BIHANG TILL K. SVENSKA VET. AKAD. HANDLINGAR. Band 6. N:o 13.

ON

THE GRAPTOLITES

DESCRIBED BY

HISINGER

AND THE OLDER SWEDISH AUTHORS

BY

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WITH 3 PLATES.

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The attention of Swedish naturalists was fixed on the graptolites, which occur so abundantly in our older Silurian strata, at a very early date. The author, who seems to have been the first to observe and mention these fossils, is the Archiater MAGNUS VON BROMELL. In his, (for its time), most meritorious work: »*Lithographiae Suecanae Specimen primum et secundum*» [1]) he, among other matters, gives an account of a collection of fossils belonging to himself: »*De vegetabilibus, fossilibus et lapidefactis.* From this it may be inferred, that some of these were graptolites, although he regards them as plants. In *Specimen secundum* the *Articulus primus* bears the title: »De musco incrustato et in lapide depicto»; No. 1 is »Lapis cinerei coloris fissilis foetidus, Suillus dictus, in superficie ostendens musci ramosi capillamenta nigra, subtilissimo quasi penicillo expressa, inventus in arenariis paroeciae Giærstad, prope oppidum Schenningiam in Ostrogothia». — Further is said: »Qui in hoc memorato lapide depictus cernitur muscus, generis est saxatilis, repentis, capillacei, non ipsam lapidis substantiam, quemadmodum in dendritis Florentinis & Germanicis nonnullis videre licet, penetrans, sed lapidis in extima superficie duntaxat subtilem figuram suam ostentans».

From this description it cannot of course be definitely ascertained, what mineral BROMELL refers to. It may have been anthraconite, the name of which BROMELL has translated to »lapis suillus». Certain varieties of anthraconite may by exposition to the air acquire a more grayish colour. — If BROMELL'S determination of the mineral is correct [2]) it can al-

[1]) Acta literaria Sueciae Upsaliae publicata. Vol. I & II. 1720—1729. Also separate: »Specimen primum», 1724. and »Specimen secundum. 1727».

[2]) It is possible, that the mineral may have been a limestone-ball from the upper graptolite-shales. These balls are always of a gray colour and somewhat fetid when scratched: but this supposition is contradicted by the circumstance, that BROMELL expressly employs the term: »lapis suillus» for real anthraconite or swinestone. No other kind of limestone, but this

most with certainty be concluded, that he by his description meant to indicate a *Dictyonema*. Nothing in his description forbids such a supposition. He denominates it: »*musci ramosi capillamenta nigra*», and compares it further with a dendrite. At the same time however, he, as it appears above, points out its dissimilarity to such forms.

Dictyonema flabelliforme is very common in the youngest aluminaceous shales of Ostrogothia; and in other provinces also balls of anthraconite are frequently found in the similar strata, which contain the same fossil, as shown, when they are split open.

Articulus secundus is entitled: »*De foliorum impressionibus et vestigiis in variis lapidibus*». Number 3 in this section is entitled: »Variarum plantarum foliaceae impressiones et vestigia in lapide fissili nigro: ex monte Dalaberg in Vestrogothiae paroeciae Dahla. — Genuina horum foliorum nomina exprimere nunc nequeo; quamvis etenim nonnulla pinnulis suis filicem, alia angustia et longitudine graminis speciem, quaedam acumine ac tenuitate salicem, alia ericam et nymphaeam minimam referre videantur, determinare tamen, quo praecise pertineant, non audeo, donec ab provinciae illius, nunc autem Nericiensis, Medico experientissimo et deliciarum harum cultore indefesso, D. D. Hesselio plura et elegantiora lapidis hujus plantigeri specimina accepero».

It is highly probable, that this mineral from Vestrogothia was a shale containing graptolites. Wahlenberg [1]) considers this to have been the case.

Among others Bromell is remarkable for his advanced opinions on the nature of fossils, which he enunciates so clearly as to leave no doubt of what he means. He says expressively: »animalia eorumque partes variae, haud minus

crushed and powdered by the peasantry as a medicine for sickly domestic animals. Doses of this material are given especially to swine: from which circumstance also its name is derived. Solutions of swinestone are in some parts of Scania in great demand as an article of trade.

[1]) »Petrificata Telluris Svecanae» in Nova Acta Reg. Soc. Scientiar. Upsal. Vol. VIII, 1821, p. 93. »Talis Graptolithus in Schisto tenuiore pallido Vestrogothiae, colore brunneo expressus, quam frequentissime occurrit; ubi autem schistus in colorem coerulescentem vel subcaesium abit, ibi picturae Graptolithi nigrae evadunt simulque lineamenta earum inter se confluunt ita ut figurae plenae lineares tantum appareant, quas pro foliis graminum habuit Bromell in Act. Upsal. 1727, 312, n. 3, aliique.»

ac vegetabilia, lapideam quandoque duritiem induere et in lapides mutari possunt; ejusmodi lapides petrificatorum nomine communi apud Lithographos comprehendi solent et adcurate distingui debent ab illis lapidibus, qui casu, naturae lusu, vel artificio quovis talem formam ac figuram acquisiverunt, quâ vegetabilia, animalia vel res naturales atque artificiales referunt, cum quibus tamen praeter figuram externam nihil commune habent».

Linné was the first who used the name »*Graptolithus*» in his »*Systema naturae*», Ed. 1, 1735, Regnum lapideum, Classis III, Fossilia, — Ordo 3. Graptolithus Petrificatum picturâ assimilans». From the list he gives, it can be inferred that Linné in 1735 by this name only meant dendritic incrustations and similar forms. By referring to his Museum Tessinianum, published in 1753, it can plainly be seen (p. 104), that he intended also at that date to designate various inorganic formations, as dendrites and the concentric structure of flints. He gives in his »Skånska Resa» (Travels in Scania) 1751, a sketch, which evidently represents some graptolites. The slab, which contained these, he had collected from a hill of gravel, named »Bybjer», close to the church at Ö. Herrestad. From the figure it is to be presumed, that the straight form represents a *Climacograptus*: the two others a convoluted *Monograptus*. In the Geological Museum at Lund there are some pieces of shale, collected by Professor Lundgren from the exact locality at Bybjer [1]). Three different types of shales are represented: 1) Graptolite-shale with *Phyllograptus* sp. 2) Gray Gala-shale with *Mon. priodon* Bronn and *Mon. Limarssoni* Tullb. mscr.; and 3) Brown shale of Birkhillage, with *Climacograptus scalaris* L., *Monogr. triangulatus* Harkn., *M. gregarius* Lapw. and *Diplograptus* cfr *fidius* His.

It appears exceedingly probable, that the Linnéan shale was of the last mentioned type. The fossils thereupon preserved would thus almost certainly have been the *Climacograptus* referred to above and *Monograptus triangulatus* Harkn., that is to say, two of the most prominent types.

[1]) Professor Lundgren has kindly communicated the fact, that no rocks exist here in situ. Graptolite-slate occurs as detached blocks in the mass of gravel, a circumstance which is also evident from Linné's description.

In the twelfth edition of the *Systema Naturae*, Tomus III, Holmiae 1768, p. 174, LINNÉ for the first time makes use of the specific denominations »*sagittarius*» and »*scalaris*».

His numero 6 is »sagittarius; Graptolithus impressionibus sagittatis. — Anonymum. Volkam. Siles. 3. p. 332, t. 4, fig. 6. — Habitat in cote. — Hoc impressionibus imbricatis, sagittatis absque pedicello, regulariter dispositis, apice eandem plagam respicientibus». — In the work of VOLKMAN, »Silesia subterranea», the figure and description, cited by LINNÉ, do not refer to a graptolite, but to a wholly different fossil, namely a *Sigillaria*. Thus it is evident, that it is now impossible to say, what LINNÉ referred to under the name »*sagittarius*».

His numero 7 is »scalaris; Graptolithus lineam striasque transversas referens. — Graptolithus. It. Scan. 147, f. 147. — Habitat in schisto communi Scaniae«. —

Under this name consequently LINNÉ alludes to the form of *Climacograptus*, already mentioned, which occurs at Bybjer in the zone of *Monograptus gregarius*.

G. WAHLENBERG [1]) held the opinion, that the graptolites are Orthoceratites. The form, which he chiefly seems to have had in view, is *Climacograptus scalaris* L., which he was acquainted with from the upper graptolitic shales in Westrogothia, and which he denominates: *Orthoceratites tenuis*. — His description runs as follows: »Ut plurimum latitudinem vix lineae et longitudinem unciae habet formamque lineärem. Articuli ejus interdum a se invicem soluti et inversi sunt ita, ut circulos semine sinapios minores in schisto expresserint. Typi longitudinalis loci siphonis nervum medullarem evidentem ostenduut, ad ejus latera dissepimenta saepe opposite tamquam in situ naturali expressa sunt, sed interdum situ suo alternant, quod quidem sive a commotione, sive ab obliquitate effectum esse potest». He says that such are to be found also in Scania, and in Dalecarlia at Osmundberg and at Furudal.

