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ON

# THE SILURIAN GASTROPODA AND PTEROPODA

OF

## GOTLAND

BY

*ustaf*  
G. LINDSTRÖM.  
" "

WITH TWENTY ONE PLATES.

COMMUNICATED TO THE R. SWEDISH ACADEMY OF SCIENCES JUNE 8<sup>th</sup> 1881 AND APRIL 9<sup>th</sup> 1884.

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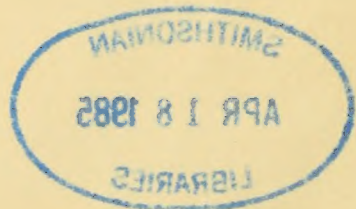
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On the Silurian Gastropoda and  
Pteropoda of Gotland

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☐ Moll.





## INTRODUCTORY REMARKS.

If, in general, it is a hazardous undertaking to describe palæozoic fossils, which, as a rule, have only a few recent congeners, with which to be compared, it is the more so in regard to the fossil Gastropoda. Every zoologist is no doubt fully aware of the great difficulties, that surround his investigations, whenever he endeavours to make out the affinities and systematic place of fossil Gastropoda in general, and especially so of those of the palæozoic era. There is indeed not much in the often distorted shells to guide him. The microscopic structure — if there ever has been anything characteristic in it, which so seldom is the case even in the recent ones — is almost invariably destroyed or changed into a homogenous crystalline, calcareous spar, nor are there usually any traces left of the muscular impressions, which are peculiar to some few families. Moreover, what the naturalist in his study of the fossil shells has to grapple with, is the same as if he had to describe recent shells only from bleached and worn specimens cast ashore along the borders of the sea. There is indeed often evidence that several of the Silurian fossils of Gotland and consequently also the shells, had been rolled and tossed about in the sea before being embedded in the strata, which, according to all appearance, are nothing but beaches or deposits in shallow water. Moreover, when once fossilized they have of necessity shared in the vicissitudes, which afterwards befell the rock through metamorphic agencies, being changed as to structure, often deformed through pressure as to their exterior shape, worn and eroded, and consequently deprived of the fine ornamentation of the surface.

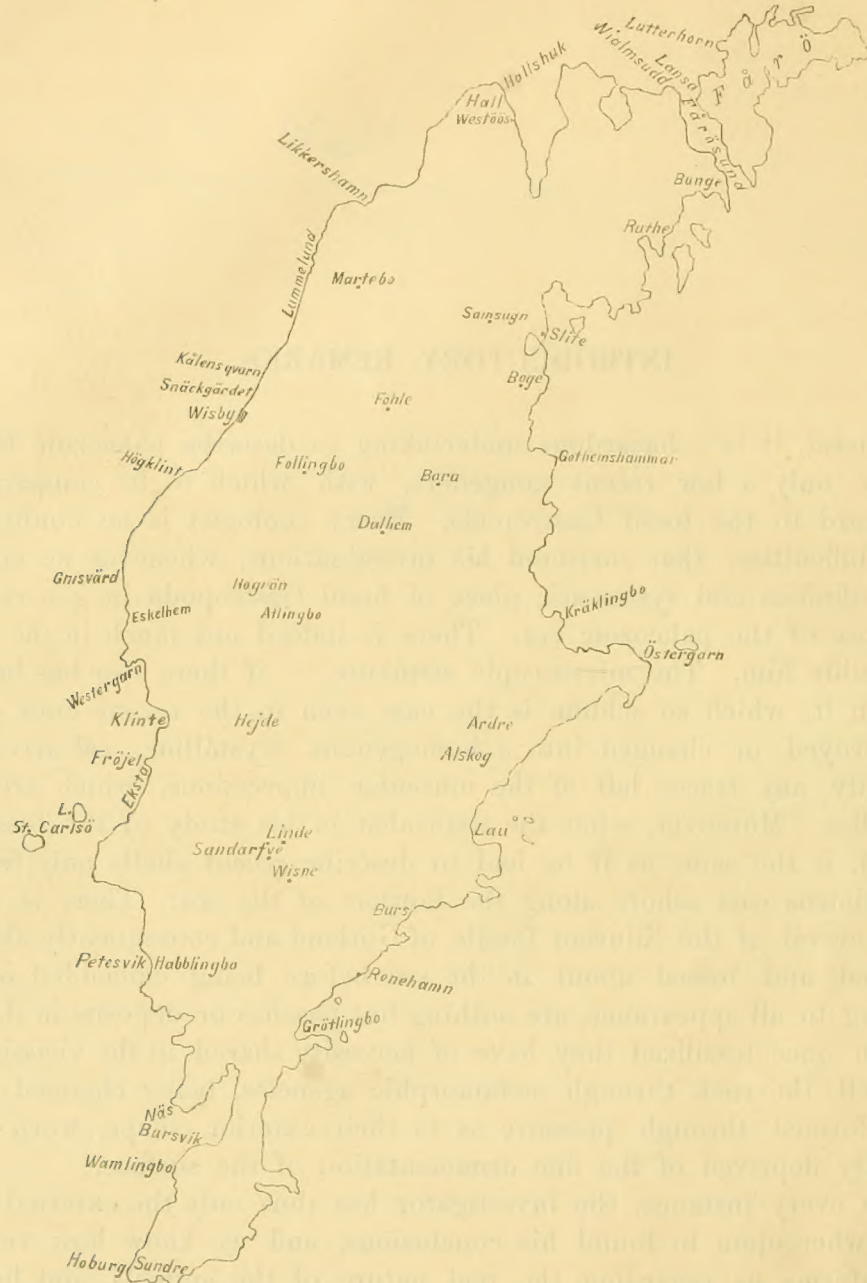
In almost every instance, the investigator has thus only the external shape of the shell, as it is, whereupon to found his conclusions, and we know how very little the empty shell informs us regarding the real nature of the animals, and how delusive, even amongst recent forms, the exterior shape can be. It may here suffice to cite an instance lately brought forward by J. CARRIÈRE.

In a paper on »*Marginella glabella* L. und die Pseudomarginellen»<sup>1)</sup> he relates his observations on two species of Gastropoda belonging, according to the structure of

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<sup>1)</sup> »Zeitschrift für wissenschaftliche Zoologie Bd 37, 1882, p. 99.

the mollusca themselves not only to different genera, but even to different families. They had assumed, as it were, exactly the same sort of investment or shell as the true *Marginella glabella*, only differing in trifling and easily overlooked details, so as to



Sketch Map of Gotland showing the principal localities.

have been considered till now as of the same species as the last mentioned. What in reality are three different species, not even appertaining to the same genus, nor to the same family, had thus been regarded as one and the same species, until the anatomical structure of the animals revealed their fundamental dissimilarity.

In spite of the certainty of many unavoidable failings and shortcomings, which as pointed out above, follow from the nature and conditions of the material, I ventured to take up this study when it was found how unexpectedly rich and varied were the forms entombed in the Silurian strata of Gotland, and thanks to the munificence of the Royal Swedish Academy of Sciences it has now been brought to its conclusion. Though fragmentary in many respects this memoir may serve in some degree as a starting point for future labours in the same field.

### Silurian strata of Gotland.

Before entering any further into the minor details of the composition of the Gastropodan Fauna, it may be proper to survey the physical conditions, in which the shells are found, as the strata, rocks and localities and also to inquire into their general faunistic characters. Through the classical researches of HISINGER the general features of the geological constitution of Gotland were very well known; but it was not until the visit of Sir RODERICK MURCHISON to the island in 1845 that the position of its strata was interpreted according to the researches, which were then carried on in other parts of Europe and especially in England by MURCHISON himself. After a stay of a few days, chiefly on the west coast of the island, he proclaimed the strata as Upper Silurian and arrived at the conclusion that they were to be subdivided into three groups, corresponding to the English Wenlock, Aymestry and Upper Ludlow, and that in fact the southernmost point with its substratum of sandstone was the youngest division, in direct opposition to HISINGER, who considered the sandstone as the oldest of the whole of the strata and underlying them all, though hidden from view north of Bursvik. The conclusions of MURCHISON were adopted by FRIEDRICH SCHMIDT, who followed up his researches and gave a more complete description. He also divided the island in three groups: Northwest Gotland or the Wisby Zone, Central Gotland and South Gotland, subdividing the second or Central Gotland in two beds, that of *Pentamerus esthonus* and *Pent. conchidium*, a division which cannot be upheld as *Pent. conchidium* occurs beneath *P. esthonus* as well as above it and moreover is restricted to very narrow limits within the large zone he has assigned to it. He assumed the strike of the strata to be N. E. and S. W. and their dip consequently from N. W. to S. E. His three groups form oblique belts across Gotland. He, as well as MURCHISON, had only palæontological evidence to adduce in favour of his opinion. MURCHISON'S, and consequently also SCHMIDT'S views have been contested, amongst others by FERD. ROEMER and HELMERSEN, and it is highly probable that their mode of viewing the stratification of Gotland is more consistent with the real state of the facts than that of the former geologists. As ROEMER and HELMERSEN have already demonstrated, there are neither stratigraphical nor palæontological evidences to support the views of MURCHISON and SCHMIDT. If, as the latter authors hold it, the shale along the west coast of Gotland belongs to at least two divisions, namely the beds around Wisby to the Wenlock shale and those south of Klintehamn to the Lower Ludlow, the superposition of these strata above each other must of necessity be seen somewhere. But as to the shale beds of Wisby they can be

followed without interruption all along the coast from Hallshuk, in the north, to Gnisvärd, south of Wisby or for a length of nearly 6 Swedish or 36 English miles. At Gnisvärd, where the fossils are already, with regard to several species, identical with those found plentifully at Westergarn, the strata are obscured for about an English mile and a half by accumulations of sand and then again the same shale beds reappear horizontal as before and continue with a few breaks to the vicinity of Klinte. It is highly improbable that there should be any traces of superposition of the strata of Westergarn and Klinte above those of Wisby on the narrow belt covered by the drift. The shale beds of Westergarn which have so much in common with those of Wisby are combined with the shales of Eksta and Habblingbo through the shale beds of Stora Carlsö. As I have shown in a former paper<sup>1)</sup> the beds of Westergarn and Stora Carlsö are absolutely identical, having not only a great percentage of species in common, but these species are also of exactly the same varietal habitus. Further, there is no doubt that the shale of Stora Carlsö is in direct continuation with the shale of the nearest, opposite shore of Eksta and that this again is combined with the shale of Habblingbo. We have thus a continuation of shale beds along the coast for a length of nine and a half Swedish miles or 57 English ones. But these beds spread also, as can easily be seen in numerous sections, far inland under the limestone beds. The shale of Petesvik in Habblingbo can be traced from the shore upwards for a Swedish mile, to the saw mill of Alfva, having there reached a height of 80 feet. Quite the same sort of shale is again met with in Fardhem, where there are sections in several places and the shale retains nearly the same palaeontological character as at Habblingbo. The same form of *Rhizophyllum Gotlandicum* has been found in both localities. But in Fardhem the shale begins to contain particles of mica and quartz in greater abundance than elsewhere and in fact partially to change into something intermediate between shale and sandstone, and this gradual transition can be followed, as it were, step by step along the road leading from Fardhem to Rone where the lowest stratum is found to have been completely changed into sandstone. This predominates along the shore towards the north for nearly three Engl. miles, now and then changing into patches of shaly limestone and at last passing into shale, as I remarked as long since as 1857<sup>2)</sup>. South of Rone, again, it is connected with the sandstone beds of the southernmost Gotland. The sandstone beds there and the shale beds of the north of Gotland thus belong to quite the same geological horizon and gradually pass into each other. But, as now the shales of Central Gotland lie under the hills of Klinte, Sandarfve and all other limestone beds there, the limestone hills of Hoburg must be considered as detached outliers of that central limestone plateau, with which they have in common many characteristic fossils, though separated from it by a wide region, where the uppermost beds have disappeared through denudation. A distance of nearly four Swedish miles intervenes between the northernmost hill of Hoburg and the nearest point northwards near Burs church, where the limestone is again found. Between the lowest stratum of shale and sandstone and the uppermost limestone, commonly called crinoidal limestone,

<sup>1)</sup> »Anteckningar om silurlagren på Carlsöarne» i Öfvers. Vet. Akad. Förhandl. 1882, nr 3, p. 5.

<sup>2)</sup> Öfversigt Vet. Akad. Förhandl. 1857, p. 33. »Till Gotlands Geologi».

strata of thinbedded limestone and shale are interposed, north of Grötlingbo and Rone, and they pass gradually upwards into the more uniform, hard crinoidal limestone. In the South of Gotland again, wherever the sandstone prevails, the intermediate stratum is oolite.

According to what has now been adduced, we have, from their petrographic character, three strata viz.

1. The oldest shale or sandstone stratum, in the following signed *a*.

2. The laminar limestone, intermingled with shale in the north, beds of oolite or pisolite in the south, signed *b*.

3. The highest limestone; covering all the other strata, signed *c*.

Along the east coast of Gotland this succession of the strata is somewhat obscured through frequent dips and contortions of the beds. In how far these three different strata can be well distinguished by their faunas, is at present, when so few groups have been monographically worked out, too early to decide and cannot be finally settled until the rich Silurian Fauna of that island will have been described through all its classes.

Regarding the chief characteristics of the different strata the following remarks may serve.

