1869); Hutt, pp. 73, 74, 76–78, pl. 17, figs 1–8, pl. 18, fig. 4, text-fig. 17, figs 1, 2 (see for further references).

Material. 5 specimens in low relief; GGU 216839, sec. 4, Kap Schuchert, Cape Schuchert Formation. Lauge Koch collection: 1 specimen; G. 4, Kap Schuchert, Cape Schuchert Formation.

Description. The largest specimen is 4 cm long with a dorsally curved proximal portion and indistinct thecae. Distally the rhabdosome becomes nearly straight. The proximal end and sicula are not known in the Greenland material.

The most proximal fragment has an initial width of 0.5 mm, and widens to 1 mm over a distance of 1 cm. The maximum distal width is 1.2 mm.

The thecae are elongated, and the proximal ones have small apertural hooks, whereas the distal thecae are cylindrical with simple apertures. Generally the thecal overlap is indistinct, but in the mesial part of the rhabdosome it is half the thecal length, and the interthecal septa are inclined at about 25° to the axis of the rhabdosome. The thecae number 5 per 5 mm in the most proximal fragment and 10–11 over 10 mm in a specimen showing the distal part.

Remarks. The present material conforms to earlier descriptions of the species, even though the very slender proximal parts with sicula (e.g. Hutt, 1975) have not been observed. In Washington Land *M. argenteus* is associated with *P. minor* and *P. ?leptotheca* indicating the upper part of the *argenteus* Zone.

Monograptus ?barrandei (Suess, 1851)

Plate 3, fig. 2

Material. 1 distal fragment, and 2 proximal ends. Lauge Koch collection: E.1, Kap Independence, Lafayette Bugt Formation.

Description. The distal fragment is a 0.5 cm long, straight and flattened specimen, which is 0.5 mm wide throughout and with the thecae numbering 5.5–6 in 5 mm.

The largest proximal fragment is 0.45 cm long and curved ventrally at the level of th3; the most proximal part is straight. The width of the rhabdosome is 0.35 mm at th1 increasing to 0.5 mm at th5.

The thecae are of the *exiguus* type with enrolled metathecal parts forming closely adpressed lobes which occupy 1/3 of the width of the rhabdosome and nearly 1/2 of the height of the thecae. The prothecal parts are nearly parallel sided. The proximal thecae number about 5.5–6 per 5 mm. The sicula is 1 mm long and the apex reaches to the aperture of th1.

Remarks. The present specimens resemble *M. cf. barrandei sensu* Elles & Wood as described by Bjerreskov (1975). However, in previously described material the distal thecae are wider spaced, 8 per 10 mm, compared to 11–12 per 10 mm in the present material.

The associated graptolites indicate the *turriculatus* Zone. This agrees with earlier reported occurrence for *barrandei* forms (e.g. Elles & Wood, 1912; Bjerreskov, 1975).

Monograptus ?convolutus (Hisinger, 1837)

Plate 3, fig. 5

Material. 1 fragment preserved in low relief; Lauge Koch collection: G.1 with MGUH 3222, Poulsen (1934, pl. 1, fig. 4), Kap Schuchert, Cape Schuchert Formation.

Description. The 6 mm long fragment is slightly curved dorsally and with 6 thecae. The maximum rhabdosome width is 2.1 mm.

The thecae are triangular, with slender prothecal parts, 0.3 mm in width. The tapering metathecal parts are situated perpendicular to the axis of the rhabdosome. The apertures appear to have one spine, but the structure cannot be clearly observed. The thecae number 5 per 5 mm.

Remarks. The fragment is similar to the part of a *M. convolutus* rhabdosome where the oldest triangular thecae are situated (e.g. Sudbury, 1958; Hutt, 1975). The specimen is also reminiscent of *Monograptus pulcherrimus* Manck and *Monograptus colossicus* (Golikov), both large members of the 'Demirastrites' group (see Golikov, 1973a). Since, however, the dimensions of the rhabdosome, the exact thecal structures and the proximal parts are unknown, the fragment is only tentatively referred to *M. convolutus*.

Monograptus ?decipiens Törnquist, 1899

Plate 3, figs 10, 11

Material: 3 flattened specimens; GGU 216767, sec. 1, Kap Independence, Lafayette Bugt Formation.

Description. Proximally the rhabdosome is circularly curved dorsally, but due to torsion of the stipe the distal part may be either dorsally or ventrally curved. The largest specimen is a 2 cm long fragment, but the proximal part with sícula has not been observed. The most proximal width is 0.6 mm, the width increasing over 3 thecae to 0.9 mm. The maximum distal width is 1.3 mm.

The thecae are biform; at least 8 proximal thecae are rastritiform, and distally the thecae become subtriangular with small retroverted apertural hooks. The state of preservation does not allow any observations of the apertural details. The most proximal rastritiform thecae are inclined at 30° to the rhabdosome and the inclination increases to 90° in the fourth theca. The thecae number 5.5 per 5 mm in the most proximal fragment, whilst distally the thecal count is 5 per 5 mm.

Remarks. The width of the rhabdosome and the thecal spacing of the specimens is similar to the original description (Törnquist, 1899). Generally *M. decipiens* only possesses a dorsal curvature, but in the present material the rhabdosomes are twisted.

The specimens are similar to the twisted rhabdosome of *Monograptus admirabilis* (Přibyl & Münch). The distal width of the rhabdosome of *M. admirabilis* is 1.2 mm and the thecae number 4–5 per 5 mm, parameters comparable to the present material. A more detailed comparison must await further material. The present specimens can be distinguished from *Monograptus simulans* Pedersen by the more slender rhabdosomes with a pronounced curvature.

M. decipiens has previously been recorded from the *convolutus* Zone (e.g. Törnquist, 1899; Bjerreskov, 1975) and from the *sedgwickii* Zone by Přibyl & Münch (1942). The present specimens are associated with a graptolite fauna indicating the *convolutus* Zone.

Monograptus cf. *M. dextrorsus* Linnarsson, 1881

Plate 3, figs 6, 7

Material: Lauge Koch collection: 2 relief fragments; 101.3, Kap Tyson, Lafayette Bugt Formation. 4 relief fragments; I.1, Kap Tyson, Lafayette Bugt Formation. 3 fragments; I.6, Kap Tyson, Lafayette Bugt Formation.

Description. The fragments in sample 101.3 are straight and each about 1 cm long with a 0.9 mm wide rhabdosome. The thecae are isolated with slender prothecal parts and free metathecal portions. No apertural structures are shown. The prothecae are 0.4 mm wide at their base, and the free metathecal parts are 0.4 mm long. The ventral walls are inclined at 25° to the axis of the rhabdosome. The thecae number 11.5 per 10 mm.

In sample I.1 straight fragments, about 1.5 cm long, 0.9 mm wide and with 10–12 thecae per 10 mm occur.

In I.6 one 2 cm long distal fragment and two more proximal curved fragments are present. Here the thecae number 5 per 5 mm. In all specimens the thecae appear to have the same form.

Remarks. The present specimens are similar to *M. dextrorsus*, in outer shape of the thecae. However, as the real thecal structures are unknown, the reference to *M. dextrorsus* is highly questionable. The thecae are more closely set than in *M. dextrorsus* Linnarsson (1881). *M. dextrorsus* was reported from the *turriculatus* Zone to the *griestoniensis* Zone by Elles & Wood (1913). In Washington Land it is associated with *M. aff. M. linnarsoni*, possibly indicating an upper Llandovery to Wenlock horizon.

Monograptus exiguus (Nicholson, 1868) s.l.

Plate 3, fig. 9

1868 *Graptolites lobiferus* var. *exiguus* Nich.; Nicholson, p. 533, pl. 19, figs 27, 28.

1975 *Monograptus exiguus exiguus* (Nicholson, 1868); Hutt, p. 91, pl. 24, fig. 5, text-fig. 22, figs 7, 8.

1975 *Monograptus exiguus* s.l. (Nicholson, 1868); Bjerreskov, pp. 60–61.

Material. 1 flattened specimen; GGU 216811, sec. 3, south of Kap Independence, Lafayette Bugt Formation.

Description. The specimen, which is 3 cm long and ventrally curved, lacks the proximal end and sicula. The width increases from 0.5 mm proximally to 0.7 mm distally.

The thecae are of the *exiguus* type with parallel prothecal walls and coiled metathecal parts. The coiled parts occupy about half the width of the rhabdosome and half the thecal height. The thecae number 11 per 10 mm throughout the specimen.

Remarks. The rhabdosomal morphology and thecae conform to other species of the *exiguus*-group. However, the width of the rhabdosome is larger than usual, but it does not approach the width of *M. exiguus primulus*. Further the thecal count per 10 mm is less than usual for the *exiguus*-group.

Bjerreskov (1975) noted that the whole *exiguus*-group needs revising. With more clearly defined species the present specimen may represent a new subspecies.

The graptolite is associated with a *turriculatus* Zone fauna.

Monograptus exiguus primulus Bouček & Přibyl 1943

Plate 3, fig. 4

1943 *Monograptus (Streptograptus) exiguus primulus* n. subsp.; Bouček & Přibyl, p. 7, figs 3e-f, pl. 1, fig. 4.

1971 *Monograptus (Streptogr.) exiguus primulus* Bouček & Přibyl, 1942; Schauer, p. 71, pl. 24, fig. 9, pl. 25, figs 4–5.

1975 *Monograptus exiguus primulus* Bouček & Přibyl, 1942; Bjerreskov, p. 62, text-fig. 18H, pl. 9D.