He further writes: »Inter omnes hos Graptolithos scalares tam vario modo expressos saepius adsunt sic dicti Graptolithi sagittarii Linnæi, quorum natura et origo adhuc magis incognitae fuerunt, sed jam ulterius vix dubitamus, quin ab iisdem Orthoceratitis minutis destructione peculiari ortum habeant».

[1]) »Petrificata Telluris Svecanae», l. c.

Thus WAHLENBERG considered, that the true graptolites only deserved this name. All the other objets of inorganic nature, which, especially in the earlier editions of LINNÉS »Systema Naturae» were comprised under the name »*Graptolithus*», he does not mention at all.

WAHLENBERG in referring to the monoprionidian graptolite, which is found in the upper graptolite shales of Westrogothia together with *Orthoceratites tenuis (Climacogr. scalaris* L.) as *Gr. sagittarius Linnæi*, employs this name for a *Monograptus*, which certainly is the species LAPWORTH subsequently named *Monograptus leptotheca*. That the Linnéan name indicates quite another species may be considered as certain, the containing rock being from Silesia, where *Monogr. leptotheca* is wanting; but it is impossible at present to ascertain, what species it may have been.

Professor NILSSON of Lund is quoted by Dr BECK [1]) and Professor EICHWALD [2]) as having published in the Transactions of the Physiographic Society in Lund some short comments on the nature of the graptolites; but in reality there is nothing written by him to that effect in the publications of that society. Probably Prof. NILSSON had some work prepared or finished in manuscript on that subject, but this was never published. Yet from BECK's account, and also from those of EICHWALD and HISINGER it seems, that NILSSON was the first who distinctly pronounced the opinion, that the graptolites are polyparies belonging to the »*Polypi ceratoporae*». He moreover proposed to name them: *Priodon*. That name being already in use he proposed later the name of *Prionotus*, which HISINGER accepted. Yet this too had been already employed.

HISINGER describes and delineates in *Lethaea Suecica, Supplementum* 1837, five species and in *Supplementum secundum* 1840 three species, of which *Dictyonema* is regarded as the impression of a monocotyledonous plant. They are all included under the name of *Prionotus* proposed by NILSSON. HISINGER moreover partakes of NILSSON's opinion concerning the relation of the graptolites to the »Polypi ceratoporae».

[1]) Notes on Graptolites, Silurian system. Part. II, pag. 695.
[2]) Lethaea Rossica. Vol. I, part I, pag. 424.

Previously [1]), on the contrary, he was of the same opinion as WAHLENBERG.

ANGELIN has left a number of annotations concerning the systematic place and the structure of the Graptolites, which annotations in all their essentials agree with the opinions expressed by BARRANDE and HALL. He completed also a plate in folio, on which some twenty Swedish Graptolites of the most important types are delineated; but this plate has never been published.

In the Palæontological Department of the State-Museum in Stockholm the type specimens are preserved, after which the figures in HISINGERS' *Lethaea suecica* were executed. As the figures, which he has given in that work, have more than once occasioned misconception, the names having been employed for species, actually very distinct from those of HISINGER, it is naturally most desirable, that the originals should be submitted to an exact revision, and that new, accurate and complete figures of them should be published.

As the opportunity of examining a greater number of specimens, and of giving new and better figures of these forms, has now arrived, owing to the fact that there exists at present in the Swedish State-Museum, a large collection of Graptolites, including, together with HISINGER's original examples, many other specimens brought together by the late Professor ANGELIN, by WEGELIN and by other investigators, I have undertaken this task at the request of the Keeper of the Palæontological Department of the State-Museum, Professor G. LINDSTRÖM.

The species described in the Lethaea Succica, Supplementum, 1837, pag. 113—114 are the following: — *Prionotus scalaris*, *Pr. pristis*, *Pr. sagittarius*, *Pr. convolutus* and *Pr. folium;* those mentioned in the Supplementum secundum, 1840, are *Pr. geminus*, *Pr. teretiusculus* and (under the name of *Impressio plantae Monocotyledoneae*), *Dictyonema*.

No. 1. The graptolite, which is the type specimen of the figure of *Prionotus scalaris*, is enclosed in a lightgray, hardened shale from Mösseberg. It is a *Climacograptus*, precisely identical with that, which LAPWORTH names *Climacograptus normalis*. Upon the same slab as this is found *Mon.*

[1]) Anteckningar i Physik och Geognosi. 4 h., pag. 168. 1828.

lobifer M. COY. In addition to this there is found in HISINGER's collection under the same name another form, preserved in a dark shale from Fägelsång; but this is not figured. and is, according to our present conception of a species a separate form.

HISINGER's description is as follows:

»*Prionotus scalaris* linearis, rectus, unciam longus, vix lineam latus, compressus, rachide centrali, capillari, utrinque dissepimentis transversis, alternis. — Icon. Petrif. suec. Suppl., Tab. XXXV, fig. 4 *a* magn. nat., *b*, magn. aucta. — *Graptolithus scalaris* L. — Loc. In strato superiori schisti argillacei Vestrogothiae, et in schisto argillaceo Scaniae ad Fägelsång etc.

I here append a description of the species according to the terminology now in use.

Climacograptus scalaris L.

Plate I, fig. 12, 13. 14.

Graptolithus scalaris LINNÉ. Syst. Nat., Ed. XII. p. 174. 1768. *Orthoceratites tenuis* WAHLENB., Petrificata Telluris Svecanae, in Nova Acta Reg. Soc. Scientiar. Upsaliae, Vol. VIII. 1821, p. 93. — *Prionotus scalaris* HIS. l. c. — *Climacogr. normalis* LAPW., On the Graptolites of County Down. Proceedings of Belfast Naturalists' Field Club. Appendix 1876—77, pl. VI. fig. 31.

The hydrosoma is 2—3 ctm. long, 2—2.5 mm. broad. with ventral margins converging downwards; the base is sharply rounded, drawn out in a more or less prolonged point; the virgula is distally elongated. The hydrothecae are found to a number of 8—9 on 10 mm., and are rectangular in shape. The exterior margin is horizontal above the aperture of the nearest hydrotheca. This margin forms an acute angle and rises vertically to the apertural border. which is rectangular to this and somewhat concave.

HISINGERS type specimens are conserved in a lightgray shale from Mösseberg in Vestrogothia, hardened by contact with diabase, and often covered by a film of a rusty colour. On the slabs there are to be seen *Monograptus lobifer* and a small *Diplograptus*. This is probably the same shale, to which BROMELL and WAHLENBERG allude.

The same species is moreover to be found at Kongslena in Westrogothia. in Scania at Röstånga, Kiviks Esperöd,

Bollerup, and in detached blocks at Bybjer, close by Ö. Herrestad and some other localities. It occurs only in the zones of *M. gregarius* and *M. lobifer*. — The figures 13 and 14 on my first plate represent HISINGER's type specimen — natural size and magnified; fig. 12 is a drawing of another specimen from the same locality, Mösseberg.

No. 2. The next species described by HISINGER is *Prionotus pristis*. The original is preserved in a darkbrown shale from the Trinucleus-zone at Draggå-bridge in Dalecarlia. Besides the specimen which HISINGER has figured, other forms, represented on Plate I by the figures 4 and 5, are seen on the same slab; the figures 2 and 3 are new delineations of HISINGER's own original specimen. HISINGER's description is as follows:

»*Prionotus Pristis* linearis, rectus, vix lineam latus, compressus, rachide centrali, capillari, utrinque dentibus latis, acutis. — Icon. Petrif. Suec. Suppl. Tab. XXXV, fig. 5. — Loc. In Calce transitionis fusca ad Draggån in paroecia Rättvik, Dalecarliæ. A Dom. J. G. CLASON lectus».

This species may provisionally be placed in the genus *Diplograptus*.

Diplograptus? pristis. HIS.

Plate I, fig. 1—11.

Prionotus pristis HIS. l. c. — *Diplograptus pristis* TÖRNQUIST. Om några graptolitarter från Dalarne, Geol. Fören. i Stockholm Förh. 1881. N:o 66, Bd. V, N:o 10, p. 443, Pl. 17, fig. 8 a—g.