Stratum *a*. The thickness above the sea is extremely variable, owing to the many curvatures and domeshaped folds into which it has been thrown. Near Halls huk the shale is 50 feet thick, in Fardhem at Burge again it is found at 70 feet above the sea level and at Alfva saw mill even at 80 feet. But it is probable that its total thickness is still larger, as shale beds are met with in Follingbo at a height of more than 100 feet. The bottom of the harbour of Wisby at a depth of 20 feet, has been found to consist of shale, and consequently this rock attains there at least that amount of thickness below the level of the sea. Owing to the curvatures in this stratum it is, however, very questionable whether these 20 feet are to be added to the amount found in Follingbo. The sandstone south of Bursvik is not by far so thick, only 20 feet at the most. But the mass hidden in the sea is probably far thicker, as, owing to the southeastern inclination of the strata, only so little is visible. Fossils are found cast ashore on Norderstrand near Wisby, enclosed in a soft, red marly limestone. They are partially of the same species as in the gray shale but also of characteristic forms. There is a low depressed variety of *Goniophyllum pyramidale*, *Phacops elliptifrons*, a small *Camerella*, but also *Arachnophyllum typus* which never occurs in any higher stratum. This red marl is in all probability the basis of the oldest and lowest shale beds of Gotland and to be found *in situ* deeper in the sea, from where fragments are thrown up. Hitherto the oldest shale beds have only been found north of Wisby. Through the presence of *Stricklandinia lirata*, *Euomphalus Gotlandicus*, *Pleurotomaria qualteriata* var. and a species of *Harpes*, only found there, they announce their age as Upper Llandovery. *Stricklandinia* does not occur higher up in the shale beds. The beds above its zone, as well as the sandstone in the south, may be regarded as of Wenlock age. Sections of this stratum are also seen in several places on the east coast of Gotland as at Slite, Östergarn, though mixed up there with bands of hard crystalline limestone.

Fossils have been found in the shale and sandstone beds, which long had been regarded as distinguishing the Upper Ludlow rocks. Such are *Phacops Downingia*, *Homalonotus* etc. But this must not detain us any longer, as also in England, according to the last editions of *Siluria*, the Ludlow beds have very few species, which are not also found in older strata. *Homalonotus* and *Chonetes striatella*, once supposed to be so characteristic and exclusive, are now also found in the lowest Wenlock beds, both in England and Gotland. It cannot, however, be denied, that there are many circumscribed faunistic areas, as for instance in the shale along the west coast from Westergarn to Petesvik, including Stora Carlsö. Within this region there can be discerned at least four different facies in the distribution of the fossils, of which I have given detailed lists in the paper above cited<sup>1)</sup>. Although there cannot be the slightest doubt that the shale beds of all these localities, as stated, lie on the same level and are coëval, the strange fact is obvious that the beds of Stora Carlsö have a fauna identical with the shale of Westergarn, which is a Swedish mile and a half distant. The fauna of Eksta at Djupvik is distinct with regard to its composition as well as its features in the common species, from both Westergarn and Petesvik in Habblingbo, but farther inland, at Fardhem, species from both Habblingbo and Eksta meet in the same bed. So again the fauna of Westergarn is distinct from that of Wisby, though both have species in common not met with anywhere else, as *Leperditia Hisingeri*, *Lindströmia Dalmani*, *Oriostoma Roemeri* and others. But, upon the whole, strange as such differences in nearly situated localities may seem, when they cannot be accounted for through changes due to time, they may, nevertheless, find their counterparts in other strata, as well as in the sea as it now is, where differences in depth or in the mineralogical nature of the bottom, cause contiguous regions of the littoral belt to differ in their faunas.

Stratum *b*. In northern and central Gotland a stratum of thin limestone flags interstratified with seams of coarse marly shale succeeds the stratum *a*. It attains a thickness of 70 feet, though at many points much less. Above the sandstone in the south of Gotland this rock is changed into coarse pisolite or oolite with a thickness at the highest of 20 feet. The change from limestone to oolite can be traced almost as gradually as that from shale to sandstone. The banded limestone reappears above the oolite in the section of Hoburg.

The stratum *c*, commonly called crinoidal limestone, covers almost the whole of the northern and central part of Gotland and, being denuded away over a large tract, between Burs and Sundre, it forms again the numerous hills around Hoburg. Its thickness amounts to at least 150 feet, measured from the steep cliffs of Lilla Carlsö, but owing to denudation it is seldom so considerable. The total amount of the Gotland strata then ought to be about 340 feet. Now the highest point determined lies 261 feet above the sea, according to STEINMETZ, near Rosendal in Follingbo, and there are thus nearly 80 feet unrepresented at that point.

As may well be imagined, this uppermost stratum is highly variable as to its structure and organic remains. In some parts it well deserves its name of crinoidal lime-

<sup>1)</sup> Silurlagren på Carlsöarne pag. 17.

stone in consequence of its richness in remains of Crinoidea, chiefly their stems and joints of stems. But in addition to this, there are also other beds of limestone, which from analogous reason have been denominated corallian limestone. This, however, is only partially true. With equal reason large portions of the limestone might be called Orthocerata limestone or Bivalve limestone or Trimerella limestone or even Gastropodan limestone, being then nothing else than a breccia of these shells. It is indeed singular that the remains of one group of animals should predominate over all others in several beds. So for instance the fine grained limestone of Föllingbo near Wisby consists largely of shells of Cephalopoda and the same is the case with the rich quarries of Samsugn, where Cephalopoda, somewhat mixed up with Gastropoda occur in enormous quantities. In other localities again shells of the Lamellibranchiates are the chief components of the rock. The largest of all Silurian bivalves in Gotland, *Megalomus gotlandicus* forms in thousands of specimens extensive banks, that stretch from the shores of Fårösund in the north across the island to the immediate vicinity of Wisby and also along the east coast at Östergarn and along the shores south of that parish. The oolitic strata near Bursvik contain almost only shells of Lamellibranchiates in great numbers of species and specimens and a similar deposit of the same richness of identical forms occurs further towards the north at Gothems hammar. At Bursvik and southwards to Hoburg there lies along the coast a bank, half a foot thick, of *Pterinea retroflexa* and besides several smaller.

Then there are localities where the chief mass consists of Brachiopoda, especially of the genera *Pentamerus* and *Trimerella*, the former within more circumscribed limits, the latter as a true rockbuilder across the island in a belt from north east to south west. The occurrence of the Gastropoda is given below. At first I shall only enumerate the different localities, where they have been found, with some few remarks concerning the geology and palæontology of their strata.

#### Localities in the stratum a.

*Wisby.* Shale beds north of that town and along the shore to Halls huk and round that cliff a small distance south in the bay of Kapellshamn, where they disappear beneath the sea.

*Gnisvärd,* a place south of Wisby to which the shale continues, rich in Brachiopoda, partly common with Westergarn and partly with Wisby. A few Gastropoda common with Wisby.

*Westergarn.* Low shale beds, uncovered along the shore line, rich in fossils, finely preserved. *Pleurotomaria labrosa* and *bicincta* are often found here.

*Stora Carlsö.* The shale beds are well exposed along the east and west coast, chiefly rich in Corals and Brachiopoda.

*Djupvik in Fröjel and Eksta.* There is a long stretch of the coast comprised under this denomination from the northern shore of Skäret in Fröjel to the shore south of Djupvik, being of almost the same soft, blue shale filled with a large number of fossils

of all orders. It is interrupted by the peculiar »calcareous shale» (kalkstensskiffer HISINGER) which, intermingled with sandy slates, occupies the shore around Skäret and contains a great number of curious tracks, besides fossils of a fauna distinct from that of the neighbouring shores.

*Habblingbo.* Along the flat shore of Petesvik a hard, blue shale, containing more limestone than those in north, is spread out, filled with Brachiopoda and also other shells. The highest point of this shale is further inland about one Swedish mile, 80 feet above the sea.

*Fardhem.* A section of micaceous shale is seen near a saw mill at Burge with fossils partly characteristic of Djupvik and partly of Habblingbo. Amongst the latter may be remarked the interesting Rhizophyllum Gotlandicum. In the same parish of Fardhem there is an extensive canal cut through a moorland, Wisne myr, lying open a fine section of the shale for nearly half a Swedish mile. The fossils it contains are very interesting, as species here meet with each other which were long considered as exclusively characteristic of widely remote localities and thus give additional support to the supposition that all shale beds are coherent and of the same age. Such are Phacops Downingia, also from the sandstone and oolite of S. Gotland and from the limestone bed b of Wisby, Tremanotus longitudinalis also from Wisby a, and the sandstone of Bursvik, Orthis canaliculata formerly from the eastern strata of Gotland, Burs etc., Strophom. funiculata, the same variety as in Habblingbo, not Eksta, Chonetes striatella, Pisocrinus ollula found in the shale of Petesvik, Pleurotomaria planorbis His. which is so abundant at Östergarn, the initial colony of Labechia or a kindred coral quite the same as that found on the same level at Slite.

*Bursvik and Hoburg.* The sandstone with thin seams of shale or clay, as described by HISINGER. The fossils are scarce, mostly of the same species as in the oolite above. The few Gastropoda found are well preserved with their shell.

*Rone.* Sandstone and shale along the shore.

*Östergarn.* Shale beds, on compact limestone, with Chonetes striatella and Atrypa didyma.

*Slite.* The lowest shale beds along the shore.

*Hallshuk.* The lowest beds there and for a while to the south along the west shores of Kapellshamn.

#### Stratum b.

*Wisby.* The limestone with interstratified shale in the neighbourhood of the town, well developed at Snäckgärdet, Skälsö, Wibble qvarn, Högklint and some localities along the coast northwards to Lickershamn, where also many fossils have been found.

*Westergarn.* On the fields farther inland, above the shale, scattered fragments of this stratum can be found.

*Lansa on Fårö.* Limestone and shale beds along the shore.

*Slite.* The median beds in the sections near the coast.

*Boge.* South of Slite in ditches along the road and in the cliffs near Klinte.

*Ruthe.* A canal leading from Stor myr is cut through strata of this group.



*Gothemhammar.* Beds of fine grained, nearly oolitic limestone with an abundance of shells of Lamellibranchiates, the same as found in the oolite of Bursvik. Fine specimens of the large Murchisoniæ have also been found here.

*Dalhem.* Along the brook near Nya Slitegårds a good section is laid open, rich especially in Brachiopods.

*Kräklingbo.* Marly limestone near the shore with the same fossils as at *Östergarn*, where the limestone *b* is nodular, compact and gray.

*Stora and Lilla Carlsö*, where the strata are filled with corals in regular bands, each species apart from the others.

*Lau.* A declivity east of the church consists of beds of marl and limestone and is very rich in finely preserved fossils.

*Grötlingbo, Näs and Bursvik.* Beds of oolite and pisolite of variable thickness. Fossils much eroded and worn, the Lamellibranchiates extremely abundant and well preserved.

*Hoburg.* Above the sandstone oolite is resting, at first sandy, and afterwards more compact and not so rich in grains of oolite as further north. Limestone beds follow above this with seams of shale, containing *Crotalocrinus*, *Labechia*, *Pentamerus galeatus*, *Orthis rustica*, *Strophomena euglypha*, *St. filosa*, *Orthis hybrida*, *Rhynch. deflexa*, *Meristella tumida*. Two peculiar forms of Gastropoda have been found here.

### Stratum c.

*Lutterhorn on Fårö.* Low cliffs of crystalline, grayish limestone with *Oriostomata* and *Tryblidia*.

*Wialmsudd* on the northwestern shore of Fårösund, hard crystalline limestone replete with Cephalopoda, Gastropoda and Trimerellæ. Near to it, farther inland, is a place *Sändvik* with the same fossils.

*Slite.* The uppermost limestone beds are rich in fine shells, especially in seams or vertical fissures filled with marl. Partly a breccia of small, comminuted shells.

*Samsugn.* In the extensive quarries of the limestone a great number of Cephalopoda, Gastropoda and Lamellibranchiata are found.

*Hall.* A canal near the farm of Westös has been cut through bluish, nodular limestone, rich in finely preserved fossils, especially *Oriostomata*.

*Halls huk, Bara, Ardre and Östergarn, Klinte, Wisby*, the top of *Carlsö*, are all localities nearly resembling each other lithologically, though their fossil contents differ.

*Follingbo, Storwede.* The limestone which is extensively quarried, varies very much within short distances, being in some places coarsely crystalline with many remains of crinoids, in others again of the finest texture resembling lithographic stone. The last mentioned variety consists mostly of fragments of Cephalopoda, with some few Gastropoda interspersed.

*Wisby* (Kyrkberget, Kålensqvarn). A gray, soft limestone, especially rich and replete with remains of Gastropoda.

*Martebo* a peculiar, yellowish soft limestone near Myre, rich in Oriostomata and their opercula.

*Fardhem and Linde.* Some isolated hills as Sandarfve and Linde kullar, partially consisting of crystalline, crinoidal limestone, partially a conglomerate of larger or smaller pieces of corals and Stromatopora and partly fine, earthy, red and gray limestone beds. The last are remarkably rich in shells of Cephalopoda and Gastropoda.

#### State of preservation.

The state of preservation of the Gastropoda as well as that of other fossils in these different rocks, is of course quite as variable as the nature of the rocks themselves and seems at first in several places quite unaccountable. So, for instance, the shells of the Gastropoda and Lamellibranchiata are in many shale beds, as a rule, dissolved and present only as nuclei, while corals, trilobites and brachiopoda are well preserved. Thus in one locality the shells are only represented as nuclei, as for instance at Petesvik in Habblingbo, and again in a neighbouring locality, Djupvik in Eksta, they are well preserved, with their shells. It may also be that many genera of Gastropoda, as in the shale of Wisby, only occur as casts or nuclei, such as Subulites, Loxonema, Murchisonia, Euomphalus, Bellerophon and Tremanotus, whilst in the same bed others as Oriostoma, Pleurotomaria and Platyceras have retained their shell. In all probability there is something in the condition of the chemical or mineralogical nature of the shell which thus causes it to be dissolved in one group and preserved in the other. In the upper limestone beds again by far the greatest number of the species are provided with their shell and all the delicate ornaments of its surface are visible.

But the difficulty is to get them out entire and perfectly intact from the rock. In such rich localities as Samsugn, Kyrkberget in Wisby many specimens can be collected as they have been detached through the disintegration of the rock, which is often crumbling to pieces on the surface. From the limestone of Sandarfve hill they can be removed by carefully using the hammer and chisel. By delicate operations with sharp needles they have been prepared out from almost all sorts of limestone and been cleaned in greater perfection than could be expected at first sight. In washing the fine, marly limestone mud, which is often found in fissures and has probably originated through the decomposition of the limestone, many small Gastropoda, such as the Murchisoniæ figured on plate XV have been obtained along with a number of other interesting fossils.