Material. About 10 specimens, all flattened; GGU 216811, sec. 3, south of Kap Independence, Lafayette Bugt Formation. Lauge Koch collection: 1 specimen; E.1, Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosomes are curved ventrally, exhibiting the fish-hooked *exiguus* shape. They have a straight proximal part, becoming strongly curved ventrally around th5; the curvature diminishes distally. The largest specimen is 2 cm long and 0.35 mm wide at th1, the width increasing distally to 0.85–0.9 mm.

The enrolled thecae are of typical *exiguus* form, but no structural details were observed. The thecae number 6 per 5 mm. The sicula is 0.9 mm long with the apex reaching to the aperture of th2.

Remarks. The specimens appear identical to the original and later described material of *M. exiguus primulus* (e.g. Schauer, 1971; Bjerreskov, 1975). The Washington Land specimens are associated with a graptolite fauna indicating the *turriculatus* Zone. This conforms to the range given by Schauer (1971) and Bjerreskov (1975).

Monograptus ?flemingii (Salter, 1852)

Plate 3, fig. 16, plate 6, fig. 2

Material. About 60 fragments on one slab, all flattened; GGU 216775, sec. 1, Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosome is straight, except for the extreme proximal end which is slightly curved dorsally. The largest specimen is a distal fragment 13 cm long. The width of the rhabdosome at th1 is 0.65 mm, at th5 1.2 mm, and at th10 1.25 mm. The maximum width is 2.9 mm.

The thecae are hooked throughout. At the level of about th10 and more distally the retroverted parts of the hooks occupy about 1/4 - 1/5 of the width of the rhabdosome. The poor state of preservation masks the interthecal septa and therefore the thecal overlap is unknown. However, in the proximal part the thecae appear to have a smaller overlap than usual for *M. flemingii*. Also the exact apertural structures have not been seen. Occasionally the apertures have a blunt appearance and face proximally, but generally they have a more beak-like structure. The thecae number 7 per 5 mm proximal, and about 13 over the proximal 10 mm; distally the thecal spacing is about 10.5 per 10 mm.

The sicula was observed in only one specimen. It is indistinct, about 1.3 mm long and the apex terminates slightly distally of th2.

Remarks. The specimens resemble *M. flemingii* in the distal width, thecal spacing and morphology. However, the increase in width in the proximal end is very slow, similar to that of *M. priodon*, corresponding to the lowest increase for *M. flemingii* as indicated by Lenz (1974). Further, the proximal thecal overlap appears smaller than usual for the species.

M. flemingii has been reported from the *rigidus* to the *lundgreni* Zones of the Upper Wenlock (e.g. by Elles & Wood, 1913).

Monograptus kochi n. sp.

Plate 3, figs 8, 12, 13

1934 *Monograptus lobiferus* (M'Coy); Poulsen, p. 11–12, pl. 1, fig. 6 (not described).

Material. At least 20 fragments, the main part preserved in low relief, some specimens are flattened; GGU 216839, sec. 4, Kap Schuchert, Cape Schuchert Formation. Lauge Koch collection: 1 specimen; G.3 with MGUH 3225, Kap Schuchert, Cape Schuchert Formation.

Horizon. The upper part of the *argenteus* Zone, Llandovery.

Holotype. Specimen MGUH 15225, GGU 216839, plate 3, fig. 13, Llandovery of Kap Schuchert, Cape Schuchert Formation.

Diagnosis. The proximal rhabdosome with dorsal curvature, becoming straighter distally. Rhabdosomal width ranges from 0.5 mm proximally to a maximum of 1.4 mm distally. Thecae uniform, subtriangular with prominent open hooks, recurved and with inward facing apertures. Thecal spacing from 7 per 5 mm proximally to 3.5–4 in the distal 5 mm. The sicula is 0.9 mm long.

Description. The rhabdosome is dorsally curved in the proximal portion, for at least the proximal centimetre and the distal part is straight. The largest fragment is a 3 cm long and straight distal part (MGUH 3225). The width of the rhabdosome increases from 0.5 mm at th1, 0.75 mm at th3, to a distal width which is generally 1.25 mm. The maximum width was measured to 1.4 mm.

The thecae are uniform throughout, subtriangular, isolated, and in the distal part of the rhabdosome 0.25 mm wide at the base of the prothecae. The apertural parts are recurved in the form of an open hook, so that the apertures face inwards. The retroverted part of the thecae are parallel sided and 0.25 mm wide in the distal thecae. The apertures appear to be simple and even. In the proximal end the thecae number 3.5 per 2.5 mm and distally 3.5–4 in 5 mm.

The sicula which has only been observed in one incomplete specimen, is approximately 0.9 mm long and with the apex slightly above the base of th2.

Remarks. The graptolite is similar to *Monograptus communis* Lapworth, but can be distinguished by the recurved open parallel sided hook and uniform thecae throughout. *M. kochi* differs from *Monograptus delicatulus* Törnquist by the straight distal end and the uniform thecae. The species can be separated from *M. lobiferus* as the recurved apertural parts are not so closely adpressed to the prothecal parts as in *M. lobiferus*.

M. kochi is associated with a graptolite fauna indicating the *argenteus* Zone.

Monograptus lobiferus lobiferus (McCoy, 1850)

Plate 4, fig. 1

1850 *Graptolites lobiferus* (McCoy); McCoy, p. 270.

1975 *Monograptus lobiferus* (McCoy, 1850); Hutt pp. 94–95, pl. 18, figs 1, 3, pl. 19, fig. 6, text-fig. 24, figs 4a, b (see for further references).

1975 *Monograptus lobiferus lobiferus* (McCoy, 1850); Bjerreskov, pp. 66–67, fig. 20C, pl. 10D.

Material. 9 flattened fragments on one slab; GGU 216767, sec. 1, Kap Independence, Lafayette Bugt Formation.

Description. The largest fragment is nearly 6 cm long. The rhabdosome is slightly flexed, and with a weak ventral curvature. The proximal end with sicula has not been observed. The most proximal part is 0.65 mm wide increasing to 1.8 mm distally.

The thecae are isolated throughout the rhabdosome, with slender prothecal parts and hooked apertural portions. The apertures have not been clearly seen, but the hooks appear to be recurved, facing obliquely dorsally-proximally in the rhabdosome. Apparently the proximal thecae possess the most pronounced recurvations of the apertural parts, facing nearly dorsally. The thecae have a pair of 0.5 mm long lateral apertural spines. Proximally the thecae number 4.25 per 5 mm and distally 7.5 per 10 mm.

Remarks. The present specimens differ from *Monograptus lobiferus harpago* Törnquist as the latter attains a smaller distal width and the apertures on the distal thecae face dorsally in the rhabdosome. The lateral thecal spines of *M. lobiferus lobiferus* have also been observed by Pedersen (1922), Bjerreskov (1975) and Hutt (1975).

M. lobiferus lobiferus has previously been reported from the *convolutus* and the *sedgwickii* Zones (e.g. Churkin & Carter, 1970; Hutt, 1975).

Monograptus ?parapriodon Bouček, 1931

Plate 4, fig. 2

Material. 1 flattened distal fragment; GGU 242900, Kap Tyson, Lafayette Bugt Formation.

Description. The specimen is a 1 cm long straight distal fragment with a uniform width of 0.8 mm throughout.

The thecae are hooked and of *priodon* morphology. The retroverted parts occupy slightly more than 1/3 of the thecal height, and the free part of the hooks is 0.35 mm wide. The prothecal parts are nearly straight and the ventral walls are inclined at 5°–10° to the axis of the rhabdosome. No overlap has been observed. The thecae number 4.5 per 5 mm.

Remarks. The thecal morphology of *M. ?parapriodon* appears similar to *Monograptus ayagusensis* Obut and Sobolevskaya; the latter, however, has more closely set thecae (14–15 per 10 mm; Obut & Sobolevskaya, 1966). The present specimen seems identical to *M. parapriodon* described by Bouček (1931). However, as only one cm of the rhabdosome has been observed, and proximal and distal ends are unknown, the specimen is only tentatively referred to *M. parapriodon*.

M. parapriodon has been reported from the *spiralis* Zone (Bouček, 1931) and from the *crispus* Zone (Schauer, 1971). In Washington Land it is associated with graptolites, which probably indicates the uppermost Llandovery.

Monograptus planus (Barrande, 1850)

Plate 4, fig. 3

1850 *Graptolithus proteus* var. *plana* Barr; Barrande, pp. 58–59, pl. 4, fig. 15.

1974 *Monograptus planus* (Barrande, 1850); Sherwin, pp. 168–169, pl. 10, figs 7, 10, 11, text-figs 2c, d.

1975 *Monograptus planus* (Barrande, 1850); Hutt, p. 99, 101, text-fig. 22, figs 11, 12.

non 1975 *Monograptus planus* (Barrande, 1850); Bjerreskov, pp. 64–65, pl. 10A.

Material. 3 flattened distal parts; GGU 216811, sec. 3, south of Kap Independence, Lafayette Bugt Formation. Lauge Koch collection: 2 flattened specimens; E.1, Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosome is dorsally curved proximally, the curvature less pronounced distally. The largest specimen is 3 cm long, but no proximal part with sicula has been observed. The width increases from 0.8 mm proximally to 1.8 mm distally.

The thecae are isolated throughout. They are biform, elongated axially proximally. In the largest specimen (pl. 4, fig. 3) four elongated thecae were observed. Distally the thecae have a triangular shape with prominent hooks. The free part of the hooks occupy about half of the distal width, and the common canal occupies half the width of the rhabdosome. The apertures face proximally, but the exact structures have not been seen. Distally the thecae number 9–10 per 10 mm.