The hydrosoma is 4—5 ctm. long, 2.5 mm. broad; growing downwards smaller, with rounded base, which is drawn out in a sharp point or »radicle». The virgula is often irregularly bent, distally elongated; no line, indicating a median septum is to be seen on the hydrosoma; the median plane between the hydrothecae is smooth and even. On a length of 10 mm. there are 9—10 hydrothecae, diverging from the axis at 22°; they are tubes of rectangular shape, assuming different appearances in relation to the different manner in which the specimens have been preserved; only the two primary hydrothecae have the apertural edges elongated in a sharp spine. The section of the hydrosoma is rectangular. On

flattened specimens there is no trace of septa between the thecae; but on those, which are preserved in relief, they appear very distinctly (fig. 9 and 11). The hydrothecae have a different appearance according to the difference of pressure; now resembling those of a *Climacograptus*, now those of *Dipl. quadrimucronatus* HALL.

From the dark, spotted Trinucleus-shales in Vestrogothia there are in the State-Museum specimens, preserved in relief; flattened in multitudes from the Dalecarlian and Ostrogothian Trinucleus-shales. The same species was found by Dr. G. LINNARSSON in a gray slate in Dd 5 near Gross-Kuchle in Bohemia.

The forms denoted in foreign literature by the name of *D. pristis*, have no resemblance to HISINGER's species, which seems not to be known from other localities than those above mentioned. The only species, that can be compared with HISINGER's is *Graptolithus pristis* of HALL: — Palæontology of New-York, Vol. I, p. 256, pl. LXXII, fig. 1 a—3. It resembles very much our Swedish species; yet it differs in certain respects, as in its very elongated basal appendix and the shape of the hydrothecæ as given on some of HALL's figures.

The insufficient material does not admit any examination of the interior structure of this species; the absence of a septum, dividing the hydrosoma in two halves seems to place it near the genus *Lasiograptus;* the position of the frequently bent and twisted virgula is in accordance with that of this genus.

The type specimens of HISINGER's *Prionotus sagittarius*, *Pr. convolutus* and *Pr. folium* are all present upon the very same piece of rock, which consists of a somewhat bituminous limestone from Furudal in Dalecarlia.

No. 3. »*Prionotus sagittarius* linearis, rectus, plures uncias longus, dimidiam latus, compressus, rachide marginali, capillari, altero latere dissepimentis transversis, distantibus, margine serrato. — Icon. Petrif. suec., Tab. XXXV, fig. 6. — *Graptolitus sagittarius*, LINN. — Loc. Cum Prionoto scalari occurit vulgatissime nec non in schisto argillaceo ad Furudal. Dalecarliæ.»

On examination of the form, which is the type of the drawing in Lethaea Suecica, it proves itself to be exactly

the same, as that which LAPWORTH has named *Monograptus leptotheca*. Yet it appears from other species in HISINGER's collection, which also are labelled *Pr. sagittarius*, that HISINGER himself used this name for all straight *Monogropti*, and also for fragments of the branches of the *Dichograptidae*.

The form, which LAPWORTH names *M. leptotheca*, occurs in Sweden always in company with *M. convolutus*, *M. lobifer*, *Dipl. folium* and *Climacograptus scalaris;* that is in other words at a certain fixed horizon near the base of the upper graptolite-bearing shales. And it is just from this stage that HISINGER and WAHLENBERG collected several of their graptolites. As in this zone no other *Monograptus* is found, which could have been meant by the name »*sagittarius*» (for the zone with *M. cyphus*, the only species that might be suggested is not found represented in Vestrogothia), I take it we are warranted in assuming that WAHLENBERG also by the name of »*sagittarius*» has meant this species. He considers it provisionally as the moiety of an *Orthoceratites tenuis* produced by splitting. Although LINNÉ, by naming it *Graptolithus sagittarius*, by that name signified all the *Monograpti* with sawlike teeth, it is however probable, that his material was not rich and that the name could be fixed on a certain species in the modern sense.

Monograptus leptotheca. LAPW.

Plate II. fig. 8–12.

Graptolithi sagittarii Linnaei apud WAHLENBERG Petr. Svec. p. 93. — *Prionotus sagittarius* HIS. l. c. — *Monogr. leptotheca* LAPWORTH. On Scottish Monograptidæ, Geol. Mag., Dec. II, vol. III, 1876 Pl. XII, fig. 4.

The hydrosoma is about 15 ctm. long, almost straight or a little bent, the proximal part long, narrow, increasing in breadth by degrees, which at last amounts to 2,5—3 mm. on the fully developed part. The general form of the hydrosoma is straight, but the first formed hydrothecae are placed on the convex margin, whereas the ventral margin sometimes is concave on the distal part. The hydrothecae consist of long and narrow tubes, to a number of 8—9 on a length of 10 mm., overlapping each other to a great extent; downwards they are narrow, where they are covered by the nearest inner hydrotheca; their free extremity swelling out, the aperture narrow;

the apertural border short, concave, the ventral margin parallel to the axis of the hydrosoma; denticle well marked. The common canal occupies a third of the breadth of the hydrosoma. Hydrothecae, inclined to the axis at an angle of 10 degrees.

Although there is some uncertainty about HISINGER's type-specimen, it may however be discovered, that it is the same species to which LAPWORTH, as above stated, is referring. Seen in a certain light there are signs of the interior margin of the theca; the convex, exterior margin is, upon the whole, parallel to the dorsal margin.

The specimen exhibits a feeble ventral curvature, yet a similar one has also been observed on good specimens from other localities.

The figures 8 and 9, Pl. II, represent HISINGER's type specimen in natural and magnified size. For comparison is in addition a Scottish specimen figured, Pl. II, fig. 9, collected by LAPWORTH at Dobbs Linn and wholly transformed to iron pyrite.

This species is found, not only in Dalecarlia, but at Kongslena and on Mösseberg in Vestrogothia, also at Röstånga and some other places in Scania, always in a constant horizon, together with *M. lobifer*, *M. convolutus*, *M. communis*, *Diplograptus folium*, *Climacograptus scalaris*, *Rastrites peregrinus* and others.

No. 4. On the same handspecimen as the foregoing, is also the original of *Prionotus convolutus*, which HISINGER describes in the following terms:

»*Prionotus convolutus* spiraliter convolutus, lineam latus, compressus, rachide marginali, capillari, altero latere dentato, dentibus ad basin usque distinctis, lanceolatis, acutiusculis. — Icon. Petrif. succ. Suppl., Tab. XXXV, fig. 7. Loc. In schisto argillaceo ad Furudal, Dalecarliae, cum praecedenti. Museum nostrum.»

On the same piece of shale there are several proximal fragments of this species. From Dalecarlia I do not know any distal portions, whereas complete specimens are found at Kongslena as well as at Röstånga, and the species proves itself, by comparing it with figures and descriptions by LAPWORTH, to be the form, which he denominates *Monogr. convolutus*, var. *spiralis*.

Monograptus convolutus. His.

Plate II, fig. 13—16.

Prionotus convolutus His. l. c. — *Mon. convolutus* var. d. *spiralis* Lapworth, On Scottish Monograptidae, plate XIII, fig. 49; Geol. Mag. 1876 — *Rastrites peregrinus* Credner, Elemente der Geologie, 3:e ed., fig. 125. p. 392. — Römer, Lethaea geognostica, Ed. 1876, Taf. III, fig. 8. — *Gastrides* Pfaff, Grundriss der Geologie, p. 245, fig. 124. — Non *Monoprion convolutus* Barrande, Grapt. de Bohême, nec *Monograptus convolutus* Geinitz, Die Graptolithen.

Hydrosoma long, convoluted in one flat spiral; the proximal part forming several concentric spirals; the distal part is less arcuate; any twisting of the axis has not been plainly observed, but that it may exist, is shown by fragments, which have the hydrothecae placed on the concave margin; on the proximal part they are always placed on the convex side. The hydrothecae are scarcely in contact with each other; they are free, rectangularly projecting tubes, sharply pointed and having the aperture directed downwards, as it appears. On a length of 10 mm. there are 10 hydrothecae on the proximal, and 8 on the distal portion. The common canal is very narrow, particularly in the proximal portion; the virgula is plainly visible on the fully developed part.

Hisinger's type specimen is very like *Rastrites peregrinus*, but if complete specimens are procurable, in which the distal part is developed, it appears at once that the species is a *Monograptus;* the hydrothecae are more triangular and feebly curved, with the superior margin convex.

The name of *M. spiralis* for this species is at any rate unsuitable, as Geinitz has given this name to a very different species of Gala age, and which moreover may be a *Cyrtograptus*. To cover such species as *M. communis* and *M. proteus* with Hisingers denomination *M. convolutus* is, I think improper; for these forms seem to keep themselves constant and different from *M. convolutus*.

This species occurs, not only at Furudal in Dalecarlia, but at Kongslena in Vestrogothia, at Röstånga, and at other localities in Scania, and also in England.