The few Gastropoda which have been found in the sandstone are remarkably well preserved, showing the fine sculpture of their surface.

In the majority of specimens the shell is entirely converted into calcareous spar, but in a few others there are remains of the microscopic structure left. So for instance in the genus Platyceras, in the common *Platyceras cornutum*, where at least three different striae can be discerned. The Patellid *Tryblidium* has also the intimate structure, to a certain extent, well preserved and also, on the inner side, the peculiar horseshoe-shaped ring of muscular scars beautifully and most distinctly visible. In

this genus, as well as in *Cyrtolites*, *Bellerophon* and *Oriostoma* some specimens still show the pattern of the original colour bands. Traces of the nacreous lustre are also present on the inside of several species of the genera *Oriostoma* and *Pleurotomaria*. A number of specimens of the genus *Oriostoma* has been found with their large, calcareous operculum in situ, thus permitting to distinguish several, nearly allied species, the shells of which show very little difference. With regard to the position of the shells in the strata it may only be remarked that such elongated shells, as *Murchisonia*, *Loxonema* and *Subulites* lie horizontally or parallel with the plan of stratification. As for the rest they are heaped together without any order as the shells at the present day cast ashore.

The *Murchisoniæ* found in the shale beds of Wisby, and also many *Bellerophons*, had been almost entirely overgrown by colonies of the bryozoan *Ceramopora* and others, many times larger than the shells themselves and thus evidently preventing all possibility for the animal to move and consequently killing it. In a small lake south of Stockholm, Hammarbysjö, I found in the spring 1882 the common freshwater bryozoan *Aleyonella fungosa* PALLAS in great abundance and nearly every colony of it had chosen a specimen of *Paludina vivipara* L. for its basis and so completely covered it that the animal was unable to move, and large numbers of them were dead, the bryozoans continuing to thrive. Thus a powerful growth of a compound species has acted and still acts as a check to the increase of another species belonging to a different group and has probably also been an agent in its extinction on localities common to them both.

#### Distribution of the Species.

There is no doubt that the *Gastropoda* I am about to describe, numerous though they be, are only a fragment of all that once made up the fauna of these animals in the Silurian seas of Gotland. Several strata literally teem with their broken shells and it is evident by several of these remains that they belonged to many other species than those mentioned further on, but too imperfect for description. As far as known at present the number of species and varieties amounts to 174 here described and figured. The numeric strength of their group in relation to that of other orders from the strata of Gotland may be seen from the following survey of the whole *Lethæa*.

List showing the number of species at present known from the  
Silurian Strata of Gotland.

<i>Crustacea</i>	<i>Trilobite</i> .....	53	
	<i>Merostomata</i> .....	2	
	<i>Phyllopoda</i> .....	4	
	<i>Ostracoda</i> .....	30	
	<i>Cirrhipedia</i> .....	1	90
<i>Annelida</i>	according to the researches of Dr J. G. HINDE with addition of the Tubicolar An- nelides .....	50	

Carried forward 140

	Brought forward 140.	
<i>Mollusca</i>		
Cephalopoda about.....	100	
Pteropoda .....	5	
Gastropoda .....	174	
Lamellibranchiata about.....	80	359
<i>Molluscoïda</i>		
Bryozoa about.....	50	
Brachiopoda .....	150	200
<i>Echinodermata</i>		
Asteroïdea .....	2	
Echinoïdea .....	1	
Crinoïdea .....	180	183
<i>Anthozoa</i> about.....	100	
<i>Graptolitæ</i> .....	5	
<i>Spongiæ</i> .....	10	
Dubious organisms (Algæ probably) and others .....	5	
<i>Tentaculitæ</i> about.....	5	
	Total 1,007 species and varieties.	

It is to be observed that the number of species in some groups has been rated somewhat low and that in all probability a detailed research will considerably increase it. As it now stands we see that the Gastropoda vie in numerical strength with such large groups as the Crinoïdea and surpass all the others.

The minor details in the distribution, geographical and geological, of the Pteropoda and the Gastropoda may be learnt from the annexed lists<sup>1)</sup>, in which first the chief localities or local regions are given in 27 columns, and then in the six last columns a summing up of their stratigraphical distribution. Under the headings of the localities, *a* signifies the lowest stratum, shale or sandstone, *b* the intermediate limestone or the oolite, *c* the uppermost limestone. When a species is recorded as found only in *a* and *c* this has been considered equivalent to its having been found in *b* also or in all strata.

As to the names of the localities, it should be borne in mind, that some of them are intended for a small district around a central point. Thus *Hall* chiefly means the strata *c* in the canal near Westös, but also the strata near the shore and at Halls huk. *Wialmsudd* includes the adjacent shores of Färösund, as the strata of Sändvik, *Gothem* and *Bara* embrace chiefly the shore deposits at Gothemshammar and a number of quarries opened westwards in the direction of Bara, where a little hill, *Bara backe*, contains the same fossils. *Linde* and *Fardhem* comprises not only the limestone hills there, but also the marly and gritty shales.

The limestone beds of Samsugn in Othem, those of Wialmsudd and Wisby as well as others are very rich in shells of Gastropoda intermingled with those of Cephalopoda. But all these localities are by far surpassed by the limestone of Sandarfve kulle. This is one of the small hills, which in the central part of Gotland, a little

<sup>1)</sup> See page 16 and the following.

south east of Klinte have been formed through denudation and all prove, through the presence of such fossils as *Pentamerus conchidium* etc., that they are of the same age with each other and also coëval with Klinteberg. Sandarfve kulle, which is one of the smallest, attains a height of about 170 feet above the level of the sea. About 80 feet of its substratum consist of shale, similar to that of Petesvik in Habblingbo. The superimposed limestone, which forms the chief part of the hill, is in the lowest beds regularly stratified with a gray crystalline limestone, which passes upwards into a concretionar irregularly bedded limestone. This is partly bluish green, soft and earthy and partly in large patches red, giving the enclosed fossils with their colour a certain resemblance to the Lower Silurian fossils of the Orthoceratite limestone in the main land of Sweden. This rock contains in great abundance beautifully preserved shells of Gastropoda of numerous species and also rare Cephalopoda, such as *Ascoceras*, *Ophidioceras*, *Cyrtoceras*, numerous Orthoceratites, and also shells of the Lamellibranchiates, all not found elsewhere. The fauna has a peculiar dwarfed character, being composed chiefly of small shells, none attaining to what may be called the average size of those of the other localities. It forms, as it were, a narrowly circumscribed, local fauna, which has hitherto yielded no less than 39 species of Gastropoda, only from the the red and gray limestones. Of these as many as 27, or 69 percent of the whole amount, are peculiar to this stratum. This surpasses by far the conditions in all other localities. According to the list, »Wisby» is richer than any other with 77 species. But it must be remembered, first, that this denomination embraces a much larger space than the former region and includes such localities as Kyrkberget and Kålens qvarn, where the limestone is in fact a *lumachello*. Besides, there are many other localities for a considerable distance along the coast where the same palæontological characters prevail. Forty one species are annotated as pertaining to the stratum *c* of Wisby, but of these only the small number of ten is peculiar. The shale beds at Djupvik in Eksta contain a Gastropodan fauna of 25 species and of these nine are peculiar. Of the other richer localities Samsugn has a total of 34 species against six peculiar, Slite 25 species in all against four peculiar, Follingbo 20 species in all against six peculiar, Klinte 23 species in all against two peculiar and Östergarn 21 species with only one species peculiar from the stratum *b*.

What must strike the attention after the first glance on the list of distribution is the great preponderance in number of species of the North Gotland localities over the localities south of Fardhem, such as Rone, Grötlingbo, Bursvik, Näs and Hoburg. This may chiefly be due to real poverty as no such rich deposits as those of North Gotland ever have been discovered there, but it is evident that the total amount of species found, especially at Hoburg, will be increased in future through continued and oftener repeated researches. Characteristic of these southern parts are the following six species, having their northern limit at Grötlingbo. They are: *Platyceras disciforme*, *Cyrtolites obliquus*, *Pleurotomaria dolium*, *Murchisonia moniliformis*, *Eunema muricatum* and *Craspedostoma spinulosum*. As a contrast to this minority, no less than 95 species, or more than half the number, have their limits within North Gotland as far as Westergarn in south on the west coast and Gothem on the east coast. A few continue as

## Synoptical List of the distribution of the Silurian

	Fårö.		Hall.	Walmudd.	Lickershamn.	Samsugn in Ohern.	Slite.	Marlebo.	Wisby.	Follingbo.	Gothen and Bara.	Gustavd.
	Interhorn.	Lansta.										
<b>Pteropoda.</b>												
<i>Conularia</i> Sow.												
1 cancellata SANDB.....		b	a						b			a
2 monile n. ....									b			
3 levis n. ....		b							bc		c	
4 bilineata n. ....		b										
5 aspersa n. ....									bc			
		3	1						4		1	1
<b>Gastropoda.</b>												
Fam. I. <b>Chitonidæ</b> GUILDING.												
<i>Chelodes</i> DAVIDSON & KING.												
1 Bergmani DAV. & KING.....												
2 Gotlandicus n. ....									c			
Fam. II. <b>Patellidæ</b> D'ORB.												
<i>Tryblidium</i> LDM.												
3 reticulatum LDM. ....	c	c	c	c			c					
4 unguis LDM. ....	c	c	c		c			c	bc	c		
5 radiatum n. ....				c								
Fam. III. <b>Tecturidæ</b> ADAMS.												
<i>Palæacmea</i> HALL.												
6 solarium n. ....												
Fam. IV. <b>Calyptræidæ</b> BROD.												
<i>Platyceras</i> CONRAD.												
7 cornutum HIS.....	c	bc	abc	c	abc	c	abc	abc	abc	c	bc	a
8 var. loricatum n. ....											b	
9 spiratum SOW p. p. ....									a			
10 disciforme n. ....												
11 enorme n. ....							bc					
12 cyathinum n. ....										c		
Fam. V. <b>Bellerophontidæ</b> M'COY.												
<i>Bellerophon</i> . MONTFORT.												
13 sphaera n. ....								c	ab			
14 fasciatus n. ....									bc			
15 globulus n. ....												
16 tenia n. ....												
17 fastigiatus n. ....												
18 tubulosus n. ....									c			
Carried forward	3	3	3	3	2	1	3	3	7	3	2	1

Teropoda and Gastropoda of Gotland.

	Westergarn.	Kräklingbo.	Östergarn.	Klinte.	Ardre.	Lilla Carlse.	Djupvik in Eksta.	Stora Carlse.	Linde and Fardhem.	Lau.	Hablingbo.	Grollingbo.	Niss.	Bursvik.	Hoburg.	Stratigraphical distribution.					
																Only found in			Common to		
																a	b	c	all strata	ab	bc
							a											*			
										b							*			*	
							1			1						2			1	2	
				c								b		a				*		*	
																	*			*	
										c							*			*	
a	b	abc	abc	c	abc	a	abc	abc	b	a	b	b	ab	abc			*			*	
			c				c	c						a	*		*			*	
	b		c			a			b			b	ab			*	*			*	
											a						*			*	
						a									*		*			*	
	b	b		c		c		c							*		*			*	
						a									*		*			*	
1	3	2	5	2	1	5	2	4	2	2	3	2	3	2	3		5	5		5	

	Fårö.		Hall.	Walmudd.	Lickershamn.	Samsugn in Öhem.	Slite.	Maribo.	Wisby.	Follingbo.	Gothem and Hara.	Gnisvård.
	Luttenhorn.	Lansa.										
Brought forward	3	3	3	3	2	1	3	3	7	3	2	1
<i>Bellerophon.</i>												
19 squamosus n.	c	c		c					c			
20 Eiseni n.				c								
21 elegantulus n.									c			
22 latevittatus n.									a			
23 gemma n.									a			
24 pilula n.									a			
25 trilobatus Sow.									a			
<i>Cyrtolites</i> CONRAD.												
26 lamellifer n.					b				b			
27 pharetra n.												
28 arrosus n.								c				
29 obliquus n.												
30 euryomphalus n.												
31 discus n.									b			
32 orbiculus n.												
<i>Tremanotus</i> HALL.												
33 longitudinalis n.	c		ac	c			c	c	abc			
34 compressus n.												
Fam. VI. <i>Pleurotomariæ</i> D'ORB. p. p. <i>Pleurotomaria</i> DE FRANCE.												
35 scutulata n.						c			c	c		
36 gradata n.												
37 Linnarssoni n.												
38 voluta n.												
39 claustrata n.					b	c			bc	c		
40 glandiformis n.												
41 biformis n.									a			
42 latefasciata n.									b			
43 Hindei n.						c						
44 Holmi n.									b			
45 Wisbyensis n.						c			c			
46 Lloydii Sow.		b	b						ac			
47 dolium n.												
48 laqueata n.									bc			
49 tubulosa n.												
50 robusta n.												
51 var. levissima n.												
52 elliptica Hts.									a?			
53 bicincta HALL.		b				c	abc	c	b	c	b	
Carried forward	5	6	5	6	4	6	5	6	25	6	3	1