Remarks. Specimens from Barrande's type locality at Želkovice, Bohemia, kindly loaned by H. Jaeger, are comparable to the Washington Land material. The longest specimen from Bohemia was flattened and lacked the proximal end. It is 5 cm long, the distal width is 1.65 mm and the thecae number 10 per 10 mm. A slightly smaller distal width of 1.4 mm with thecae numbering 10–12 per 10 mm was reported by Hutt (1975). In Australian specimens Sherwin (1974) reported a width of 1.25 mm.

M. planus from Bornholm has twisted apertures (Bjerreskov, 1975). However, material of *M. planus* from the type locality of Želkovice lacks twisted apertures, and thus the specimens from Bornholm cannot with certainty be referred to *M.*

planus. Additional material from Bornholm suggests that at least two forms from the *turriculatus* Zone possess *M. planus* rhabdosome dimensions, but have twisted apertures. One form appears identical to *Monograptus resurgens* Linnarsson and is probably a separate species. A redescription of the whole group is being prepared by the author.

The present specimens occur with a graptolite fauna indicating the *turriculatus* Zone.

Monograptus praecedens Bouček, 1931

Plate 4, figs 5, 6

1931 *Monograptus praecedens* n. sp.; Bouček, p. 6, 17, figs 3a, 3b.

? 1971 *Monograptus (Monograptus) priodon praecedens* Bouček; Schauer, p. 57, pl. 36, figs 14–15, pl. 37, fig. 3.

1975 *Monograptus praecedens* Bouček, 1931; Bjerreskov, p. 74, pl. 11A, fig. 21 A.

Material. 6 flattened specimens; GGU 242838 and 242839, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation.

Description. The largest specimen is a 6 cm long distal fragment. The straight rhabdosome increases in width from 0.8 mm at th1, 1.5 mm at th5, 1.75 mm at th10, 2.0 mm at th15 to a maximum distal width of 3 mm.

The uniform thecae are hooked and of the *priodon*-type. Distally the free part of the thecae occupy 1/3 of the width of the rhabdosome. The retroverted parts of the hooks are 0.75 mm wide, and the apertures apparently face ventrally to proximally. The interthecal septa are inclined at 30°–35° to the axis of the rhabdosome. Proximally the thecae number 12.5 per 10 mm and distally 9.5 per 10 mm.

The sicula was not clearly observed. In one specimen (pl. 4, fig. 6) the length appeared to be 1.25 mm, and the apex apparently reached to the middle of th2. Th1 originated very close to the aperture of the sicula.

Remarks. The present material appears to be identical to specimens from the Silurian of Röstånga, Sweden (now in the Tullberg collection of the Geological Survey of Sweden). The Washington Land species has longer rhabdosomes with less closely set thecae than those of *M. praecedens* from Bornholm (Bjerreskov, 1975) (15 per 10 mm). On the specimen figured in Bouček (1931, fig. 3b) the number is 13 per 10 mm.

There is variation in the rhabdosomal dimensions of specimens referred to *M. praecedens*, and also the species occurs over a wide stratigraphical interval (e.g. Schauer, 1971; Bjerreskov, 1975). Thus closer examination of the species is needed.

Originally *M. praecedens* was recorded from the *spiralis* Zone (Bouček, 1931). In Washington Land the species is associated with a graptolite fauna indicating the uppermost Llandovery.

Monograptus priodon (Bronn, 1835)

Plate 6, fig. 3

1835 *Lomatoceras Priodon*; Bronn, p. 56, pl. 1, fig. 13.

1913 *Monograptus priodon* (Bronn); Elles & Wood, p. 418, p. 420, pl. 42, figs 2a-e, text-figs 282a-b.

1971 *Monograptus (Monograptus) priodon priodon* (Bronn); Schauer, pp. 56–57, pl. 35, figs 6–8, pl. 36, figs 8–11, pl. 37, figs 1–2.

1975 *Monograptus priodon* (Bronn); Berry & Murphy, pp. 56–57, pl. 4, figs 1, 4, 5, pl. 8, fig. 3.

1975 *Monograptus priodon* (Bronn, 1835); Bjerreskov, p. 70, pl. 10, fig. B.

For further references see e.g. Elles & Wood (1913) and Schauer (1971).

Material. In all around 100 specimens, preserved from flattened to full relief. GGU 216783, sec. 2, Kap Independence, Lafayette Bugt Formation. GGU 216812, sec. 3, south of Kap Independence, Lafayette Bugt Formation; GGU 216851, sec. 4, Kap Schuchert, Lafayette Bugt Formation. GGU 242838, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. GGU 242839, sec. 5, Kap Lucie Marie, Kap Lucie Marie Formation. GGU 242840, Kap Lucie Marie, Kap Lucie Marie Formation. GGU 242917, Kap Godfred Hansen, Lafayette Bugt Formation. GGU 242918 Kap Godfred Hansen, Lafayette Bugt Formation. Lauge Koch collection: 101.1, Kap Tyson, Lafayette Bugt Formation. E.5, Kap Independence, Lafayette Bugt Formation. E.6, Kap Independence, Lafayette Bugt Formation. E.11, Kap Independence, Lafayette Bugt Formation. E.12, Kap Independence, Lafayette Bugt Formation. I.6, Kap Tyson, Lafayette Bugt Formation.

Description. Rhabdosome up to 12 cm long, with an initial width of 0.65–0.8 mm, increasing to a maximum distal width of 2.2 mm in relief specimens (GGU 216851) and 2.7 mm in flattened specimens (E.6). The thecae are of the characteristic hooked *priodon*-type. They number 12–13 per 10 mm proximally and 9–10 per 10 mm distally. The sicula length is 1.25–1.4 mm.

Remarks. The present specimens are identical to earlier described material of this ubiquitous species. It is very common in the well represented *spiralis* Zone of Washington Land. It is a long ranging species, reported from the *crispus* to *riccartonensis* Zones (e.g. Elles & Wood, 1912; Urbanek, 1958), and as such is of minor stratigraphic importance.

Monograptus aff. *M. proteus* (Barrande, 1850)

Plate 4, fig. 4

Material. 1 large specimen and 2 fragments, all flattened; GGU 216811, sec. 3, south of Kap Independence, Lafayette Bugt Formation.

Description. In the large specimen (plate 4, fig. 4) the rhabdosome is coiled both dorsally and ventrally into an open spiral. The length of the rhabdosome must have exceeded 3 cm. No proximal end with sicula has been observed. Proximally the width of the rhabdosome is 0.8 mm, increasing to 1.2 mm distally.

The thecae are apparently isolated and triangular with slender prothecal parts. In the distal part of the rhabdosome they are 0.35 wide at their base. The thecae have prominent free metathecae with retroversion of the outmost apertural parts. No

details of the apertures were seen. The thecae number 5.5 per 5 mm proximally and 5 per 5 mm distally.

Remarks. The shape and dimensions of the rhabdosome and the thecal morphology suggest close affinity to *M. proteus*. However, the latter obtains a larger width distally and has a relatively wider common canal compared to the free part of the thecae. The twisted apertures of *M. proteus* have not been observed in the Washington Land material.

M. aff. M. proteus also resembles *Monograptus conspectus* (Přibyl) in thecal morphology, but the latter has more distant thecae, 8–9 per 10 mm, and the free parts of the thecae, which have more pronounced hooks, occupy less than half the width of the rhabdosome.

M. proteus has been reported from the *turriculatus* to the *crispus* Zones (Přibyl, 1945). The present specimens occur with a *turriculatus* Zone fauna.

Monograptus riccartonensis Lapworth, 1876

Plate 3, figs 14, 15

1876 *Monograptus riccartonensis* sp. nov.; Lapworth, pp. 355–356, pl. 13, figs 2 a-e.

Material. 1 distal fragment and 2 proximal fragments; Lauge Koch collection: F.1 and F.2, Graptolithnaes, Lafayette Bugt Formation.

Description. The distal fragment is 4 cm long and preserved in low relief. The width of the rhabdosome increases from 1.25 mm proximally to 1.5 mm distally. Proximally, the rhabdosome is curved dorsally, and distally it is straight.

The thecae are hooked and of *prionod*-type. The free ventral walls are nearly parallel to the axis of the stipe, and the interthecal septa are inclined at 30° to the axis of the rhabdosome. The thecae appear to overlap for about half the thecal length, excluding the retroverted hooked part. The hooks are most conspicuous in the proximal part of the rhabdosome. Proximally the thecae number 9.5 per 10 mm and 8.5 per 10 mm distally.

Both proximal fragments are dorsally curved and with a 2 mm long sicula, the apex of which reaches to the aperture of th2. Th1 is 0.7 mm wide. The proximal thecae have a visible apertural spine (a lateral pair of spines) about 0.35 mm long. Proximally the thecae number 6.5 per 5 mm.

Remarks. The specimens are similar to *M. riccartonensis*, but have closer set thecae in the proximal part. This is in contrast to the specimens figured in Elles & Wood (1912, pl. 42, figs 8a-e). Further the sicula appears to be slightly longer. Otherwise the specimens conform to earlier descriptions of the species.

M. riccartonensis is associated with *Plectograptus? intermedius* and most likely indicates presence of the *riccartonensis* Zone.

Monograptus rickardsi n. ssp.

Plate 4, fig. 8

Material. 3 flattened specimens; GGU 216811, sec. 3, south of Kap Independence, Lafayette Bugt Formation.

Description. The rhabdosome appears straight throughout. In the proximal part the width of the stipe is 0.8 mm at th1, 0.5 mm at th5 and 1.6 mm at th10. The maximum distal width is 2.5 in an 8.5 cm long distal fragment.

The thecae are hooked of the *priodon*-type with rather large retroverted apertural parts. Distally they occupy 1/3 of the width of the stipe. In flattened specimens the thecal overlap is 1/3 of the non-hooked part of the thecae. Proximally the thecae number 11 per 10 mm and 8.5 per 10 mm distally.