No. 5. The third Graptolite on the slab from Furudal is a *Cephalograptus*, which Hisinger describes in the following manner:

»*Prionotus folium* oblongo-lanceolatus? rectus, duas lineas latus, compressus, rachide centrali, capillari, utrinque pinnulis angulæ acuto excuntibus, linearibus, acutiusculis, dense incumbentibus. — Icon. Petrif. Suec. Suppl. Tab. XXXV, fig. 8 a. magn. nat. b, magn. aucta. — Loc. Cum praecedenti. Mus. nostr.

On the slab there are two complete specimens, and one fragment of a larger individual, besides more incomplete parts. Hisinger's figure is thus constructed from these specimens. His magnified figure has no resemblance to anyone of the originals. The figures 15, 16 and 17 on my first plate are figures of the actual specimens from which Hisinger composed his figures.

Cephalograptus folium. His.

Plate I, fig. 15—19.

Prionotus folium His., l. c. — *Diplograptus folium* Törnquist, Om några graptolitarter från Dalarne; l. c. p. 142, fig. 7. — Non *Diplograptus folium* Nicholson *nec* Harkness.

Seen from the narrow proximal part the hydrosoma strongly and continually increases in breadth to about the point where the two first hydrothecae cease; then its ventral margins are almost parallel; above, it is rounded: its length amounts generally to 2.5 ctm. and its breadth to 5 mm. The virgula is distally elongated, narrow. On 10 mm. there are 10 hydrothecae, inclined to the axis at an angle of 5°, which increases to 35°; narrow, very long tubes, probably of square section, a little curved; the apertural margin rectangular to the axis of the theca. On some specimens the test of the hydrothecae seems to be covered by faint, transverse striæ, rectangular to the axis of the theca.

This species, which seems to be wholly unknown to foreign authors, belongs to a group, consisting only of two varieties, which, formerly included in the genus *Diplograptus*, was separated by Hopkinson under the name cited. The representative previously known is *Cephalograptus cometa*, Geis.

The external form of the two species last mentioned is most singular, the hydrosoma rapidly decreasing in size

downwards because of the inclination of the long and narrow, almost equally broad hydrothecae. How far *C. cometa* also has a transversally striated membrane, I do not know. This fact can only be observed on very well preserved examples. On those of *C. folium* from Scania it is apparent, also that on splitting a piece of shale the virgula is seen on the one half only of the divided specimen, and that the separating walls issue from this virgula alternately at determined distances; the other half is deprived of virgula; the separating walls of the hydrotheca are carried forward completely to the middle line, but leave between them an oblong, narrow space, which is occupied by the common canal. From this it is evident that the interior structure deviates in a high degree from that of the *Diplograptidae*, where there is a separating membrane, a septum between two common canals. The genus *Cephalograptus* thus belongs to the large section of Graptolites, which from *one* common canal develop two series of hydrothecae; its nearest affinities are with the *Retiolitidae*.

This species occurs, at Furudal in Dalecarlia, and at Kongslena in Vestrogothia, also in Scania at Röstånga and Kiviks-Esperöd.

No. 6. In *Supplementum secundum* HISINGER describes and delineates two Graptolites from Fågelsång.

»Tab. ~~XXXVII~~ XXXVIII Fig 3. *Prionotus? geminus* (Nob.) duplex, e trunco communi egrediens. — Loc. In schisto transitionis argillaceo ad Fågelsång, Scaniae; cum Prionoto Scalari, minus frequens.»

HISINGER's type specimen is a fragment of the proximal part of a *Didymograptus*, belonging to the well known *D. Murchisoni*-type. As HISINGER's form can not be separated as a distinct species, I propose to place it as a subspecies of this polymorphous type:

Didymograptus Murchisoni BECK. *geminus. HIS.

Plate III, fig. 5—10.

Prionotus? geminus HIS. l. c. — BOECK, Bemærkninger angaaende Graptoliterne, Christiania 1851, fig. 24. — *Graptolithus geminus* SCHARENBERG. Ueber Graptolithen, Breslau 1850, p. 13, pl. I, fig. 1— ? *Did. Murchisoni* TÖRNQU., Fågelsångstraktens undersiluriska lager; Lund 1865, p. 17, fig. 11. — *Did. furcillatus* LAPWORTH, On the Graptolites of the Arenig and Llandeilo Rocks of St Davids, p. 649, pl. XXXV, fig. 3; Quart. Journ. Geol. Soc., 1875.

The branches of the hydrosoma grow out at a somewhat different height from the sides of the pointed sicula; the whole hydrosoma attains in most cases to no greater length than 4 ctm.; the greatest breadth amounts to 3.5 m.m. The branches are rigid, showing underneath, at their commencement a feeble curvature, so that the dorsal margin is convex: the distal part is straight or it shows a feeble curvature in consequence of which the distal points of the branches become somewhat bent outwards. The primary angle of the branches is ordinarily about 310°; so that the angle between the branches is a little more than rectangular. The branches are commonly at their origin slender, gradually expanding upwards, but in some forms they rapidly attain a greater breadth. The latter is the case in HISINGER's type-specimen, in which the branches narrow themselves very rapidly towards the base. Hydrothecae 10—12 on 10 m.m., inclined to the axis at an angle of about 45°; the apertural margin straight, the outer edge straight or somewhat concave, forming an acute angle with the former: apertural spine visible.

Besides this variety, there is another found at Fågelsång which seems to be identical with *D. bifidus*. HALL: but it occurs in a different horizon. Forms corresponding to *D. indentus*, HALL, occur also in Scania; but the typical *D. Murchisoni* BECK (in: MURCHISON, Silurian System 1839, Notes on Graptolites, pag. 695, pl. 24, fig. 4), which is characterized by its considerable length, and by the branches showing a tendency to cross each other, is not yet found in Sweden.

Did. geminus occurs in Scania at Fågelsång in a black shale underlying the *Glossograptus*- and *Gymnograptus*-zone; moreover it is found in Norway at Christiania, and in England in the lower part of the Llandeilo-group. *Graptolithus ornus* BARR. is probably a closely allied species to that under description. This occurs in BARRANDES stratum Dd 3.

No. 7. Another species occurring at Fågelsång is that which HISINGER describes as follows.

Tab. 38

»Fig. 4. *Prionotus teretiusculus* (Nob.) a ceteris Prionoti speciebus forma sua teretiuscula optime distinguitur. Loc. Ocurrit rarius in Schisto argillaceo ad Fågelsång cum Prionoto sagittario et Pr. gemino».

HISINGER does not give any peculiar character for this species; but his type specimen shows clearly to which of the graptolites preserved in full relief and occurring at the said locality, he is especially alluding. On Plate 2 I have given a new figure of his type specimen, and also several figures of this species, partly of flattened specimens, partly of examples preserved in relief.

Diplograptus teretiusculus. His.

Plate II, fig. 1–7.

Diplograptus dentatus BRONGN., LAPWORTH and HOPKINSON, On the Graptolites of the Arenig and Llandeilo Rocks of St. Davids. Quart. Journ. Geol. Soc., 1875, p. 656, pl. XXXIV, fig. 5. — NON *Diplogr. teretiusculus* TÖRNQUIST, Geologiska Iakttagelser öfver Fågelsångstraktens undersil. lager, Lund 1865.

Hydrosoma divided in two parts by a septum, in the middle of which the virgula is situated, its length amounting to 8—10 ctm., its breadth to 3 mm., the ventral margins almost parallel, somewhat converging downwards; the proximal extremity is rounded, furnished with a long and narrow radicle, the virgula is distally prolonged, narrow; hydrothecae 9 to 10 mm., inclined to the median line at an angle of 22°; on the specimens preserved in relief, the hydrothecae resemble tubes, their outer margin is concave below, where the lower hydrothecae are in contact: the upper free part of the outer margin is convex; the inner border shows above a concavity, by which the hydrothecae become somewhat tumid. Only on specimens, preserved in natural form, are there impressions to be seen, indicating the separating interior walls, which continue inwards to the common canal. The flattened examples are preserved in many different ways and deviate considerably in appearance from those which have preserved their natural shape.

The individuals preserved in relief — HISINGER's type specimen is such a one — have a highly characteristic appearance; they are very similar to *D. putillus* HALL. The transverse section of the hydrosoma is rounded-elliptic; the distance from one series of hydrothecae to the other is very great; the middle of the hydrosoma is distinguished by a vertical impressed line, marking the place of the septum; the free part of the hydrothecae is short, and their outer margin short and curved. The aperture seems to be wide: the aperturalmargin is obliquely inclined to the axis. Specimens of this kind also show an impressed line, passing from the innerwall of the theca downwards to the middle of the hydrosoma, which indicates the existence of separating innerwalls.