	Färö.		Hall.	Walmudd.	Tikkerhamn.	Samsögn in Othem.	Site.	Marlebo.	Wisby.	Pollingbo.	Gothen and Bara.	Gaisvärl.
	Lutcherhorn.	Laussa.										
Brought forward	5	6	5	6	4	6	5	6	25	6	3	1
<i>Pleurotomaria.</i>												
54 qualteriata SCHLOTH.									a			
55 valida n.												
56 Othemensis n.						c						
57 comata n.												
58 æquilatera WAHLENBERG	c		c	c		c	c		a	c	c	
59 labrosa HALL		b					b		a			
60 limata n.	c		c	c	bc		c		abc			a
61 replicata n.									a?			
62 alata WAHLENBERG	c	c	c		a	c	ac		a			
63 var. subcarinata n.		b										
64 var. opposita n.												
65 prætexta n.									a			
66 togata n.									a			
67 frenata n.									a			
68 undulans n.									a			a
69 Marklini n.												
70 cirrhosa n.												
71 planorbis His.												
72 helicina n.									a			
73 exquisita n.												
<i>Murchisonia</i> D'ARCH. & VERN.												
74 cingulata His.			c									b
75 cava n.								c	c			bc
76 moniliformis n.												
77 obtusangula n.									c			
78 subplicata n.								c				
79 compressa n.												
80 attenuata His.							ac		abc	c		b
81 crispa n.												
82 munda n.							c					
83 tortuosa n.										c		
84 imbricata n.							c		c			
85 cancellata n.												
86 cochleata n.												
87 detlexa n.												
Fam. VII. <i>Euomphalidæ</i> n.												
<i>Euomphalus</i> Sow.												
88 gotlandicus n.							a	c	ac			
89 triquetrus n.							abc	c				
Carried forward	8	9	9	8	6	9	14	10	41	9	7	3

	Westergarn.	Kräklingbo.	Östergarn.	Klinte.	Arde.	Lilla Carlso.	Djupvik in Eksta.	Stora Carlso.	Linde, Parham,	Lan.	Hablingbo.	Gröttingbo.	Näs.	Bursvik.	Hoburg.	Stratigraphical distribution.				
																Only found in			Common to	
																a	b	c	all strata	ab
3	6	7	7	3	1	16	2	11	3	5	4	2	9	2	13	5	16	9	3	7
				c											*		*			
						a									*		*			
a							a										*	*		
a			c		c		a								*		*	*		
a			c				a						b				*	*		
a													b	b				*	*	
															*				*	
															*				*	
															*				*	
															*				*	
a			c												*		*		*	
		b						c									*		*	*
		ab						a							*			*	*	*
						a									*				*	*
						a									*			*	*	*
															*			*	*	*
															*			*	*	*
															*			*	*	*
															*			*	*	*
															*			*	*	*
		b			b											*		*	*	*
		b			b											*		*	*	*
									c								*	*	*	*
																	*	*	*	*
																	*	*	*	*
																	*	*	*	*
																	*	*	*	*
																	*	*	*	*
																	*	*	*	*
																	*	*	*	*
																	*	*	*	*
9	7	12	10	5	2	21	5	18	3	8	4	4	11	2	24	6	27	17	6	9

	Fåro.		Hall.	Viålmudd.	Lickersham.	Samsugn in Othem.	Site.	Marcho.	Wisby.	Follingbo.	Gothem and Bara.	Gaisvård.
	Lutterhorn.	Lansa.										
Brought forward	8	9	9	8	6	9	14	10	41	9	7	3
<i>Euomphalus.</i>												
90 tuba n. ....						c						
91 præcursor n. ....									a			
92 Walmstedti n. ....												
<i>Loxonema</i> PHILLIPS.												
93 sinuosum SOWERBY .....									a			
94 attenuatum n. ....						c						
95 intumescens n. ....									c			
96 fasciatum n. ....												
97 strangulatum n. ....												
Fam. VIII. <b>Trochidæ</b> D'ORB. p. p.												
<i>Trochus</i> L.												
98 Gotlandicus n. ....	c	bc	c		b		c		bc			
99 fulminatus n. ....								bc	bc			
100 mollis n. ....						c						
101 Stuxbergi n. ....						c			c			
102 undulans n. ....						c	c					
103 profundus n. ....						c						
104 cavus n. ....												
105 Lundgreni n. ....	c					c						
106 Kolmodini n. ....										c		
107 Dalli n. ....									e			
108 Wisbyensis n. ....	c					c			c			
109 lamellosus n. ....			c			c						
110 incisus n. ....					c	c			c	c		
111 gyrans n. ....									c			
112 densestriatus n. ....												
113 australiformis n. ....												
Fam. IX. <b>Umbonidæ</b> n.												
<i>Pycnomphalus</i> n. gen.												
114 obesus n. ....		c		c								
115 acutus n. ....				c				c	c			
116 trochiformis n. ....									c			
Fam. X. <b>Turbinidæ</b> ALDER.												
<i>Oriostoma</i> MUNIER-CHALMAS.												
117 discors Sow. ....	c	c	c	c		c		c	c	c	c	
118 var. rugosum Sow. ....				c		c	c	c	ac	c	c	
119 contrarium n. ....	c		c	c		c			ac			
120 globosum SCHLOTH. ....	c	c	c	c				c	a		b	
121 var. sculptum Sow. ....	c	c	c	c		c	b	c	a			
Carried forward.	15	14	15	15	8	23	18	16	58	13	10	3

Westergrn.	Krakingbo.	Ostergarn.	Klinte.	Ardre.	Lilla Carlso.	Djupvik in Eksta.	Stora Carlso.	Linde, Fardhem.	Tan.	Hablingbo.	Grollingbo.	Näs.	Bursvik.	Hoburg.	Stratigraphical distribution.					
															Only found in			Common to		
															a	b	c	all strata	ab	bc
9	7	12	10	5	2	21	5	18	3	8	4	4	11	2	24	6	27	17	6	9
															*		*			
								c							*		*			
						a									*		*			
															*		*			
		b	c					c							*		*			*
															*		*			*
			c		c										*		*			*
															*		*			*
															*		*			*
								c							*		*			*
															*		*			*
															*		*			*
															*		*			*
		b													*		*			*
			c												*		*			*
															*		*			*
a		b		c		a									*		*			*
															*		*			*
a			c					c							*		*			*
		b	c	c											*		*			*
a	c	c			c		a	ac		a					*		*			*
			c		c	a	a							b	*		*			*
12	8	17	17	7	5	24	7	23	3	9	4	4	11	3	26	7	47	23	6	12

	Fårö.		Hall.	Widmsudd.	Lickershamn.	Samsögn in Öhem.	Slite.	Martho.	Wisby.	Pollingbo.	Gothem and Berra.	Guisvård.
	Intterhamn.	Lansa.										
Brought forward	15	14	15	15	8	23	18	16	58	13	10	3
<i>Oriostoma.</i>												
122 coronatum n. ....											c	
123 acutum n. ....							c					
124 Wisbyense n. ....									bc			
125 angulifer n. ....												
126 Roemeri n. ....									ab			a
127 helicinum n. ....			c	c		c						
128 alatum n. ....									bc			
129 angulatum WAHLENB. ....	c	c		c		c	c		e	c	c	
130 lineatum n. ....												
131 nitidissimum n. ....												
132 dispar n. ....										c		
<i>Cyclonema</i> HALL.												
133 delicatulum n. ....					b				ab			
134 apicatum n. ....												
135 cancellatum n. ....												
136 distans n. ....												
137 strictum HIS. ....						c			a			
138 zocatum n. ....												
139 adstrictum n. ....												
140 carinatum SOW. ....						c	c			c		
141 nodulosum n. ....												
142 tenuissimum n. ....										c		
143 giganteum n. ....									a			
144 perversum n. ....												
145 ( <i>Trochonema</i> ) turritum n. ....						c		c	c			
<i>Eunema</i> SALTER.												
146 muricatum n. ....												
<i>Craspedostoma</i> n. gen.												
147 spinulosum n. ....												
148 elegantulum n. ....						c	c			c		
149 var. brevispira n. ....												
150 filistriatum n. ....						c						
151 involutum n. ....									c			
152 glabrum n. ....												
Fam. XI <i>Phoridae</i> GRAY.												
<i>Autodetus</i> n. gen.												
153 calyptratus SCHRENK. ....			ab		b		c		b			
Fam. XII <i>Litorinidae</i> GRAY.												
<i>Holopea</i> HALL.												
154 nux n. ....						c						
155 transversa n. ....										c		
Carried forward	16	15	17	17	10	31	23	17	68	19	12	4

Västergarn.	Kraklingbo.	Östergarn.	Klinte.	Andre.	Lilla Carlssö.	Djupvik in Ekstån.	Stora Carlssö.	Ivide, Fardhem.	Lau.	Hablingbo.	Gröllingbo.	Näs.	Bursvik.	Hoburg.	Stratigraphical distribution.					
															Only found in			Common to		
															a	b	c	all strata	ab	bc
12	8	17	17	7	5	24	7	23	3	9	4	4	11	3	26	7	47	23	6	12
		<i>b</i>		<i>c</i>				<i>c</i>	<i>b</i>								*			*
																	*			*
		<i>b</i>														*				*
<i>a</i>																	*			*
																	*			*
			<i>c</i>				<i>c</i>										*			*
			<i>c</i>					<i>c</i>					<i>b</i>				*			*
								<i>c</i>									*			*
								<i>c</i>									*			*
								<i>c</i>									*			*
								<i>c</i>									*			*
		<i>b</i>	<i>c</i>					<i>c</i>									*			*
						<i>a</i>				<i>a</i>					*		*			*
						<i>a</i>									*		*			*
								<i>c</i>									*			*
			<i>c</i>														*			*
														<i>b</i>		*				*
														<i>b</i>		*				*
			<i>c</i>					<i>c</i>									*			*
								<i>c</i>									*			*
								<i>c</i>									*			*
		<i>b</i>					<i>a</i>	<i>c</i>	<i>b</i>		<i>b</i>		<i>ab</i>	<i>ab</i>			*			*
								<i>c</i>									*			*
																	*			*

	Fårö.		Hall.	Walmudd.	Ljkersham.	Samsugn in Öthem.	Slite.	Markeb.	Wisby.	Follingbo.	Gothem and Bara.	Gnisvård.
	Interhorn.	Tansa.										
Brought forward	16	15	17	17	10	31	23	17	68	19	12	4
<i>Holopea.</i>												
156 perforata n. ....									c			
157 nitidissima n. ....									c	c		
158 applanata n. ....									c			
Fam. XIII <i>Scalaridæ</i> BRODERIP.												
<i>Callonema</i> HALL.												
159 obesum n. ....									b			
160 scalariforme n. ....									b			
<i>Holopella</i> M'COY.												
161 teres n. ....							c					
162 regularis n. ....									a			
163 minuta n. ....												
Fam. XIV <i>Pyramidellidæ</i> GRAY.												
<i>Machrochilina</i> BAYLE.												
164 cancellata n. ....												
165 bulimina n. ....												
166 fenestrata n. ....						c						
Fam. XV <i>Subulitidæ</i> n.												
<i>Subulites</i> CONRAD.												
167 ventricosus HALL .....		b							a			a
168 ventricosus var. curvus .....						c			c			
169 attenuatus n. ....		b		c				c	a			a
<i>Euchrysalis</i> LAUBE.												
170 lineolata n. ....												
<i>Onychochilus</i> n. gen.												
171 physa n. ....							c					
172 reticulatum n. ....												
173 cochleatum n. ....						c						
ADDENDUM.												
<i>Murchisonia.</i>												
174 paradoxa n. ....												
	16	17	17	18	10	34	25	18	77	20	12	6



	Stratigraphical distribution.																			
	Only found in			Common to																
	a	b	c	all strata	ab	bc														
Westergarn.	13																			
Kräkingbo.	8																			
Östergarn.	21																			
Klinte.	23																			
Ardre.	8																			
Lilla Carlso.	5																			
Djupvik in Eksta.	27																			
Stora Carlso.	8																			
Linde and Fardhem.	35																			
La.	5																			
Ilabbingbo.	10																			
Grollingbo.	5																			
Näs.	4																			
Bursvik.	13																			
Hoburg.	6																			
	28	10	67	26	8	16														
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15	8	21	23	8	5	27	8	42	5	11	5	4	13	6	29	12	81	27	9	16

far as Klinteberg, but as they mostly are scarce there and frequent in the north they may be considered as North Gotland shells.

Only five species are common to the strata over the whole island and consequently the most characteristic species of all Gastropoda. These are *Platyceras cornutum*, *Tremanotus longitudinalis*, *Pleurotomaria alata*, *Oriostoma sculptum* and *Autodetus calyptratus*.

With the exception of the minor faunal districts which have been sketched above, such as Sandarfve and Djupvik, there are in other respects no obvious grounds for discerning larger, faunistic divisions, as was attempted in my paper on the Brachiopoda of Gotland<sup>1)</sup> some years ago. There are so many characteristic forms common, such as *Autodetus*, *Craspedostoma* and *Tremanotus*. Moreover, it is generally the case that distinctions based upon the occurrence of the species, are sooner or later effaced in the same degree as the material for study increases. It is then evident, that all such considerations have only a relative or transient value and properly speaking are only valid for the time they were made, as each year brings new forms and modifies older conclusions. New species are discovered and those formerly found are obtained from localities and strata where they were unknown.

As to the vertical distribution of the species as many as 29 have hitherto been found exclusively in the lowest or shale beds, signed *a* on the synoptical lists. It has not been possible, at present, to ascertain the succession of these species within the shale beds or if there really be zones of vertical distribution within the range of the more than hundred feet it comprises in thickness. In common with *b* it has besides nine species and with both *b* and *c* 27 species and contains thus in all 65 species. The next stratum *b* is nearly as rich, although having only twelve species of its own, and in common with *a* nine species, common with both *a* and *c* 27 species and with *c* alone sixteen species, thus in all 64 species. Richest of all is, however, the third stratum *c*, with so many as 81 species peculiar to it, which in addition to 16 common with *b* and 27 species common with both *a* and *b* make up the sum total of 124 species.

With regard to the occurrence of the 25 genera, of which the gastropodan fauna consists, in the different strata, there are some, as *Tryblidium*, *Palæacmæa*, *Trochus*, *Pycnomphalus*, *Craspedostoma*, *Holopea*, *Euchrysalis*, *Macrochilina* and *Onychochilus*, which are restricted exclusively to the highest strata. Some again, as *Oriostoma*, are most abundantly represented in the uppermost strata, though there are also species of it in the middle limestone and the shale.