The sicula is obscure, but appears to be 1.3 mm long; and the apex reaches to the hooked part of th2.

Remarks. The present specimens resemble *Monograptus rickardsi rickardsi* Hutt, but can be separated by the larger distal width of 2.5 mm and by the more distant thecae (cf. Hutt, 1975). In *Monograptus rickardsi minor* Hutt the thecal spacing is comparable to the present specimens, but in this subspecies the proximal part is more slender than in the Washington Land material. Neither lateral thecal spines nor processes, which are characteristic of *M. rickardsi*, can be observed in the rather badly preserved specimens from North Greenland.

M. rickardsi n. ssp. is very much similar to specimens from the *turriculatus* Zone of Bornholm which Bjerreskov (1975) referred to *M. priodon*?. In particular the dimensions of the rhabdosome are identical, but the resemblance of the thecal structure cannot be determined. Consequently, the Washington Land material may represent a new subspecies of *M. rickardsi*, but the material is too poorly preserved to allow confident erection of a new subspecies.

M. rickardsi n. ssp. is associated with a *turriculatus* Zone fauna. This is in accord with the stratigraphic level reported for *M. rickardsi* by Hutt (1975).

Monograptus aff. *M. speciosus* Tullberg, 1883

Plate 4, fig. 9

Material. 1 specimen preserved in low relief infilled with pyrite. Lauge Koch collection: E.7, Kap Independence, Lafayette Bugt Formation.

Description. The fragment is 3 cm long and ventrally curved. The width is 0.65 mm throughout, and the proximal end is not preserved.

The thecae are hooked and the 0.25 mm wide retroverted parts appear to be adpressed to the free ventral walls of the thecae. The retroverted parts occupy 1/4 of the length of the free ventral thecal walls and 1/3–1/4 of the width of the

rhabdosome. The apertural structures were not observed. Proximally the thecae overlap for 1/4 of the length of the free ventral walls, and distally the overlap increases to half the length. Throughout the rhabdosome the thecae number 9.5–10 per 10 mm.

Remarks. Morphologically the specimens most resemble *M. speciosus*. However, they are more slender distally (cf. Tullberg, 1883, and Bjerreskov, 1975) as the maximum distal width is only 1.25 mm in flattened specimens. Further, the retroverted apertural parts may be more adpressed to the proximal parts of the thecae, and the thecal overlap increases distally.

M. speciosus has been reported from the *lapworthi* Zone (Tullberg, 1883; Bjerreskov, 1975). The present fragment is apparently associated with graptolites indicating the uppermost Llandovery (Lauge Koch collection nos. E.5 - E.11).

Monograptus spiralis spiralis (Geinitz, 1842)

Plate 6, fig. 4

1842 *Graptolithus spiralis*; Geinitz, p. 700, pl. 10, figs 26–27.

1935 *Monograptus arcticus* sp. n.; Ianishevsky, pp. 36–37, pl. 5, figs 5a-c.

Further references in Törnquist (1912), Přibyl (1945) and Schauer (1971).

1973b *Oktavites spiralis spiralis* (Geinitz), 1842; Golikov, pp. 39–41, pl. 8, figs 1–6.

Material. In all about 25 specimens. 5 specimens; GGU 216783, sec. 2, Kap Independence, Lafayette Bugt Formation. 1 specimen; GGU 216784, Kap Independence, Lafayette Bugt Formation. About 13 flattened specimens; GGU 216812, south of Kap Independence, Lafayette Bugt Formation. 1 relief specimen, possibly referable to *M. spiralis spiralis*; GGU 242840, Kap Lucie Marie, Kap Lucie Marie Formation. Lauge Koch collection: 1 flattened specimen; E.5, Kap Independence, Lafayette Bugt Formation. 10 fragments; E.9, Kap Independence, Lafayette Bugt Formation. 2 flattened specimens; E.11, Kap Independence, Lafayette Bugt Formation.

Description. *M. spiralis spiralis* from Washington Land is identical to the species from other areas (Přibyl, 1945; Schauer, 1971; Bjerreskov, 1975). Giant rhabdosomes with 9 whorls and with a total rhabdosome length of up to 100 cm have been recorded from the Lafayette Bugt Formation, Kap Independence. In these large specimens the maximum distal width of the stipe is 3.5 mm, and the distal thecae number 8.5 per 10 mm.

The sicula is known from one specimen (GGU 216812). It is 1.0 mm long and with the apex situated between th2 and th3. Th1 is 0.75 mm wide.

Remarks. The Washington Land material is characterised by very large specimens, which are not normally common. One similar specimen was reported by Bjerreskov (1975), and the specimens from Novaya Zemlya, described as *M. arcticus* by Ianishevsky (1935), also represent these huge forms of *M. spiralis spiralis*.

M. spiralis spiralis is very common. Its occurrence together with e.g. *R. geinitzianus angustidens*, *S. grandis grandis* indicates the *spiralis* Zone in the Upper Llandovery.

Monograptus teichertii n. sp.

Plate 4, figs 10–12

? 1934 *Rastrites peregrinus* Barande var. *socialis* Törnquist; Poulsen, pl. 1, fig. 7 (not described).

Material. About 50 fragments, preserved flattened or with very low relief; GGU 216839, sec. 4, Kap Schuchert, Cape Schuchert Formation. 1 fragment possibly referable to *M. teichertii*; MGUH 3226, Kap Schuchert, Cape Schuchert Formation.

Horizon. The *argenteus* Zone, Llandovery.

Holotype. Specimen MGUH 15240, GGU 216839, plate 4, fig. 12, Llandovery of Kap Schuchert, Cape Schuchert Formation.

Diagnosis. Proximal end dorsally curved, distal part ventrally or dorsally curved. Slender rhabdosome with width from 0.65–0.8 mm. Isolated uniform subtriangular thecae with tapering, slightly recurved apertural parts, numbering 6.5–7 per 5 mm. The sicula is 1 mm long.

Description. The slender rhabdosome is dorsally bent proximally, and the distal part is slightly dorsally or ventrally curved. The width is 0.65 mm at th1, 0.7 mm at th3. The maximum distal width is 0.8 mm.

The thecae are isolated, subtriangular and uniform. In the distal part of the rhabdosome the prothecal parts are 0.25 mm wide and the ventral prothecal walls are inclined at 30°–35° to the rhabdosome. The apertural region tapers, is slightly recurved, and the apertures may face proximally. In some specimens the dorsal thecal walls appear to be prolonged beyond the ventral wall, and the apertures may be wide. The free part of the thecae occupy nearly 2/3 of the width of the rhabdosome. The thecae number 6.5, occasionally 7, per 5 mm throughout the rhabdosome.

The sicula is 1 mm long and the apical part terminates near the middle of th2. Th1 originates close to the aperture of the sicula.

Remarks. *M. teichertii* is separable from other monograptids with similar thecal morphology (e.g. *Monograptus intermedius* (Carruthers)) by the closer spaced thecae and the slender rhabdosome with the nearly uniform width throughout.

The thecae on the specimen figured as *R. peregrinus socialis* (Poulsen, 1934) are unrecognisable and the specimen may be a fragment of *M. teichertii* as the slab contains about ten other fragments all belonging to this species.

M. teichertii is associated with a fauna which indicates the *argenteus* Zone.

Monograptus turriculatus (Barrande, 1850)

Not figured

1850 *Graptolithus turriculatus* Barr.; Barrande, pp. 56–57, pl. 4, figs 7–11.

1975 *Monograptus turriculatus* (Barrande); Hutt, pp. 111–112. text-fig. 22, fig. 9, 10 (see for further references).

1978 *Spirograptus turriculatus* (Barrande); Wang, p. 311, pl. 3, fig. 6.

Material. About 10 flattened specimens; GGU 216811, sec. 3, south of Kap Independence, Lafayette Bugt Formation. Several flattened, badly preserved specimens, most likely referable to *M. turriculatus*, GGU 216846, sec. 4. south of Kap Independence, Lafayette Bugt Formation. Lauge Koch collection: 3 specimens; E.1 and E.2, Kap Independence, Lafayette Bugt Formation.

Remarks. The present specimens are identical to previously described individuals of the species. The size of the present rhabdosomes varies from 2 to 5 whorls, and the maximum diameter of the youngest whorl is 1 cm.

In the samples GGU 216811 and E.1 the specimens are associated with typical *turriculatus* Zone graptolite faunas. In sample GGU 216846 several flattened and indistinct small specimens are most likely referable to *M. turriculatus*.

Monograptus sp. 1

Plate 4, fig. 7

Material. One flattened, badly preserved proximal fragment; GGU 242832, sec. 5, Kap Lucie Marie, Offley Island Formation.

Description. The fragment is 3.5 mm long with four thecae. The width of the gently curved rhabdosome is 0.4–0.5 mm.

Th1 is subtriangular with the apertural part retroverted into a small hook-like tapering structure. In the following thecae the ventral walls become subparallel and the thecae elongated, but still with the tapering, small, hooked, apertural parts. Thecal overlap not distinguishable. The free apertural parts occupy 1/3 of the width of the rhabdosome.

The sicula is 1 mm long and extends beyond the aperture of th1, which originates 0.3 mm from the aperture of the sicula.

Remarks. The poor material cannot be referred with certainty to known monograptid species. The fragment is associated with *M. vomerina* ssp. 2. This faunal association is not indicative of any precise stratigraphic level.

Monograptus sp. 2

Plate 4, fig. 20

Material. 1 flattened fragment; GGU 216778, sec. 2, Kap Independence, Lafayette Bugt Formation.

