

THE ASCOCERATIDÆ AND THE LITUITIDÆ

OF

THE UPPER SILURIAN FORMATION OF GOTLAND

DESCRIBED

BY

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WITH SEVEN PLATES.

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INTRODUCTION.

Remains of Cephalopoda are found in all strata of Gotland, though in variable number, being most plentifully represented in the uppermost strata. In the oldest stratum, which consists of shale beds, corresponding to the English Upper Llandovery and Wenlock shale, they are pretty common. One of the best localities is near Wisby, where *Orthoceras cochleatum* SCHLOTH. abounds and is one of the most characteristic fossils together with two fine species of *Phragmoceras*. The shale beds at Djupvik in Eksta contain gigantic *Orthoceratites* as *O. annulatum* SOW., *O. Lindströmi* BARR. and others. The shale of Petesvik in Hablingbo also harbours several species, many of them the largest ever found in Gotland, as a largesized species of *Trochoceras*. In the coëval sandstone of the southernmost part of the island very few Cephalopoda have been found.

The next stratum in succession, homotaxical with the Wenlock limestone, in the south above the sandstone changed into oolite, is not so rich in Cephalopoda. There are mostly mere casts of little value. In the oolite again some rather good specimens have been found, belonging to some three or four species. A classical locality is at Östergarn, from where so many rare and fine species have been obtained as *O. angulatum* HIS., *O. intermedium* BOLL, *O. Hagenowi* BOLL, *O. imbricatum* HIS. and several others. Quite the same species occur farther in the south, in an almost identical limestone, along the eastern shores of Grötlingbo and Hamra. Several good specimens of the large *Nautilus Hisingeri* D'ORB., the *Naut. complanatus* of HISINGER, have been found there.

But the true Cephalopodan stratum is the uppermost limestone, the beds of which cover two thirds of the surface of the whole island, being carried away by denudation south of Fardhem and again appearing in the hills of Hoburg and along the eastern shoreline of the southernmost peninsula. Its age is Upper Ludlow and it is separated from the Wenlock beds through a great thickness of so called Crinoidal Limestone, which is chiefly composed of the remains of crinoidea and of some broken and worn corals. Immediately below the beds of the Cephalopodan limestone there are thick banks of the large bivalve shell *Megalomus gotlandicus* and these beds stretch along with the Cephalopoda, sometimes intermingled with them from the northern shores of Gotland at Wialmsudd in Fleringe as far south as Ardre and Alskog, thus occupying a zone of seven Swedish or 42 English miles in length.

In order to clear up the stratigraphical conditions, in which the Cephalopoda of Gotland are found, the annexed table may be of some use, showing the different geological links of which Gotland consists, according to the latest researches.

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| <p>h. Cephalopodan strata.....</p> <p>g. Megalomus banks, also with Trimerella.....</p> <p>f. Crinoidal and coralline conglomerate beds.....</p> <p>e. Pterygotus and Palæophonus beds, chiefly near Wisby, but also occurring in other places.....</p> <p>d. Wenlock limestone, in the north of Gotland bands of shale and limestone, the latter increasing upwards. In the south of the island, above the sandstone, there are oolite beds alternating with limestone, both containing bivalve shells in great number.....</p> <p>c. Shale beds with <i>Orthis Lovéni</i>, <i>Strophom. Lovéni</i>, <i>Stroph. Walmstedti</i> near Wisby. Faunal character changing towards south; distinct, but coëval faunal regions formed at Westergarn — Stora Carlsö, Fröjel, Eksta, Hablingbo. The lithological character by degrees changed into sandstone from Rohne — Grötlingbo to Hoburg.....</p> <p>b. Marly beds most developed north of Wisby near the level of the sea. <i>Stricklandinia lirata</i>, <i>Bronteus platyactin</i>, <i>Palæocyclus porpita</i>, <i>Goniophyllum pyramidale</i>, <i>Leperditia baltica</i>, <i>Calymmene papillata</i>.....</p> <p>a. Red shale, below the level of the Baltic. It has fossils in common with b and c, as <i>Goniophyllum</i>, but of a peculiar type, <i>Phacops quadrilineata</i>. <i>Arachnophyllum typus</i> is the most characteristic; there are also some peculiar brachiopoda.</p> | <p>} Ludlow beds 190 feet</p> <p>} 40 feet</p> <p>} Wenlock shale 80 feet</p> <p>} Upper Llandovery.</p> |
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It is highly probable that the uppermost, vast deposit of the Cephalopoda (h) was formed in shallow water near the shores. The immense masses of the shells of these animals, which in some places almost entirely make up strata from four or five feet in thickness from the smallest to the most gigantic specimens, prove the litoral character of the deposit. After the death of the animal and the decomposition of its soft parts the shell must have been floating on the surface of the sea, buoyed up by its manifold air chambers, unless they were replenished with organic deposits. Having drifted about, they were washed ashore in large numbers, quite as *Spirula* now a days, which in innumerable heaps covers the shores of the ocean islands.

In these localities of the uppermost limestone the Silurian Cephalopoda lie imbedded almost *pêle-mêle*, species of many genera, often exclusively such, but sometimes with small gastropoda, bivalves, brachiopoda and corals mixed up with them. Generally the Orthoceratites lie horizontally, but also in all other imaginable positions. The immense lapse of time during which the deposition of these strata lasted, may be inferred from the following facts. There is namely good evidence that a great number of the Orthoceratites had been fossilized, nearly as we now see them, already in the Silurian sea, before they were entombed in the sediment forming on its bottom. The Orthoceratites are very often, especially in certain localities, as for instance in Östergarn, found deprived of the shell, only as nuclei and the chambers filled with mud, hardened into stone, or with calcareous spar. On the surface of this nucleus other smaller Upper Silurian organisms, as Corals and

Bryozoa, had fixed themselves and grown luxuriantly, which of course could not possibly have been the case, if the substratum had not already then been as hard as we now find it. In the same way, the large siphuncles of the Actinocerata are often found detached and covered with Corals and Bryozoa. The filling up of the air chambers must have occurred after the death of the animal and since the shell had been washed ashore or lay in shallow water or even far later when enclosed in the solid rock and participating in the metamorphic changes which this underwent during the succeeding periods. It is not to be confounded with the *depôt organique*, which, smaller in degree, took place during the lifetime of the animal.

In most species the shell has been exceedingly thin, even in the largest, scarcely attaining a thickness of half a millimetre and in a few of the largest Orthoceratites it reaches at the highest two millimetres near the aperture. What wonder then that relatively so few have been preserved with the shell and that in some localities we only meet with the nuclei and faint traces of the shell? This is then often wrinkled and crumpled through the weight of the superimposed strata. As a rule the shells are better preserved in the limestone beds and entirely wanting, or nearly so in the marly shale beds. The infiltrated mass is commonly calcareous spar, which in the way, as BARRANDE has so well described, has crystallized at the same time from both sides of the septa and met in the centrum of the airchamber, thus causing the false appearance of adventive septa. In a few instances patches of fleshy red baryte have been formed in Orthoceratites found in shale near Wisby and even of black fluor calcium. The shells which lie in the limestone are naturally transformations of the original ones into calcareous spar. As to some found in the shale beds there may be an exception and the original shell at least in some respect preserved. So for instance with some of the Phragmocerata of the shale. In them it has a glossy, yellow-brown or blackish hue and the colour pattern is very distinct, coming near to the angular, black bands that prevail in the recent Nautilus. Also in some Orthoceratites from Östergarn the colour pattern is very well preserved and consists of narrow, whitish, longitudinal stripes. The pearly lustre is preserved on the inside of the shell remarkably well in a few Orthoceratites.

There is a great variation in the size, some having only one or a few millimetres in diameter, and others again are gigantic. The largest ever found is from the limestone of Follingbo and must, when entire, have attained a length of 2 metres, having in the aperture a diameter of 12 centimetres.

It is self evident that the specimens very seldom are found so free as to be at once fit for delineation or description. Only by employing great care they may be extracted from the rock, and then they must be cleaned and prepared from out the enclosing stony matter.

The most remarkable localities in the uppermost limestone, from which the greatest number of species has been collected, are in order from north to south: Sändvik near Fårösund, Samsugn and Klints i Othem, Storugns near Capellshamn, Bjers in Heinum, Fohle, Follingbo, Linde and Sandarfe, Lye, Ljugarn, Hamra and Hoburg.

Owing to the presence of large masses of Stromatoporæ and large Corals, the banks of Cephalopoda in these strata are seldom regularly stratified. They form rather a massive

limestone, in which there also reigns a great variability, patches or pockets of marl and shale occurring in the midst of the limestone and the limestone itself also changes from whitish gray to intensely red. The red limestone, so much resembling some varieties of the German Devonian limestone of the Harz mountains or even of the Lower Silurian Orthoceratite Limestone of the main land of Sweden, predominates in the south of Gotland, in the parishes of Lye and Ardre, near Ljugarn, but it is also found on Sandarfve kulle. The Cephalopodan limestone is in some places coarse and crystalline, in others again soft and earthy.

The oldest descriptions of Gotland Cephalopoda extant are given by German authors. The fragments of Silurian rocks which lie scattered on the plains of Northern Germany, whether derived from the present Islands of Gotland and Ösel, or probably also in large numbers from destroyed strata of lands formerly lying between those islands, were the source, from which the German naturalists early had collected their material for description. As usual in these times there were given no detailed descriptions of these shells which were called *Alveoli*, *Lapides cancris*, from an imagined similarity with the tail of the crayfish, also *Gammarolithus*, *Ichthyospondyli sive vertebræ piscium*, *Spondylolithi sive Dolicholithi* etc. Such general descriptions of nuclei etc., impossible to discern specifically, are met with in the works of VOLKMANN, HELWING, REINHARD, KUNDMANN and even SCHRÖTER and ARENSWALD.

KLEIN was in 1731 the first, who gave any somewhat intelligible descriptions and figures in his »Descriptiones tubulorum marinorum. In quorum censum relati Lapides caudæ cancri GESNERI et his similes». At page 8, under the heading »Tubuli concamerati: 2 cylindrifformes» stands

- »1. Gothlandicus; crassus; cameris strictioribus singularis, truncatus etc. Tab. II, fig. 3—4.» This is *O. cochleatum* SCHLOTH.

Page 10 we have »Sp. II Superficie aspera. α) sulcati.

1. Major; Gothlandicus, superficie bis novies sulcata. Siphone inter centrum et peripheriam. Tab. V f. 8. Cameras exhibitas in alio Exemplo polito. Tab. IX f. 10.
2. Minor ex viginti sulcis asper. Tab. V fig. 9.» — Both these are *O. angulatum* WALENB.

BREYNIUS, JOANN. PHIL. wrote »Dissertatio physica de Polythalamiiis. Gedani 1732». Page 34 »*O. siphunculo axem transeunte graciliori*, Tab. V f. 7» is no doubt an Upper Silurian species with closely set septa, but it is impossible to determine it. P. 34. »*O. siphone inter centrum et peripheriam externe sulcatus*. Tab. VI f. 3—5» is *O. angulatum* WAHL. P. 37 »*O. siphone ad peripheriam locato*, Tab. VI f. 1—2» is *O. cochleatum*.

AD. MODÉER is the first Swedish naturalist who gave specific distinctions of our species in his paper »Slägtet Rörkamring, Orthocera» in »Sv. Vetensk. Akademiens Handl. 1796» p. 63—97, 143—170. He unites the Cephalopoda and the Foraminifera in the same group, as so many before and after him. At p. 83 he has »N:o 4, Får-Rörkamring (Orthoc. sulcata) Gotland» which no doubt is the often occurring *O. angulatum*. P. 150. »*O. adunca*

Klo-Rörkamring». He says that it no doubt is a Gotlandic petrification with »Pipan» (the pipe = the siphuncle) in the centrum.

W. HISINGER. In enumerating his numerous papers chronologically it may be seen, how our knowledge of the Gotland Cephalopoda has increased.

1798 »Minerografiske Anmärkningar öfver Gottland» in »Vetenskaps Akad. Handl.» p. 286.

»Helmintholites ammonites Klinteberg o. fl. st.».

1808 »Samling till en mineralogisk Geografi öfver Sverige», p. 276 »Ammoniter».

1826 »Versuch einer mineralogischen Geographie von Schweden» p. 228. »Orthoceratites imbricatus, angulatus, crassiventris» these according to what WAHLENBERG in 1818 had published.

1827 »Gottland, geognostiskt beskrifvet» Vet. Akad. Handl. p. 323. »Stycken af en ganska stor Orthoceratit med slät yta ej olik Orthoc. communis» (= Fragments of a very large O. with smooth surface, not unlike O. communis.) O. angulatus W., O. imbricatus, O. crassiventris. Orth. undulatus (= O. annulatus Sow.) is for the first time described in this paper. All these species are again enumerated on page 333 and in the table, but are there called Orthocera communis, imbricata, angulata, undulata n. sp., crassiventris.

1828 Bidrag till Sveriges Geognosie, part 4, (also called »Anteckningar i Physik och Geognosie») p. 221 where almost the same annotations on Gotland are contained as in the preceding. O. imbricatus is, however, by him identified with O. undulatus Sow. Min. Conch. tab. 59 and O. crassiventris with O. cochleatus. A new species is by HISINGER referred to O. annulatus Sow. t. 133, but this, however, is identical with HISINGER'S O. undulatus, and O. annulatus His. has later by BOLL been named O. Hisingeri. In this publication thus six species are enumerated.

1829 Esquisse d'un tableau des Petrifications de la Suède.

p. 8 Nautilus complanatus.

p. 9 Orthoceratites imbricatus,

» angulatus,

» annulatus,

» undulatus,

» crassiventris,

» lineatus,

Ammonites Dalmani, concerning which species see below.

p. 11 Euomphalus (Ammonites?) costatus.

We thus have nine species of which three are mentioned for the first time.

1831 Anteckningar etc. Häft. 5. He enumerates the same as in the publication of 1829 with addition of lithographed figures of nearly all species. Only O. lineatus has been changed into »Scyphia empleura MÜNSTER» and thus translated to the sponges.

1831 Esquisse d'un tableau etc. Nouv. Edition. The same species as before.

1835 Icones Petrificatorum Sueciæ. Fasc. I. Animalia Articulata et Mollusca Cephalopoda. This was the first instalment of the next work and contained only ten plates without any descriptions. Seven species of Upper Silurian Cephalopoda are figured.

- 1837 *Lethæa Suecica seu Petrificata Sueciæ*. The same species as enumerated in »Esquisse» 1829 are here described and figured, with exception of *O. lineatus*, which is not mentioned at all, but there is a figure of it in the Supplement, pl. XXXVI fig. 1 »Forma elongato-conica etc.» the same as he called *Scyphia empleura* in part 5 of »Anteckningar». In the same Supplement p. 113 pl. XXXV f. 1 there is a cast of a *Trochoceras* figured, »Testa ovato-oblonga» etc. without specific name. *Euomphalus costatus* is here named *Inachus costatus*. *Lituities lituus* is said to belong also to the Silurian of Gotland, having been found there in an erratic block.
- 1840 »Anteckningar» etc. part 7. The same species are again enumerated and we have a new name, *O. nodulosus*, instead of *O. lineatus*, this name having been given to a Lower Silurian fossil. There is also *Goniatites? Dalmani* instead of *Ammonites Dalmani*.
- 1841 »Förteckning öfver en geognostisk och petrefactologisk samling från Sverige och Norrige, tillägnad Kongl. Vetenskaps-Academien af en dess Ledamot.» This catalogue was published anonymously, but by comparing it with the other works of HISINGER, it can not be in the least doubted that it is from his hand. As it is the last paper he published, we may here sum up the results of his contributions to the knowledge of the Silurian Cephalopoda of Gotland, by enumerating them all:

1. *Nautilus? complanatus*. As SOWERBY already in 1820 had published a *Nautilus complanatus*, D'ORBIGNY in Paléont. Universelle (Paléont. étrangère pl. 41) renamed it as *Naut. Hisingerii*. This name must be kept, as the shell is a real *Nautilus* and not a *Phragmoceras*, as BARRANDE supposed.
2. *Orthoceratites angulatus* WAHLENB.
3. » *imbricatus* HIS. (uncertain if the same as WAHLENBERG'S; HISINGER'S is identical with *Orth. pseudo-imbricatum* BARR.)
4. » *undulatus* HIS. (*O. annulatum* SÖW).
5. » *annulatus* HIS. (*O. Hisingeri* BOLL.).
6. » *crassiventris* WAHL. (*O. cochleatum* SCHLOTH.).
7. » *nodulosus* HIS.
8. *Inachus costatus* HIS. Was by him regarded as a Gastropod, but is in reality a *Trochoceras*.

Ammonites Dalmani HIS. was held by him to be derived from Gotland. The original specimen evidently had been early deposited in the collections of the »Bergs-Collegium» at Stockholm along with other foreign fossils and wrongly labelled as coming from Gotland. Herr Amtsrath C. STRUCKMANN in Hannover who recently examined HISINGER'S specimen declares that it without the least doubt is a variety of *Ammonites gigas* and is found in the Upper Jurassic strata near Hannover.

E. VON SCHLOTHEIM describes *Orthoceratites cochleatus* for the first time in »Beiträge zur Naturgeschichte der Versteinerungen in geognostischer Hinsicht» (Taschenbuch für die gesammte Mineralogie von Leonhard 7:r Jahrg. 1:e Abth. 1813 p. 34).

1820 Die Petrefactenkunde; at p. 55 he describes an *O. undulatus* probably a fragment of a large *Trochoceras*. *O. cochleatus* is again described.