It may be questioned whether not any evidence is found of mutations in such species, which occur in several strata, or in those, which have been found also in younger or older formations. Such changes, also indicated through the presence of nearly related species or varieties in older or younger formations, have most obviously occurred in the following species, which are now enumerated. The matter is more closely considered in the description of each species.

<sup>1)</sup> Bidrag till kännedomen om Gotlands Brachiopoder. Öfvers. Vet.-Akad:s Förhandl. 1860, p. 337.

1. *Tryblidium reticulatum* LDM.
2. *Tryblidium unguis* LDM.
3. *Platyceras cornutum* HIS.
4. *Pleurotomaria limata* n. n.
5. *Pleurot. elliptica* HIS.
6. *Pleurot. bicincta* HALL.
7. *Pleurot. labrosa* HALL.
8. *Pleurot. qualteriata* SCHLOTH.
9. *Euomphalus Gotlandicus* n.
10. *Oriostoma rugosum* SOW.
11. *Subulites ventricosus* HALL.

In regard to the distribution of the Gotland Gastropoda beyond the limits of that island very little is at present known. As common with the nearest strata of **Ösel** and **Estland** the following species have been annotated: *Tryblidium unguis* LDM, *Platyceras cornutum* HIS. very common, *Pleurotomaria elliptica* HIS., *Pleurot. bicincta* HALL, *Oriostoma angulatum* WAHL., *Or. sculptum* SOW., *Or. discors* SOW. very common, *Pleurot. planorbis* HIS., *Autodetus calyptratus* SCHRENK, *Pleurot. qualteriata* var.

From the Upper Silurian strata of **Scania** at Bjersjölagård and Klinta I have seen *Platyceras cornutum* HIS. *Platyc. enorme* LINDSTR., *Autodetus calyptratus* SCHRENK and indeterminable nuclei of *Murchisonia*, *Pleurotomaria* and *Bellerophon*.

From **Norway**, I have only seen the few following species:

*Conularia laevis* n., *Pleurotomaria elliptica* HIS., *Oriost. globosum* SCHLOTH. In common with **England** the following species have been found viz. *Platyceras cornutum* HIS., *Platyc. spiratum* SOW., *Pleurotomaria limata* nom. nov. (= *Euom. carinatus* SOW.), *Pl. labrosa* HALL, *Pl. alata* HIS., *Pl. Lloydii* SOW., *Pl. bicincta* HALL, *Bellerophon trilobatus* SOW., *Loxonema sinuosum* SOW., *Oriostoma discors* SOW., *Or. rugosum* SOW., *Or. sculptum* SOW., *Cyclonema carinatum* SOW.

With the rich fauna of **Bohemia** not a single species can, for the present, be recorded as common. I have had access to a collection of 65 species of Bohemian Silurian Gastropoda, acquired by the State Museum of Sweden from the late M. SCHARY of Prag, and I cannot find in it a single species to identify. *Euomphalus pulcher* BARRANDE comes very near to *Oriost. Roemeri* and *Euom. simplex* BARR. near to *Oriost. sculptum* SOW., but they are probably different.

From the Silurian formation of **Podolia** and **Galizia** FRIEDR. SCHMIDT in »Einige Bemerkungen über die Podolisch-Galizische Silurformation» (1875) p. 17 enumerates six species of Gastropoda, but of these *Euomph. (Pleurotomaria) alata* is probably the only one which can be considered as identical.

VON ALTH gave in 1874 a list of Silurian Gastropoda in his work »Ueber die palæozoischen Gebilde Podoliens», page 31, amounting to 14 species, but as I have not seen a single specimen of them, I can not with any certainty identify them with those from Gotland.

Of **N. American** Silurian Gastropoda I have found as identical, *Platyceras cornutum* HIS., *Pleurotomaria labrosa* HALL, *Pleurot. bicincta* HALL, *Subulites ventricosus* HALL.

*Pleurotomaria bicincta* HALL, *Pleurot. elliptica* HIS., *Tryblidium unguis* LDM. occur in the highest strata of the Lower Silurian of Estland and *Pleurot. elliptica*, *Pleurot. qualteriata* are common with the Orthoceratite limestone of the Lower Silurian of

Sweden. Upwards, into the Devonian strata of France and N. America, only the following species is passing, viz. *Pleurot. labrosa* HALL, also found in the »Devonien inférieur» at Néhou and in North America in the Lower Helderberg rocks. *Platyceras cornutum* HIS. can in some of its varieties scarcely be distinguished from the Eifelian *Pileopsis prisca* to which it at all events stands in very close relation. *Bellerophon trilobatus* SOW. also seems to be a species which has continued in the Devonian time.

#### Zoological characters of the gastropodan fauna.

If we except *Chelodes* and the genera *Subulites*, *Euchrysalis* and perhaps *Onychochilus*, all the other belong to the large section, which on account of the circular peristome has been called that of the *Holostomata*. *Chelodes* as one of the *Chitonidæ*, belongs to the strange order *Placophora*. *Subulites*, *Euchrysalis* and possibly also *Onychochilus* again exhibit such characters in their aperture as to entitle us to place them with the great order *Siphonostomata*, hitherto regarded as of mesozoic origin and entirely unknown in the palæozoic formations. It cannot be denied that the evidence offered further down supports this conclusion and that it probably shall be corroborated by further observations. If then, as I suppose, *Subulites* is one of the *Siphonostomata*, these have originated much earlier than in the Gotlandic Silurian, as there are well preserved species of that genus in the Lower Silurian strata of Dalecarlia. *Subulites nitens* LDM (in *Fragmenta Silurica* p. 14) occurs already as early as in the Lower Gray Orthoceratite Limestone of Sjurberg, where besides this no other forms of the same order are known. A larger species, probably *Subulites* (*Helicites*) *utricularis* WAHLENBERG (*Subul. elongatus* PORTL. according to *Fragm. Silur.* p. 13), is found in the uppermost stratum of the Lower Silurian of Dalecarlia, the *Leptæna* limestone.

Of the fifteen families represented, as many as twelve are also recent. It must, however, be conceded that it is with great diffidence that several families, such as the *Litorinidæ*, the *Pyramidellidæ*, the *Turbinidæ* have been introduced in the lists. Of the 25 genera again, the majority or 23 are considered to be extinct and only two, *Pleurotomaria* and *Trochus*, still persisting. The former genus, rich as it was in the Silurian times, had not then reached its acme, which was attained in the Jurassic seas and now it has dwindled away to four species in the recent seas. Together with *Murchisonia* it gives to the fauna of the Gotland Gastropoda its chief character, their 54 species making nearly a third of the whole fauna. Like *Pleurotomaria* there are other genera, the systematic place of which cannot be contested. The beautifully preserved muscular scars on the inner side of *Tryblidium* certify their near connection with the recent *Patellidæ*. *Chelodes* with its numerous very characteristic plates belongs in all probability to the *Chitonidæ*. The numerous *Oriostomata*, forming such a prominent feature in the fauna, testify through their operculum and their nacreous interior strata to their relation with the *Turbinidæ*. It is also very likely that the strange *Autodetus* is an ancestral form representing the modern *Phoridæ*, the presence of which family has already been observed in the Devonian strata. But instead of attaching other objects to its shell as its presumed descendants, it fixed its own shell with the apex to other bodies. Of the occurrence of such an archaic form as *Dentalium*, nothing

as yet has been ascertained. A few tubes from the shale beds of Wisby and Östergarn might possibly once have appertained to that group, but their imperfect condition precludes identification.

As genera especially characteristic of the Silurian beds of Gotland, may be mentioned: *Craspedostoma*, *Onychochilus* and probably also *Pycnomphalus*, though it is not certain whether the last does not occur in England and Oesel, but referred to the genus *Platyschisma* in a conception which is not that of the first author. *Autodetus*, which is spread over the whole island, occurs also on the neighbouring Oesel, though it is uncertain whether so common there as on Gotland and not recorded from any other Silurian region except Scania. As characteristic of the Upper Silurian formation in general may be annotated *Chelodes*, which has also been found in Bohemia, *Tremanotus*, *Cyrtolites* and *Subulites* also known from N. America and Canada, *Subulites* also from England, and *Tryblidium* found in Estland and Canada.

Concerning the many palæozoic genera, of which I have appended an Index in the end of this memoir, it depends much on individual opinions, as to what genus these old fossil shells are to be referred, but it is evident that it is highly futile to establish the genera only on a single and variable character. When comparing large numbers of specimens belonging to the same species and collected in the same locality the great variability in the form of the aperture, the columella, the height of the spire, the umbilicus, will be evident, and it is only necessary to remind of such forms as *Platyceras cornutum* to discover the wide range within which some species vary, chiefly those which have a large horizontal and vertical distribution. In almost the same degree *Cyclonema delicatulum* varies with high or low spire, slender or ventricose whorls, with open or closed umbilicus.

Among structural peculiarities ought to be observed that in the genus *Euomphalus*, as it has been long known, the shell, in the rule, near the apex or in the oldest whorls, is divided into one or several compartments or chambers by concave diaphragms, without, however, having any communication or siphon between them. The chambered apex has very often through the fossilisation become deciduous and the blunt end indicates the place, where the partition once traversed the shell. In *Murchisonia*, *Loxonema* and a presumed *Trochus*, *Tr. gotlandicus*, the apex is filled with a compact mass of calcareous matter quite as in the recent *Magilus*.

The peculiar and cellular structure of the external walls in *Autodetus* is a feature well deserving attention. In a few genera, as *Platyceras*, *Pleurotomaria*, *Euomphalus*, there is a tendency in several species to form scalarid varieties and in some species all specimens found have assumed that peculiarity in growth. In the large genus *Pleurotomaria* it is easy to follow the morphological changes which the characteristic slit band is subject to, from a concave groove to the large, thin lamina in the group *Alatæ*. In respect to the sculpture of the surface I have called the spiral lines, keels and ridges, which run from the apex to the aperture for longitudinal, as they follow the shell in its whole length, and, consequently, those intersecting them are to be denominated transverse. Some authors call all the later for lines of growth. But besides the real lines of growth or the old apertural lips, which are conspicuous by

their lamellar edges, often uneven and at irregular distances from each other, there are fine and elevated, as it were, ornamental lines. These do not always run parallel to the lines of growth, but cross them obliquely in some species, as *Pleurotomaria exquisita* and *Onychochilus cochleatum*. These elevated lines of varying size are in several species replaced by sunk and narrow grooves. It would then be proper to distinguish between *lines of growth* and *ornamental lines*, which are formed independently of the former or coördinate to them.

Through the presence of certain genera the following conclusions may be drawn as to the character of the fauna, of which they formed an ingredient and consequently of the natural conditions of the sea in which the including strata were deposited.

1. *The fauna of the silurian beds of Gotland was a littoral fauna.* Such genera as *Chelodes* and *Tryblidium* make this conclusion valid. The *Chitonidæ*, to which *Chelodes* belongs, live now generally down to a depth of 25 fathoms, though some small ones have been found exceptionally at 100 fms. *Tryblidium* is a member of the group of the *Patellidæ*. These are in a still higher degree shallow water shells, living near the shore on seaweeds and rocks, and the occurrence of the *Tryblidia* is suggestive of the former presence of algæ, on which they might have lived, though no traces of these are left. It has been said<sup>1)</sup> that the Upper Silurian shales of England through their fossils and the nature of the shale itself make it evident that they have been formed in a deep sea. Since the explorations of the later years the range of the deep sea region upwards cannot be considered higher than 400 fathoms. But already at a less considerable depth there reigns, as has been shown, an almost absolute stillness in the water and the motion of the surface cannot influence the bottom at a depth below 40 fms. Occasionally, at more exposed coast lines, as near New Foundland the bottom has been disturbed to a still greater depth, when violent tempests have raged, but this is of course exceptional and the traces of the disturbance must again, during the otherwise prevailing calm be effaced through new sediment.

In consequence of what has been advanced above, shells imbedded at greater depths could not show signs of having been subjected to any abrading motion of the waves. Now, the fossils enclosed in the shale beds of Gotland on the contrary attest in many instances by their abraded condition that they have been tossed about by the waves and, consequently, have not been imbedded in a bottom of any considerable depth. The great movement in the sea, where they lived, is also evident through the shells sometimes having been broken and then mended. Thus there are specimens of *Pleurotomaria labrosa* from the shale of Westergarn, showing such a break in the body whorl, which had again been repaired during the lifetime of the animal. The superincumbent limestone strata are for the most part conglomerates of corals and other fossils, and, when fine grained, the limestone consists entirely of a sort of calcareous sand, the grains of which are comminuted shells and corals. It thus highly resembles the limestone, which is forming now a days out of similar material along the shores or on the beaches of the tropical regions for instance near the Westindian islands.

<sup>1)</sup> FUCHS, Welche Ablagerungen haben wir als Tiefseebildungen zu betrachten? in »Neues Jahrbuch für mineralogie etc.», II Beil. Bd. 1883, p. 565.

It must have been in some sheltered bights, where a calcareous mud found stillness enough to allow it to settle down, that such deposits as the fine grained limestone of Sandarfve, or Samsugn with their numerous and beautifully preserved shells originated.

In general the shells were middle sized, only a few, as *Pleurotomaria valida*, or *Pl. cirrhosa* attaining a greater size. Fragments of an undeterminable shell from the shale of Gnisvärd attain in the height of the body whorl alone 82 mm. and in breadth 98 mm., this being the largest fossil shell, known in Gotland. This size and the comparative rarity of tiny shells also militate against any assumption of great depth for these forms, as only small sized species have been dredged up from the abyssal depths.

2. *The fauna had a tropical character.* In consideration of the great numbers of *Pleurotomariæ*, *Trochi*, *Turbinidæ* and the large *Pteropods* the assumption of a tropical character of the fauna may seem justifiable.