Compressed examples deviate in appearance very much from those last described; they present many different aspects, owing to the position in which the hydrosoma is preserved; commonly they remind us most of the *Diplograptus foliaceus* MURCH., sometimes of *D. quadrimucronatus* HALL. or even *D. pristis* His. Several specimens thus preserved in different ways are represented on Plate II, fig. 4—7.

Transitional forms fossilized in semi-relief show clearly, that these individuals so different in aspect belong to one and the same species.

This species occurs in great abundance at Fågelsång, in the zone of *Didymograptus geminus*, in the zone of *Glossograptus*, in the zone of *Gymnograptus*, and the superjacent shale. These strata belong, no doubt, to the Llandeilo-beds.

The figures and the description, which LAPWORTH gives of a species, which he calls *Diplograptus dentatus* BRONGN., (l. c.) agree very well with flattened specimens of this species; yet this is said to occur in Wales in strata of upper Arenig-age: but *D. teretiusculus* appears at first in strata, that cannot be older than the Llandeilo. Moreover there is no sufficient evidence that the denomination given by BRONGNIART ought to be employed for this form.

No. 8. Finally HISINGER has in *Supplementum secundum* Tab. XXXVIII given the figure of a fossil also belonging to the family of the Graptolites.

»Fig. 9. Impressio Plantae Monocotyledoneae, Loc. In schisto aluminaceo ad Berg, Ostrogothiae».

Dictyonema flabelliforme Eichw.

Plate III, fig. 1—4.

Bromell, »Musci ramosi capillamenta nigra». Lithographiae succanæ, specimen secundum. Articulus I, N:o 1, 1727. — *Gorgonia flabelliformis* Eichwald, Schichtensyst., Russlands, 1840. — *Phyllograpta* Angelin, Palæont. Scand. I, p. IV, 1854. — *Fenestella socialis* Salter according to Kjerulf, Ueber die Geologie des südlichen Norwegens. p. 79, 1857. — *Rhabdinopora flabelliformis* Eichwald, Lethæa rossica I, 1. p. 369, 1862. — *Dictyonema Hisingeri* Göppert, Ueber die fossile Flora etc. 1862, p. 455, tab. XXXVI, fig. 6—11, tab. XLV, fig. 3, 4. — *D. flabelliformis* Törnquist, Fågelsångstraktens undersilur. lager, Lund, 1865, p. 22. — *Ceramites Hisingeri* Liebm., Hamb. lit. u. krit. Blätter 1848, N. 12. — The name *Dictyonema* was already published by Hall 1851 in Palcont. New York, Vol. II, page 174.

The hydrosoma forms by its branches a flat, extended disc, growing out from a long and narrow sicula, which in its distal part divides into two branches, which immediately again give off new branches; by reiterated dichotomy a multitude of subparallel branches appear, connected by fine chitinous filaments, which in short almost regular, distances are stretched out nearly horizontally from one branch to another. Every branch bears, as it appears, two series of hydrothecae, alternating with each other. The horizontal chitinous threads seem always to arise from the apertural edge of a hydrotheca; in certain forms there is seen one thread extending from every hydrotheca — this is not the case with Hisinger's specimen —; on others from only *one* of *two* thecæ, which seems to be most common for examples from Fågelsång and for that from the Piperviken in Norway; on other specimens again, only every third or fourth theca bears one chitinous thread extending to the nearest branch. This has been observed on several specimens from Åby in Ostrogothia, which are preserved in the State-Museum at Stockholm. The hydrothecae are to be observed only on well preserved specimens, and on these with difficulty; they seem to form elongated tubes, with the apertural-edge scarcely projecting forward; sometimes there are to be seen long impressed lines, indicating interior septa. On a length of 10 mm. there are 10—15 hydrothecae. There are no traces of a virgula.

The oblong-triangular hydrosoma, whose upper borderline is faintly curved, arises from the sicula by reiterated dichotomy. It is quite evident, that it was fanlike and not funnel-shaped; for all the reiterated divisions are to be seen on almost every specimen; in evidence of this opinion may be adduced the circumstance, that neither of the lateral branches on their outer margin are provided with horizontal chitinous filaments. These horizontal threads having served to hold the branches apart, have thus acted as a mechanical element, in the same manner as the virgula of the *Rhabdophora*.

To separate those forms from each other which have a different number of horizontal filaments, as species or even as varieties, seems to be erroneous, their number even on the same specimen being variable.

This species has attained a considerable size, individuals of 15—20 ctm. in length being often found. Yet at some horizons the specimens are commonly small. The individuals have lived sociably together, of which the shales of the youngest Scandinavian Cambrian rocks covered with their polyparies afford evident proofs.

This species occurs always at a fixed horizon, namely in one of the youngest beds of the Cambrian system, which is named the Dictyonema-shale. At the same level it is represented in Estland; the *Graptopora socialis* Salter (Murchison, Siluria, Ed. 2 and 3, p. 47. Fossils 7, fig. 3), which occurs in the upper part of the Lingula-flags in England, cannot with certainty be identified with our form; the indifferent figure in Siluria precludes any certain conclusion.

D. flabelliforme occurs at Berg (Hisinger's type specimen), at Åby, and other localities in Ostrogothia; at Orrholmen in Vestrogothia; in Scania at Andrarum, Kiviks-Esperöd, Gisslöf, Flagabro, Jerrestad, Sandby at the Fågelsångs-river; at the last named place the Dictyonema-shales are superimposed by alum schist and balls of anthraconite with *Acerocare ecorne* Ang. — It is moreover to be found on Bornholm and in Norway; in Estland; in Belgium and probably also in Great Britain.

This fossil, which unquestionably belongs to the family of the Graptolites, was considered by Göppert to be a plant; the evidence for this opinion was that he had observed on a slab, derived from Estland, a conformation, which he interpreted as a fruit.

Corrections.

When this paper already had been published, Prof. BRÖGGER told me, that he did not share my views on the structure of *Dictyonema flabelliformis*, and he considers that it really has its branches arranged in a funnel or inverted cone and that it is endowed with hydrothecæ resembling those of the other graptolites. The specimens at my command, when I gave the description on page 20, were such that I could but think that *Dictyonema* forms a flat lamina, nor did I see any organs, that might be interpreted as hydrothecæ, only the processes, which often are characterized through a longitudinal, impressed line on the hydrosoma and are prolonged in a small apex. These processes emit a filament to the nearest parallel branch.

Having heard Prof. BRÖGGER'S opinion, I found in the Museum of the Swedish Geological Survey some well preserved specimens in demi-relief, and I examined them as accurately as possible. In splitting the slate I found, that a lower lamina of the branching hydrosoma really originated from the same sicula as the upper lamina of the hydrosoma. On the lateral branches real hydrothecæ were apparent, resembling those of the Dichograptidæ. That they are so rarely observed, depends probably on the circumstance, that they are directed inwardly toward the centre and that they are covered by the polypary when compressed in the slate. On the lateral branches they are sometimes visible, because these are directed outward.

SCHIMPER, in Traité de paléontologie végétale, 1869, p. 183, partakes of GÖPPERT'S opinion; but in ZITTEL'S and SCHIMPER'S »Handbuch der Palaeontologie» *Dictyonema* is placed amongst the Graptolites.

HISINGER entitles a fossil figured in Supplementum 2, pl. 37, fig. 5: »*Prionotus giganteus?*» The original of the figure is to be seen in HISINGER'S collection. It is certainly not a Graptolite. It resembles nothing more than the impression made by an Orthoceratite.

Additions.

To page 7. In the library of the Roy. Academy of Sciences at Stockholm I have lately seen a letter from Prof. S. NILSSON to HISINGER, dated 27 Dec. 1835 in which he writes: »I have named the genus of Graptolites Prionotus (of πριονωτος like a saw) as well in my annotations, where a sketch of a monograph on this genus is to be found, as in letters to several foreigners. I must complain that I through a slip of memory once when visiting you in Stockholm gave the name wrongly." (Probably Priodon). »The name Prionotus I consider characteristic and I therefore intend to retain it». (»Graptolithslägtet har jag kallat Prionotus af πριονωτος (lik en såg) såväl i mina anteckningar, der ett utkast finnes till en monographie öfver detta slägtet, som ock i bref till flere utländningar . . . Beklagligen har jag genom ett minnesfel kommit vid ett besök en gång hos Herr Brukspatronen i Stockholm att uppgifva namnet oriktigt, hvilket då Herr Br. upptecknade. Namnet Prionotus anser jag vara karakteristiskt, hvarför jag ämnar bibehålla det».)

I cannot conclude these pages without expressing my deeply felt gratitude to Prof. CHAS. LAPWORTH of Birmingham, to whom I am under great obligation for his kind and effective assistance in revising this paper when printing.