1822 Nachträge zur Petrefactenkunde; p. 58 *O. undulatus* and figure 1 a—b pl. XI.

GEORG WAHLENBERG. His »Petrificata telluris Suecanæ» was printed already in 1818 and distributed to his scientific friends before 1821, when it appeared in the collected volume of the »Acta Societ. Upsaliensis». At p. 89 he describes *O. imbricatus*, but as the original specimen is lost, there is now no possibility to apply his description to any distinct form of the Cephalopoda, and it might be best not further to cite WAHLENBERG as author of the species, so long known as *O. imbricatus* of HISINGER. It is possible that WAHLENBERG really meant the same form: his description of *O. angulatus*, of the identity of which there is no doubt at all, is also very inexact. Besides these both he also described *O. crassiventris*.

GABRIEL MARKLIN, the indefatigable collector, named several Orthocerata, which he sent abroad in exchange for other fossils. In a paper by H. VON MEYER, »Beschreibung des Orthoceratites striolatus und über den Bau und das Vorkommen einiger vielkammerigen fossilen Cephalopoden» (in »Nova Acta Acad. Cæs. Leop.» 1831 vol. 15,² p. 93) is said: »Schweden ist bis jetzt das reichste Land an Orthoceratiten. Herr MARKLIN theilte mir folgende Species mit:¹⁾ *O. crispus* MARKL. (undulatus His.), *O. cochleoides* MARKL., *O. pyramidalis* MARKL., *O. inflexus* MARKL., *O. striatus* MARKL.» Through researches in the Marklinian collection at Upsala I have found, that of these *O. pyramidalis* is a Lower Silurian species; there are no specimens preserved of the two following, nor of *O. cochleoides*. Instead we have in his collection some other species, as *O. columnare* MKL., which have been adopted by BOLL and others. *O. intermedium* MKL., as described and figured by BARRANDE, is not identical with the specimens so named by MARKLIN in his museum. These are the same which were later called *O. Hagenowi* by BOLL. As MARKLIN never published his species, his name as an author of *O. intermedium*, which in reality belongs to BARRANDE, must be cancelled.

ANGELIN, N. P. in a collection of type specimens edited in 1838 and called »Museum palæontologicum suecicum» has only »*Orthocera cochleata* SCHLOTH.

In »Fragmenta Silurica» published 1880 there are the following nine species described and figured, viz:

- Orthoceras cochleatum SCHLOTH.
- » nummularium Sow.
- » lamellatum ANG.
- » Hagenowi BOLL.
- » intermedium (as of MARKLIN but in reality of BARR.)
- » columnare MARKL.
- » asserculatum ANG.
- » tessellatum ANG.
- Ophidioceras reticulatum ANG.

SIR RODERICK MURCHISON during his tour in Gotland together with E. DE VERNEUIL collected fossils and gave a list of them in the paper, which he in 1847 published in the

¹⁾ I have only cited the names of MARKLIN's own species, not those of older authors.

Journ. of the Geol. Soc. of London with the title »On the Silurian Rocks and their Associates in parts of Sweden». We there find the following Cephalopoda mentioned, viz:

p. 20 *Orthoceras annulatus*, *ibex*, *ludensis*, *regularis*, *imbricatus*, *angulatus*
(*O. virgatus* Sil. Syst.).

O. trochlearis HIS. is also mentioned, but as this is Lower Silurian it must have been found in an erratic block.

E. BOLL gave descriptions of several Gotland species in his »Beitrag zur Kenntniss der Silurischen Cephalopoden im norddeutschen Diluvium und den anstehenden Lagern Schwedens» in Mecklenburg. Archiv für Naturgeschichte 1857.

Page 16: *Orthoceras columnare* MARKL., p. 18 *O. Hisingeri* (*O. annulatum* HIS.), p. 19 *O. gotlandicum* BOLL, p. 20 *O. verticillatum* v. HAGENOW, *O. ornatum* BOLL, p. 21 *O. cochleatum* SCHLOTH., *imbricatum* WAHLENB., p. 22 *O. Hagenowi* BOLL (= *O. intermedium* MARKL., not BARRANDE), p. 24 *O. angulatum* WAHLENB., p. 25 *O. annulatum* Sow.

In 1859 BOLL in »Petrefactologische Kleinigkeiten» (Mecklenb. Arch. p. 161) made some additions and declared that *O. Hagenowi* probably is identical with *O. tenuis* EICHW. from Oesel. This can, however, not be the case, as EICHWALD identifies his specimen with the Swedish Lower Silurian species of WAHLENBERG and moreover gives a very insufficient description.

G. VON HELMERSEN did not publish the relation of his tour in Gotland, undertaken in 1845, before 1858, as »Geologische Bemerkungen auf einer Reise in Schweden und Norwegen» (Mém. Acad. Sc. Imp. de St. Petersbourg T. VI). The only Cephalopoda which he enumerates are *Orthoc. ibex* (= *O. annulatum*), *O. angulatum* (by him identified with *O. virgatum* S. S.), *fimbriatum* Sow. (= *O. annulatum* Sow.), thus only two species.

FR. SCHMIDT published in 1859 »Beitrag zur Geologie der Insel Gotland» (Archiv für Naturk. Liv-, Ehst- und Kurlands 1:e Ser. Bd. II). He there enumerates *O. cochleatum*, *annulatum* S. S., *undulatum* S. S.?, *angulatum*, *cochleatum* (from Slite, but this is quite another species, *O. nummularium* or other), *gotlandicum* BOLL, *Hagenowi* BOLL, *imbricatum*, *Cyrtoceras læve* S. S., *Gomphoceras ellipticum* M'COY.

J. BARRANDE gives in his grand work, *Système Silurien de Bohême* in 1874, vol. II, part III, complete descriptions and beautiful figures of a number of Gotlandic species. We find there *Orthoceras cochleatum* SCHL.

O. columnare MARKL. and BARRANDE himself identifies his own *O. Dahlli* with this species.

O. gotlandicum, probably identical with HAGENOW's *O. verticillatum*.

O. Hisingeri BOLL.

O. imbricatum according to BARRANDE, but it is not certain whether also according to WAHLENBERG and certainly not identical with HISINGER's species. I have given a new name to this species of BARRANDE and called it *O. orientale* (coming from the east of Gotland).

O. intermedium MARKL. according to BARRANDE, but this is, as above stated, quite different from the specimens which MARKLIN so named. This species is, however, to be conserved as of BARRANDE, not of MARKLIN.

O. Lindströmi BARR.

O. Lovéni BARR.

O. pseudo-imbricatum BARR. the same as *O. imbricatum* HIS.

O. refragans BARR. probably the same as *O. Hisingeri* BOLL.

O. Sjögreni BARR.

O. tenerum BARR. synonymous with *O. ornatum* BOLL.

BARRANDE also named a *Phragmoceras* from Gotland, of which he had received a figure from ANGELIN, as *P. Angelini*. It can not be decided which fossil is meant therewith, as it is not possible to get access to the correspondence of BARRANDE; it is best not to adopt it. In the same volume BARRANDE, p. 686, gives a general view of the Cephalopoda of Sweden, according to information given him by ANGELIN in 1860. It concerns chiefly the occurrence of the generic groups.

In his »Parallèle entre le dépôt silurien de Scandinavie et de la Bohême» p. 25 BARRANDE says: »Malgré la très-frappante analogie de leurs formes avec celles de notre calcaire inférieur E. nous n'avons cependant constaté jusqu'ici que très peu d'identités spécifiques. Nous citerons seulement: *Orth. annulatum* MURCH.(!) et *O. dulce* BARR., qui paraissent être communs à Gothland et à notre étage E.» — BARRANDE also cites on the authority of BIGSBY, *Thesaur. Sil.*, *Orth. Wahlenbergii* HELMERS. as from Gotland, but in the *Thesaurus* p. 182 there stands only »Sweden» as the locality, whereas in the paper of HELMERSEN there is no *O. Wahlenbergii* at all mentioned, nor can I find that he has described it elsewhere.¹⁾

In 1867 the author of this memoir published a catalogue of the Gotland fossils then known and there are 14 species of Cephalopoda enumerated, including *Inachus costatus*. In the last List of 1888 there are 37 species. It is impossible at present to evaluate numerically the species, which compose the Cephalopodan fauna of Gotland. It may be enough to know that all genera, which are described from the Upper Silurian (E) of Bohemia, excepting *Mesoceras* also have been found in Gotland. Besides, there may be two or three new generic types more, one amongst the *Ascoceratidæ* and two amongst the *Phragmoceratidæ*.

In the following pages the *Ascoceratidæ* and the *Lituitidæ* have been described. Unless otherwise stated the material forming the basis of these descriptions, belongs to the Palæontological Department of the Swedish State Museum at Stockholm.

¹⁾ BOLL l. c. p. 15 has described a Lower Silurian species as *O. Wahlenbergii*.

Family **ASCOCERATIDÆ**.

This family comprises as far as at present is known four genera, viz:

Ascoceras BARR.

Glossoceras BARR.

Billingsites HYATT.

Choanoceras n. g.

The common feature in their structure, that unites all these genera, is the abnormal growth and morphology of the septa formed during the last stage of their existence. Having begun with regularly formed septa the later ones are bent obliquely in a sort of a high saddle towards one of the sides, and all that succeed the first sigmoid septum are incomplete or leave a large lacuna in their central part, which lacuna is framed by the lateral borders of the septa. The siphuncle is broad, with nummuloid or bulbous elements. The three first genera have attained a more pronounced development of the characteristic structure, which has been coming on by degrees in Choanoceras, without such a sudden transition from a Nautiloid stage as in them. A common feature for them all is the truncation which seems to have been repeated several times.

The systematic position and the affinities of this family have long been a puzzle, at least as long as the last stage of growth was the only one known. As BARRANDE left this group, it consisted of the two genera Ascoceras and Glossoceras, he himself having declared that Aphragmites could not any longer be retained as a genus of its own and that its both species coincided with true Ascoceras forms. BARRANDE regarded this family as of equal significance as the large families of the Nautilidæ and of the Goniatitidæ and gave it a collateral place, as the third family of the Bohemian Cephalopoda. He has been in this respect followed by FISCHER in his recent »Manuel de Conchyliologie». But nearly all the other authors, who more or less extensively have mentioned these fossils in their memoirs or Manuals, have placed the Ascoceratidæ in immediate vicinity of Gomphoceras. So BILLINGS, GIEBEL, WILTSHIRE, WRIGHT, BLAKE, ZITTEL and FOORD. This has in some respect been caused by the accidental similarity of the truncation and in some degree by the inflated shell in these genera, which also seems to have lead some authors to accept the idea that Ascoceras and still more Aphragmites was in its entirety the living chamber of the animal. FERD. ROEMER places Ascoceras next to Trochoceras, BRONN and WOODWARD next to Gyroceras, PHILIPPI between Lituites and Cyrtoceras. NICHOLSON includes it within his family of the Orthoceratidæ.

HYATT¹⁾ disregarding the fundamental similarity in structure, placed his own genus *Billingsites* amongst the *Mesoceratidæ* and the other genera in the family of the *Ascoceratidæ* and both these families next each other between the *Gomphoceratidæ* and the *Mælonoceratidæ*. There is no valid ground to separate *Billingsites* from the *Ascoceratidæ* and join it with *Mesoceras*. This latter genus, which has been founded by BARRANDE on a single specimen — none having since his days been found — is known only by the living chamber, which highly resembles that of the *Gomphoceratidæ*, with which group also FISCHER and FOORD have united it. There is no evidence whatever of septa like those of *Ascoceras* and there is consequently no foundation of placing it with the *Ascoceratidan* genus *Billingsites*.

HYATT also included *Ophidioceras* amongst the *Ascoceratidæ* because »the costated, compressed whorls have some resemblance to those of *Ascoceras* and the aperture is closely similar to *Glossoceras*». The exterior resemblance, as to the ornamentation, is very slight, if any, and the similarity of the aperture is of no signification when the most important character, the sigmoid septa, is wanting. The dispositions of HYATT must then be changed thus, that *Billingsites* is to be placed amongst the *Ascoceratidæ* near *Glossoceras* on account of its contracted aperture, while *Ophidioceras* may keep its more natural place amongst the *Lituitidæ*, which has been given it by BARRANDE. Strangely enough HYATT has revived *Aphragmites* in spite of its disavowal by its own author BARRANDE. HYATT thinks »it is a distinct genus with simple septa and sutures». According to BARRANDE its chief characteristic should, however, consist in its total want of septa, which also is indicated by its name.

MILLER joins *Conoceras* BRONN with *Ascoceras*. But if that genus, as is likely, is identical with *Bathmoceras*, there is no reason to retain it within the *Ascoceratidæ*.

The question of the systematic place of the *Ascoceratidæ* has got a somewhat changed aspect since the discovery of their earlier stages of growth. In this earlier shell there is nothing at all which might exclude them from the large group of the *Nautiloidea*. We find the same sort of septa and siphuncle in them all. Then it must be decided to which family or genus it bears the closest affinity. The gently curved shell, gradually tapering, the position of the siphuncle close in the vicinity of the ventral side, its perfect concordance as to the bulbous or nummuloid form of the elements in the *Ascoceras* and the strongly recurved necks of the septal apertures are features common to both the *Ascoceratidæ* and a large group of numerous species of *Cyrtoceras*, those figured on plates 108—160 of BARRANDE. Peculiar to the *Ascoceratidæ* is the feature that the septa are placed at irregular intervals and at the longest distance the more they approach the *Ascoceras* proper. *Choanoceras* is more deviating through the shape of its septa, which remain nearly the same during its growth, and through the central position of its siphuncle. Nevertheless it may be reckoned as an outlying member of this family through the conformity of its uppermost septa with those of the *Ascoceras*. — I think we ought to place the *Ascoceratidæ* next the *Cyrtoceratidæ* or between the *Cyrtoceratidæ* and the *Poterioceratidæ*, with which there may be some sort of affinity through the irregularly inflated living chamber of the latter.

¹⁾ Genera of Fossil Cephalopods, Proc. Boston Soc. N. H., vol. 22, 1883, p. 278 etc.

Gen. **Ascoceras** BARRANDE. 1848.

- Syn. *Cryptoceras* BARR. 1846. Notice préliminaire sur le Système Silur. et les Trilobites de Bohême p. 43.
 » *Ascoceras* BARR. 1848 in HAIDINGER'S Berichte über die Mittheilungen von Freunden der Naturw. in Wien Bd. III, p. 268.
 » *Aphragmites* BARR. 1865. Syst. Sil. de Bohême vol. II, 1^{ère} Série, pl. 1 à 107, fourth page of »Distribution».

This remarkable genus is during a long period of its life Nautiloid as to the structure of its shell and at last changes into that shape, which for so long a time has been alone known as the Ascoceras. There are thus two stages to be taken in consideration separately, in a description, viz. 1) the Nautiloid, and 2) the Ascoceras proper.

1. *The Nautiloid.* I have called this stage so, because it corresponds with the common type of the suborder of the Nautiloidea. It cannot properly be called an Orthoceratite stage as the shell is not straight, but curved and thus rather a *Cyrtoceras*, having also the siphuncle formed in accordance with that genus. If it ever was quite entire and intact, before attaining its last stage, the shell has been bent in a large arch, *pl. VI fig. 3*, but it is evident that it broke off and was decollated several times during its growth. In some, (*Asc. fistula*) *pl. VI, f. 2*, the Nautiloid was more straight, though somewhat twisted. The thin shell which only slowly widened, is generally transversally striated or annular with small modifications in the different species. The interior structure is highly uniform in all, with oblique watch glass like septa, higher on the dorsal side than on the ventral, placed at much irregular distances from each other, sometimes close, sometimes widely apart, the distance increasing with the augmenting width of the shell. The siphuncle is always placed near the ventral side and consists of tubular, narrow elements, enclosed in a calcareous sheath of their own and connected with the funnel of the downwards curved septal aperture. In some there is a tube on the upper surface of the septum, which encloses the basis of each siphonal element.

2. *The Ascoceras proper.* The shell, often pyriform or flaskshaped, consists of two different portions, the lower or the larger, usually wider portion, containing the septa and its more narrow necklike continuation, ending with the round aperture. The shell is almost always flattened from two opposite sides, in the lower or essential portion with an ovate section and cylindrical in the neck with circular section. There are two different sorts of septa: 1) Regular, Nautiloid septa and 2) Sigmoid, Ascoceratite septa proper. The first septum, which in fact may be regarded as the last Nautiloid septum and forms the bottom of the shell, is strengthened from within by organic deposits of calcareous matter. It is in a distinct group of species followed by a second septum of regular shape, but in the plurality of species the abnormal sigmoid septa follow immediately on the first. The number of the sigmoid septa varies from three to seven, but is very constant in one and the same species. A fragmentary specimen of an unknown species has indications of no less than twelve septa (*Pl. IV fig. 38, 39*). The septa are continuous from the ventral to the dorsal side, as may be seen in so many nuclei, where the sutures continue uninterruptedly across the shell (*Pl. II f, 16, pl. IV f. 45* etc.). But in the interior of the shell

this continuity is broken (*See pl. III f. 9—11*). There it is seen that the first sigmoid septum alone is entire, and all the following are open or lacunose along their centre, the organic deposit has not been secreted there (*See pl. III f. 8, 10—11*). The deposition has ceased where a septum has touched the surface of the next preceding septum, but around the margins, where they do not meet, all are entire. The margins thus form a sort of a frame around a central, empty space and there is a sort of imbricate arrangement of them in their position relatively to each other. In a certain way the curvature of the septa may, as HYATT has remarked, be compared with the saddle of the septa in *Goniatites*, though much more exaggerated in *Ascoceras*. Moreover, on the interior of the dorsal side in the shell the septa form a semicircular sinus so that they are widest along the sides and most restricted in the middle. The siphuncle, always near the ventral side, consists of one element less than the number of the septa, and the elements are almost always broad, nummuloid, rapidly increasing in breadth upwards. This siphuncle stands in immediate connection with the siphuncle of the *Nautiloid* through a little peculiar tubular duct, which is different in each species and is closed with a calcareous secretion, when the decollation has occurred. The earlier septa are more distantiated from each other, the uppermost being closer together, the distance between the first and second, and between the second and third being the largest. Interiorly, in the centre of the shell, the 2d, 3d, 4th advance furthest and the uppermost again are most narrow and receding. In *Glossoceras* again there is a steady increase in breadth and the uppermost are most prominent of all. Along the dorsal side the septa are bent in an inwards directed curve, then after a more or less broad swing they again closely approach the dorsal side and lastly turn across the shell towards the ventral side which they encircle.