Description. The distal fragment is slightly dorsally curved and 0.75 cm long. The rhabdosome is 1.2 mm wide throughout. The thecae are indistinct and appear as small beaks. No interthecal septum has been observed, but thecal overlap is probably present. The thecae number 5.5 per 5 mm.

Remarks. The material is too incomplete and badly preserved for reference to any known monograptid species. The thecae are superficially similar to those of *Monograptus tenuis* (Portlock) but this species has 0.7 mm wide thecae excluding the hoods (Hutt, 1975). *Monograptus acus* Lapworth has inclined ventral thecal walls, and an average width of 2 mm and thecae numbering 8 per 10 mm.

Monograptus sp. 2 is associated with *Climacograptus* sp. and the sample is probably referable to the *convolutus* Zone (discussed earlier).

Monograptus sp. 3

Plate 4, fig. 14

Material. 2 flattened specimens; GGU 216780, sec. 2, Kap Independence, Lafayette Bugt Formation.

Description. The two fragments without proximal ends are slightly curved dorsally. The best preserved specimen is 1.2 cm long. The proximal width of the rhabdosome is 0.45 mm, mesial width 0.5 mm, decreasing distally to 0.45 mm.

The thecae are apparently isolated and have slender prothecal parts with nearly parallel walls. The prothecae increase in width from 0.25 mm proximally to 0.35 mm distally. The metathecal parts are retroverted into small enrolled lobes with the apertures apparently adpressed to the ventral prothecal walls. The retroverted parts occupy 1/2 of the width of the rhabdosome, and 1/3 of the height of the thecae. No details of the apertural parts have been observed. The thecae number 5 per 5 mm.

Remarks. The fragments cannot be confidently referred to any known species. They resemble *Monograptus sartorius* Törnquist, but this species is only 0.3–0.4 mm wide and has more triangular thecae with free apertures. *Monograptus gemmatus* (Barrande) has more widely spaced thecae and different thecal morphology. The specimens resemble *Monograptus* cf. *undulatus* Elles & Wood (see Hutt, 1975), but cannot be referred to this species as the thecae differ and the rhabdosome increases faster in width. The material is too fragmentary for erection of a new species.

Monograptus sp. 3 occurs with a graptolite association referable to the *convolutus* Zone.

Monograptus sp. 4

Plate 4, figs 15, 16

Material. 2 flattened, badly preserved specimens; GGU 242917, Kap Godfred Hansen, Lafayette Bugt Formation.

Description. The largest specimen, which is without the proximal end, is 3 cm long and contorted with $1\frac{1}{2}$ volutions. Both dorsal and ventral curvatures are present, and the thecae are mainly situated on the dorsal side of the stipe. Proximally the width of the rhabdosome is 0.4 mm increasing to 0.65 mm distally.

The thecae are triangular, isolated and without overlap. They have slender prothecal parts and small retroversions in the apertural regions. In the distal part of the rhabdosome the common canal is 0.2 mm wide and the retroverted part of the thecae occupy less than $\frac{1}{3}$ of the width of the rhabdosome. The proximal thecae are apparently more elongated, but this may be due to the contorsion of the rhabdosome. Distally the thecae number 4.5 per 5 mm.

One proximal end with sicula is present on the same hand specimen and is possibly referable to this species. The sicula is 0.65 mm long and the apex reaches between th1 and th2. Th1 is 0.25 mm wide and th2 is 0.4 mm wide. The proximal thecae appear to be triangular and noticeable hooked without elongation of the prothecal parts. The thecae number 3.5 in the proximal 2.5 mm.

Remarks. The graptolite resembles *Monograptus tullbergi spiraloides* Přibyl with regard to shape of the rhabdosome and the thecal morphology, but this species has a much wider distal rhabdosome at 1.6 mm. The rhabdosomal morphology combined with the bad state of preservation does not allow exact reference to any monograptid species. *M.* sp. 4 is associated with *S. grandis grandis* and *M. priodon*, indicating an uppermost Llandovery horizon.

Genus *Rastrites* Barrande, 1850

Type species. Subsequent designation. Hopkinson, 1869, p. 158; *Rastrites peregrinus* Barrande, 1850, p. 67, pl. 4, fig. 6; from the Llandovery of Bohemia.

Diagnosis. See Bulman, 1970, V134.

Rastrites sp.

Plate 4, figs 17, 18

Material. 2 flattened distal fragments; GGU 216780, sec. 2, Kap Independence, Lafayette Bugt Formation.

Description. One specimen (plate 4, fig. 18) has a dorsally curved rhabdosome with 7 thecae. The proximal end is 1.25 mm wide increasing distally to a width of 1.65

mm. The metathecal parts are perpendicular to the axis of the rhabdosome, and the thecae number 3–3.5 mm per 2.5 mm.

The second specimen (plate 4, fig. 17) has a straight rhabdosome with 4 thecae, and a width of 1.65 mm. The metathecal parts are also right on the rhabdosomal axis, and the thecae number 3 per 2.5 mm. In both specimens the apertural parts may have disappeared as no hooks, horns or spines have been observed.

Remarks. The material is too small and incomplete for certain reference to any known *Rastrites* species. The fragments are similar to *Rastrites approximatus* Perner in the thecal spacing (12 per 10 mm) and in the perpendicular metathecal parts. However, *R. approximatus* is reported to obtain a width of 2.5 mm (cf. Törnquist, 1907). In the present specimens the original width is not known, but may have been small.

Rastrites sp. is associated with a graptolite fauna indicative of the *convolutus* Zone.

Family CYRTOGRAPTIDAE Bouček, 1933
Subfamily CYRTOGRAPTINAE Bouček, 1933
Genus *Cyrtograptus* Carruthers, 1867

Type species. *Cyrtograptus murchisoni* Carruthers, p. 540, fig. 1; from the Wenlock Shales, Wales.

Diagnosis. See Bulman, 1970, V135.

Cyrtograptus n. sp.
Plate 6, fig. 5

Material. 1 flattened but nearly complete specimen; Lauge Koch collection: E.11, Kap Independence, Lafayette Bugt Formation.

Description. The main stipe is 8 cm long, and the proximal end has a tight dorsal curvature of 1½ volutions. The main stipe has in all 2 volutions. The width increases from 0.65 mm at th1 to 1.35 mm at th27, and the maximum distal width of 1.5 mm excluding thecal spines, is obtained 4 cm distally of the sicula.

The thecae are hooked and spinose, numbering 4 per 2.5 mm in the extreme proximal part and 6.5 per 5 mm in the distal end. The rhabdosome apparently has one cladium of the first order, generating from th27. The thecae on the cladium are obscured by torsion of the stipe.

The sicula is about 1.25 mm long and the apex reaches to the base of th3.

Remarks. The specimen is similar to *Cyrtograptus murchisoni bohemicus* Bouček in the curvature of the proximal part of the main stipe and the cladia of the first order. However, *C. n. sp.* can be distinguished by the far closer set thecae. Also the

dimensions of the extreme proximal end have not been observed in any other representative of *Cyrtograptus*, and thus the specimen most probably represents a new species.

C. n. sp. is associated with *R. geinitzianus angustidens* and *M. spiralis spiralis* which are indicative of a stratigraphical level in the uppermost Llandovery.

Cyrtograptus sp.

Plate 4, fig. 19

Material. 1 badly preserved specimen; GGU 242918, Kap Godfred Hansen, Lafayette Bugt Formation.

Description. The main stipe, which is 2 cm long without the proximal part, is curved into an open spiral. There are 3 cladia; between cladium 1 and cladium 2 there are 5 thecae; from cladium 2 to cladium 3 there are 8 thecae. The cladia appear to be nearly stiff.

The thecae are indistinct, and the width of the rhabdosome cannot be measured with certainty as the stipe is twisted, but it appears less than 1 mm throughout. The thecae number 4 per 5 mm between cladium 2 and 3. Cladium 1 has 5 thecae per 5 mm and cladium 3 has 4 thecae per 5 mm.

Remarks. The distance between the cladia is reminiscent of *C. purchisoni* and *Cyrtograptus centrifugus* Bouček. However, the specimen is too badly preserved for reference to any species. The associated graptolites, including *R. geinitzianus angustidens*, indicate the uppermost Llandovery to Lower Wenlock.

Genus *Barrandeograptus* Bouček, 1933

Type species. Designated by Bouček (1933). *Cyrtograptus pulchellus* Tullberg, 1883; from the Upper Llandovery, Sweden.

Diagnosis (emended). See Bjerreskov, 1975, p. 88.

Barrandeograptus ?pulchellus (Tullberg, 1883)

Plate 4, fig. 13

Material. 2 flattened fragments; GGU 242918, Kap Godfred Hansen, Lafayette Bugt Formation.

Description. The largest specimen is straight, 5 cm long and 1.0 mm wide. The proximal end with sicula has not been seen.

The thecae are axially elongated, somewhat triangular with free apertural parts, and nearly straight ventral walls, inclined at about 30° to the rhabdosome. The

prothecal part is 0.5 mm wide and the overlap is 1/2–1/3 of the thecal length. The apertures appear blunt and are perpendicular to the thecal axis, but exact details have not been observed. The thecae number 8.5 per 10 mm.

Remarks. The dimensions of the rhabdosome and the morphology of the thecae are similar to those of *B. pulchellus* (cf. Bjerreskov, 1975). However, no cladia have been observed, and consequently the specimens are only tentatively referred to this species.

B. pulchellus was originally described from the *lapworthi* Zone in Röstånga of Sweden (Tullberg, 1883). The present specimens are associated with a graptolite fauna indicating the uppermost Llandovery to Lower Wenlock.

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Plates

Plate 1

Fig. 1. *Climacograptus* sp. MGUH 15187 from GGU 216778. Lafayette Bugt Formation, Kap Independence, sec. 2, \times 5.