Plate I.

Diplograptus? pristis His.

Fig. 1. A complete specimen from the Trinucleus-shale of Dalecarlia, enlarged 3 times.

2—3. Hisinger's type-specimen in natural size and magnified 3 times. From near the bridge of Draggå in the parish of Rättvik, Dalecarlia.

4—5. Another specimen on the same hand-specimen as the former, natural size and 3 times enlarged.

6. A third specimen, magnified 3 times, showing the position of the bent virgula.

7. A specimen, which, through compression, has acquired the appearance of a Climacograptus.

8. The base of a specimen enlarged.

9. A specimen from Ostrogothia, partially preserved in relief and showing the interior walls of the hydrothecæ, magnified 3 times.

10. The base of a specimen, five times enlarged.

11. Fragment of a specimen from the Trinucleus-shale of Bestorp, Vestrogothia, in demirelief and showing the interior walls of the hydrothecæ, 3 times enlarged.

Climacograptus scalaris L.

12. A complete specimen from Mösseberg, Vestrogothia, magnified 3 times.

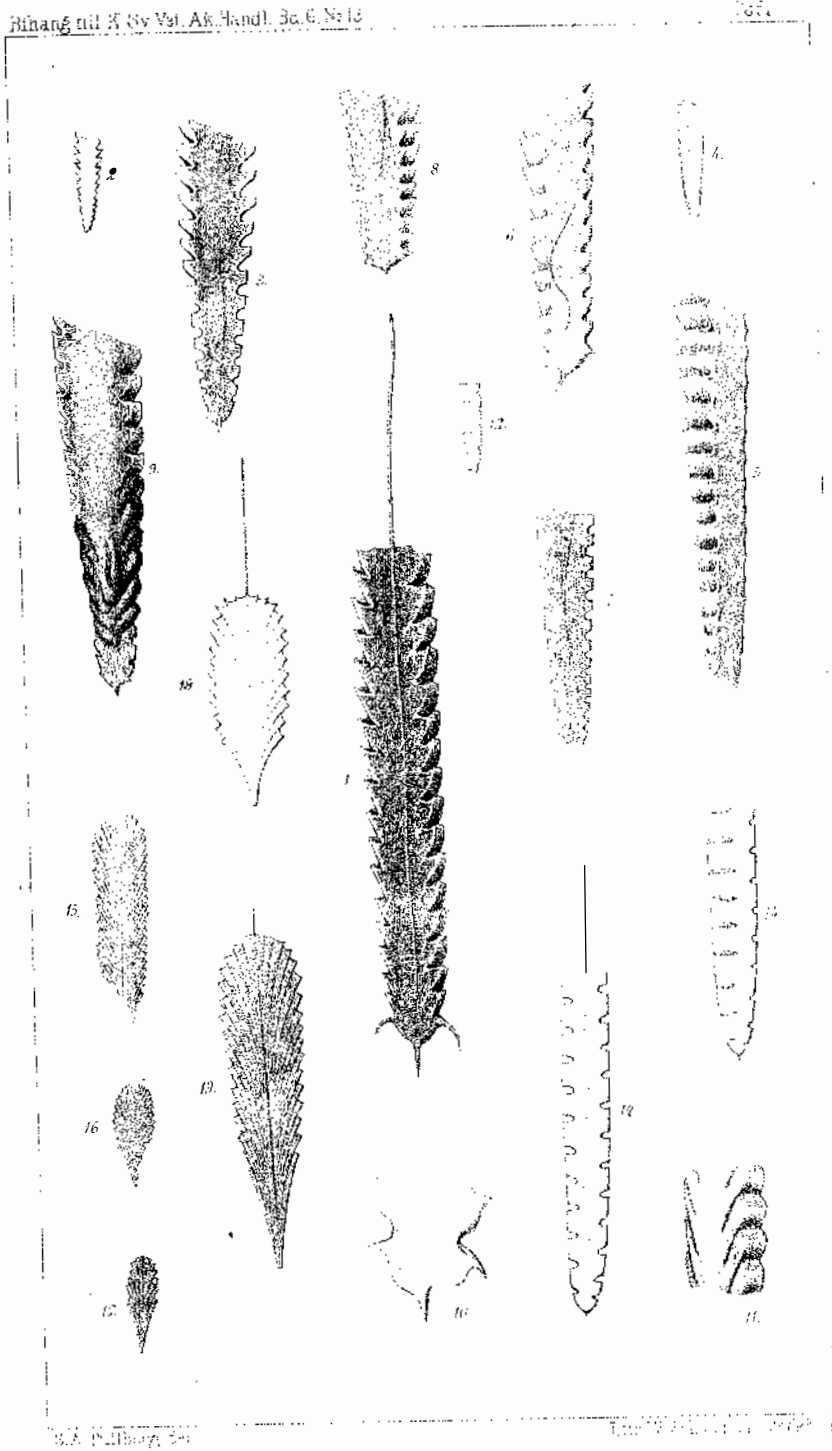
13. The type specimen from Hisinger's collection, natural size.

14. The same, enlarged 3 times.

Cephalograptus folium His.

15—17. The type specimens, after which Hisinger's figure is constructed, natural size.

18—19. Specimens from Scania, from the zone of *Monograptus leptotheca* Lapw., enlarged 3 times.



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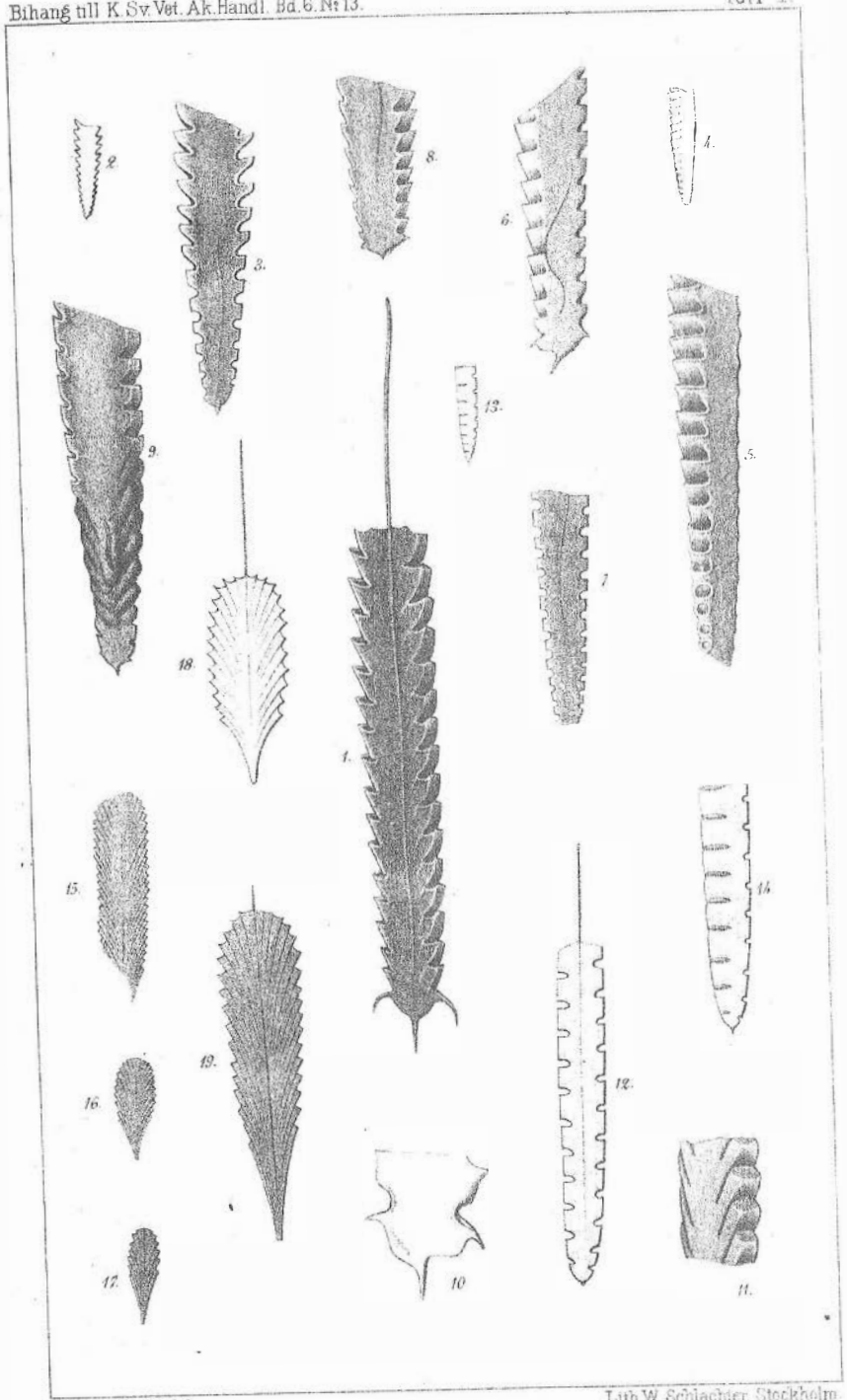


S. A. Tullberg del. Lith. W. Schlachter, Stockholm.

Plate II.