At the first sight of the almost sudden change from the *Nautiloid* to the *Ascoceras*, it might readily be supposed that most important modifications in the nature of the mollusc, in its structure and functions must have stepped in. And no doubt, there has been some change, at least in volume, as it seems to be evident that the shell has been, as it were, moulded on the body of the animal. But when we again find, that there in several instances is evidence of a curious reversion in the shape of the septa and siphuncle to the *Nautiloid* stage in the *Ascoceras*, after all the sigmoid septa have been there formed, it is questionable whether there really has been such a great change in the shape of the animal itself, as the altered form of the septa seem to imply. It would namely be very strange if the animal could thus twice modify its body, so as to revert again to a *Nautiloid* shape, after having once changed it. Of this curious reversion of characters instances may be seen in the specimens delineated *pl. I fig. 21—24*, *pl. II f. 18*, *pl. IV f. 34*, showing a specimen with three *nautiloid* septa, *pl. V f. 22, 22 a*, with four regular septa above the sigmoid ones. Further on these forms are described more in detail.

There are specimens (*Pl. V f. 26—27*) which show, that the *Ascoceras* shell as a direct continuation of the *Nautiloid* was completed without having a single septum interiorly. It cannot be doubted that this shell has been an exterior one or enclosed the animal and not *vice versa*. The rich ornamentation of its surface, the long body chamber in the *Nautiloid* and the deposit of fresh calcareous strata from within, after the decollation, testify this sufficiently. In the shell of *Spirula* enclosed within the body of the animal there is

By the table given above it is seen, that most of the seventeen species have been found in the uppermost stratum of Gotland, as it contains no less than 15 different species, of which all, a doubtful variety of *A. cochleatum* included, occur only in that stratum. Those, which occur in the lowest stratum, belong to a peculiar group. From the intermediate strata c—g there have as yet no specimens of *Ascoceras*, nor of the other genera been found, only in d some indeterminable fragments in the oolite of Bursvik and the limestone of Östergarn. In three species the Nautiloid has been found in connexion with the *Ascoceras* and in one, *A. fistula*, both in the same stratum, but disconnected. There has no doubt once existed still more specific forms of *Ascoceras* in the strata of Gotland. So may the shell figured in *Pl. IV fig. 25* belong to a distinct species and also the specimen of the same plate *f. 38—39*, but we must abide till there is more material for a description.

If an attempt were to be made to subdivide the species of *Ascoceras* in smaller groups, this will be possible only in a few instances and chiefly in consequence of their interior structure.

Group 1 embraces the three species *A. cochleatum*, *A. dolium* and *A. fistula*. They are distinguished from the others in having the least number of sigmoid septa of all, viz. constantly three, but in compensation they alone have a regular septum between the septum of the truncature and the first sigmoid, thus two regular septa, while all the others have only one regular septum, that which forms the bottom. In a certain way they resemble the species of Billingsites HYATT, having only three sigmoid septa and beneath these at least one of the ordinary shape. The two first are also ovoid, but their aperture is simple.

Group 2 consists of the curious species *A. decipiens*, *A. siphon* and *A. gradatum*, which have the first element of the siphonule constricted in its midst, as if it were to be divided into two. This duplicature exactly resembles the interior edges of the second normal septum in the preceding group. It is, as it were, the only traces of a second normal septum, which was only begun, and never completed or, perhaps rather, the only rest left of a septum which once existed.

Shortly to repeat the history of this remarkable genus it seems to have been altogether unnoticed before BARRANDE in 1846 was the first to create it, giving it the name of *Cryptoceras*¹⁾ in his »Notice préliminaire sur le Système Silurien et les Trilobites de Bohême» p. 43. He there only says, that it is a »genre que nous avons créé pour classer des formes auparavant inconnues et très-bisarrés». Already in the next year²⁾ he was obliged to change the name into *Ascoceras*, as the former was so nearly alike to *Crypto-*

¹⁾ In 1849 D'ORBIGNY (Cours élémentaire de Paléontologie et de Géologie I, p. 286) created a Cephalopodan genus *Cryptoceras* apparently without being aware of BARRANDE's older genus. That of D'ORBIGNY consists of two Nautiloid shells from the Devonian and the Carboniferous Formations. To increase the confusion the editor of the Second Edition of WOODWARD's Manual of Shells p. 189 included *Ascoceras* of BARRANDE as a synonym within the *Cryptoceras* of D'ORBIGNY. But in the Supplement there is a description of *Ascoceras* as BARRANDE left it, without any mention of its identity with *Cryptoceras*.

²⁾ In the second meeting, Sept. 1847, of the »Freunde der Naturwissenschaften in Wien», but the paper was not published before 1848 in HALLINGER's »Berichte über die Mittheilungen von Freunden der Naturwissenschaften in Wien» Bd. III, p. 268. — Also in N. Jahrbuch für Min. Geol. 1848, p. 764.

cerus, a name previously employed for a genus of insects. He then also gave the first description. He says that the air chambers are not »perpendicular» (h. e. rectangular) to the axis of the shell, but nearly parallel and he regarded it as a curved shell in which the chambered portion was bent so as partly to embrace the not chambered portion, in analogy to *Ptychoceras*, though both parts of the *Ascoceras* shell are in close contact.

Still in 1854 (N. Jahrbuch p. 11) he held this view with the addition that both the bent parts were enclosed within the same exterior shell and that the siphuncle stretched from the body chamber into the air chambers, though it was not yet possible to discover how the different chambers were in communication.

In a new paper (1855 in *Bullet. Soc. Géol.* XII p. 157, translated in N. Jahrbuch p. 257), »*Ascoceras* as the prototype of *Nautilus*», he treats of its nature at large. He gave up the view of the analogy with *Ptychoceras* and compares it rather with *Endoceras*, regarding the sigmoid septa along the dorsal side as homologous with those of *Endoceras*, the empty body chamber besides them was then homologous with the large siphuncle of that genus and consequently the empty space above it and the air chambers formed the true body chamber. He says further that there is no communication between the air chambers themselves, nor between them and the body chamber, but there is a small aperture at its lower end, which seems to enter into the flattened prolongation of the lowest air chamber. *Ascoceras* was more imperfect than *Orthoceras* because the shell was more simple.

At the request of BARRANDE, BRONN sent him some remarks on this paper and these remarks, which have not been published, caused BARRANDE to write a sort of postscriptum, when the paper was translated in German in the N. Jahrbuch. BRONN accompanied it with some very remarkable notes. BARRANDE believed that *Ascoceras* had beneath the sigmoid septa only a single deciduous septum, but BRONN again, what is most important, thought that there must have been a series of such, as in *Gomphoceras*. As for other points of resemblance which they and other authors saw between *Ascoceras* and *Gomphoceras* see further on.

Contrary to BARRANDE BRONN also says, that *Ascoceras* already in an early stage of evolution breaks off the part which consists of regular air-chambers. *Orthoceras* is rather to be designated as the early stage of *Ascoceras*. BARRANDE again contended that *Ascoceras* was the early or lower type, in consequence of the incomplete septa.

In his last great work, *Système Silurien de Bohême*, vol. II part I p. 334, he again recapitulates his views concerning the structure and relations of *Ascoceras*. He maintains the perfect analogy with *Endoceras* and that the lowest part of the body chamber, parallel with the air chambers, represents »le large siphon ventral de *Endoceras*» (p. 347). But besides this he assumed a smaller siphuncle in the deciduous chambers. He speaks namely of two sets of air chambers: one persistent and another of »caduques». The persistent were formed of the sigmoid septa and if I catch his meaning rightly, it is evident that he regarded the first sigmoid septum as the first septum of the *Ascoceras* and which formed its bottom, instead of a nearly regular septum, the last of the Nautiloid stage, forming the truncated extremity. Hence, when he later on in 1877 (*Syst. Sil.* vol. II, Supplem. p. 98 pl. 491) found a specimen with two septa beneath the first sigmoid one, he regarded these as deciduous ones, though they in fact are the two first septa of the *Ascoceras* and the lower-

most of these is the truncated extremity. A comparison with such forms as *Ascoc. fistula* (*pl. I f. 20, 22, 24, 25*) where there also are two regular septa beneath the first sigmoid one, a peculiarity which is restricted to a certain group of *Ascoceras*, makes it evident that *Asc. Murchisoni* BARR. also had two such regular septa and that none of its deciduous Nautiloid ones has as yet been found. The *Ascoceras* begins where the truncated septum is situated and has been augmented from within by thick deposits. Or rather, it begins with those septa which have a bullate or nummuloid siphuncle, as these have, but it never begins with the first sigmoid as *Asc. Murchisoni* should have done according to BARRANDE and FOORD. Neither BARRANDE nor any body of his followers had consequently ever seen the »partie caduque», as FOORD supposes¹⁾. Nevertheless BARRANDE had adopted the views of BRONN that the shell through decollation had lost a certain number of air chambers, but he thinks that they could not have been many in the series and probably only one. In the last notice, however, he thinks that the series of deciduous septa was considerably elongated and that truncation occurred several times.

BARRANDE'S immediate followers, GIEBEL, PHILLIPPI, FERD. ROEMER and SALTER added a little to our knowledge of the geological distribution of *Ascoceras*. BILLINGS (*Canad. Rep. for 1853—56 p. 310* and in subsequent papers) described three new species and as he had only nuclei to study, he saw the continuous outlines or sutures of the septa across the shell and he also says of the siphuncle that it is situated »one line» from the »dorsal» (= ventral) side and is very narrow.

BLAKE in his *British Fossil Cephalopoda* says that the sigmoid septa are parts only of those on the opposite side (the ventral). But again he talks of »hidden» septa and »sigmoid» septa, as if there were two different sets, and means with the former the ventral portion of the sigmoid ones. The sigmoid portions of the septa do not coalesce into a single septum, as he thinks, but, as shown above, they are distinct and separate, lying above each other, as seen by the sutures, though incomplete in their midst and meeting a little inside. When he says that the sigmoid portions of the septa not are developed in *Aphragmites*, it might be inferred that he supposes that the other portions were developed, but in that assumed genus no septa at all are to be seen, excepting the oldest Nautilidean one. Why they should be called »hidden» in *Ascoceras* I cannot find, as they are plainly visible on the ventral side of well preserved nuclei and by no means constantly hidden. He says that the earlier part is unknown and still he further on states that the earlier septa are of the ordinary kind.

HYATT (*Genera of fossil Cephalopods, Proc. Bost. Soc. N. Hist. XXII, April 1883 p. 279*) gives some short notes concerning this and kindred genera. His systematic views of these have been mentioned above. It is somewhat startling to find that he describes *Billingsites* (p. 278, probably the same genus as named *Billingoceras* on p. 279) as having septa continuous with the septa on the dorsal side and then again speaks of the »imperfect septa» of *Aphragmites*. His opinion that the sigmoid part of the septa is to be regarded as »large dorsal saddles» is probably well founded. Of *Aphragmites* he says that BARRANDE originally made it with »simple septa and sutures», but on consulting the work of BARRANDE it is evident that he described it as deficient of septa and consequently

¹⁾ *Geol. Magazine*, 1889, p. 121, Note on the deciduous septa of *Ascoceras Murchisoni*.

without sutures. The annulation of the shell is not at all characteristic to Aphragmites as one species only has annulations, the other not. HYATT says that the septa are in the »living chamber». But what preeminently characterizes a body chamber is the absence of septa. If there are septa formed on the bottom of a body chamber as often is the case, the boundaries of that chamber are altered and removed, but it cannot be said that the septa are *in* the body chamber, being in reality *beneath* it. As to Ascoceras it may seem justifiable to compare the inflated shell formed on a long series of septa and as long as itself rests without septa (as in the Aphragmites stage), with the swollen body chamber of Gomphoceras, but there is the great difference, that septa have been formed on its bottom in Ascoceras and sometimes two different sets, and when this occurs the volume of the body chamber has been restricted. HYATT also says that Glossoceras »clearly» is derived from an annulated stock like Cyrtoceras residuum BARR., which has »similar» *annulated* whorls. It is very difficult to see how this can be, as the known forms of Glossoceras are not annulated at all, but have very smooth and finely striated shells.

ZITTEL in his »Handbuch der Palæontologie Bd. 1, p. 371 adopts partly the same views as HYATT. In figure *c*. ZITTEL has rightly designated the septa (or »Luftkammern») to the left of the siphuncle as continuations of those on the right or the sigmoid air-chambers. But this is lost view of in the descriptive letterpress, where, if I catch the meaning right, he speaks of two sets of air chambers or septa. »Bei günstiger Erhaltung beobachtet man auf der dorsalen (?) Seite der Schale hinter den Wohnkammern einige niedrige Kammer», with a normal siphuncle. I suppose he means the same as those signed *c* in the figure *e*. He seems also to adopt two different kinds of siphuncle on the dorsal side. He supposes that Aphragmites represents a stage where some normal, low air chambers have been truncated from the lower end, but quite the same might be as well said of Ascoceras. The latest description given is by FOORD in Cat. Foss. Cephalop. of Brit. Museum p. 246, which is very complete and lucid. As he had no specimens to show him the interior of the sigmoid portion of the septa he in fig. 42 interpreted *c. s.* as coalesced septa, which in reality is only the first sigmoid, the others being developed only on the sides, which are cut away. In figure 41 b., copied from BARRANDE, there ought to be seen, on the ventral side, lower down, the sutures of the septa.

1. *Ascoceras cochleatum* n.

Plate I fig:s 1—1 a, 7—10, pl. VI. f. 1 a—c.

Distribution. Six specimens have been found in the soft, grey shale near Wisby, in the stratum signed *b* and homotaxical with Upper Llandovery.

Only the Ascoceras stage of growth is at present known.

Shell short, obese, ovate, a little tapering towards both ends with a necklike constriction somewhat below the aperture. The transverse section is ovate. About ten transverse ribs cover the outside and three or five very narrow ones cross the neck. The larger ribs are much distantiated, with an interstice of one millimetre, faintly scooped out. As they are preserved only as nuclei without shell, any finer ornamentation cannot be discerned. The ribs are nearly parallel with each other and at right angles with the axis of the shell; they are arched downwards both on the dorsal and ventral side; rather

more so on the former. The outline of both the ventral and the dorsal side has nearly the same curvature. On the interior surface of the necklike part there are some fine oblique striae impressed from the destroyed inside of the shell. They are imbricate and when seen in a section they are serrated. (*Pl. VI f. 1 b, c.*)

There are two regular septa and three sigmoid ones. The first of the latter is low and does not reach to the median axis of the shell; the second is at a distance of 7 millim. from this, and the third is close to the second. Both are so much curved inward, that they surpass the median axis, and that the body chamber at their greatest bend is only 3 mm. in breadth, whilst the curve is 8 mm. The siphuncle is situated near the ventral side, and the scar of the Nautiloid siphuncle on the first septum is circular. Length of the shell 20 mm., breadth 11 mm., shorter diameter 9 mm.

This species is related to the Bohemian *Ascoceras Deshayesi*, having nearly the same sort of transverse screwlike ribs. It is, however, much shorter and of a more ovate shape and the body chamber much more widened below.

In the red limestone at Holms hallar in Wamlingbo there has been found a single, but fragmentary specimen of an *Ascoceras*, which as far as can be seen, is a mutation of *Asc. cochleatum* or may range as a variety derived from it. It is, at present at least, with so scanty material not possible to find whether it differs in any greater degree. The screwlike ribs are nearly identical and on the thin shell there are only a few indistinct longitudinal lines sculptured. It measures 37 mill. in length and 17 millim. in breadth, the lesser diam. being 12 millim.

2. *Ascoceras dolium* n.

Pl. I f. 2—6.

Only the *Ascoceras* stage has been found. *Distr.* The Museum of Stockholm keeps two specimens from the stratum b near Wisby.

Shell short, obese, ovate, ventral side considerably more curved than the dorsal side. In a transverse section the shell has an oval shape.

The surface is transversally ribbed by dense imbricating lines highest at their inferior rim and sloping upwards. There are six such lines on a length of 4 millim:s. On the ventral side they are bent downwards, on the dorsal side again they are quite as straight as on the largest lateral surfaces and at right angles with the longitudinal axis of the shell. Near the truncated end they are more narrow and dense and this seems also to have been the case near the aperture, which is broken.