#### Older descriptions of Gotland Gastropoda.

There has been no want of workers in this field, as we can learn by a review of the memoirs of the authors previous to this. The first time any mention has been made in print of the Silurian Gastropoda of Gotland was when MAGNUS VON BROMELL published the »*Articulus secundus*» of his »*Lithographia Svecana*»<sup>1)</sup>. He there, pages 28—37, enumerates and summarily describes 21 different numbers of fossil Gotland Gastropoda. But as both the descriptions and the figures are very unsatisfactory — the originals being mostly mere nuclei — I have not been enabled with any degree of certainty to identify more than a few. Thus N:o 5, page 30, and N:o 6, p. 31, in all probability are specimens of *Pleurotomaria alata*. N:o 21, p. 36, is an *Oriostoma* and probably *Oriostoma sculptum* Sow. In N:os 26—27 we see nuclei of *Murchisoniæ* and N:o 27 may be *M. attenuata*.

LINNÆUS has left no descriptions of any fossil Gotland Gastropoda. In the relation of his travel on Gotland in 1741 he only mentions them in passing. On page 189 he says: »*Petrificata pläckades af oss hela timarna på västra Stranden (af Kapellshamn), ibland hwilka woro ganska många Conchitæ striatæ och Cochlitæ*» . . . i. e. »*Petrifications were collected by us for several hours on the western shore, amongst which were a great number of Conchitæ striatæ and Cochlitæ*» . . .

WILHELM HISINGER began his long, honourable and meritorious activity as the explorer of the geology and palæontology of Sweden so long back as in 1789 at the early age of 23 years with his first memoir and in 1798<sup>2)</sup> he published »*Minerographiske anmärkningar öfver Gottland*». On page 286 he enumerates with other fossils only a single »*Turbo? i pisolit kalksten*». In 1808 »*Samling till en mineralogisk Geografi öfver Sverige*» was published and there he only recapitulates the remarks in the preceding paper. The number of Gastropoda accepted by HISINGER was raised to ten in his geological de-

<sup>1)</sup> In the »*Acta Literaria et Scientiarum Sveciæ*», Vol. III, Upsala 1738.

<sup>2)</sup> In the Transactions of the R. Swedish Ac. of Sciences.

scription of Gotland (Gottland, geognostiskt beskrifvet in Vet. Ak. Handl. 1826, p. 311). He enumerates 5 sp. of *Helix* (= *Oriostoma*) and 4 of *Turbo*, of which 8 had been some years ago described and denominated by WAHLENBERG in the memoir which further down shall be taken into due consideration. Himself he there only added *Turbo* sp. and *Turritella* meaning nuclei of *Murchisonia*. In the translation of his »Mineralogisk Geografi» in German by the renowned chemist FR. WÖHLER in 1826 the eight *Helicites* and *Turbinites* determined by WAHLENBERG are also enumerated on p. 228. In 1828 he published again in the fourth part of his »Anteckningar i Physik och Geognosi» the description of Gotland, which he gave in the Transactions for 1826, almost verbally with only a few additions. Thus there is the first figure, tab. VI f. 3, delineated as well as the others by Prof. P. F. WAHLBERG of *Murchisonia compressa* n. and of *Pleurotomaria planorbis* HIS. tab. VI f. 2, then named as *Turbinites centrifugus*. On tab. VI f. 6 there is under the name of *Turbinites* a variety of *Platyceras cornutum*. *Helix obvallatus* had been removed from the Gotland fossils and the number of species thus changed to nine. In 1829 »Esquisse d'un Tableau des Pétrifications de la Svède, distribuées en Ordre Systématique» appeared, containing 11 species, the same as before with addition of *Delphinula funata* Sow. (= *Oriostoma sculptum* Sow. et others), *D. subsulcata* HIS. (= *Or. globosum* SCHLOTH.), *Euomph. substriatus* HIS. (*Pleurot. planorbis* HIS.), *Euomph. costatus* (a cephalopodous shell of the genus *Trochoceras*) and *Turritella cingulata* HIS. The names *Delphinula* and *Euomphalus* were then employed for the first time by HISINGER. In 1831 a new description of Gotland is given in the fifth part of »Anteckningar», and we there again find the same eleven species as enumerated before. But in fact there are only nine, as *Euomphalus costatus* is a Cephalopod and *E. substriatus* and *centrifugus* later by HISINGER himself were declared to be identical. New figures, good for the time, were given of several of them.

A new edition of »Esquisse d'un Tableau» was published in 1831 also with 11 species, the same as before.

HISINGER'S greatest Palæontological work, »Lethæa Svecica», is commonly cited as published in 1837. But it seems that a part of it, from a quotation of BRONN in Vol. 3 of his »Handb. einer Geschichte der Natur, Nomenclator Bd I, p. XLI», where NILSSON is evidently an erratum for HISINGER, was already published in 1836 under the title »Icones petrifactorum Sueciæ, Fasc. I, tab. I—X., Animalia articulata et Mollusca Cephalopoda». In the *Lethæa* he describes 13 species, to which are to be added one more, from the »Supplementum Secundum» to the *Lethæa* 1840, thus making a total of 14 species, when *Inachus costatus* is excluded as a Cephalopod. These are as follows, viz.

- Euomphalus cornu arietis* = *Oriostoma discors* Sow.
- Eu. alatus* = *Pleurotomaria alata*.
- Eu. æquilaterus* = *Pleurotomaria æquilatera*.
- Eu. catenulatus* = *Oriostoma rugosum* Sow.
- Eu. subsulcatus* = *Oriost. globosum* SCHLOTH.
- Eu. funatus* = *Oriost. sculptum* Sow. & O. ROEMERII n.
- Eu. supra angulatus* = *Oriost. angulatum* WAHL.
- Inachus angulatus* identical with the preceding.
- Inachus sulcatus* = *Pleurotomaria planorbis* HIS.
- Turbo striatus* = *Cyclonema striatum*.



*Turritella cingulata* = Murchisonia cingulata p. p.  
*Turritella attenuata* = Murchisonia attenuata.  
*Pileopsis cornuta* } = Platyceras cornutum.  
*Pil. sulcata* }

There are in reality thus thirteen species described by HISINGER in the Lethæa, when two out of the fourteen are identical with others and one, *E. funatus*, comprises two different species. Nor has this number been increased in the last publications of HISINGER, in the sixth part of »Anteckningar» and in »Förteckning öfver en Geognostisk och Petrificat-Samling från Sverige och Norige», printed in 1841. There is, however, the important corrections made that *Turritella cingulata* is considered to be a *Pleurotomaria* and that *Murchisonia compressa* is separated from it and referred to separately as »Stenkärnor af Turritellor», Leth. pl. 12, fig. 6 b.

In »Die Petrefaktenkunde» by SCHLOTHEIM (1820) there is only one of the the Gotland species described on page 162, *Trochilites globosus*, the type specimen of which I have had occasion to examine through the kindness of Professors BEYRICH and DAMES. It is the same that somewhat later was called *Euom. funatus* by SOWERBY.

GEORG WAHLENBERG describes in his »Petrificata Telluris Svecanæ», published in the »Acta Soc. Scient. Upsaliensis (1821), p. 68, *Turbinites cornu arietis*, which SOWERBY had already called *Euomphalus discors* and further

*Turbinites alatus* WAHL. is = *Pleurotomaria alata*.  
*Helicites catenulatus* (p. 72) is = *Oriostoma rugosum*.  
*Hel. supra angulatus* is identical with  
*Hel. angulatus* = *Oriostoma angulatum*.  
*Hel. æquilaterus* = *Pleurot. æquilatera*.  
*Hel. obvallatus* »occurrit in Gotlandia rarius» = *Pleurot. qualteriata* p. p.?  
*Hel. obvallatus* WAHLENBERG is different from *Pl. qualteriata*.

WAHLENBERG thus described in all six species, which were later adopted by HISINGER.

Professor N. P. ANGELIN, when a student of the University of Lund, distributed small collections of Gotland fossils under the title: »Museum palæontologicum svecicum» and a list of these is printed in the Danish »Naturhistorisk Tidsskrift af KRÖYER», 2<sup>d</sup> Vol. 1838. Amongst the 50 species there mentioned, we find *Euomphalus cornu arietis* (= *Oriost. discors*), but ANGELIN's specimens are *Oriostoma Roemeri*, *Euomphal. alatus* His = *Pleurot. alata* and *Littorina? striata* n. sp. In the existing copies of the »Museum» no specimens of the last species have been found and consequently the identity cannot be made out. In his works on the Palæontology of Sweden ANGELIN has not given any estimate of the numeric value of the Gastropoda. But he seems to have mentioned as his opinion to BARRANDE <sup>1)</sup> that the Scandinavian Upper Silurian beds were not so rich in these fossils as Bohemia, where BARRANDE then considered that he had 200 species, a number which is now manifold increased.

In his paper »On the Silurian Rocks of Sweden» <sup>2)</sup> Sir RODERICK MURCHISON also gave a sketch of the geology of Gotland. On page 29 he enumerates the following nine species of Gastropoda, viz.

<sup>1)</sup> Parallèle entre les dépôts siluriens de Bohême et de Scandinavie, p. 59.

<sup>2)</sup> Quarterly Journal, Geol. Society of London 1847, p. 29.

*Euomphalus discors, rugosus, funatus, sculptus, carinatus, alatus* (Pleurot. alata), *Turritella obsoleta*, *Murchisonia corallii*, and *Turbo corallii*. The three last mentioned I have not been able to identify, as they have not been found in any one of the collections where MURCHISON and VERNEUIL in London and Paris have deposited the fossils they brought home from Gotland. As to *Eu. carinatus* Sow. I have through casts of the original specimens, received from Dr J. G. HINDE, ascertained that it is identical with the Gotland fossil described further down under the name of *Pleurotomaria limata*, as the name *Pl. carinata* was already before preoccupied.

G. VON HELMERSEN visited Gotland on a Geological tour in 1845, but it lasted till 1858 before he published a memoir on his observations, entitled »Geologische Bemerkungen auf einer Reise in Schweden und Norwegen». He enumerates in all 10 species: *Euomph. discors, rugosus, funatus, carinatus, alatus, catenulatus, Turbo striatus, Turritella cingulata, Murchisonia corallii* and *Natica inflata*. Of all these the last from Klinteberg is the only addition to those former known. He does not mention the author of that species, but it is likely that he thereby intended to designate a species described by F. AD. ROEMER in »Versteinerungen des Harzgebirges» tab. 7, fig. 8. Of all species found on Klinteberg there is none but *Platyceras spiratum* which comes near to ROEMERS species, though this is many times larger. I think then that HELMERSENS *N. inflata* must stand as a synonym to *Pl. spiratum*.

FRIEDRICH SCHMIDT made his researches on the palæontology and geology of Gotland in 1858 and published the results during the following year in a pamphlet, entitled »Beitrag zur Geologie der Insel Gotland»<sup>1)</sup>. He enumerates 22 species of Pteropoda and Gastropoda. But his *Euomph. cornu arietis* must be removed, as he also mentions *E. discors* and his *Patella* sp. has since been found to be identical with *Pholidops*. Then there remain 20 species and they are:

- Comularia Sowerbyi* = *Con. cancellata* SANDB.  
*Theca anceps* = *Platyceras enorme*.  
*Pileopsis cornuta* } = *Platyceras cornutum*.  
*Natica parva* }  
*Bellerophon dilatatus* \*.  
*Belleroph. aymestrensis* \*.  
*Pleurotomaria articulata* = ? *Murchisonia mouiliformis* n.  
*Murchisonia cingulata* = *M. compressa* n.  
*Turritella obsoleta* \*.  
*Euomphalus catenulato aff.* \*  
*Euomph. sculptus* = ? *Oriostoma sculptum* Sow.  
*Euomph. catenulatus* = *Or. fagosum* Sow.  
*Euomph. funatus* = *Oriostoma globosum* SCHLOTH.  
*Euomph. discors* = *Or. discors* Sow.  
*Inachus sulcatus* = *Pleurotom. planorbis* HIS.  
*Inach. angulatus* = *Oriost. angulatum*.  
*Turbo striatus* HIS. = *Cyclonema striatum*.  
*Trochus helicitis* = ? *Pycnomphalus acutus*.  
*Troch. coelatus* M'COY \*.  
*Capulus calyptratus* SCHRENK = *Autodetus calyptratus*.

BIGSBY gives in his *Thesaurus Siluricus*, 1868, in the lists of Gastropoda some Gotland species, which he copied from former authors. He has in all 30 species

<sup>1)</sup> Those marked \* I have been unable to identify.

of Gastropoda from Gotland. But 23 remain, when seven are suppressed as partly duplicates <sup>1)</sup> and partly depending on misapprehension of the German terms of HELMERSEN <sup>2)</sup>. These real species are in the main the same as given by MURCHISON, HELMERSEN and SCHMIDT and need not again be enumerated.

Finally in a small paper »Nomina fossilium siluricorum Gotlandiæ» published in 1867 I gave the names of 23 Gastropoda, but in reality there are only 19, as *Eu. cornu arietis* must be united with *E. discors*, *E. supra angulatus* with *Inach. angulatus*, *Inachus costatus* removed to the Cephalopoda and *Aeroculia sulcata* united with *A. cornuta*. The remaining 19 are:

	Name in the present memoir.
<i>Macrocheilus sp.</i>	= <i>Pleurotom. valida</i> n.
<i>Turbo striatus</i> HIS.	= <i>Cyclonema striatum</i> HIS.
<i>Trochus sp.</i>	= <i>Tr. gotlandicus</i> n.
<i>Euomph. alatus</i>	= <i>Pleur. alata</i> WAHLENB.
<i>Eu. discors</i>	= <i>Oriostoma discors</i> SOW.
<i>Eu. æquilaterus</i>	= <i>Pleur. æquilatera</i> WAHL.
<i>Eu. catenulatus</i>	= <i>Or. rugosum</i> SOW.
<i>Eu. subsulcatus</i>	= <i>Or. globosum</i> SCHLOTH.
<i>Eu. funatus</i>	= <i>Or. Roemeri</i> n.
<i>Inachus angulatus</i>	= <i>Or. angulatum</i> WAHL.
<i>In. sulcatus</i>	= <i>Pleurot. planorbis</i> HIS.
<i>Pleurot. balteata</i>	= <i>Pleurot. labrosa</i> HALL.
<i>Holopella</i>	= <i>Loxonema sinuosum</i> SOW.
<i>Murchisonia cingulata</i>	= <i>M. compressa</i> p. p.
<i>Murchis. attenuata</i> HIS.	The same.
<i>Trochita calyptrata</i>	= <i>Autodetus calyptratus</i> SCHRENK.
<i>Aeroculia cornuta</i> HIS.	= <i>Platyceras cornutum</i> HIS.
<i>Bellerophon dilatatus</i>	= <i>Tremanotus longitudinalis</i> n.
<i>Subulites sp.</i>	= <i>S. ventricosus</i> HALL.