Fig. 2. *Climacograptus* sp. MGUH 15188 from GGU 216778, Lafayette Bugt Formation, Kap Independence, sec. 2, \times 10.

Fig. 3. *Pseudoclimacograptus* (*Clinoclimacograptus*)? *washingtoni* n. sp. MGUH 15189 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, \times 10.

Fig. 4. *Pseudoclimacograptus* (*Clinoclimacograptus*)? *washingtoni* n. sp. Holotype. MGUH 15190 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, \times 10.

Fig. 5. *Petalograptus minor* Elles. MGUH 15191 from GGU 216839. Cape Schuchert, Kap Schuchert, sec. 4, \times 5.

Fig. 6. *Glyptograptus* (*Pseudoglyptograptus*) sp. MGUH 15192 from GGU 216780. Lafayette Bugt Formation, Kap Independence, sec. 2, \times 10.

Fig. 7. *Glyptograptus* (*Pseudoglyptograptus*) sp. MGUH 15193 from GGU 216780, Lafayette Bugt Formation, Kap Independence, sec. 2, \times 5.

Fig. 8. *Petalograptus ?conicus* Bouček. MGUH 15194 from GGU 216811. Lafayette Bugt Formation, Kap Independence, sec. 3, \times 5.

Fig. 9. *Pseudoclimacograptus* (*Metaclimacograptus*) *hughesi* (Nicholson). MGUH 15195 from GGU 216767. Lafayette Bugt Formation, Kap Independence, sec. 1, \times 10.

Fig. 10. *Plectograptus? intermedius* n. sp. MGUH 15196 from Lauge Koch coll. F.1. Lafayette Bugt Formation, Graptolitnæs, 220 m above sea level, \times 10.

Fig. 11. *Plectograptus? intermedius* n. sp. Holotype. MGUH 15262 from Lauge Koch coll. F.1. Lafayette Bugt Formation, Graptolitnæs, 220 m above sea level, \times 10.



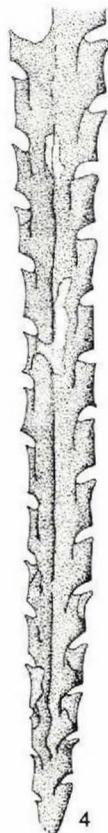
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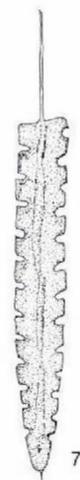
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Plate 2

- Fig. 1. *Monoclimacis? crenularis* Lapworth. MGUH 15197 from GGU 216780. Lafayette Bugt Formation, Kap Independence, sec. 2, $\times 5$.
- Fig. 2. *Monoclimacis? ?renularis* Lapworth. MGUH 15198 from GGU 216767. Lafayette Bugt Formation, Kap Independence, sec. 1, $\times 10$.
- Fig. 3. *Monoclimacis crenulata sensu* Elles & Wood. MGUH 15199 from GGU 216783. Lafayette Bugt Formation, Kap Independence, sec. 2, $\times 10$.
- Fig. 4. *Monoclimacis aff. M. linnarssoni* Tullberg. MGUH 15200 from GGU 242838. Kap Lucie Marie Formation, Kap Lucie Marie, sec. 5, $\times 10$.
- Fig. 5. *Monoclimacis aff. M. linnarssoni* Tullberg. MGUH 15201 from GGU 242838. Kap Lucie Marie Formation, Kap Lucie Marie, sec. 5, $\times 10$.
- Fig. 6. *Pristiograptus bjerringus schucherti* n. ssp. MGUH 15202 from GGU 216846. Cape Schuchert Formation, Kap Schuchert, sec. 4, $\times 5$.
- Fig. 7. *Pristiograptus dubius ?ludlowensis* (Bouček) MGUH 15203 from GGU 216789. Lafayette Bugt Formation, Kap Independence, sec. 2, $\times 5$.
- Fig. 8. *Pristiograptus regularis regularis* (Törnquist). MGUH 15204 from GGU 216780. Lafayette Bugt Formation, Kap Independence, sec. 2, $\times 10$.
- Fig. 9. *Monoclimacis* sp. MGUH 15205 from GGU 216781. Lafayette Bugt Formation, Kap Independence, $\times 10$.
- Fig. 10. *Monoclimacis vomerina* ssp. 2. MGUH 15206 from GGU 242832. Offley Island Formation, Kap Lucie Marie, sec. 5, $\times 10$.
- Fig. 11. *Pristiograptus dubius ?ludlowensis* (Bouček). MGUH 15207 from GGU 216789. Lafayette Bugt Formation, Kap Independence, sec. 2, $\times 5$.
- Fig. 12. *Monoclimacis ?vomerina* (Nicholson). MGUH 15208 from GGU 242838. Kap Lucie Marie Formation, Kap Lucie Marie, sec. 5, $\times 5$.
- Fig. 13. *Monoclimacis vomerina* ssp. 1. MGUH 15209 from GGU 216812. Lafayette Bugt Formation, south of Kap Independence, sec. 3, $\times 10$.
- Fig. 14. *Monoclimacis vomerina* ssp. 2. MGUH 15210, GGU 242832. Offley Island Formation, Kap Lucie Marie, sec. 5, $\times 10$.
- Fig. 15. *Monoclimacis* sp. MGUH 15211 from GGU 216767. Lafayette Bugt Formation, Kap Independence, sec. 1, $\times 10$.
- Fig. 16. *Pristiograptus bjerringus schucherti* n. ssp. Holotype. MGUH 15212 from GGU 216846. Cape Schuchert Formation, Kap Schuchert, sec. 4, $\times 10$.
- Fig. 17. *Pribylograptus ?leptothea* (Lapworth) MGUH 3224 from Lauge Koch coll. G.4. Cape Schuchert Formation, Kap Schuchert, $\times 10$.
- Fig. 18. *Pristiograptus* cf. *P. jaegeri* Holland, Rickards & Warren, 1969. MGUH 15213 from Lauge Koch coll. F. 3. Lafayette Bugt Formation, Graptolitnæs, 220 m above sea level, $\times 5$.

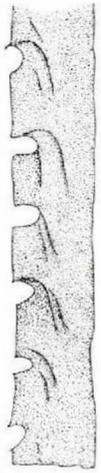
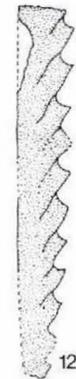
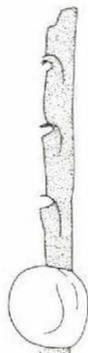
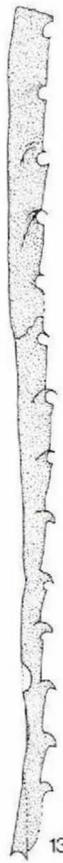
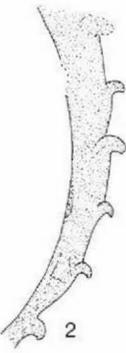
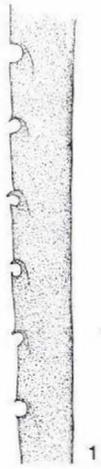


Plate 3

- Fig. 1. *Bohemograptus bohemicus bohemicus* (Barrande). MGUH 15214 from Lauge Koch coll. F.4. Lafayette Bugt Formation, Graptolitnæs, 220 above sea level, $\times 5$.
- Fig. 2. *Monograptus ?barrandei* (Suess). MGUH 15215 from Lauge Koch coll. E.1. Lafayette Bugt Formation, Graptolitprofillet (north), $\times 10$.
- Fig. 3. *Monograptus argenteus* (Nicholson). MGUH 15216 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, $\times 10$.
- Fig. 4. *Monograptus exiguus primulus* Bouček & Přibyl. MGUH 15217 from GGU 216811. Lafayette Bugt Formation, 10 km south of Kap Independence, sec. 3, $\times 10$.
- Fig. 5. *Monograptus ?convolutus* (Hisinger). MGUH 3222 from Lauge Koch coll. G.1. Cape Schuchert Formation, Kap Schuchert, $\times 5$.
- Fig. 6. *Monograptus* cf. *M. dextrorsus* Linnarsson. MGUH 15218 from Lauge Koch coll. I.6. Lafayette Bugt Formation, Kap Tyson, $\times 5$.
- Fig. 7. *Monograptus* cf. *M. dextrorsus* Linnarsson. MGUH 15219 from Lauge Koch coll. I.1. Lafayette Bugt Formation, Kap Tyson, $\times 5$.
- Fig. 8. *Monograptus kochi* n. sp. MGUH 15220 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, $\times 5$.
- Fig. 9. *Monograptus exiguus* s.l. MGUH 15221 from GGU 216811. Lafayette Bugt Formation, 10 km south of Kap Independence, sec. 3, $\times 10$.
- Fig. 10. *Monograptus ?decipiens* Törnquist. MGUH 15222 from GGU 216767. Lafayette Bugt Formation, Kap Independence, sec. 3, $\times 5$.
- Fig. 11. *Monograptus ?decipiens* Törnquist. MGUH 15223 from GGU 216767. Lafayette Bugt Formation, Kap Independence, sec. 1, $\times 5$.
- Fig. 12. *Monograptus kochi* n. sp. MGUH 15224 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, $\times 10$.
- Fig. 13. *Monograptus kochi* n. sp. Holotype. MGUH 15225 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, $\times 5$.
- Fig. 14. *Monograptus riccartonensis* Lapworth. MGUH 15226 from Lauge Koch coll. F.1. Lafayette Bugt Formation, Graptolitnæs, 220 m above sea level, $\times 5$.
- Fig. 15. *Monograptus riccartonensis* Lapworth. MGUH 15227 from Lauge Koch coll. F.2. Lafayette Bugt Formation, Graptolitnæs, 220 m above sea level, $\times 5$.
- Fig. 16. *Monograptus ?M. flemingii* (Salter). MGUH 15228 from GGU 216775. Lafayette Bugt Formation, Kap Independence, sec. 1, $\times 10$.