There are two regular septa beneath the sigmoid ones; the first is the septum of the truncature which is thick and joins with the shell, having been strengthened from within after the decollation. The next is parallel with the septum of the truncature and abuts on the inside of the dorsal side without any sigmoid curve. It is distant from the truncature quite as much as the ventral edge of the uppermost sigmoid septum is distant from itself. Next we have three very thin sigmoid septa of which the second attains with its largest sigmoid curve a breadth of 10 millim:s, and 3 millim:s more are left there for the body chamber. At the broken top of the shell the septum has nearly four millim:s where it is at most narrow and 7 millim:s at the sides, the largest diameter

of the shell being there 9 millim:s. On the dorsal side of the siphuncle the septa join each other in the usual way.

The siphuncle is placed near the ventral side. Its first element is large and ovate. In the three upper elements the lining walls are wanting and probably dissolved away. The siphuncle is rather wider at the top than at its base.

Length of the shell 18 millim:s, largest diam. 12 millim:s, the shorter one 10 millim:s.

This species differs from the nearly related *Asc. cochleatum* through its more plump and obese shape, the different outlines of the dorsal and ventral sides and through the more numerous and imbricating, transverse lines.

It has some resemblance with *Asc. Keyserlingi* BARR. as to the ornamentation, but it is else quite different.

3. *Ascoceras fistula* n.

Pl. I f. 11—39, pl. III f. 9—11, pl. VI f. 2.

Distribution. This species is not seldom found in the uppermost stratum of Gotland (h.), around Slite, at Samsugn and Klints in Othem. A small slab from Slite, figured on *Pl. I f. 17*, and belonging to the Mineralogical Cabinet of the University of Upsala contains no less than 20 specimens of this species.

1. *The Nautiloid stage of growth, Pl. I figs. 28—39.*

Shell very narrow, cylindrical, slightly curved, increase of width so slow that in a fragment having 34 millim:s in length, the width at the upper end has increased only to 4 millim:s from 2 millim:s in the lower end. The initial shell has not been found, there being always a truncature. A fragment, *fig. 36*, has an oval section near the truncature, as well as on a distance of 4 mm. from it, while it is quite circular near the broken aperture. Its total length is 9 mm. Other specimens have a quite circular section in their whole length. The inferior apex is a little swollen or bent in a different direction.

The ornamentation consists of narrow, transverse wrinkles, arched downwards on the ventral side. They are often arranged in annular folds resembling those which occur in several *Orthoceratites*, as *O. annulatum*; and as often, as with them, evanescent. Seen in a longitudinal section the fine striae on these wrinkles have a serrulated appearance.

The septa are regularly concave, somewhat oblique, higher on the dorsal side and slanting toward the ventral. They are much crowded in small specimens and become more and more distantiated the longer the shell grows. Thus for instance in a specimen 40 millim:s in length and 4 millim:s when widest there are in all 27 septa and of these 14 are situated on a length of 13 millim:s and the other 13 on a length of 21 millim. The distance is in the beginning about one millim. between each septum, then it is a little irregularly increased, the space being now and then shortened till it rises to near 3 millim:s, and becomes at last so much as 7 mm.; the greatest distance between two septa being 11 millim:s. The shape of the septum is then also changed, it is not quite so oblique and forms around the siphuncle a distinct neck. The first septum next the oldest truncature is distant from this end nearly as much as the space from the said septum to the third septum. The necks of the septa are short. The siphuncle is situated

near the ventral side and consists of straight, narrow tubes which continue without interruption through the whole shell and some of the elements have a length of 11 millim:s.

It is true that this Nautiloid stage has not been found in immediate connexion with the Ascoceras stage, but it may be inferred from its close similarity in structure with specimens of other species found adherent to the Ascoceras from other localities that the described Nautiloid and the following Ascoceras belong to the same species. The similarity of their surface ornamentation, the position of the siphuncle and the circumstance that both are found together in the same rock and nowhere else, strengthens this assumption.

2. *The Ascoceras stage.*

The shell is long, slender, cylindrical, wider near the truncated end. At the top of the third sigmoid septum the shell forms a slight, necklike constriction, which is bent in an obtuse angle. The inferior, broader portion which contains the septa, is ovate in section, the superior, necklike part is circular.

The truncated end has the same shape as the septa of the Nautiloid stage, and is strongly lined with new depositions from within probably before the decollation and has thus attained nearly the same thickness as the shell. The aperture of the siphuncle is closed uniformly with the same deposition.

The outside of the flasklike, inferior part of the shell is regularly fluted by transverse, narrow ribs, 14 on a length of 5 millim:s curved downwards on the ventral side. Around the superior cylindrical portion they are fine and more numerous. In a section the fine striæ, which cover them, form regular, but bluntly serrated lines. There are in the rule five septa, two regular and three sigmoid ones. In some specimens there is moreover, in the deep saddle of the third sigmoid septum a fifth short additional septum of the regular type. When largest the sigmoidal septa are 6 millim:s broad near the outside, and only 3 millim:s interiorly, the diameter of the shell being there 7 millim:s. One specimen, *Pl. I fig. 27 & a*, shows the peculiarity that the first and second sigmoid septum do not join in the interior of the shell and that thus the second is quite as complete as the first. On *plate III* are given schematized figures (9—11) of the sigmoid septa of this species. In *fig. 9* they are seen together, front view from the ventral side, in their natural position and in *figs. 10—11* the third sigmoid septum alone is represented as if dissected out, and seen, *fig. 10*, in front with its large lacuna, and, *fig. 11*, in lateral aspect.

From the formation of a fourth additional regular septum on the bottom of the body chamber above the sigmoid ones may be concluded, that the animal continued to occupy the whole length of that chamber even after the completion of the sigmoid septa.

The siphuncle consists of short nummuloid elements which increase upwards in breadth, if not in volume, the second being the largest and the third the broadest of all. The septal necks are short.

Length 41 millim., breadth 8 millim., shorter diameter 5 millim.

4. *Ascoceras pupa* n.

Pl. I. fig. 40—52.

Distribution. From the uppermost limestone of Linde klint and Sandarfve kulle. Only the Ascoceras stage is known.

The shell is nearly perfectly cylindrical with quite circular section, a little enlarged at half the height and narrower towards both ends. A necklike constriction exists just above the top of the sigmoid septa. The margins of the circular aperture which seems to be entire, are very thin and uneven.

The surface is transversally annulated by faintly projecting ridges. These are covered with parallel, sharp and threadfine transverse lines, somewhat imbricating and in their turn again crossed by most delicate longitudinal lines, both forming a network, especially near the aperture. For the rest the shell is smooth and glossy between the transverse lines. In some specimens again the longitudinal lines continue all way down, making the whole surface reticulate.

The transverse lines are rather unequally crowded, more numerous on the ridges and absent or scanty between them. There are about 26 on a length of 6 mm:s, while the annular ridges on the same distance are only 6. The transverse lines and the ridges are curved downwards on the ventral side.

There are four sigmoid septa and below them only the septum of the truncature, the intermediate septum, present in the preceding species, being absent in all specimens of *Asc. pupa*. The greatest breadth of the sigmoid septa amounts to 7 millim:s, breadth at the saddle 4 millim:s.

The septum of the truncature is thick and in direct continuation with the thick lining which covers the inside of the shells.

A narrow oblique duct combines the siphuncle of the Nautiloid with that of the *Ascoceras*. This duct, which is widening upwards, where it opens in the *Ascoceras* siphuncle, is closed below by thick deposits around its inferior aperture. The *Ascoceras* siphuncle is situated close against the ventral side of the shell, whilst that of the Nautiloid is placed at a little distance from that side. In no other species the siphuncle has this position. There are four elements, the first large and beadlike. The three superior elements are very short and transverse. On the inferior surface of the septum (*fig. 51*) of the truncature the siphuncle of the Nautiloid stage is seen encircled with a strong neck. The smaller ring is derived from the interior deposits.

Length 24 millim., largest diam. 9 millim.

5. *Ascoceras reticulatum* n.

Pl. I fig. 53—56.

Found only in one specimen in the uppermost limestone of Sandarfve kulle.

General shape cylindrical, laterally compressed, and the section is consequently oval, ventral and dorsal sides convex, the ventral more so. The aperture is broken off, but by its basis it may be seen that it has been broad and bent towards the dorsal side. The surface of the shell is even, without any annular elevations, densely sculptured by sharp transverse lines, as many as seven on a length of one mill. and curved downwards on the ventral side. Seen in profile each line forms a projecting angle or tooth, the superior side of which is a little longer than the inferior one. Faint longitudinal lines cross them, forming small points where they meet, and are larger in the interspaces. The inferior truncated end is fragmentary. There are four sigmoid septa nearly resembling those of *Ascoc. pupa*.

The shell seems to have been broken several times during its growth which is indicated through the irregularity of the transverse striæ in some places.

Length 30 mm., longest diameter 12 mm., the shorter 8 mm. Breadth of septa 4 mm.

This species is very characteristic and quite distinct from the preceding species. Its longitudinal axis is nearly crescent shaped, in Asc. pupa it is straight, the section is ovate, not circular, and, moreover, the ornamentation of the shell is quite different.

6. *Ascoceras bohemicum* BARR.

Pl. III fig. 32—33.

- Syn. 1855 *Ascoc. bohemicum* BARR. Bull. Soc. Géol. XII p. 74. Pl. V, f. 20—28.
 » 1855 » Id. N. Jahrb. f. Min. p. 277, pl. 3, f. 1—8.
 » 1867 » Id. Syst. Silur. Bohême, Vol. II, I, p. 354. Pl. 93, fig. 1—14, pl. 94, f. 28—37, pl. 96, fig. 46—49.
 » 1877 » Id. Supplem. p. 97. Pl. 494, fig. 14—15, pl. 513, fig. 14—16.
 » 1888 » LINDSTRÖM. List of Upp. Sil. Faun. p. 7.
 » 1888 » A. FOORD. Cat. Foss. Cephal. in the Brit. Museum, I, p. 252.

Distribution. One large, nearly complete specimen and fragments of another from Hoburg, in the south cliff, in the stratum below the uppermost crinoidal limestone.

Shell large with elliptic outline, both dorsal and ventral sides convex, the cylindrical neck bent straight towards the dorsal side.

The surface is sculptured by crowded, transverse riblets running obliquely on the sides and bent downwards on the ventral side. There are 22 of them on a length of 5 millim:s. They are sharp-edged and the space between them is nearly double their size. No longitudinal lines are seen in the weathered specimens.

There are four sigmoid septa, along the surface so much curved toward the ventral side, that the fourth attains a breadth of 34 millim:s, the total breadth of the shell being 43 mm. The first sigmoid is low and the distance between it and the next is greater relatively than in some other species, viz. 17 millim:s, between the second and the third 7 millim:s and between the 3d and the 4th three millim:s.

The specimens do not show the siphuncle nor the septum of the truncature.

Length 116 millim., breadth 43 millim., lesser diam. 33 millim.

The Gotland specimens agree in all respects with the descriptions given by *BARANDE*, at least as to his large specimens. Much smaller specimens sent from Bohemia under this denomination scarcely belong to this species. I have not cited *Asc. bohemicum* from Prof. *BLAKE*'s work as occurring in England as his figure shows a very badly preserved specimen. He says that the specimen has »at least four sigmoid septa», but the figure shows only two and of these the first has no homology in unquestionable specimens of *Asc. bohemicum*, and he himself, moreover, doubts whether the specimen belongs to this species.

7. *Ascoceras manubrium* n.

Pl. II (all figures), pl. III fig. 1—8, 13—31, pl. VI fig. 3.

Distribution. Sandarfve kulle, Linde klint, Mannagårda in Lye, the shore of Ferese at Östergarn in a detached stone probably from the stratum d., in the first localities from the uppermost stratum.

The Nautiloid stage (Pl. III fig:s 12—31). In one instance both stages have been found still in connexion and from the structure and ornamentation of the Nautiloid in this special case, other detached pieces found in the same stratum, can with a high degree of certainty be regarded as also belonging to this species, as they have the same structure and ornamentation. The surface in all these has transverse annulations and is near the Ascoceras quite even, reckoned from the third septum and upwards. The annulations are very close in the youngest specimens. Parallel to them there are everywhere fine striæ (*fig:s 19, 26, 30, 31*) about 12 on a length of 3 millim:s and sometimes they may be seen to be crossed by fine longitudinal lines.

The shell is quite cylindrical, gradually tapering to a blunt end and faintly curved (*fig:s 22, 26*), in a transverse section quite circular (*fig. 16*), becoming more flattened and elliptic near the Ascoceras stage.

That Nautiloid specimen which is in direct connexion with the Ascoceras (*fig:s 12—17*) contains four regular septa, obliquely concave in so far, that they are high on the dorsal side and deepest on the ventral side, where the siphuncle is situated. Besides a wide neck, as common, on their inferior surface, there is around the siphuncle a peculiar structure of a short conical tube, widest at its base and directed somewhat obliquely upwards. It forms, as it were, the basis of each siphonal element (*f. 17 b*). The varying distance of the septa may best be seen through the following measures:

Distance from the first to the second septum.....	13 millim.
» » the 2d to the 3d.....	8 »
» » the 3d to the 4th.....	14 »
» » the 4th to the truncat.....	22 »

In a second specimen (*fig. 20*) the distances are:

From the 1st to the 2d.....	3 millim. (nearly)
» the 2d to the 3d.....	3 »
» the 3d to the 4th.....	8 »
» the 4th to the 5th.....	18 »

It may in general be said that the distance increases the farther up the septa lie. In a small specimen (*fig. 28*) there are 13 septa, very irregularly disposed on a length of 22 millim., and above them a very long body chamber. The siphuncle is always straight, narrow and cylindrical and regularly situated at a little distance from the ventral side.

Dimensions. The specimen with Ascoceras and Nautiloid in connexion. Length 1 decim., breadth at superior margin 22 millim., lesser diam. 16 millim. At the lower and dorso-ventral diam. 12 millim., lesser diam. 10 millim.

The Ascoceras stage. The shell is elongated, compressed or flattened, of oval section, the neck long and cylindrical, making a third of the whole length of the shell. The aperture is circular. The ventral side is regularly arched, *fig. 3, Pl. II*, the dorsal one nearly straight or faintly convex. The ornamentation is nearly the same as in Ascoc. bohemicum, and consists of close set transverse riblets running obliquely over the sides and curved down on the ventral side. These riblets are imbricated and about 15 are contained within a length of 5 millim:s. On the neck they are finer and have minute, longitudinal striæ in the interspaces. In others there are also longitudinal folds or stripes giving the

surface in some places a peculiar appearance as if having facets (*fig. 1, 15*). The internal cast (*Pl. II fig. 8 a*) of the neck shows very fine, interrupted, irregular, transversally impressed lines, probably produced by the mantle of the animal. The septum forming the apex is of the same shape as those in the Nautiloid, sometimes much convex (*fig. 11*). On the inner side it is much strengthened through depositions, so as to be almost as thick as the shell. There is no intermediate septum between this and the sigmoid ones. As the numerous large and well preserved specimens of this species are instructive for the morphology of the sigmoid septa, these may here be described in detail. They are generally seven, though there are specimens which have only six septa, and again there is one (*Pl. II fig. 18*) where there has been forming an eighth septum of the common concave or watch-glasslike shape on the bottom, above the sigmoid septa, being a remarkable recurrence to the initial stage. Again there are specimens, as for inst. that in connexion with the Nautiloid (*Pl. III fig. 17*), without the least trace of any septum. Such shells must be regarded as so recently formed or young that no septa had yet been secreted in them (Aphragmites), and we learn by this as well as from other species, that the shell of the Ascoceras stage was, as to its exterior, quite ready formed or at least nearly so before any septa were secreted. Such specimens show how little real value there is in such a genus as Aphragmites. Quite different it is when there are adult specimens of Ascoc. manubrium without any septa at all, these having been destroyed in the interior, but have left a trace of their former presence by their outlines on the surface of the nucleus.

The first sigmoid septum is quite entire and complete. But already the next, the second one, has a large central lacuna which is hemmed in on all sides by a narrow frame, at the points, where this septum is in contact with the first septum (*See Pl. III fig. 8*). The third septum in the same way embraces the second septum and its lacuna is consequently still larger. As a constant rule the higher the septum is situated or the longer it is, the larger is the lacuna. Thus, in this species, the seventh has the largest lacuna. The third septum is largest of all (*fig. 18 c pl. II*) in so far it is developed. Its arched superior portion is nearly twice as large as the corresponding one of the first septum. This arch of the septa is, as seen on *pl. II fig. 17*, provided with a shallow sinus at its inferior margin. If we compare *Pl. II fig. 16* and *fig. 18* of two specimens of almost equal size, the latter sectioned vertically along its median axis, there will be remarked the great difference in the size and appearance of the septa. The former representing the nucleus, after the shell has been peeled off, has all the septa in juxtaposition, showing their exterior outlines or sutures where they have been secreted in a narrow strip above each other and where they thus far are perfect. Now it is to be borne in mind, that the septa do not continue across the shell in a straight line, so as to be as large in the interior as seen on the outside. Their surface in the interior is bent in a semicircle (*see pl. II fig. 21*) so that in a transverse section they are seen to be widest near the lateral surfaces of the shell and most narrow in the diameter between the dorsal and the ventral sides. In the section represented in *Pl. II fig. 18* again they have been cut where their innermost curve is situated. A model, constructed according to several specimens, and figured in *pl. III fig. 8*, elucidates these peculiarities.

On the ventral side the septa are quite regular, although there is very little place left for them to develop through the large size of the siphuncle. When seen from above

the bottom has the appearance delineated in *pl. III fig. 7*. Near the dorsal side the first septum (1.) occupies the whole space and around it the succeeding septa are arranged. Around the siphuncle the septa are raised in a small cone.