To these must be added one more, viz. *Theca sp.*, which was regarded as a Pteropod, but is identic with *Platyceras enorme*, and thus the number of species known in 1867 amounts to 20.

At the outset of this work only 20 or at the highest 23 species thus were known. The great increase is due chiefly to the material which had been accumulated during a long series of years in the Palæontological department of the Swedish State Museum of Natural History at Stockholm and the main part of information and most of the original types for the figures have been derived from that collection. But in preparing my work I have also been fortunate enough to have received contributions from many institutions and naturalists who have lent me specimens or whole collections for study and in other respects rendered me much valuable information. Prof. WALMSTEDT and Dr G. HOLM have sent me all specimens I wanted from the Cabinet of the University of Upsala, Prof. LILLJEBORG has given me free access to the Marklinian Collection in his charge; the late lamented Dr G. LINNARSSON, his successor Dr A. TULLBERG and Hr VON SCHMALENSEE have kindly lent me specimens from the Geological Survey of Sweden;

<sup>2)</sup> *Aeroculia sulcata*, *Euomph. catenulatus*, *E. cornu arietis*, *Nat. inflata*, *Murchisonia articulata*.

<sup>3)</sup> BIGSBY did not see the meaning of HELMERSEN, when the latter in his lists has »*Turbo (Steinkern)*» etc. and BIGSBY wrote »*Turbo Steinkerni*» and even »*Euomph. Stinkerni*».

Professor B. LUNDGREN has sent me specimens from the Museum of Lund and Lector STENBERG from the Museum of the town of Mahnö, Prof. JOHNSTRUP in Copenhagen has sent me from the Mineralogical Museum of the University the whole collection of Silurian Gastropoda of Gotland formerly made by ANGELIN and others, Dr L. KOLMODIN, O. A. WESTÖÖ and M. KLINTBERG have lent me specimens from the Museum of the College of Wisby and also from private collections. From the Academician FRIEDR. SCHMIDT I received what he had collected in Estland and Oesel. Messrs JOHN GRAY in Hagley, JOHN E. LEE in Torquay, HENDERSON and JAMES SIMPSON, both in Edinburgh, presented to the State Museum specimens of English and Scottish Silurian Gastropoda. Good collections were also sent from Prof. A. H. WORTHEN in Springfield and Mr S. A. MILLER in Cincinnati together with information on American fossil Gastropoda. My thanks are also due for many good elucidations and specimens to Professors BEYRICH and DAMES in Berlin, P. T. CLEVE in Upsala, W. H. DALL in Washington, H. DOUVILLÉ in Paris, J. HALL in Albany, Dr J. G. HINDE in London, who kindly undertook to send me casts of some critical species, M. D. OEHLERT in Laval for a fine collection of Devonian fossils, Prof. FERD. ROEMER in Breslau, Prof. H. TRAUTSCHOLD in Moskwa, Lector S. L. TÖRNQUIST in Lund and Mr J. F. WHITEAVES in Ottawa, Canada. To all these friends I have to express the deep obligation under which I lie for their kindness to promote my work.

I have been most fortunate to have had the assistance of an excellent draughtsman, Hr G. LILJEVALL, in the execution of the plates. He has not only drawn on stone all the figures with the exception of the plates XV and XVIII, but also cleaned and prepared the original specimens before they were figured and he had his full share in our common interest for the work. His plates speak for themselves and are in no need of my praise.

## PTEROPODA.

The fossil remains of the Upper Silurian Pteropoda of Gotland are by no means so common nor so characteristic of several beds, as are those of the Gastropoda. As I do not consider the Tentaculites as Pteropods in consequence of their close affinity to the fixed Cornulithes and similar, there is only one genus known.

### Gen. **CONULARIA** MILLER.

1818 MILLER in SOWERBY'S Mineral Conchology III. p. 108.

*Shell pyramidal, extremely thin, of several strata, each of these homogenous and transparent, brown or red; near the initial apex the shell is partitioned off by a transverse diaphragma. Apex often deciduous. Aperture narrow, partially closed by tongue-like prolongations from the corners. Side corners grooved or blunt. Along the middle of each face there runs from the aperture to the apex one or in some species two folds, which project only a little distance inwardly. In others they are totally wanting or represented by one or two longitudinal septa placed on the inner side. Surface ornamented by transverse ridges, smooth or tuberculated, forming an obtuse angle along the median line of the surface with its apex directed towards the aperture.*

The systematic place of this genus and its allies has long been subject to some discussion and difference of opinion. Among the various opinions on the nature of Conularia may be annotated that it was ranged with the Cephalopoda by J. SOWERBY, BRONN, F. A. ROEMER, BLAINVILLE, G. B. SOWERBY, FLEMING, HOENINGHAUS; this may partly have been occasioned by a false appearance of a siphuncle in the diaphragm, of which HALL still speaks as present in his *Conularia trentonensis*. D'ARCHIAC and VERNEUIL seem to have been the first who considered Conularia as a Pteropod and they were in this view followed by D'ORBIGNY, MORRIS, DE KONINCK, LEONHARD, G. SANDBERGER, AUSTIN and almost all later naturalists.

HÆCKEL again, in his *Morphologie* vol. II, page CXIII, denies that the Conulariæ as well as the other palæozoic fossils hitherto presumed to be Pteropods belong to that group of Mollusca and he thinks that no true Pteropods are found in a fossil state anterior to

the tertiary formations. In still stronger terms than HÆCKEL, NEUMAYR in his paper »Zur Kenntniss der Fauna des untersten Lias in den Nordalpen», Abhandlungen der K. K. Geologischen Reichsanstalt Bd VII Heft. 5 p. 18, also objects to the affinity of the Conulariæ with the Pteropods and he regards them rather as Gastropods nearly allied to the palæozoic Capulidæ<sup>1)</sup>. But if we closer consider into this matter, there appear points of connexion between the Conulariæ as palæozoic presumed Pteropoda and the recent ones, which make it most likely that the questionable fossils really are Pteropods. First, as to the exterior shape, it seems very difficult to deny that the palæozoic Hyolithes and several of the recent, as for instance *Cleodora australis* RANG resemble each other in a high degree. There are also instances of a pyramidal shape in the threesided shell of *Cleodora lanceolata* RANG or *Cleodora pyramidata* and several others, *Cleodora Deluciana* forming an irregular sixsided pyramid thus making an approach to the foursided shell of Conularia. As to the peculiar transverse ornamentation of the last mentioned genus there are several instances of close resemblance to what obtains in *Conularia lævis*; as for instance in *Cleodora balantium* RANG (*Balan-tium Childreni* ADAMS p. p.) and others. Moreover, amongst the now living Pteropoda there is a sufficiently large amount of widely different forms, more so than in any other group of the mollusca, that it is almost unnecessary to talk about close correspondence in the exterior shape between species so widely apart in a chronological point of view as the Silurian or palæozoic and the recent ones.

If not the nature of the shell in Conularia did exclude all thought of their being Gastropoda allied to the thick-shelled Capulidæ, the presence of two peculiar longitudinal septa on the inner surfaces of the shell of some Conulariæ, as for instance *C. bilineata* and *C. aspersa* at once makes such a comparison impossible. Their presence, on the contrary, is a homology with the recent Pteropoda, amongst which several of the *Cleodoræ* and the *Styliolæ* are provided with quite similar septa. These septa do not occur in all Conulariæ, but are represented in many by one or more median, ingoing folds. When more specific forms shall have been found and there is more

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<sup>1)</sup> Lately also IHERING in his paper: »Die Aptychen als Beweismittel für die Dibbranchiatennatur der Ammoniten» in N. Jahrbuch für Miner. und Geol. 1881, Bd 1 p. 87 insists that the Conulariæ are no Pteropods, but rather to be considered as Cephalopoda, analogous to *Endoceras*. Of course the thinness of the shell in most of the Conulariæ cannot in itself be held as a very valid argument for their relation to the Pteropods, but taken in connexion with the characteristic ornamentation of its exterior, with the remarkable longitudinal septa of the interior the aspect of the matter looks otherwise. The argument proffered that since the Palæozoic period no Pteropoda have been found before the Tertiary age is of no value. Since the year 1881, when IHERING published the statement given above, Conulariæ as well as Hyolithes have been detected in mesozoic formations and moreover the circumstance of a fossil form not having been found does not imply that it never did exist when the strata in question were formed. The same mode of reasoning might some time ago have been as well applied for instance to *Chiton*, of which then no specimens were known in the strata between the palæozoic and latest tertiary. The significance of the size in the palæozoic and the recent ones is not to be taxed as high as IHERING and his followers think. Nor can I find on what grounds IHERING enumerates HALL and SALTER amongst the supporters of his views. The former in his latest works at least places the Conulariæ amongst the Pteropoda, as well as SALTER in his posthumous Catalogue. DANA in the Manual of Geology makes the mistake to delineate the septum of Conularia with a siphonal opening. The presence of one or more diaphragms in this shell proves quite as little their nature of Cephalopoda as the occurrence of diaphragms in true Gastropoda or even other groups of animals (*Serpulæ* and others, *Amplexus* amongst *Corals*) prove anything for their being Cephalopoda.

ample material to work upon, these peculiarities in structure may serve to subdivide the Conulariæ in narrower circumscribed subgenera, as there are concomitant characters, for instance in the ornamentation.

As to the peculiar diaphragmas, which have been observed in so many Conulariæ near the apex, in some species one, in others several, there is nothing in this feature that is discordant with the interior structure of the Pteropods, in so many respects aberrant from the other Mollusca. In the genus *Triptera* QUOY & GAYMARD (*Cuvieria* RANG) <sup>1)</sup> there is a diaphragma or entire transverse septum near the apex, dividing the shell into one large chamber, where the animal is lodged, and one smaller, forming the empty tip and often deciduous, quite as it has been the case with *Conularia*, where the apex is gone below the septum. In consequence of what now has been stated, this genus *Conularia* may be left amongst the Pteropods, until some positive and decisive facts have been adduced, causing its removal into another systematic place.

There is, however, a species, *C. fecunda*, described by BARRANDE in his *Syst. Silur. de Bohême*, vol. III p. 38, which has an exceptionally thick and heavy shell, of many superimposed layers of shelly matter. Such a fossil may throw doubt on the Pteropodan nature of the whole genus. This species links another curious fossil, *Tetradium* FR. SCHMIDT, non DANA <sup>2)</sup>, with the Conulariæ and makes it probable that it may stand in some affinity to them, though it not, as has been supposed, is likely to have been the operculum of some *Conularia*. It is quite as heavy and compact as *C. fecunda* and the anterior aperture has the side corners prolonged into hornlike spines. As to the interior tubular structure as shown by SCHMIDT in his fig. 8, and which according to him also is seen in *Conularia*, it may probably be derived from some parasitic fungus, as so often is the case and also may be seen further down in *Tryblidium*. In the specimens of *Conularia*, which I have examined, I have not hitherto found anything at all analogous.

In Sweden the Conulariæ make their first appearance in the Upper gray Orthoceratite limestone of the isle of Öland with a species, which is scarcely discernible from the later, which occur in the Chasmops limestone of Böda on Öland, in the younger Retiolites shale of Borenhult in Östergötland and, as it now seems likely, also in the Upper Silurian strata of Gotland under the name of *C. cancellata* SANDB.

Of this genus there are found in Gotland five species of which three are comparatively common, but of the two others only one specimen to each is known.

These species may be arranged in the following groups.

\* Ornamental ribs thick with closely set tubercles.

1. *C. cancellata* SANDBERGER.
2. *C. monile* n.

<sup>1)</sup> Description de deux genres nouveaux appartenant à la classe des Pteropodes, Ann. Sc. Nat. Tome XII p. 324.

<sup>2)</sup> SCHMIDT *Miscellanea Silurica* II. in *Mém. de l'Acad. Sc. de St. Petersburg* VII Ser. Tome XXI. N:o 11 p. 42.

\*\* Ornamental ribs smooth.

3. *C. lævis* n.

\*\*\* Ornamental ribs extremely narrow and close with microscopically minute tubercles. Two median septa along the faces.

4. *C. ilineata* n.

5. *C. aspersa* n.

### 1. *Conularia cancellata* SANDBERGER.

Pl. I fig. 1—3.