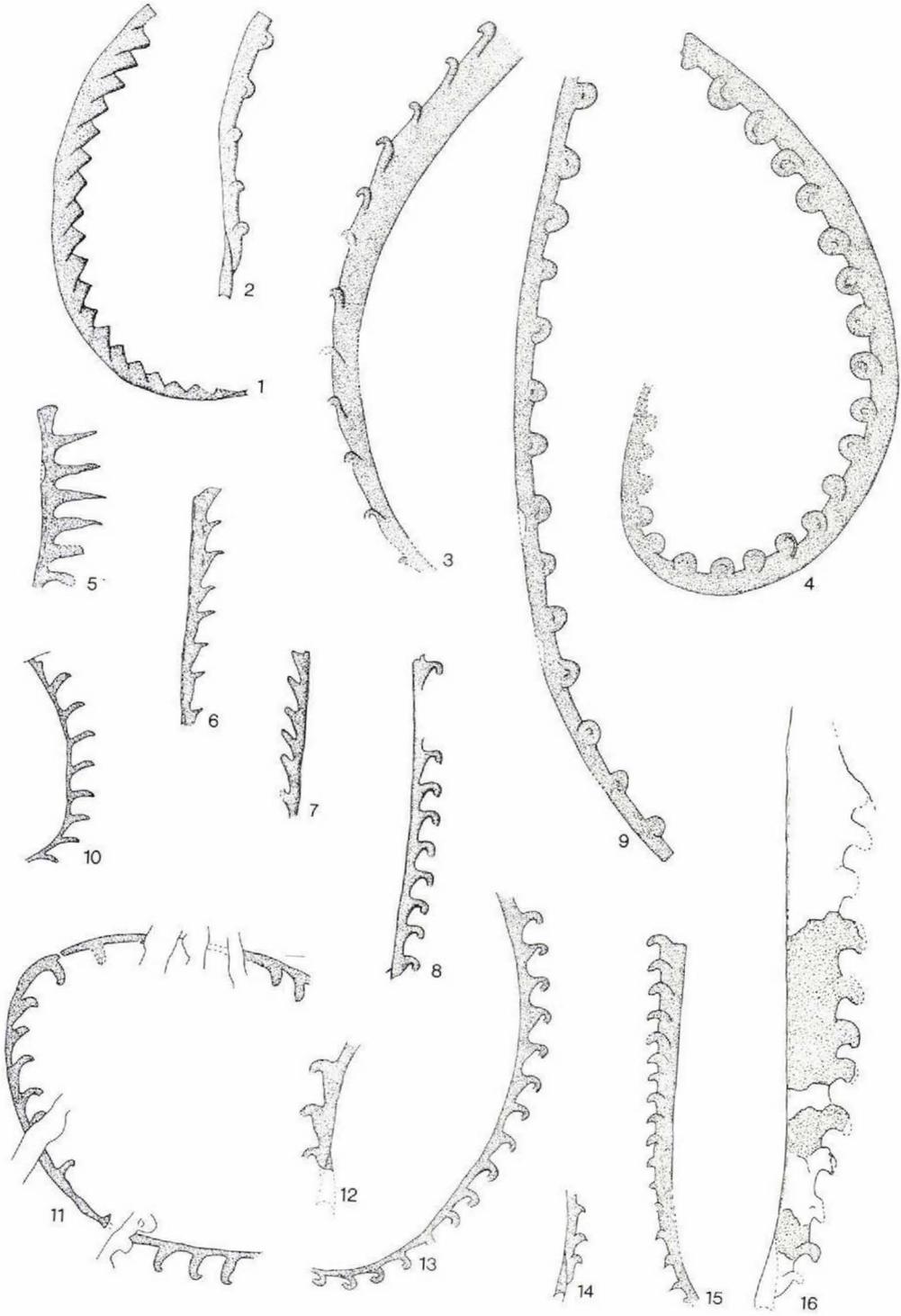


Plate 4

- Fig. 1. *Monograptus lobiferus lobiferus* (McCoy). MGUH 15229 from GGU 216711. Lafayette Bugt Formation, Kap Independence, sec. 1, \times 5.
- Fig. 2. *Monograptus ?parapriodon* Bouček. MGUH 15230 from GGU 242900. Lafayette Bugt Formation, Kap Tyson, \times 10.
- Fig. 3. *Monograptus planus* (Barrande). MGUH 15231 from GGU 216811. Lafayette Bugt Formation, 10 km south of Kap Independence, sec. 3, \times 5.
- Fig. 4. *Monograptus* aff. *M. proteus* (Barrande). MGUH 15232 from GGU 216811. Lafayette Bugt Formation, 10 km south of Kap Independence, sec. 3, \times 5.
- Fig. 5. *Monograptus praecedens* Bouček. MGUH 15233 from GGU 242839. Kap Lucie Marie Formation, Kap Lucie Marie, sec. 5, \times 5.
- Fig. 6. *Monograptus praecedens* Bouček. MGUH 15234 from GGU 242839. Kap Lucie Marie Formation, Kap Lucie Marie, sec. 5, \times 5.
- Fig. 7. *Monograptus* sp. 1. MGUH 15235 from GGU 242832. Offley Island Formation, Kap Lucie Marie, sec. 5, \times 5.
- Fig. 8. *Monograptus rickardsi* n. ssp. MGUH 15236 from GGU 216811. Lafayette Bugt Formation, 10 km south of Kap Independence, sec. 3, \times 5.
- Fig. 9. *Monograptus* aff. *M. speciosus* Tullberg. MGUH 15237 from Lauge Koch coll. E.7. Lafayette Bugt Formation, Kap Independence, \times 10.
- Fig. 10. *Monograptus teichertii* n. sp. MGUH 15238 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, \times 10.
- Fig. 11. *Monograptus teichertii* n. sp. MGUH 15239 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, \times 10.
- Fig. 12. *Monograptus teichertii* n. sp. Holotype. MGUH 15240 from GGU 216839. Cape Schuchert Formation, Kap Schuchert, sec. 4, \times 10.
- Fig. 13. *Barrandeograptus ?pulchellus* (Tullberg). MGUH 15241 from GGU 242918. Lafayette Bugt Formation, Kap Godfred Hansen. \times 5.
- Fig. 14. *Monograptus* sp. 3. MGUH 15242 from GGU 216780. Lafayette Bugt Formation, Kap Independence, sec. 2, \times 10.
- Fig. 15. *Monograptus* sp. 4. MGUH 15243 from GGU 242917. Lafayette Bugt Formation, Kap Godfred Hansen, \times 5.
- Fig. 16. *Monograptus* sp. 4. MGUH 15244 from GGU 242917. Lafayette Bugt Formation, Kap Godfred Hansen, \times 10.
- Fig. 17. *Rastrites* sp. MGUH 15245 from GGU 216780. Lafayette Bugt Formation, Kap Independence, sec. 2, \times 5.
- Fig. 18. *Rastrites* sp. MGUH 15246 from GGU 216780. Lafayette Bugt Formation, Kap Independence, sec. 2, \times 5.
- Fig. 19. *Cyrtograptus* sp. MGUH 15247 from GGU 242918. Lafayette Bugt Formation, Kap Godfred Hansen, \times 5.
- Fig. 20. *Monograptus* sp. 3. MGUH 15248 from GGU 216778. Lafayette Bugt Formation, Kap Independence, sec. 2, \times 10.