The septum of the truncature or the last Nautiloid septum (*Pl. II fig. 18 a, pl. III f. 5*) is strengthened by depositions from the interior so as to be nearly as thick as the shell itself. It consists of two strata, *b*, the original septum, *c*, the larger interior stratum which is also continuous and common with the shell. As may be seen by *fig. 5 pl. III* the shell again consists of three strata, *a*, the thinner exterior one and *c*, the same as before and innermost a dark stratum formed by the sigmoid septa.

The neck of the last Nautiloid septum is prominent and closed by a thick secretion from the interior. On the interior surface round the aperture of the septum of the truncature is the same sort of basal tube, which is so characteristic to the Nautiloid. It is seen in a section, *Pl. II fig. 18 a, Pl. III f. 17 a* and also restored according to a specimen, *pl. III fig. 6*. It becomes more narrow towards the apex. It is in this position only a structure without use, as no tubular siphuncle for which to serve as a basis, was ever formed, when the animal changed into the Ascoceras shape. The elements of the Ascoceras siphuncle are broadly nummuloid, the second being the broadest of them all. The septal neck around them is very small.

Dimensions. Spec. A. Length 15,8 centim., breadth dorso-ventral diam. 31 millim., lateral-diam. 22 millim. — Spec. B. Length 16 centim., dorso-ventral diam. 31 millim., minor diam. 21 millim.

An attempt has been made in *pl. VI fig. 3* to reconstruct this the largest of our Ascocerata. The details are taken from the detached parts found in the same locality, Sandarfve kulle. But it is highly probable that the shell never has occurred in this complete shape, as there is evidence that decollation has taken place many times during the Nautiloid stage.

8. *Ascoceras ampulla* n.

Pl. IV fig. 1—4.

The type specimen is from the limestone of Samsugn in Othem.

Only the Ascoceras-stage has been found.

Shell flaskshaped, much flattened, dorsal and ventral sides convex, the ventral more so. Neck short, making a fourth of the total length. The ornamentation consists of transverse striæ, more dense and crowded and consequently finer near the aperture. They are longitudinally folded by broad wrinkles. There are four sigmoid septa, as to their position and shape like those of *Ascoc. bohemicum*. The first is the shortest and most widely separated from the others.

Length 50 millim., dorso-ventral diam. 21 millim., lesser diam. 13 millim.

This species nearly resembles *Ascoc. bohemicum* as to its shape and the form of the septa. It is, however, smaller, its ornamentation is different and it is moreover much flatter and more compressed in the direction of the smaller diameter.

9. Ascoceras collare n.

Pl. IV fig. 5—7.

Only two specimens of the *Ascoceras* stage have been found at Gannviken in Grötlingbo.

Shell ovate-oblong, dorsal side nearly straight, the ventral one convex. Neck short, scarcely a fourth of the total length. The weathered surface does not show any trace of the ornamentation. There are five sigmoid septa. Their interior surface has impressions of short, horizontal, interrupted and wavy lines, caused by the mantle (*fig. 6, a*). The necks of the septa are so much developed as to be nearly as large as in *Asc. bohemicum* and in *Choanoceras*. The aperture of the siphuncle on the inferior surface of the truncature is surrounded with a similar neck like a prominent ring and this is closed from within by secreted matter. As in *Asc. manubrium* there has been a basal tube on the superior surface of the septum, but in this species it is narrow and so oblique that it leans against the septum.

Length of the shell 43 millim., dorso-ventral diam. 17 millim., minor diam. 12 millim.

10. Ascoceras lagena n.

Pl. IV fig. 17—24, Pl. VI fig. 4.

1888 *Ascoceras* LINDSTR. On the genus *Ascoceras* BARR. Geol. Magazine p. 532 with figure.

Of this shell both stages in connexion have been found at Samsugn and Klints in Othem.

The Nautiloid stage. Regularly cylindrical and faintly curved, surface ornamented by a network of intercrossing longitudinal and transverse striæ or folds, the longitudinal ones being in some parts more strongly expressed. The narrow, tubiform siphuncle is situated close to the ventral side. The septa are regularly concave, the concavity increasing with the size of the shell and it is somewhat oblique as its dorsal edge is placed much higher than the ventral one. The necks are short. The septa are, as common with the *Ascoce-rata*, much irregularly distantiated. In the youngest specimens (*f. 21*) they are nearly equally distributed, but in a somewhat larger (*fig. 19*) there is great inequality, the distance varying from 2 millim. to 6 millim. In the piece which yet is coherent with the *Ascoceras* the distance between the two lowest septa is 10 millim. and between the second and the bottom of the *Ascoceras* 8 millim. The diameter of the shell being 10 millim.

The Ascoceras stage. The *Ascoceras* shell is elongated, tumid, much curved, crescent-shaped, the ventral side forming a convex arch and the dorsal one being concave. The neck is broken but has probably been long. The ornamentation partly resembles that of the Nautiloid (compare *fig. 17 a* and *22*) consisting of narrow longitudinal folds crossed by finer lines making a mosaic of small quadrates, further down (*fig. 17 b*) the transverse folds predominate, much distantiated and prominent. The shell is very thin and seems to be but a direct continuation of the septum of the truncature. This septum is still thin,

though a little thicker than the septa of the Nautiloid. There are four sigmoid septa, the constant number in all specimens. They are elongated and narrow. The siphuncle is still in direct communication with the narrow siphuncular tube of the Nautiloid in the best preserved specimen and it consists of the common elements, placed nearer the central axis of the shell, than in most others of this genus.

From the limestone of Lunnmelund there has been found a specimen with an uncommonly long neck (*pl. IV f. 25*), making two thirds of the remaining part of the shell. The four sigmoid septa are larger than in *A. lagena*, with which it seems to be nearly related. It is indistinctly transversally striated.

On *plate VI f. 4* there is a restored figure of *A. lagena* showing it to be one of the most curved of all species.

11. *Ascoceras cucumis* n.

Pl. IV fig. 40—47.

Several specimens of the *Ascoceras* stage have been found in the superior limestone of Sandarfve kulle.

Shell elongated, nearly evenly cylindrical, ventral side regularly arched, the dorsal one faintly concave or almost straight. Neck short, not forming an angle against the rest of the shell, making about a seventh of the total length. The exterior surface is transversally and microscopically striated and longitudinally folded by regularly distantiated wrinkles. Transverse section oval.

There are five sigmoid septa, regularly distantiated from each other. The siphuncle has, at least in the beginning, a rather central place between the ventral side and the central axis of the shell and continues upwards in an oblique direction. Its first element is more bulbous than nummuloid. The inferior aperture is closed by somewhat irregular calcareous concretions.

Length of the shell 60 millim., dorso-ventral diam. 14 millim., minor diam. 10 millim.

Near to this species some forms of *Ascoceras* range, which cannot be described as separate species, as there is only a single incomplete specimen of each extant. The specimen figured *pl. IV fig. 36—37* from Samsugn in Othem, may be only a variety of this species. It is, however, more straight, has only four slightly curved septa and the ornamentation differs a little.

Resembling *Asc. cucumis* in exterior shape there is a fragmentary specimen from Linde klint (*fig:s 38—39*), which is most remarkable as it has had no less than twelve (12) sigmoid septa, as may be inferred from the remaining fragments.

12. *Ascoceras decipiens* n.

Pl. V f. 1—34, pl. VI f. 5.

This species has been found in the Nautiloid stage as well as in the *Ascoceras* stage in the uppermost limestone of Sandarfve kulle, Linde klint, Duckarfve backe, Mannagårda in Lye and Holmshallar in Wamlingbo.

The Nautiloid stage. Some specimens having both stages still in connexion allow the determination of detached pieces from the same strata as belonging to this species. They are faintly curved as a *Cyrtoceras*, the dorsal side being concave and the ventral one convex, cylindrical, quite circular in section. The shell is finely, transversally striated and also longitudinally crossed by fine folds. The apex is rounded, blunt, and does not show any distinct scar. The septa are of the common watch-glass shape and as seen in *fig. 34 a* placed at irregular distances from each other. They have a distinct neck around the siphuncle. The siphuncle is as usual near the ventral side, narrow, tubular and its elements of varying length, according to the length of the interseptal space, as common in this genus.

There is a remarkable specimen, figured in *f. 26—27*. The *Ascoceras* shell is formed in uninterrupted continuation with the Nautiloid shell, but both are without the least trace of any septum. It may be that there had been septa, but that these have been destroyed during the process of the fossilization. But it seems more probable, that it had been evacuated by the mollusc, before it had had time to withdraw entirely from the Nautiloid and secrete septa in the *Ascoceras* shell. The body chamber of the Nautiloid continues or is changed into the *Ascoceras* and the dividing septum was secreted afterwards. Thus this specimen represents a shell in its earliest »Aphragmite» stage. In the figures *23—24* we have an interesting specimen still more advanced. The Nautiloid is seen beneath, with its straight tubular siphuncle, partitioned off by the septum of the truncature and in the *Ascoceras* only the first sigmoid septum is ready formed.

A section (*see fig. 25*) shows how both the Nautiloid and the *Ascoceras* cohere through a common shell. The dividing septum of the truncature is lined from within the *Ascoceras* with a nearly twice as thick calcareous organic secretion, which is continued up along the sides of the *Ascoceras*. This shell consequently consists of two strata.

The Ascoceras-stage. Shell short, laterally much compressed, ventral side regularly curved, the dorsal one straight, with the neck, which makes a fourth of the entire length, bent towards it. The ornamentation is nearly the same as in *Glossoceras gracile*. It changes with its position on the shell, being finer lower down and on the ventral side, coarser on the neck. The microscopic fine, transverse and imbricated lines are crossed by narrow longitudinal folds.

There are four sigmoid septa in all the eight specimens which have been sectioned. One specimen, *fig. 22 ♂ a*, is very remarkable in having four regular, Nautiloid septa secreted above the sigmoid ones in the cavity formed by their curves. This is a reversion to the original Nautiloid stage which also has been found in a few instances with others. See *pl. IV fig. 34* where there are three adventive Nautiloid septa. With the septa also the character of the siphuncle is changed.

In the enlarged figure *22 b* an organic deposit is seen above the fourth sigmoid, thickest in the angle where the septum joins the shell and then stretching up along this it thins out. This deposit occurs also in all the other *Ascoceratidæ* though perhaps in none so evident as here.

The siphuncle is very peculiar in this species. The narrow tube which leads from the Nautiloid siphuncle into the *Ascoceratidan*, is so much oblique that it leans against

the bottom of the septum of the truncature and is directed towards the ventral side. Generally it is only its superior side which in longitudinal sections is seen protruding into the siphuncle of the *Ascoceras* (*fig. 24 a*). The other has coalesced with the bottom. The siphuncle of the *Ascoceras* proper consists of four elements rapidly decreasing in size upwards. The first is longer than the following three, and it is much longer than broad, quite in contradistinction with other species, the ratio between length and breadth being as 4 : 3. In all specimens which have been studied it has, moreover, a peculiar feature, difficult of interpretation. Interiorly on the middle of the side of the hollow (*fig. 22 a*) there is seen in a longitudinal section an ingoing duplicature, sharp and pointed on its ventral side, blunt on the dorsal. This duplicature continues all round the walls of the first element of the siphuncle, as seen in other sections (*fig. 19, 20*), and is most prominent on the ventral side. It is as if this first element had been beginning to divide into two, though the division never had been completed. Now there is always a septum in connection with such a duplicature, which in reality only is its continuation. But in this species it has not been found. That this feature is of some important significance is evident by its recurring not only in all specimens of this species which have been sectioned, but also in the two next species. Can it be interpreted as the first vestiges of a second septum, like that in *Asc. fistula*? Or is it not rather to be regarded as a useless remnant from a former second septum?

The following three elements are flat and broad, more so than in other species. In the specimen with the additional septa the siphuncle assumes again the shape it had during the Nautiloid stage, with tubular elements enclosed in strong walls, connected with the large, downward curved necks of the septa.

Dimensions: Length 37 millim., dorsal-ventral diam. 10 millim., minor diam. 7 millim. In this species the difference in size between full grown shells is more prominent than in others. Small sized adult specimens measure in length 30 millim., d. v. diam. 8 millim., minor diam. 5.

This species resembles as to its ornamentation so nearly *Glossoceras gracile* as sometimes to be mistaken for it. Hence its specific name. It differs, however, on closer inspection not only in exterior form, the neck is more straight and large, the sigmoid septa quite different and, moreover, there is the peculiar duplicature in the siphuncle.

13. *Ascoceras siphon* n.

Pl. V fig. 35--42.

Specimens of the *Ascoceras* stage have been obtained from Sandarfve kulle, Linde klint, Løjsta klint and Ljugarn.

Shell elongated, nearly of the same width the whole length, tubular, only slightly laterally compressed, regularly curved, dorsal side concave, the ventral one convex. Neck long, nearly a third of the total length, only a little narrower than the rest of the shell. The ornamentation consists of transverse, imbricated lines. There are five sigmoid septa, which are much narrower in the middle of the shell. The duct from the Nautiloid siphuncle is oblique.

In the first element of the siphuncle there is a duplicature as in the preceding species though not so prominent.

Length 45 millim., dorso-ventral diam. 8 millim., minor diam. 6. A smaller, though adult specimen is 34 millim. in length, dorso-ventral diam. 6 millim., minor diam. 5 millim.

14. *Ascoceras gradatum* n.

Pl. IV fig. 8—12.

A few specimens from the limestone of Hoburg. A doubtful specimen from the neighbouring Holms hallar in Wamlingbo.

Shell laterally complanated, thick, ventral side convex, dorsal side straight, neck not much narrower than the rest. The surface of the shell is so much altered, that no ornamentation can be discerned, only a few transverse lines on the neck. There are four sigmoid septa with wide curvature exteriorly. When cut longitudinally in a plane from the dorsal to the ventral side along the median axis, they show a peculiar steplike outline, not seen in other species. Their surface is marked by a serrated outline (*fig. 10 a*) no doubt occasioned by the peculiar wavy, imbricated lines, which are seen in so many Cephalopoda and have been formed by the mantle. They are of course here seen in profile. The siphuncle is wide and large, the first element is nummuloid and the duplicature is so large that it reaches from the ventral side to the centre of the siphuncle. The septa are bent in a peculiar sinus on the ventral side near the siphuncle.

Length 38 millim., dorso-ventral diam. 15, minor diam. 10 millim.

Gen. *Glossoceras* BARR. 1865.

There is nothing especially to be added to the generic characters as given by BARRANDE, if not the very remarkable increasing width of the sigmoidal part of the septa from below upwards, quite contrary to those of *Ascoceras*. (Compare *pl. V fig:s 50—51* with *fig:s 5, 7, 11* of the same plate). It is, as has been dilated upon in the description of the *Ascocerata* (*Asc. decipiens* for inst.), almost impossible to distinguish certain species of *Ascoceras* from *Glossoceras* as to their nearly identical ornamentation. In behalf of the structure of the septa they are quite unlike and distinct.

Glossoceras gracile BARRANDE.

var. *curta* BARR.

Pl. V fig. 44—52.

Syn. 1867. *Gl. gracile*, var. *curta* BARR. Syst. Sil. vol. II, pt. I, p. 373, pl. 96 fig. 35—45.

» 1889. » A. FOORD. Catal. of the Foss. Cephal. of Brit. Museum. Pt. I p. 254.

Distribution. Sandarfve kulle, Linde klint and Mannagårda in Lye, in the uppermost limestone.

Only the *Ascoceras* stage has been found.

Shell laterally compressed and consequently with elliptico-oval section. The neck is sigmoidally curved, first bent in an obtuse angle towards the straight dorsal side and then again, near the aperture against the convex ventral side. The aperture is trilobate, with a broad tongue-like lobe from the dorsal side and two small blunt lobes on both sides of the semicircular sinus of the ventral side. The margin of the aperture is thickened by a weal.

The sculpture consists of fine, imbricate, transverse lines more or less closely set and they are crossed by fine, often indistinct longitudinal folds, forming sometimes together a fine network.

There are four sigmoid septa, which in their innermost curve increase in breadth the higher they are situated. The first sigmoid septum is 3 millim. broad, the fourth nearly 6 millim. Exceptionally a specimen, delineated in *fig. 44*, has five distinct septa. There is no intermediate septum between the thick septum of the truncature and the first sigmoid one. The siphuncle is placed close to the ventral side and consists of four nummuloid elements, of which the oldest is as large as the two following. The neck of the septa is curved downwards. The aperture of the old siphuncle is closed in no ordinary way.

Length 41 millim., largest diam. 9 millim., shorter diam. 6 millim.

Although there may be some trifling deviations, as in the shape of the large lobe of the aperture, I have joined the Gotland specimens with the Bohemian form. The more elongated Bohemian type has not yet been met with in Sweden and the variety *curta* is also very rare, about seven specimens having been hitherto collected. The Bohemian specimens have 6 septa and are as a rule larger than ours.

Gen. **Choanoceras** n.

(Deriv. *χόανος* a funnel.)

Syn. 1888. *Choaniceras* LINDSTR. List of Fossil Faunas of Sweden p. 7. Name only given, without description.

Shell resembling a faintly curved *Orthoceratite* with the lower extremity truncated and conically pointed. Aperture probably simple. Body chamber very large, occupying almost $\frac{9}{10}$ of the whole shell. Septa from four to six, formed as a pointed oblique funnel. In the younger specimens with only four septa, these are all equally well developed. In the more advanced or adult specimens there are six septa, of which three are complete and the three youngest ones incomplete or lacunose. The siphuncle is nummuloid in the older, cylindrical in the younger and the necks of the septa hooklike and strongly recurved.