Diplograptus teretiusculus His.

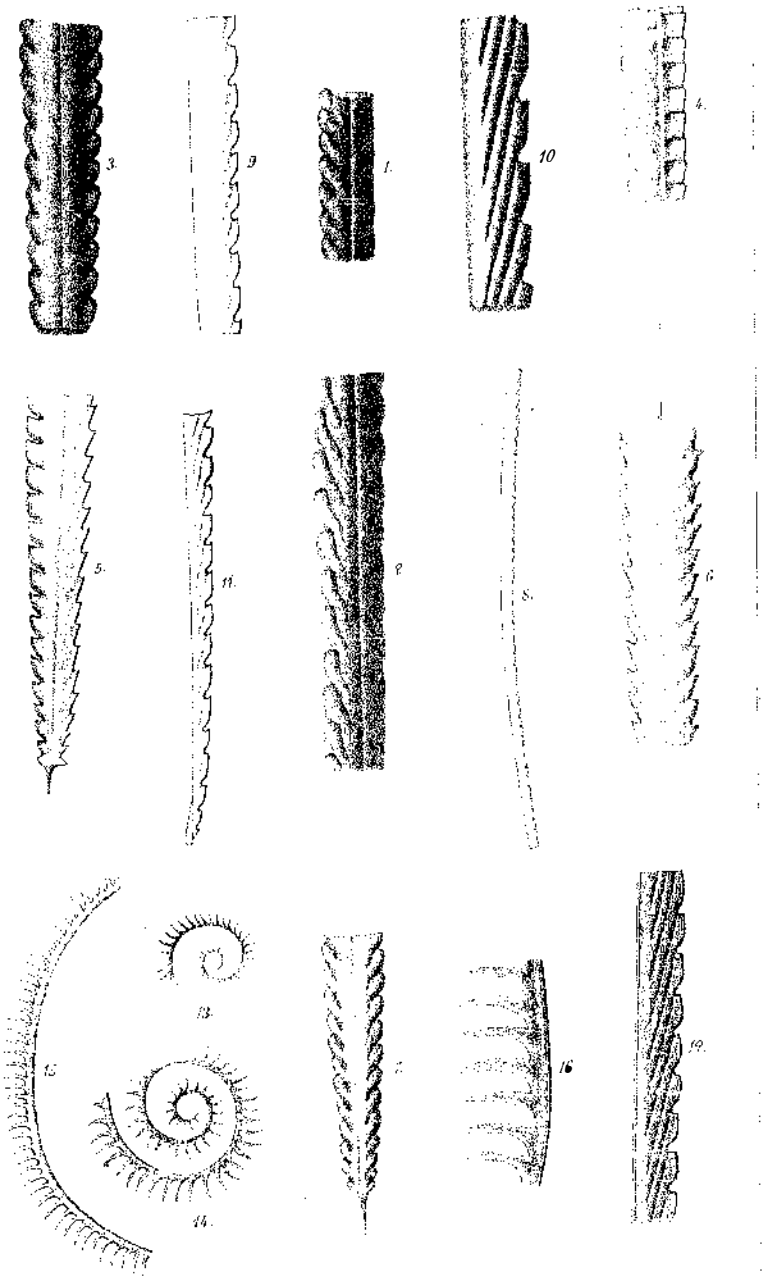
Fig. 1. The type specimen in Hisinger's collection, fossilized in relief, magn. 3 times.
2. Specimen from Fågelsång, Scania, magn. 4 times.
3. Another specimen, same locality, also in relief. magn. 4 times.
4—5. Compressed, oblique specimens, magn. 3 times.
6 7. Specimens preserved in demi-relief.

Monograptus leptotheca Lapworth.
(= Prionotus sagittarius His.)

8—9. Hisinger's type specimen from Furudal, Dalecarlia, natural size and magnified 3 times.
10. A specimen from Dobbs Linn, Birkhill, Scotland, collected by Prof. Ch. Lapworth, altered into iron pyrites, magnified 4 times.
11. The proximal part of a specimen from Kongslena, Vestrogothia.
12. The developed or adult part of a specimen from Scania; the last two magnified 3 times.

Monograptus convolutus His.

13. Hisinger's type specimen, nat. size.
14. The proximal end and the adult part, nat. size, from Kongslena, Vestrogothia.
15. Fragment of the adult part, nat. size.
16. Fragment of the distal part, showing dorsal convexity; magnified.



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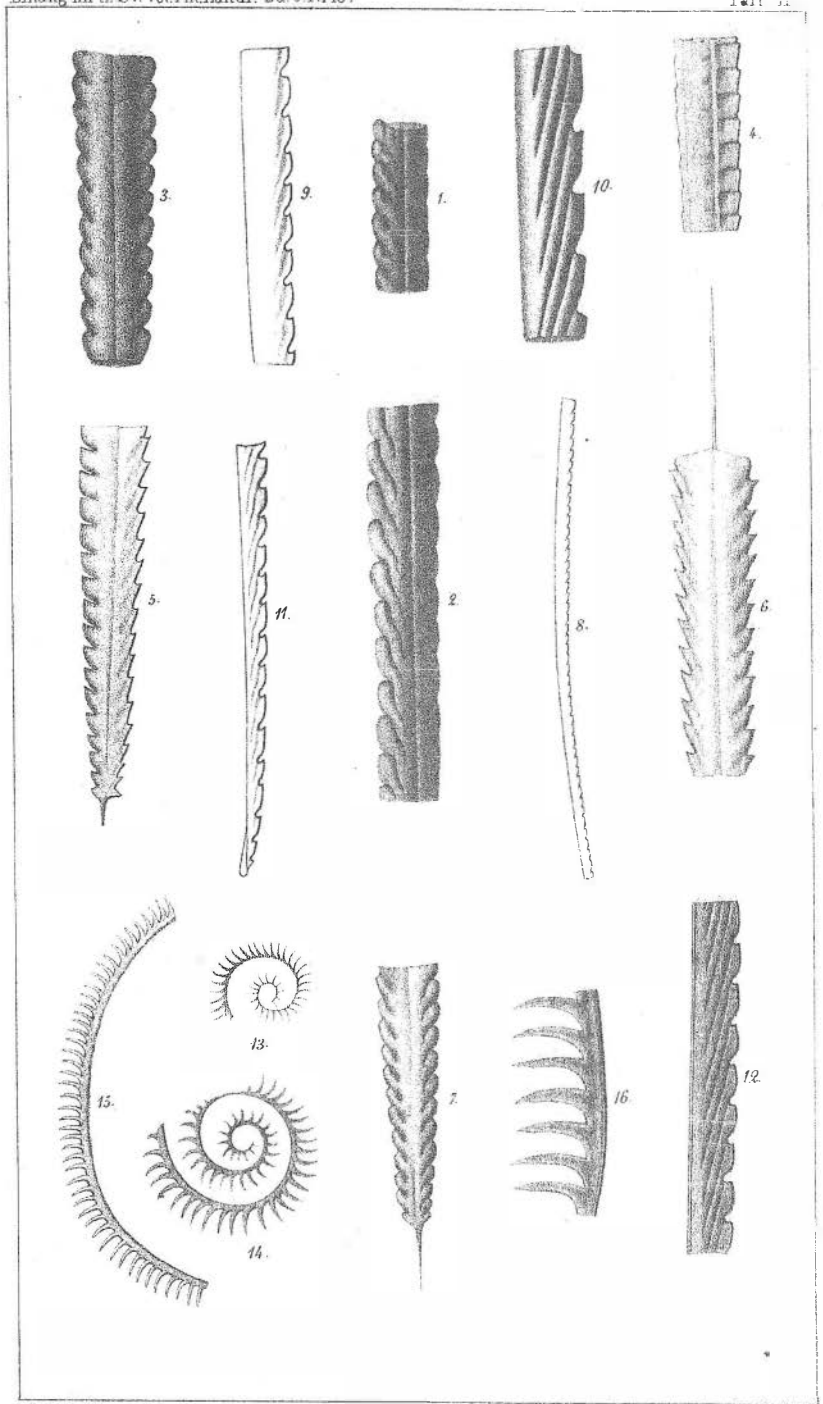