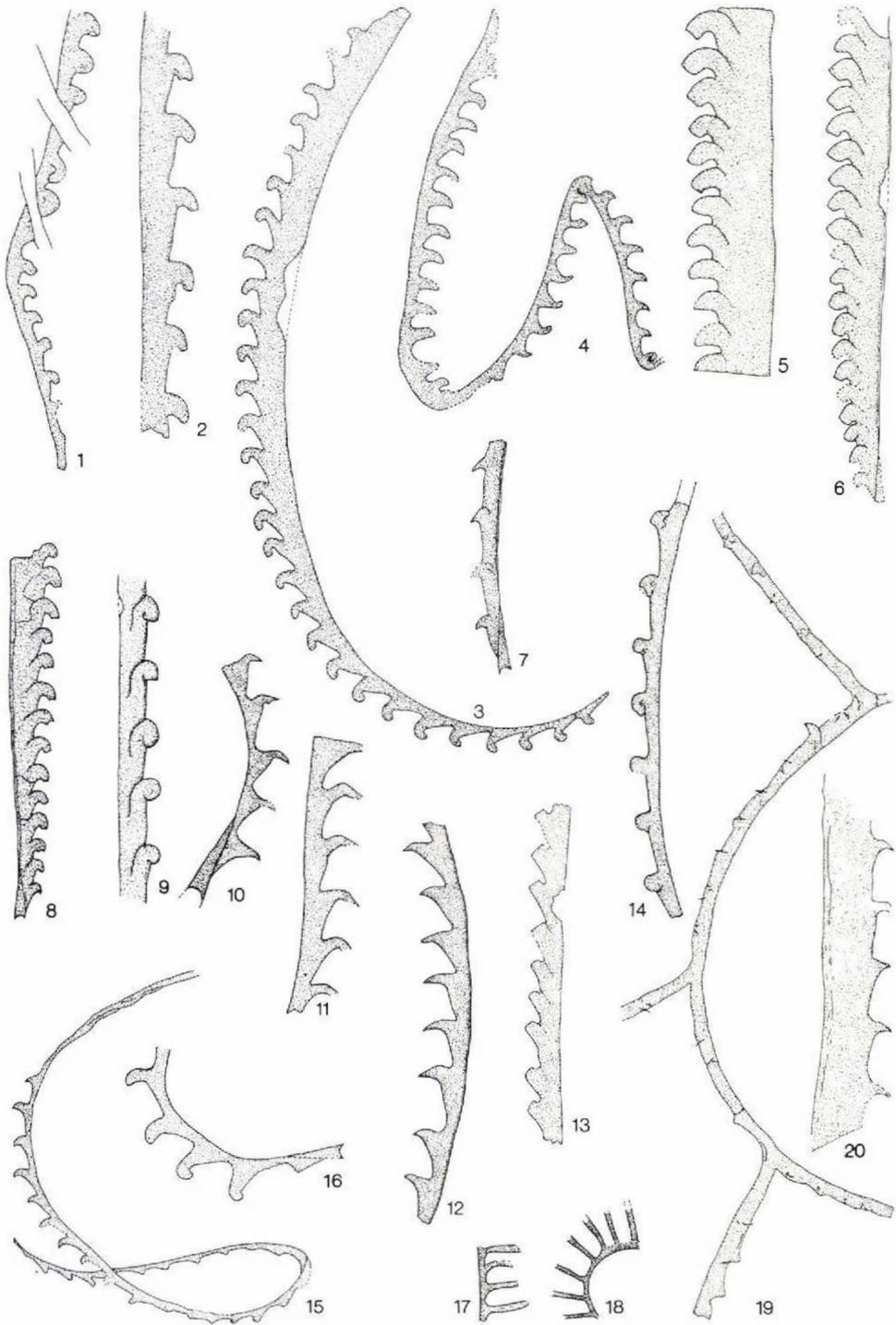


Plate 5

Fig. 1. *Dictyonema* sp. 2, a: MGUH 15249 and b: MGUH 15250 from Lauge Koch coll. E.2. Lafayette Bugt Formation, Kap Independence, $\times 2.5$.

Fig. 2. *Dictyonema* aff. *D. polymorphum* Ruedemann. MGUH 15251 from GGU 242918. Lafayette Bugt Formation, Kap Godfred Hansen, $\times 3.3$.

Fig. 3. *Dictyonema* sp. 1. MGUH 15252 from Lauge Koch coll. E.1. Lafayette Bugt Formation, Kap Independence, $\times 2.5$.

Fig. 4. *Callograptus ?pulchellus* Schrock. MGUH 15253 from GGU 216775. Lafayette Bugt Formation, Kap Independence, sec. 1, $\times 3.5$.

Fig. 5. *Dictyonema* sp. 2. MGUH 15254 from Lauge Koch coll. E. 2. Lafayette Bugt Formation, Kap Independence, $\times 2.75$.

Fig. 6. *Callograptus ?pulchellus* Schrock. MGUH 15255 from GGU 216775. Lafayette Bugt Formation, Kap Independence, sec. 1, $\times 3.1$.

Fig. 7. *Stomatograptus grandis grandis* (Suess). MGUH 15256 from GGU 216784. Lafayette Bugt Formation, Kap Independence, sec. 2, $\times 3$.

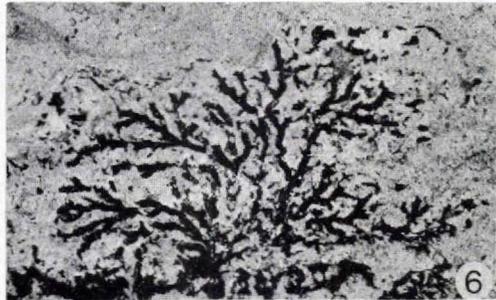
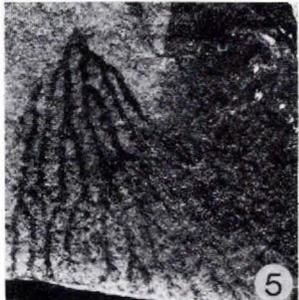
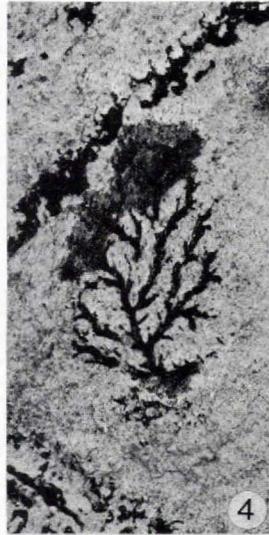
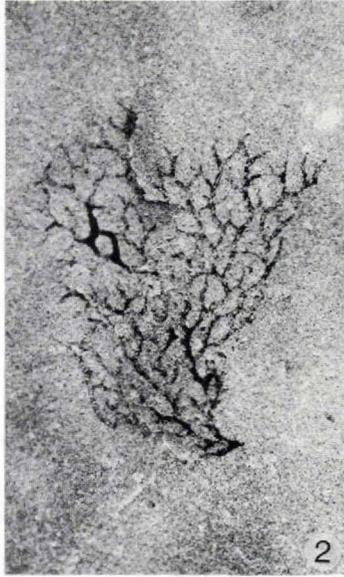
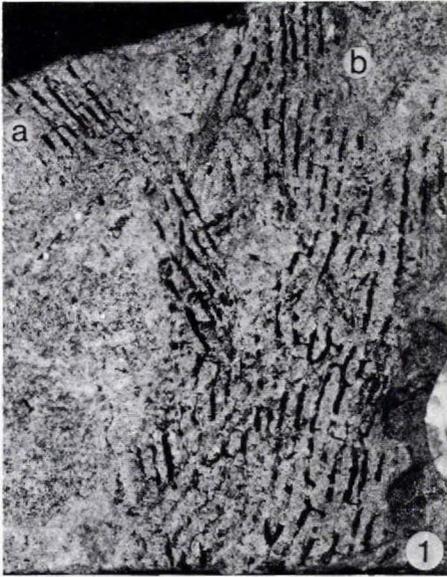


Plate 6

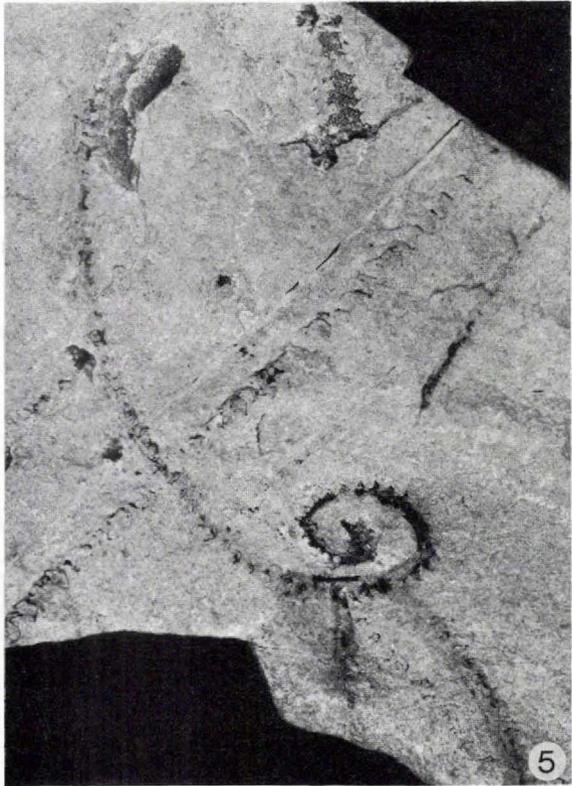
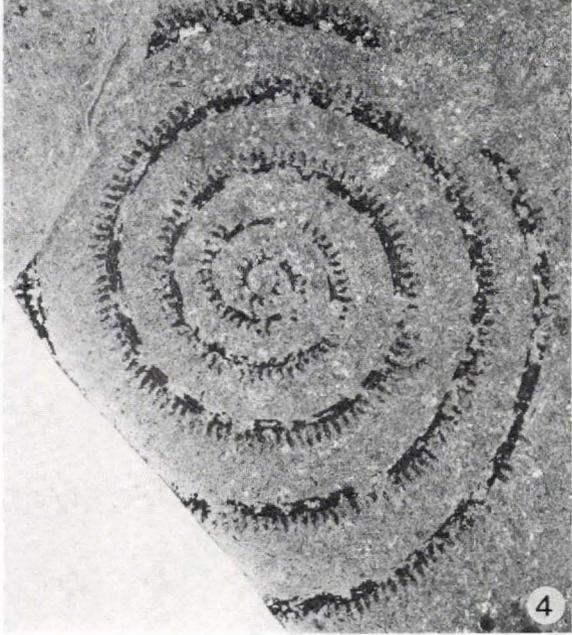
Fig. 1. *Retiolites geinitzianus angustidens* Elles & Wood. MGUH 15257 from GGU 242900. Lafayette Bugt Formation, Kap Tyson, $\times 5$.

Fig. 2. *Monograptus ?flemingii* Salter. MGUH 15258 from GGU 216775. Lafayette Bugt Formation, Kap Independence, sec. 1, $\times 3$.

Fig. 3. *Monograptus priodon* (Bronn). MGUH 15259 from GGU 216851. Lafayette Bugt Formation, Kap Schuchert, sec. 4, $\times 5$.

Fig. 4. *Monograptus spiralis spiralis* (Geinitz). MGUH 15260 from GGU 216783. Lafayette Bugt Formation, Kap Independence, sec. 2, $\times 1.2$.

Fig. 5. *Cyrtograptus* n. sp. MGUH 15261 from Lauge Koch coll. E.11. Lafayette Bugt Formation, Graptolitprofillet, Kap Independence, $\times 2.4$.



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