This interesting genus, which for the present consists of only a single species, is the exact contrast to *Ascoceras* in the arrangement of its lacunose septa. In *Choanoceras* they are very poorly developed, whereas in *Ascoceras* their dorsal portion attains a size many times exceeding that of the ventral portion. On the concave side the septa are parallel and equidistant, on the convex side again they approach more or less. In the three youngest septa there is an open or empty space. As to the position of the lacunose septa it may

also be quite contrary to *Ascoceras*, in case, what is not certain, the convex side of the shell is the ventral side and the concave side the dorsal one as assumed in *Ascoceras*. In *Choanoceras* the lacunose part of the septa is placed against the convex side, in *Ascoceras* again near the concave side.

If I am right to interpret, as has been done below, the smaller specimens with four complete septa as younger stages in which the lacunose septa had not yet been developed, then there is the great dissimilarity between this genus and *Ascoceras*, that in the former the initial stages already foreshadow the appearance of the latest, through the great similarity of the septa, whilst in *Ascoceras* there is a long continuation of a regular Nautiloid growth or structure before the *Ascoceras* stage sets in. In *Choanoceras* the truncation seems to have been executed regularly before the shell had attained its final shape. In the siphuncle both of *Ascoceras* and *Choanoceras* the nummuloid elements are prevailing, but are more developed in *Choanoceras*, which also has the necks of the septa larger.

Besides this genus there is another Cephalopodan shell of unknown affinities (*Pl. VII figs. 18—20*) with much pointed and funnel like septa, but regularly placed on the median axis of the straight shell, so that the siphuncle coincides exactly with that axis. As seen by the figures the neck of the septa is uncommonly long and continues down till it meets the bottom of the next septum, thus forming, as it seems, the entire siphuncle. It thus cannot be shown to belong to this group, having only the similarity of the extraordinary pointed septa.

Sp. ***Choanoceras mutabile*** n.

Pl. VI figs. 6—19, pl. VII figs. 1—17.

Distribution: In the uppermost limestone strata of Samsugn and Klints in Othem, from Stor-Wede in Follingbo and from the shore of Boge, probably in a piece of limestone detached from the overlying limestone rock.

This remarkable fossil occurs in sets of two different forms, distinguished by their interior structure, but exteriorly quite similar. The shell resembles a faintly curved Orthoceratite, cylindrical and regularly circular in a transverse section. At the inferior, truncated end it is pointed into an oblique cylinder, bordered superiorly by an oblique edge. It is very difficult to decide which side is to be regarded as the ventral one and which as the dorsal, as contrary to *Ascoceras* the septa are smallest near the convex side.

The surface is commonly glossy through weathering, but in some spots there is still the original ornamentation left (*Pl. VII figs. 5, 10 & 14*) consisting of longitudinal, wavy and sometimes interrupted lines. The surface of the largest specimen (*Pl. VI figs. 6, 7, 9*) is covered by microscopically small elevated points (*fig. 6 a*), probably not superficial, but belonging to an interior stratum of the shell. On the surface there is near or immediately above the truncature a belt where the sutures of the septa are plainly seen running in equidistant parallel lines (*Pl. VI fig. 6—9*).

A common feature of all specimens is the large size of the body chamber. In the largest specimen, 9,6 centim. in length, it occupies 9 centim. and in the same way pro-

portionally with the other specimens. The body chamber ends as a truncated cone, obliquely on the side of the central axis of the shell near the convex side and in some specimens close to it.

As a series of specimens can be followed from the smaller and more regular to the larger and more deviating or having the true Ascoceratid characters, it will be best to begin the description of the former as probably representing the earliest stage of development. In *pl. VII fig. 9* we see the smallest specimen, 45 millim. long by 15 millim. broad, with a length of the body chamber of 33 millim. There are four extremely thin septa, deeply funnel shaped, having a difference of 13 millim. between their bottom and their uppermost edges. Near the concave side they are parallel or regularly distantiated from each other with 3 millim., in the bottom or lowest down they are widest apart with 5 millim. and on the convex side they approach near to each other with a curvature, as close as one millim. and again at the edges they are as much distantiated as on the other side or even a little more owing to their ascending steeper there than on the other side. Around the siphonal aperture the bottom of the septum is elevated and the neck is curved downwards and backwards, as to resemble a hook when seen in a section (*Pl. VI fig. 10 a*). In the older septa a spur has grown out from this hook toward the centrum through which the aperture of the siphuncle has been contracted. This progressive growth is of use when the shell is ready to decollate a part of itself, as will be seen further on. The elements of the siphuncle are in the youngest specimens nearly cylindrical, only a little swollen in the middle, 5 millim. in length and 3 millim. in breadth.

Next in size and further development we have the specimens delineated in *pl. VII figs. 4—8*. In *figs. 7* and *8* the siphuncle already approaches to the bulbous form, its elements having both diameters alike. In *fig. 4* likewise, though the bulbous character there is more prominent. The shape and the position of the septa, which in all seem to be four, is quite the same as in the youngest form. In *fig. 12* there is a decided change to the nummuloid shape, the diameters being 3 and 5 millim., but still four septa. In *fig. 3* a most remarkable specimen is represented. It is larger than any of the preceding, has four regular septa and a fifth incomplete one. This specimen thus leads us from the first mentioned specimens to those which have three or more incomplete septa. This adventive septum is quite regular on the concave side of the shell and has a lacune in its middle on the convex side and is consequently only visible near its upper and lower end in a section going through the centrum. The elements of the siphuncle are decidedly nummuloid, the first having 3 millim. in height and 5 in breadth, the following decreasing a little till the fourth which has 2 : 5. The necks of the septa are hooklike and recurved and more strongly developed than the other. From this transitory or intermediate specimen we pass to those which may be regarded as the oldest (*Pl. VI f. 10—19, pl. VII f. 1—2*). Here we find commonly only three complete septa and three incomplete, making six in all. Their obliquity is here more pronounced than in the preceding. In *fig. 16* their extent is shown, when seen from above. There are the elliptic lacunæ of the three youngest or uppermost septa and it is seen how they expand towards the concave side of the shell and form only a narrow stripe along the convex side. All the septa which succeed the third septum have been losing in width, so that the sixth or

uppermost is the most narrow and the edges of the fifth and fourth are seen beneath the edges of the sixth. The bottom of the lacuna is formed by the third septum (*A. fig. 15*). The exact boundary line of the sixth septum around the siphuncle is copied in *fig. 14*.

The siphuncle (*fig. 10, 10 a*) consists of five nummuloid elements, of which the uppermost, owing to the extreme obliquity of the septa near the convex side, are irregular. The ratio of the diameters in the lowest elements is as 3 : 5 or the same as in the former specimens. The necks of the septa are very large and when seen from below (*f. 8 a, 8*) they resemble a button. When the truncation has taken place, the aperture of the siphuncle has been closed by a peculiar secretion, resembling a little plug (*pl. VI f. 8, 8 a, 10 a*). I suppose that this has been effected from within, as there is no trace that the truncated part has been strengthened from without and there only is the thin, lowest septum occupying the place of an outer shell. Some specimens, as that delineated on *pl. VII f. 1, 2*, have seven septa, viz. three complete and four lacunose.

On the nucleus of the shell (*fig. 14*) there are (b) several impressions of the interior surface, showing longitudinal lines and a serrated edge. On the superior surface of the septa there is along the upper edge a row of small pits (*14 c*) and also on the inferior surface (*fig. 13 x*).

The way in which the decollation was effected may be seen in a section given *pl. VII fig. 17*. The shell has burst just below a septum and thus laid it bare.

Fam. **LITUITIDÆ.**Gen. **Ophidioceras** BARRANDE.

There is nothing to add to the generic characters given by previous authors, if not that the body chamber is of an excessive length in all the Gotland specimens which have been sectioned. It occupies more than one whorl, in some more than two.

BARRANDE already in 1874 mentions *Ophidioceras* as occurring in Gotland according to a notice of ANGELIN. Two species have hitherto been found there. One, *O. reticulatum*, has a vertical distribution from the lower shale beds to the uppermost limestone-beds inclusive. It has not as yet occurred in the intervening beds d—c. Horizontally it has been found from the northernmost to the southernmost localities of the island. The second species, *O. rota*, is restricted to the uppermost limestone beds of a few places in the south-eastern Gotland. Both species are very well distinguished from each other through the characters given below.

I see no reason of placing this genus with the *Ascoceratidæ* as HYATT has done. Its species have quite different ornamentation, a ventral keel and the form of the aperture is also different. Moreover, they want totally the sigmoid septa.

1. *Ophidioceras reticulatum* ANGELIN.

Pl. VII figs. 21—33, 38—40.

- Syn. 1880. *O. reticulatum* ANG. in *Fragmenta Silurica* p. 9, Tab. XV, fig. 31—32, Tab. XVI f. 1.
 » 1885. » LINDSTR. *List of Foss. Upp. Sil. Foss. of Gotland* p. 6.
 » 1888. » ID. *List of Fossil Faunas of Sweden* p. 7.

Geological & Geogr. Distribution. In the stratum *c* it has been found at the following localities:

Fårö, Lansa, the canal from Stormyr in Rute, the shale of Slite, Grogarnsberg, Wisby Norderstrand, Westergarn, Djupvik in Eksta, Petesvik in Hablingbo, Bursvik.

In the strata *f—h*:

Fårö, Lansa and Lauters gamla hamn, Sändvik in Fleringe, quarries in Hangwar, Slite, Lännaberget, Samsugn in Othem, Klints in Othem, Rums in Martebo, Storwede in Follingbo, Grogarnsberg, Ljugarn, Lau backe, Linde klint, Sandarfve kulle, the cliff near Fröjel church, the limestone beds above Djupvik in Eksta, Petes-canal in Hamra, Holms hallar in Wamlingbo.

Descr. Whorls at most 4, commonly 3, flattened and broad, in section showing the ventro-dorsal diameter longer than the diameter crossing it at right angles (*Figs. 25, 27, 30*). The last whorl has grown out straight near the aperture, but none of the Gotland specimens has the aperture complete. The side ribs of the whorls are rather distantiated, being about three on a length of 10 millim. The shell is finely reticulated, as seen in the magnified figures *21 a, 29 a*, the transverse striæ being in the exterior whorls sometimes stronger than the longitudinal ones (*figs. 21 a—b*). The ventral keel (*figs. 22, 32, 33*) is bordered by two thin edges and is sculptured by regular curves directed backwards and crossed by longitudinal lines.

The body chamber is long, occupying half the first whorl. The septa are regularly distantiated, as many as 23 in the second whorl from the outside, gently curved and very thin (*figs. 23, 24, 31, 31 a—b*). The siphuncle is placed near the ventral or exterior side, although in some specimens a little closer to the central axis. It is slender and narrow and where its component parts meet the funnel of the septa, they are, as it were, strangled (*f. 31 a*). The siphuncle has much thinner walls than the septa. It ends blind against the ventral side of the initial chamber (*fig. 31 b*). The inside of the shell has left peculiar traces of impressions of the mantle on a nucleus from Östergarn (*figs. 38, 40*). They consist of wavy, interrupted, imbricated lines, forming a serrated edge when seen in a section, being thus of a character, which returns in the Ascoceratidæ, as well as in other Cephalopoda.

As may be seen through the figures *21, 29* and *25, 27, 30* there is some variability as to the size and shape of the whorls, but the chief characters are retained.

Dimensions. Largest diameter 32 millim. Breadth of largest whorl near the aperture 12 millim., thickness of the same 9 millim., average distance of septa 3 millim., breadth of keel 4 millim. There are dwarf specimens, full grown, with straight end of the last whorl, having in diameter 20 millim. and only three whorls.

From the second Gotland species, with which it sparingly occurs in the same beds in Linde and Sandarfve, it is easily distinguished by its less numerous and broader whorls, by its ornamentation, entirely reticulate, and by its ventral siphuncle. As to foreign species it comes near to *O. simplex* BARRANDE (pl. 97 f. 1—12, vol. II pt. 1, page 184), which also has a ventral or external siphuncle, but more narrow whorls and the septa more irregularly distantiated. The English *O. articulatum* SOW. (BLAKE p. 230, pl. XVIII f. 14, 15) is too badly preserved to be identified with the Swedish species. The siphuncle is, however, nearly external, but the septa are more remote from each other.

2. *Ophidioceras rota* n.

Pl. VII, f. 34—37.

Syn. 1888. *O. rota* LINDSTR. List of Fossil Faunas of Sweden p. 7.

Distribution. In the uppermost limestone strata of Mannagårda in Lye, Linde klint and Sandarfve kulle.

Whorls six and a half, narrow, terete, the transverse diameter being larger than the dorso-ventral one (*fig. 36*). The end of the last whorl has grown straight, but no

specimen shows the aperture entire. The ribs are narrow, closely set, so that six are contained within a length of 10 millim. The three innermost whorls have a fine reticulate ornamentation, but the longitudinal striæ cease at the beginning of the fourth whorl, so that the three outermost whorls have only transverse striæ (*f*, *34 a*) but of two kinds, some larger, regularly distantiated and between them smaller, microscopically fine.

The keel of the ventral side (*fig. 35*) is traversed by sharp, almost imbricated curves, directed backwards.

The body chamber is extraordinarily long, occupying the entire first whorl. In the young specimens the body chamber is still longer occupying more than two whorls. The second whorl has 27 septa. The siphuncle is placed near the dorsal or interior side of the shell and is narrow and slender.

Dimensions. Largest diameter 37 millim. Breadth of the largest whorl 7 millim. Thickness of same 8 millim. Distance between the septa 2 millim. Breadth of the keel 3 millim.

The only previously known species, with which this has any affinity, is the Bohemian *O. rudens* (BARR. pl. 45 f. 13—24), but the more obovate whorls of this and their different ornamentation sufficiently distinguish them.

PLATE I.

PLATE I.

All the figures of this and the other plates are in natural size, unless they are otherwise signed on the plates.

- Fig. 1. **Ascoceras cochleatum** n.
 » 1. a » » from the end.
 » 2. **Ascoc. dolium** n. one of the two specimens found, showing the sigmoid septa.
 » 3. » » the largest specimen from the side and with details of ornamentation.
 » 4. » » from the dorsal side, nat. size.
 » 5. » » from the truncation, showing the siphuncle.
 » 6. » » section showing the septa. The first and second sigmoid septum do not join.
 » 7. **Ascoc. cochleatum** n.
 » 8. » » Longitudinal section of the same.
 » 9. » » A fragment of the ventral part of the cast.
 » 10. » » The same, lateral view.
 » 11. **Ascoc. fistula** n. specimen from Samsugn in Othem.
 » 12. » » Longitudinal section of the same.
 » 13. » » Neck magnified.
 » 14. » » Another specimen, dorsal view.
 » 15. » » End laterally.
 » 16. » » Septum of the truncature with siphuncle.
 » 17. » » Small slab of limestone with twenty one more or less perfect specimens, collected by Professor P. T. CLEVE in the uppermost limestone of Slite and now in the Museum of the University of Upsala.
 » 18. » » Longitudinal section of a specimen with a fragment of the Nautiloid in the aperture.
 » 19. » » Longit. section of another specimen and *a*, the end thereof magnified.
 » 20. » » Section near the truncature.
 » 21. » » Nucleus with the sutures of the enclosed septa: the ventral side has been obliquely sectioned.
 » 22. » » Longitudinal section of the same specimen along an axis directed from the dorsal to the ventral side, and near it cut rectangularly to show the aspect of the septa from the ventral side. Above the three sigmoid septa there is a regular septum.
 » 23. » » The same seen from the ventral side and represented as if entire, to show the aspect of the siphuncle and septa when sectioned from the ventral side.
 » 24. » » Longitudinal section of another specimen a little on the side of the siphuncle, having the septa near the dorsal side somewhat more bulging than ordinarily. In this as in the former specimen there is an extra septum of common Nautiloid type deposited above the youngest or third Ascocerate septum. In the body chamber the inferior end of a Nautiloid of probably this same species is seen, showing the peculiar, aduncate curvature of the apex.
- Fig. 25. **Ascoc. fistula** n. Inferior portion of another specimen sectioned longitudinally, through the central axis.
 » 26. » » The same sectioned longitudinally somewhat on the side of the central axis.
 » 27. » » Apex of a fragment, where the first and second sigmoid septum do not meet and consequently both are entire. *a*. Enlarged figure of the same.
 » 28. » » Part of Nautiloid, assumed to belong to this species, lateral view.
 » 29. » » The same, ventral view.
 » 30—33. » » Longitudinal sections of smaller fragments of the Nautiloid. Fig. 32 *a*, Section of the shell.
 » 34. » » Longitudinal section of an apparently entire Nautiloid.
 » 35. » » Exterior of the same enlarged.
 » 36. » » Apex of another Nautiloid with three transverse sections *a*, *b*, *c*.
 » 37. » » Longitudinal section of a nearly similar fragment.
 » 38. » » Section near the circumference.
 » 39. » » Transverse section.
 » 40. **Ascoc. pupa** n. Lateral view of specimen from Linde.
 » 41. » » Lateral view and ornamentation of shell enlarged, specimen from Sandarfe.
 » 42—43. » » Ventral and dorsal view of the same specimen from Linde.
 » 44. » » Lateral view of the same specimen, enlarged.
 » 45. » » Specimen from Linde klint.
 » 46. » » » from Sandarfe kulle.
 » 47. » » Longitudinal section and siphuncle enlarged.
 » 48. » » Another specimen longitudinally sectioned.
 » 49. » » Siphuncle of the same enlarged. *a*. the siphuncle still more enlarged.
 » 50. » » Longitudinal section of the same specimen between the central axis and the circumference.
 » 51. » » The septum of the truncature from its inferior surface enlarged and the siphuncle still more enlarged.
 » 52. » » Specimen from Linde klint.
 » 53. **Ascoc. reticulatum** n. Specimen from Sandarfe. *a*. & *b*., ornamentation of shell magnified.
 » 54. » » Transverse section.
 » 55. » » Longitudinal section.
 » 56. » » Shell from the ventral side.