S. A. Tullberg del.

Lith. W. Schlachter, Stockholm

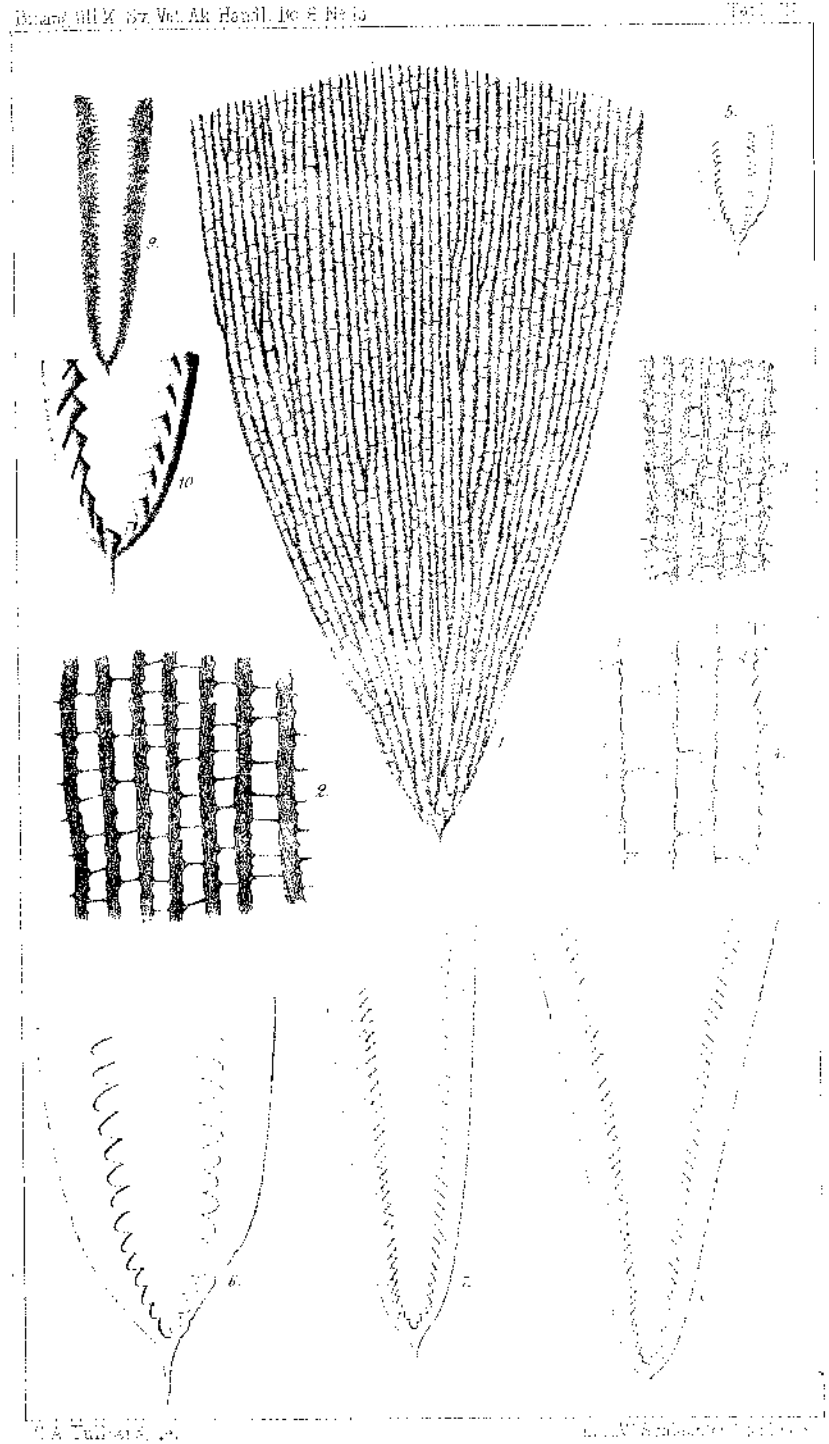
Plate III.

Dictyonema flabelliforme EICHW.
(= Impressio plantæ monocotyledoneæ HIS.)

Fig. 1. A complete specimen, natural size, from Sandby near Fågelsång, Scania.
2. Part of the hydrosoma of a specimen from the same locality, magnified 4 times.
3. Part of a specimen in HISINGER'S collection from Berg, Ostrogothia (»Kanalbottnen»), magnified 4 times.
4. Part of a specimen from Åby, Ostrogothia, magnified 4 times.

Didymograptus Murchisoni BECK, ****geminus*** HIS.

5. The type specimen in HISINGER'S collection, natural size.
6. The same magnified.
7—8. Two complete specimens from Fågelsång, magnified 2 diameters; the originals are in the Museum of the University of Lund.
9. A specimen, natural size.
10. The proximal part of a specimen fossilized in relief, magnified 3 times.



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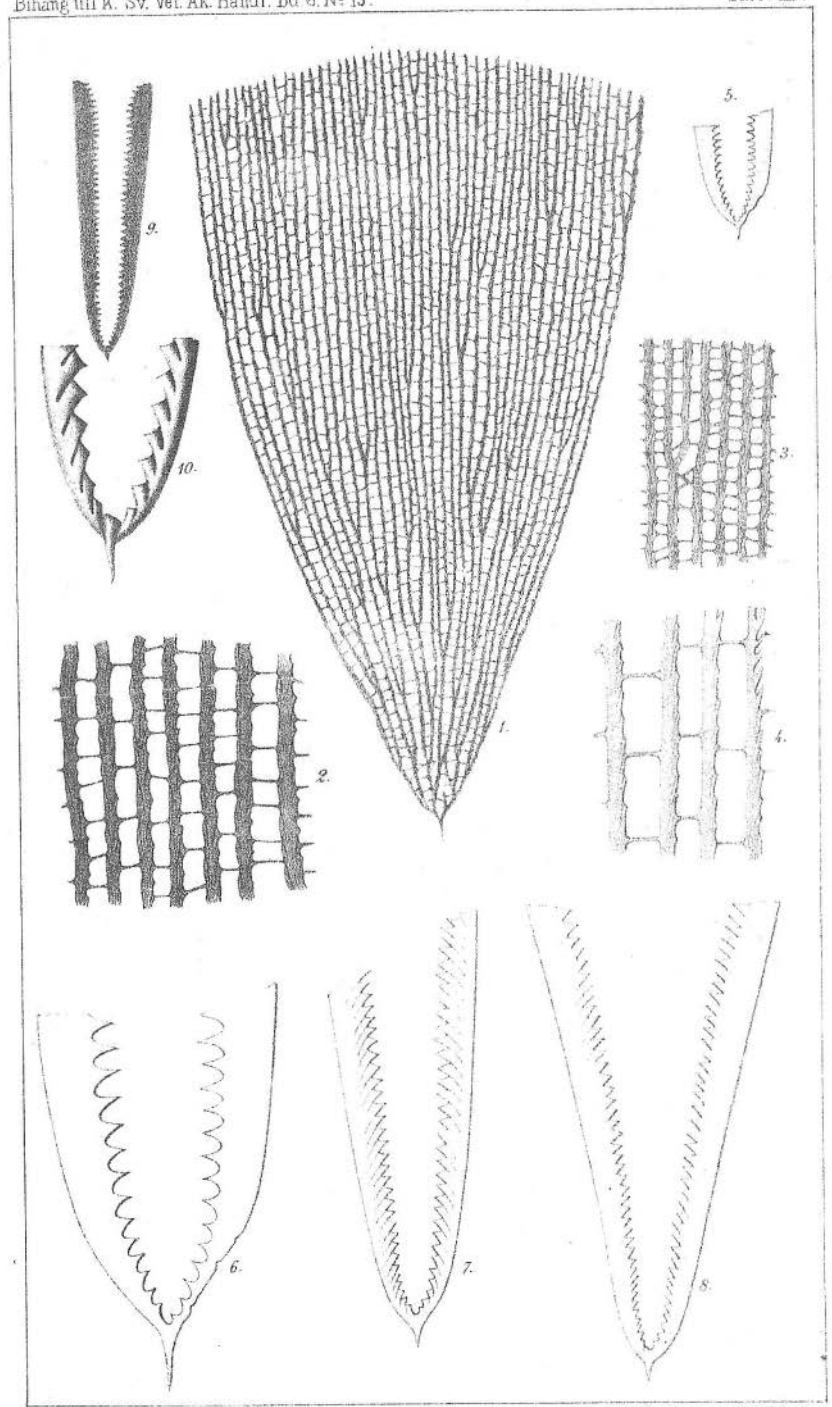

S. A. Tullberg, del. Lith. W. Schlachter, Stockholm.