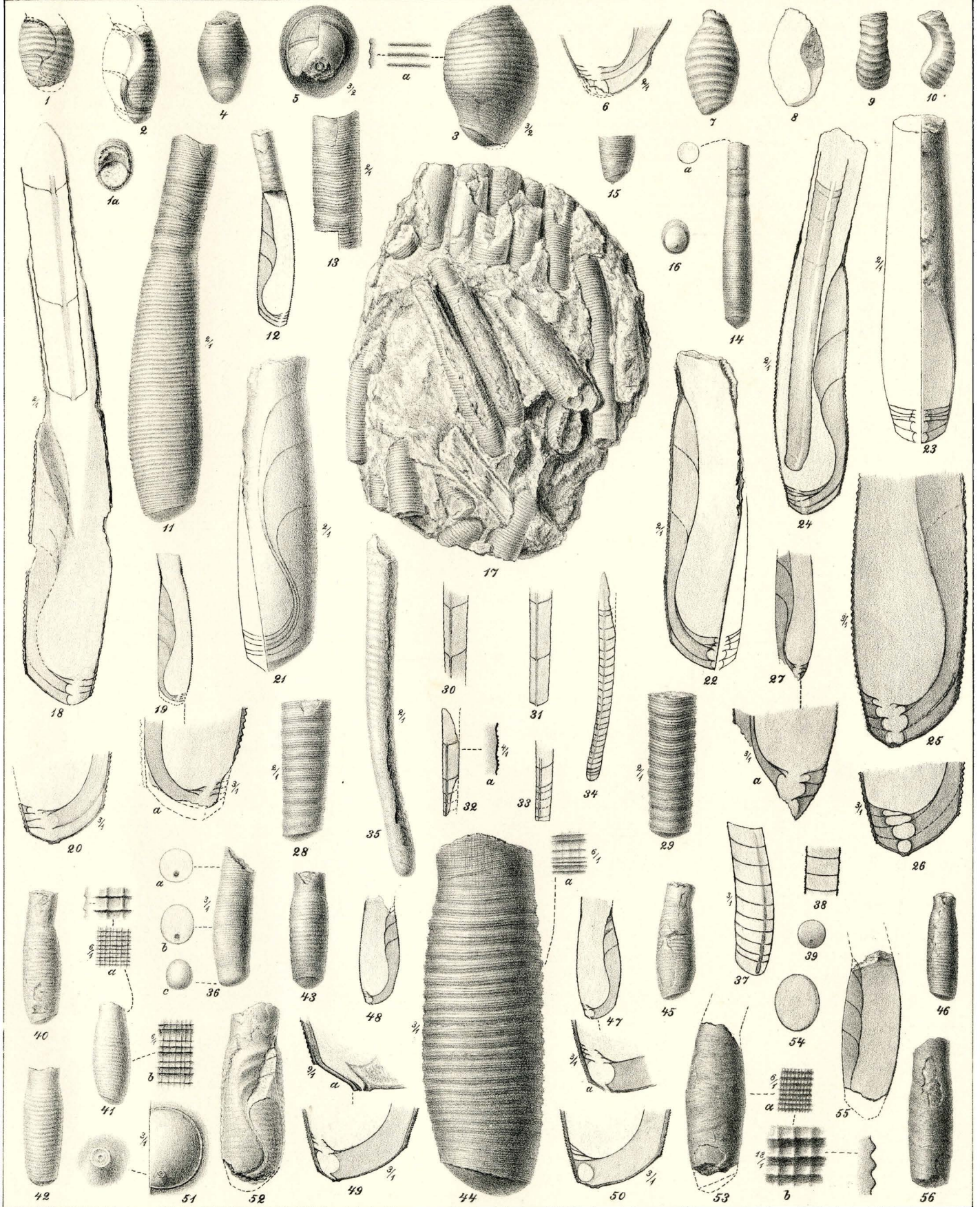


PLATE II.

P L A T E II.

Ascoceras manubrium n.

All specimens from Sandarfve kulle, excepting that delineated in figure 15, which is from Mannagårda in Lye.

Fig. 1. Lateral view. Fig. 2. The truncature from below. Fig. 3. Another specimen in lateral aspect with details of ornamentation. Fig. 4. Transverse section. Figs. 5—8. Details of the narrow, necklike aperture. Fig. 9. A complete, though smaller specimen, lateral view. Fig. 10. Ventral aspect of the same. Fig. 11. Fragment of an irregularly grown specimen. Fig. 12. Truncature of the same from below. Fig. 13. Apex of the same in longitudinal section. Fig. 14. The same magnified. Fig. 15. Fragment of a very large specimen from Lye. Fig. 16. Decorticated specimen from Sandarfve showing the sutures of six sigmoid septa. Fig. 17. Nucleus of the ventral part seen from its interior surface, with sutures of six septa. Fig. 18. Longitudinal section; a. apical part of the same showing seven septa and above them an adventive regular one. Fig. 19. Transverse section of another specimen taken at a height corresponding to A in fig. 18. Fig. 20. Transverse section at a height corresponding to B in fig. 18. Fig. 21. Transverse section, taken at a height corresponding to C in fig. 18 and showing only five septa.

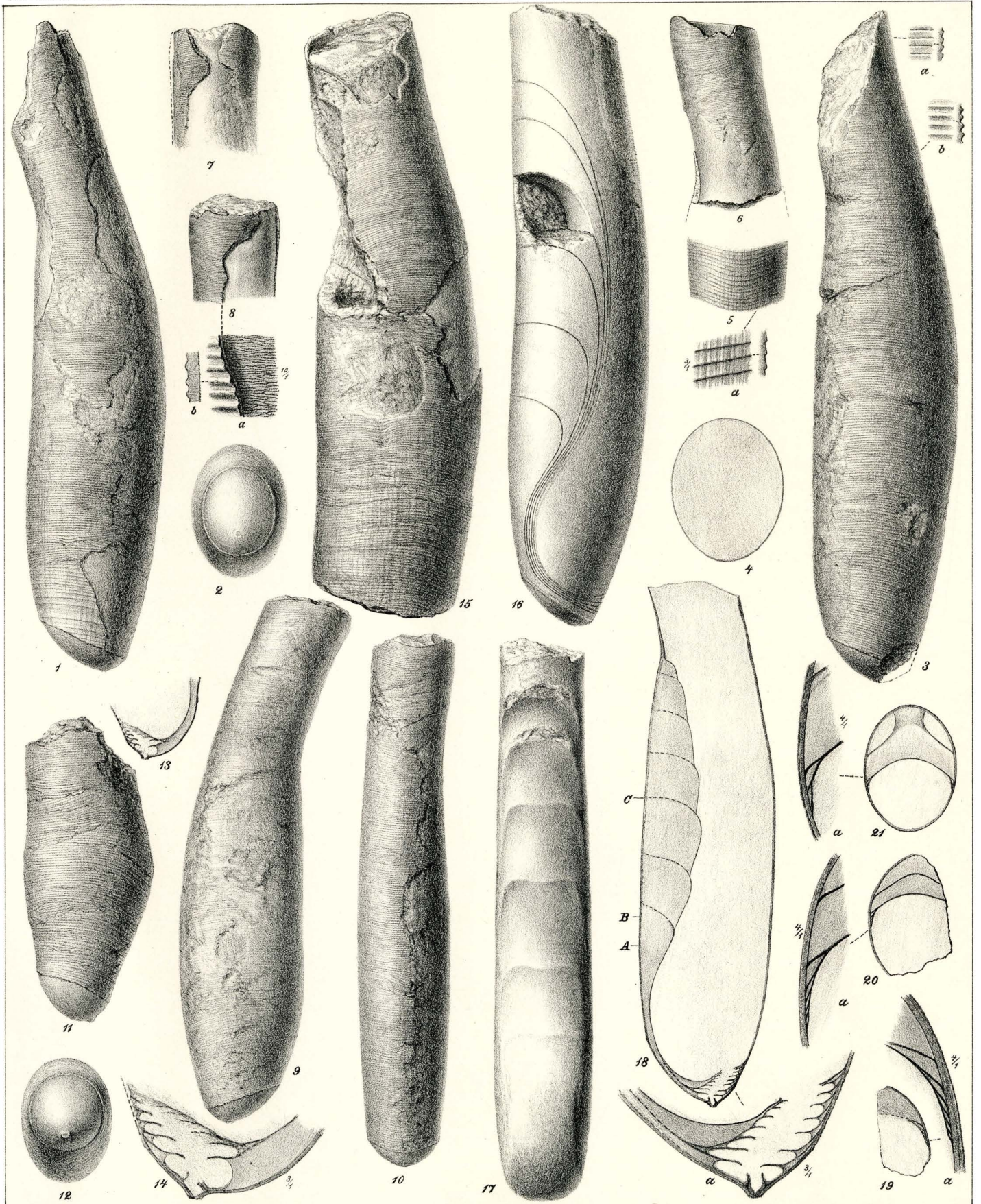


PLATE III.

PLATE III.

Ascoceras manubrium n.

- Fig. 1—2. Sections of apices with six and seven septa from Sandarfve.
- » 3. Nucleus of the end of another specimen with the sutures of six sigmoid septa and one Nautiloid septum, seen from the ventral side.
 - » 4. Longitudinal section showing the two strata, of which the shell is composed, *a.* the exterior one, *c.* interior lining it.
 - » 5. Longitudinal section near the apex, *a.* the exterior shell, *b.* the septum of the truncature, *c.* the interior lining stratum, 1, 2, 3 sigmoid septa forming the innermost dark stratum, near the ventral side.
 - » 6. Interior view of the bottom of the body chamber longitudinally sectioned along the dorsal side. Specimen from Sandarfve kulle magnified.
 - » 7. Idealized view of the same, as seen from above, to show how the seven septa are arranged above each other in the bottom. Ventral side down.
 - » 8. A model of an Asc. manubrium, sectioned along the median line, to elucidate the structure and arrangement of the septa.

Ascoceras fistula n.

- » 9. Ideal view of its three sigmoid septa seen from the ventral side.
- » 10. The third septum, shown as free and, as it were, dissected out from the shell, to exhibit the large vacuum in the middle.
- » 11. The same, lateral aspect.

Ascoceras manubrium n.

- » 12, 13, 14. Different views of a specimen with a fragment of the Nautiloid still left in situ, from Sandarfve kulle. Fig. 14, dorsal view.
- » 15. Transverse section of the Ascoceratid part near the upper margin.
- » 16. View of the Nautiloid apex; same specimen.
- » 17. Longitudinal section of the same, the Ascoceras having not yet any septa, thus being in the »Aphragmite»-stage; *a.* the siphuncle of the Nautiloid continued into the siphuncle of the Ascoceras, *b.* siphuncle of the lowest septum of the Nautiloid.
- » 18. A joint of a specimen from Linde klint; *a.* magnified section of the shell.
- » 19. Ornamentation of the same.
- » 20. Longitudinal sections of a Nautiloid specimen from Linde.
- » 21. Ditto from Sandarfve.
- » 22—25. Different views and longitudinal section of a Nautiloid from Sandarfve, younger stage.
- » 26—28. Still younger specimen, same locality.
- » 29. Longitudinal section and 30—31 details of ornamentation of very small specimen from Linde klint.
- » 32. **Ascoceras bohemicum** BARR. nat. size from Hoburg.
- » 33. View of its inferior apex and *a.* transverse section near the ventral side, showing the four septa.



PLATE IV.

PLATE IV.

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|----------|------------------------------|---|----------|-----------------------------|---|
| Fig. 1. | Ascoceras ampulla n. | from Samsugn, Othem, with sculpture of the shell magnified. | Fig. 23. | Ascoceras lagena n. | Longitudinal section of another specimen. |
| » 2. | » | » Dorsal view of the same with ornamentation of the neck magnified. | » 24. | » | » A large specimen with the sutures of the four septa. |
| » 3. | » | » The neck from the ventral side. | » 25. | Ascoceras sp. indet. | from Lummelund with uncommonly long neck. |
| » 4. | » | » Transversal section near the apex and magnified portion of it. | » 26. | » | » Transverse section of the same at A. |
| » 5. | Ascoceras collare n. | Lateral view of specimen from Hamra. | » 27. | Ascoceras sp. | Samsugn, Othem, longitudinal section a little on the side of the central dorso-ventral axis and obliquely as only to show the first element of the siphuncle. |
| » 6. | » | » Longitudinal section and <i>a.</i> impressions of the mantle on the septa in the interior. | » 28. | Ascoceras sp. | Kyrkberget in Wisby. |
| » 7. | » | » Truncature and the siphuncle magnified. | » 29. | Ascoceras sp. | Nucleus from the stratum <i>d</i> near Wisby. |
| » 8. | Ascoceras gradatum n. | from Hoburg. | » 30. | » | » The same in longitudinal section. |
| » 9. | » | » Longitudinal section of another specimen and <i>a.</i> apex magnified. | » 31. | » | » Another specimen from the stratum <i>c</i> of Wisby. |
| » 10. | » | » Longitudinal section of another specimen and <i>a.</i> interior surface of the septa, sectioned, magnified. | » 32. | » | » A fragment from Klints in Othem, having a peculiar angular form of the first sigmoid. |
| » 11—12. | » | » Fragments of a specimen, longitudinally sectioned. | » 33. | » | » Its ornamentation magnified. |
| » 13. | Ascoceras sp. indet. | from Samsugn in Othem longitudinally sectioned. | » 34. | Ascoceras sp. | showing three regular septa above the sigmoid ones, from Samsugn in Othem. |
| » 14. | » | » Ornamentation of the same. | » 35. | Ascoceras | from Hoburg, with the sigmoids very little prominent, <i>a.</i> marks of ornamentation. |
| » 15. | » | » Transverse section. | » 36. | Ascoceras | from Samsugn related to <i>Asc. cucumis</i> . |
| » 16. | » | » Dorsal view. | » 37. | » | » Transverse section. |
| » 17. | Ascoceras lagena n. | from Samsugn in Othem with fragment of the Nautiloid in situ and magnified details of the ornamentation. | » 38. | » | » Fragment of an <i>Ascoceras</i> with indications of an uncommonly large number of septa (12); <i>a.</i> lower end magnified. From Linde klint. |
| » 18. | » | » Same specimen longitudinally sectioned. | » 39. | » | » A restoration of the same specimen in natural size. |
| » 19. | » | » Section of a fragment of a Nautiloid of this species. | » 40. | Ascoceras cucumis n. | from Sandarfve kulle and details of ornamentation <i>a—d.</i> |
| » 20. | » | » Ornamentation of the same. | » 41. | » | » Transverse section of the same. |
| » 21. | » | » Section of another specimen. | » 42. | » | » Neck and aperture. |
| » 22. | » | » Ornamentation of the same. | » 43. | » | » Ornamentation of the neck from the ventral side. |
| | | | » 44. | » | » Another fragment of a neck. |
| | | | » 45. | » | » A nucleus showing the sutures of the septa. |
| | | | » 46. | » | » Longitudinal section and <i>a.</i> enlargement thereof. |
| | | | » 47. | » | » Another specimen in a longitudinal section. |

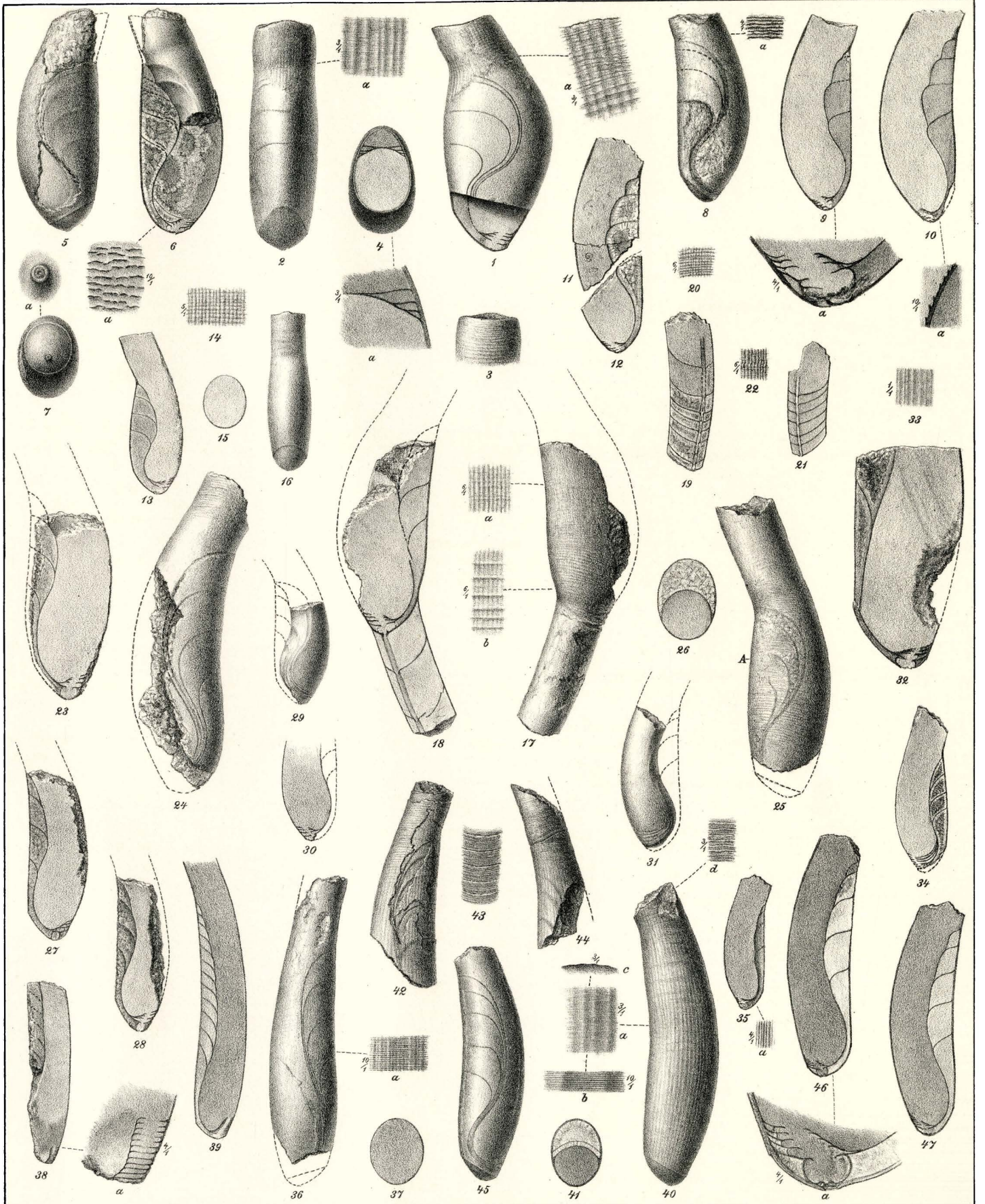


PLATE V.

PLATE V.

Ascoceras decipiens n.

- Fig. 1. Specimen from Sandarfve kulle, lateral view and details of ornamentation.
- » 2. The same, ventral aspect with ornamentation.
- » 3. Its apex and *a.* enlargement thereof.
- » 4. Neck and ornamentation.
- » 5. Longitudinal section and enlarged figure of the apex.
- » 6. Transverse section of the same.
- » 7—8. Sections of another specimen.
- » 9—10. Sections of a specimen from Linde klint.
- » 11—12. Various sections, 12 *a.* especially to show the siphuncle.
- » 13—14. Specimen with the sutures of the septa and the same sectioned.
- » 15. Uncommonly small specimen from Ljugarn.
- » 16. Transverse section showing the arrangement of three septa, the dorsal side up, ventral down.
- » 17. Transverse section across the inferior apex, between the septum of the truncature and the first sigmoid septum.
- » 18. Fragment of which three different oblique sections have been taken, in order to show the different aspects of the siphuncle.
- » 19. Section along the line A—B of the magnified section *a.* of fig. 18.
- » 20. Ditto along C—D.
- » 21. Ditto along E—F, the smaller, black ring being the narrow siphonal duct of the Nautiloid in transverse section.
- » 22. Longitudinal section of a specimen from Sandarfve kulle with four regular septa above the sigmoid ones.
- » 22 a. The same magnified ten times.
- » 22 b. Dorsal portions of the uppermost septa of the same.
- » 23. Specimen from Sandarfve kulle with fragment of the Nautiloid in situ.
- » 24. Longitudinal section of the same and the same magnified *a.* The siphuncle of the

Nautiloid is seen to continue in the siphuncle of the Ascoceras, in which only a single sigmoid septum has been formed.

- Fig. 25. Part of the same specimen from the ventral side showing the different strata of which the shell and the septa are composed.
- » 26. Another specimen of Ascoceras and Nautiloid in union from Mannagårda in Lye and its ornamentation.
- » 27. Longitudinal section of the same.
- » 28. Transverse section of the Ascoceratidan portion.
- » 29. Ditto of the Nautiloid.
- » 30—34. Different fragments of the Nautiloid, 32—34 from Sandarfve and 30—31 from Ljugarn, sectioned and with ornamentation.

Ascoceras siphon n.

- » 35. Transverse section of the following.
- » 36. Nucleus from Linde klint with the sutures of the septa.
- » 37. Its neck with ornamentation.
- » 38. Another specimen, same loc., sutures somewhat deviating.
- » 39. Section of the same.
- » 40. Another specimen, *a.* apex sectioned.
- » 41—42. Two different specimens longitudinally sectioned, sp. 41 from Linde klint.
- » 43. Transverse section of fig. 42.

Glossoceras gracile var. *curta* BARR.

- » 44. Apex of a fragment and *a.* magnified.
- » 45. The same in transverse section.
- » 46. Fragment possibly belonging to this species.
- » 47. Complete specimen from Sandarfve kulle, lateral view with various details.
- » 48. Same specimen, ventral view.
- » 49. The aperture from above.
- » 50—52. Various specimens in longitudinal section and magnified.

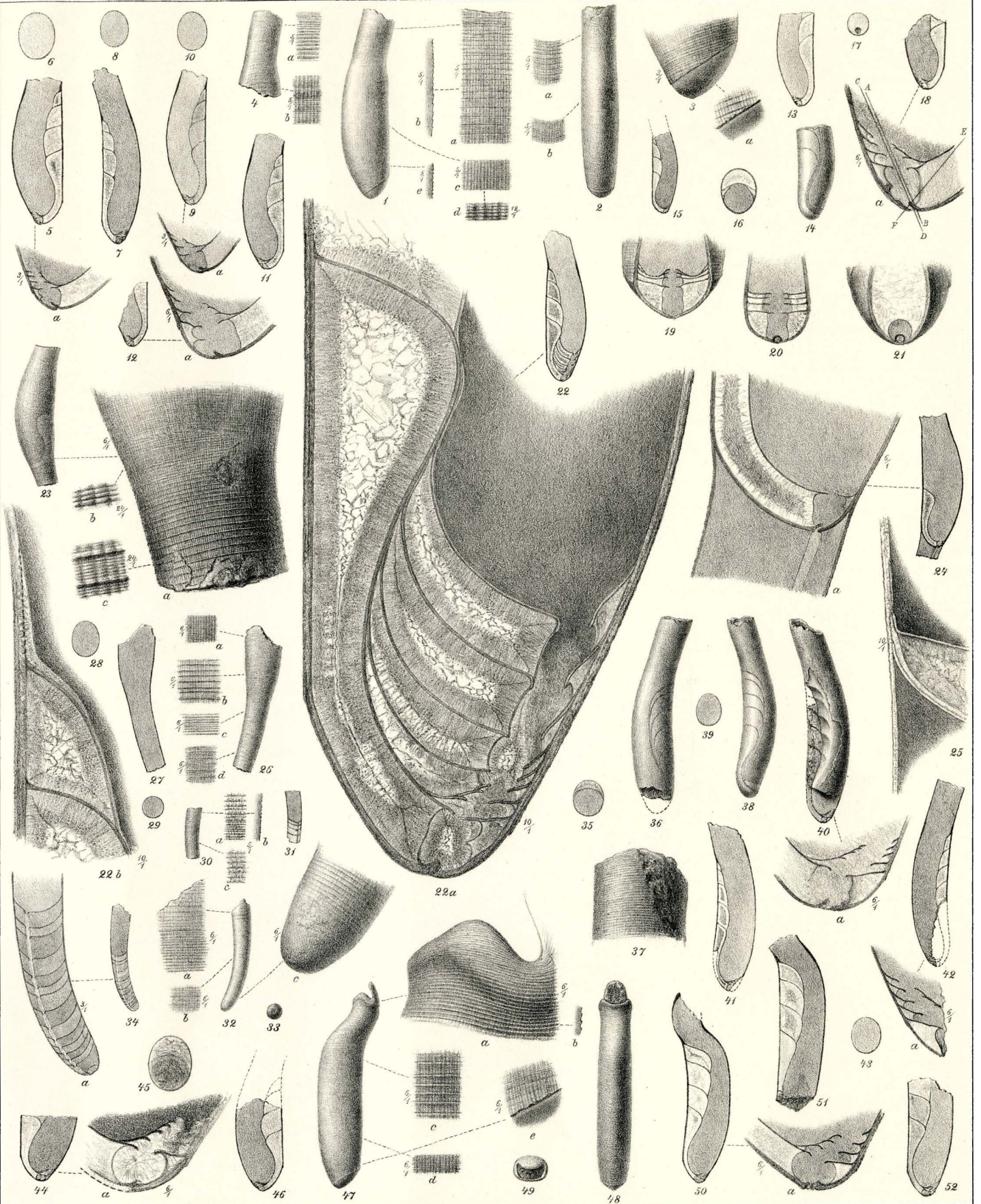


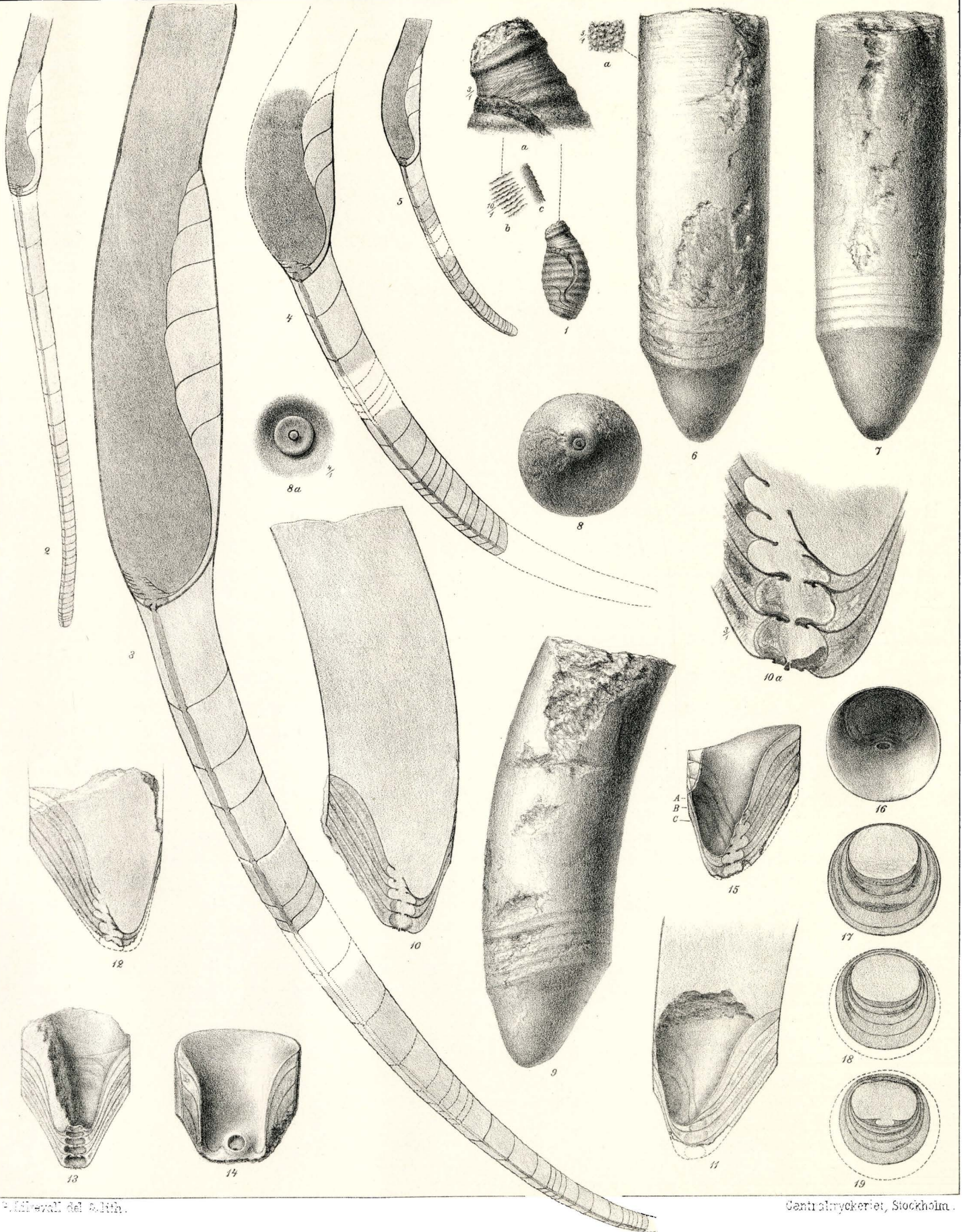
PLATE VI.

PLATE VI.

- Fig. 1. **Ascoceras cochleatum** n. from Wisby.
 » 2. **Ascoceras fistula** n. Schematized, represented as complete.
 » 3. **Ascoceras manubrium** n. Ditto.
 » 4. **Ascoceras lagena**. Ditto.
 » 5. **Ascoceras decipiens**. Ditto. In all these figures the shaded parts signify such portions as have been really found, pointed ones as they are supposed to have been.

Choanoceras mutabile n.

- » 6—7. Shell, natural size from the convex (6) side and the concave (7). Fig. 6 a. part of the surface of the interior stratum magnified. From Samsugn in Othem.
 » 8. Apex of the same seen from below.
 » 8 a. The same magnified to show the shape of the button-like funnel of the septum and the little plug which closes the siphuncle.
 » 9. The shell, natural size, lateral view.
 » 10. Longitudinal section of this specimen.
 » 10 a. The siphuncle of the section in fig. 10, magnified.
 » 11. The inferior part of the body chamber hollowed out to show the sutures of the incomplete septa on the inside.
 » 12. Longitudinal section of another specimen from Klints in Othem.
 » 13. Longitudinal section facing the side where the septa are lacunose.
 » 14. Likewise, facing the side where the septa are complete.
 » 15. Longitudinal section from the concave to the convex side, and showing the hollow interior shell with outlines of the incomplete septa.
 » 16. Bottom seen from above, showing the siphuncle and the outlines of the incomplete septa.
 » 17—19. Transverse sections of the specimen fig. 15, 17 corresponding with A., 18 with B., 19 with C.



P L A T E VII.

P L A T E VII.

Choanoceras mutabile n.

- Fig. 1. Specimen from Samsugn with seven septa, of which five are incomplete.
- » 2. Same specimen from the side of the lacunose septa, a little sectioned to show that the septa join each other as in Ascoceras.
- » 3. A specimen showing transition from the initial stages to the later with one incomplete septum.
- » 4. Younger specimen from Samsugn without lacunose septa and with more cylindrical siphuncle elements.
- » 5. Surface ornamentation of the same.
- » 6—8. Fragments with cylindrical elements of the siphuncle.
- » 9. Smallest specimen from the shore of Boge, with four septa and cylindrical elements of the siphuncle.
- » 10. Ornamentation of its surface.
- » 11. Another small specimen with only three septa.
- » 12. Specimen from Föllingbo with nummuloid elements of the siphuncle and no lacunose septa.
- » 13. *a*. The exterior shell, *b*. The inferior side of the septum. At \times small pits. This figure is magnified from the septum marked \times in fig. 16 and likewise in fig. 12.
- » 14. Part of the shell (*a*) to show the interior impressions of its wall (*b*) and the pits on the upper edge on the inside of the septum (*c*).
- » 15. A section to elucidate the position of the just mentioned impressions: *b*. inside of the shell, *c*. inside of the septum.
- » 16. Longitudinal section of a shell, showing the relative position of the septa and the wall; \times . the point where the pits, figured in fig. 13, are situated.
- » 17. Fragment showing how the truncation takes place or how an inferior part of the shell is broken away from the rest.
- » 18. An unknown Cephalopodous shell from the limestone of Slite with funnelshaped septa; *a*. the two uppermost septa magnified.
- » 19. The same two septa sectioned to show the prolonged funnel.
- » 20. A schematic representation of these septa.
- » 21. **Ophidioceras reticulatum** ANG. from Öthem, Samsugn; *a*. part of it to show ornamentation, *b*. ornamentation of largest

- whorl still more magnified.
- Fig. 22. **Ophidioceras reticulatum** ANG. The ventral keel of the same.
- » 23. » » Section of a specimen, same loc.
- » 24. » » Innermost whorls of same section.
- » 25. » » Transverse section, showing the position of the siphuncle.
- » 26. » » Another specimen, same loc.
- » 27. » » Transverse section of all whorls.
- » 28. » » Details of ornamentation.
- » 29. » » A third specimen from Samsugn.
- » 30. » » Transverse section.
- » 31. » » Section of specimen with narrower whorls from Fårö; *a—b* details of siphuncle and septa.
- » 32. » » Ventral keel of specimen from Föllingbo.
- » 33. » » Transverse section of largest whorl to show the form of the keel. Föllingbo.
- » 34. **Ophidioceras rota** n. Largest specimen from Sandarfve kulle.
- » 34 *a—c*. » » Details of its ornamentation.
- » 35. » » Ventral keel.
- » 36. » » Transverse section of specimen. fr. Linde kliut.
- » 37. » » Longitudinal section of specimen. fr. same loc.
- » 38. **Ophidioceras reticulatum** ANG. Nucleus of specimen from Grogarn with impressions of the inside of the shell; *a*. magnified, *b*. seen edgewise.
- » 39. » » Transverse section of the whorl.
- » 40. » » Keel of the nucleus, the striæ being nearly horizontal.