<i>Conularia quadrisulcata.</i>	1824.	DALMAN (not Sow.) Vet. Akad. Handl. 374, tab. IV f. 3.
»	1828.	HISINGER Anteckningar hft. 4; 72, 236.
»	1829.	Id. Tableau des pétrif., 8.
»	1831.	Id. » » Ed. 2, 6.
»	1837.	Id. Lethæa Suecica, 30, pl. X f. 5.
»	1839.	SOWERBY in MURCHISON Silurian Syst. II, 626, pl. XII f. 22.
»	1840.	HIS. Anteckn. VII, 70.
<i>C. Sowerbii.</i>	1843.	MORRIS Catal. Brit. Foss. 168.
»	1845.	VERNEUIL in MURCHIS., VERN. & KEYSERL. Russia vol. II, 348, pl. 24 fig. 5 a—b.
»	1854.	MORRIS Catal. Brit. Foss. 2d Ed. 232.
»	1855.	SALTER Appendix to SEDGWICKS British Palæozoic Fossils, VI.
»	1858.	FR. SCHMIDT Untersuch. Silurform. Estlands, 209.
»	1859.	SALTER Siluria 3d Ed., 550, pl. 25 f. 10.
»	1860.	EICHWALD Lethæa rossica vol. I, part II, 1052.
»	1867.	ETHERIDGE in Siluria 4:th Ed., 534.
»	1867.	LINDSTRÖM Nomina fossilium Gotlandiæ, 23.
»	1873.	SALTER Catal. Cambridge Sil. Fossils, 67, 153, 171, 185.
<i>C. cancellata</i>	1847.	SANDBERGER Neues Jahrb. f. Min. & Geol., 20 (= <i>C. quadrisulcata</i> Sil. Syst.)
»	1848.	BRONN Nomenclator, 327.
»	1855.	MAC COY in SEDGWICK'S Brit. Palæoz. Rocks, 287.
»	1867.	ETHERIDGE in Siluria 4:th Ed., 534.
»	1869.	HEIDENHAIN Graptolithführende Geschiebe der norddeutschen Ebene. Zeitschr. d. Deutsch. geol. Ges., 162.
<i>C. curta.</i>	1847.	SANDBERGER N. Jahrb., 14 (= <i>C. quadrisulcata</i> DALMAN, HIS.)
»	1848.	BRONN Nomenclator, 327.
<i>C. erenijugata.</i>	1847.	SANDBERGER N. Jahrb., 19 (= <i>C. Sowerbyi</i> VERN. and MORRIS).
»	1848.	BRONN Nomenclator, 327.
<i>C. proteica</i>	1854.	BARRANDE Neues Jahrb. f. Min. & Geol., 2.
»	1865.	Id. Défense des Colon. III, 41.
»	1867.	Id. Syst. Sil. Boh. III, 48, pl. 5—6.

Shell conical, quadrilateral, but so much compressed from the sides, that it looks almost bilateral, two of the four faces being on the same side, divided through a deep furrow, which runs exactly along the median line of that side from the aperture to the apex. The two other dividing furrows are situated at the exterior edges of the shell. A transverse section near the apex is in well preserved specimens rhomboidal, further down towards the apex elliptical or resembling the number 8, being deeply indented along the median axis of the sides by the lateral grooves. The four sides are each, near the aperture, prolonged into a broad tonguelike lobe, through which the aperture is much narrowed, as these four lobes nearly meet and only have a narrow



opening between them. The shell is exceedingly thin and consequently wrinkled and much crushed, but still retaining the delicate details of its fine ornamentation. It consists of two layers, the inner one being thinner and of a paler colour. The colour is pale yellow and in some instances brownish. The transverse ridges of crenulations which adorn the exterior surface are five on a length of 2 millimeters, and bent in an obtuse angle upwards, towards the median axis of the side, in some the inclination being so feeble, that the ridge nearly has the form of a straight line. The longitudinal axis is not always exactly in the midst of the side, being in some specimens situated a little nearer the outer edge and thus dividing the face in two unequal moieties. The furrows between these ridges are nearly twice as large as them. The ornamentation of the ridges and the furrows varies with the distance from the apex. Near this the ridges are smooth without any indentations, but they are higher up first beaded by blunt tubercles, which from the middle of the shell take the shape of more or less blunt spines, as is shown on a magnified scale in figures 1—3. Each spine continues downward into the furrows in a sort of handlelike prolongation, obliquely slanting towards the median axis of the side and between these handles there are oval, excavated pits. The spines of the adjacent ridges, as seen in figures 1—2, are arranged in alternating position; every second row having its spines above each other and placed opposite to the interstices of the two nearest, below and above. In a longitudinal section therefore, as figure 3, there are seen alternating long and short spiny projections, the long ones being real spines, the shorter again the next ridge, cut through in a spot between two of its spines. The spines are interiorly hollow towards their base and consequently, when the point is broken off, as often happens, an annular opening is formed. The septum, which is situated near the deciduous apex and closes the shell, when the apex is gone, is smooth and glossy, of the same pale yellow colour as the shell and covered by a few irregularly concentric lines.

*Dimensions.* Height 44 millim., breadth of a face near the aperture 16 millim.; fragment of another face 23 millim.

*Occurrence.* It has been found in the oldest shale beds (*a*) in Fårö at Kyrkviken, and other localities, in the lowest beds at Hallshuk, on the shore south of Gnisvärd, and at Djupvik in Eksta. It has also been collected in the overlying limestone of Lansa in Fårö, Snäckgärdet and Vattenfallet near Wisby. It is most common in Fårö, from where the State Museum possesses nearly 30 specimens.

This species has a wide distribution in time and space. I cannot distinguish the specimens occurring in the Upper gray Orthoceratite limestone of Öland, in the Chas-mops limestone and in the Retiolites shale at Borenshult from the Upper Silurian species<sup>1)</sup>. There are only small variations depending on the state of preservation and others of mere subordinate value. Nor can I find any specific distinction between the English and Bohemian specimens, which I have seen, and the Swedish ones. The beautiful plates of BARRANDE moreover are decisive. It is unaccountable how this species has been so often named as *C. Sowerbyi* DE FRANCE. In vain I have searched in

<sup>1)</sup> For an elucidation of the various groups of the Swedish Silurian formation, mentioned here and elsewhere in this memoir, see Appendix A.

the »Dictionnaire des Sc. Nat.» where it is stated that DE FRANCE has named it. I only find in vol. 32 p. 193, article »Mollusques», which is entirely written by BLAINVILLE, »Conul. Sowerbii DEF. Dict. des Sc. nat., Fossiles», but on turning to that article nothing at all is found concerning Conularia. The accompanying figures are exact copies from the Mineral Conchology of SOWERBY of his *C. quadrisulcata*, which no doubt is a Carboniferous species. *C. Sowerbyi* is consequently a synonym of this species and not of the Silurian one. When thus neither the name *C. quadrisulcata* nor *C. Sowerbyi* can be employed, we are obliged to adopt the next in chronological order and then we have three described, all at the same time, by SANDBERGER. But these three species, cited above, are only synonyms. Of these I have chosen *C. cancellata* as being given to the species of the »Silurian System». *C. curta* has the priority but is very unappropriate and seems to be founded on a spurious specimen. As SALTER, App. Brit. Pal. Fossils p. VI, remarks, the Devonian *C. Gerolsteiniensis* D'ARCH. & VERN. is so nearly related to this, that it may be considered as a variety.

Amongst the American Conulariæ, described by HALL, *C. trentonensis*, Pal. N. York vol. 1 p. 222, possibly is the same as *Con. cancellata*. See also EICHWALD Leth. ross. 1 p. 1057 on *Con. trentonensis*.

## 2. *Conularia monile* n.

Pl. I, figs. 9-12.

Shell formed as a regular, foursided, narrow and elongated pyramid. The transverse section of the aperture is a regular quadrangle having each of its corners inflected by a groove. The shell substance is comparatively thicker in this than in the other species and consists of an exterior, darkly coloured stratum, which is thicker than the interior thin and pale one. The ornamenting, transverse ridges, of which eight are contained within a length of 2 millim., are bent in an obtuse angle, larger than in any other Swedish species. Its apex is situated exactly on the median axis of the face. The interstitial furrows are quite as large as the ridges or a little narrower. The ridges near the apex of the shell are smooth or nearly so, higher up they are closely studded by narrow, elongated, laterally compressed or sharply edged lamellæ, ending in an acuminate point upwards and placed in oblique rows on the ridges, their lower apex turned against the median axis. The intervening furrows are quite smooth. On the nucleus, where the shell has been destroyed, there is an impression of a median ridge, nearly one millim. broad. It runs on the inside of the shell along the median axis of each face, thus corresponding to the line which may be thought combining all the apices of the angular ridges on the outside. It forms consequently a blunt, longitudinal ridge on the interior wall of the shell. Height 24 millim., diameter at the aperture 14 millim., diameter across the lower broken end 5 millim., diagonal line at the upper aperture 14 millim., diagonal at the lower end 6 millim. Found only once in the limestone strata *b* near Wisby.

### 3. *Conularia lævis* n.

Pl. I figs 13—16.

Shell regularly pyramidal, foursided, elongated and narrow. Transverse section of the aperture quadrate, the four faces being of the same size or nearly so. Owing to the deep furrow along the middle of each face the outline of the transverse section becomes nearly quadrilobate. The shell substance is thicker than in anyone of the other species. It is glossy, brownish yellow and an exterior thicker stratum covers the interior one, which is paler and thinner. It is transversally wrinkled by irregular folds, curved upwards in a gentle arch, sometimes large and sometimes narrow. In some specimens there are only faint traces of such wrinkles and the shell is almost smooth, even for long distances. The wrinkles are often not continuous across the deep, longitudinal furrow, which divides each face into two halves, but are in pairs, which do not always exactly correspond with each other, the opposite ones not being placed on the same level. Besides these wrinkles there is no other ornamentation excepting smaller and finer striæ parallel to the wrinkles. The longitudinal median furrow is, as already mentioned, uncommonly deep, but there are no vestiges of any septum, connected with it on the inside as in some other species. The grooves in the corners are entirely smooth and the transverse folds cease ere they reach them.

Height of the most complete specimen 27 millim., diameter at aperture 12 millim., diagonale 14 millim., diam. of the broken apex 4 millim. A fragmentary specimen from a detached block of the white limestone of the stratum *c* measures 35 millim. in length, 13 millim. in breadth.

It has been found in several specimens in Fârö, in the limestone of Bara hill, near Wisby in the middle limestone stratum, *b*, and in the passage bed with *Pterygotus* between the strata *b* and *c* and lastly in the limestone with *Rhizophyllum* near the church of Lau.

This beautiful species, so dissimilar to the other Gotland species is nearly related to the English Lower Silurian (Caradoc) *C. lævigata* SALTER Mem. Geol. Survey, III, 354, which, however, is rhomboidal in its section. The Bohemian *C. pyramidata* HÖENINGHAUS (BARRANDE. Syst. Sil. Boh. vol. III, p. 50, pl. 2 fig. 1—6) is much larger, but of the same tapering, straight pyramidal form and has the wrinkles unequal. A much later species, the *Con. missourensis* SWALLOW from the Carboniferous formation, comes also very near to *C. lævis*.

### 4. *Conularia bilineata* n.

Pl. I figs 4—8.

Shell regularly foursided, pyramidal, but short in proportion to its broad basis. Two of the sides are larger than the others and the opposite sides are of the same

size. The section of the aperture is rectangular with the corners rounded and a little bent in by the grooves. The substance of the shell is extremely thin, quite as much as in the following species, and seems to consist only of a single stratum, which has a chestnut brown colour. The outer surface is very finely striated by arched, almost microscopically minute, transverse lines. They form a gentle curve, highest at the median, longitudinal axis of the face and lowest at the corners, where they again are slightly bent upwards. They are so crowded as to be about 26 within a length of 2 millim. from the midst of the shell and upwards (fig. 7), but lower down, near the apex, they are more apart (fig. 6), that the interstitial furrows there are nearly thrice as large as the elevated lines. When these transverse lines are examined with high magnifying powers they are seen to be covered with closely set, elongated, oval tubercles (fig. 8), protracted into acuminate apices above and below. The interstitial furrows are quite smooth and glossy. What is most remarkable in this species is the presence of two longitudinal septa on the interior surface of each face. They are seen on the outside through the transparent shell, as two black longitudinal lines, which continue slightly diverging from each other, being one millim. distant near the apex and 3 millim. near the aperture, always on both sides of the median axis of the face. They project a little inward in the cavity of the shell, as seen in fig. 5 and they correspond evidently with the single ridge of which there is a faint trace in *Conularia monile* and are probably also homologous to the longitudinal septum of the recent *Styliola*. — Height 40 millim., breadth at aperture 32 millim., shorter diam. of same 28 millim., diagonal 35 millim., breadth at apex 5 millim. Hitherto only one specimen has been found in the shale beds at Lansa in Fårö.

### 5. *Conularia aspersa* n.

Pl. VII figs 1—3; pl. XIX fig. 1.

Shell tapering, conical, probably regularly pyramidal, but this cannot be ascertained as the extreme thinness of its substance has caused that it has been preserved only in compressed and wrinkled specimens and consequently the outlines of only one face is laid in view, when the soft, marly limestone in which it is enclosed, is split open. Although the thin shell is bent in many creases and wrinkles, its delicately ornamented surface is beautifully clear and distinct. Along the median axis of each face there run two straight, nearly parallel septa, visible on the outside as dark narrow lines. There are absolutely no ingoing folds on the exterior surface, where they are situated, what is so common in other species except the preceding one. They slightly deviate in their course upwards and are nearly two millimeters apart near the aperture. The transverse rows of the ornamental tubercles are more closely set than in the preceding, nearly related species. They number as many as 14 along a longitudinal line of one millim. Being so close, they with their tiny tubercles give the surface a chagreened appearance. The tubercles are nearly circular knobs with the interstices confusedly streaky. The colour is dark brown or chestnut.

Length 51 millim., breadth near aperture 25 millim.

Several specimens have been found in the Pterygotus beds between the middle and superior limestones at Vattenfallet near Wisby.

This and the preceding species form a division of their own with two septa on each face and the microscopically minute ornamentation. Among coëval species the Bohemian *C. munita* is somewhat resembling.

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# GASTROPODA.

## Fam. I CHITONIDÆ GUILDING.

### Gen. CHELODES DAVIDSON & KING.

1867 *Chiton* BARRANDE Syst. Sil. de Bohême vol. III p. 175.

1874 *Chelodes* DAVIDS. & K. Qu. Journ. Geol. Soc. p. 167.

*Valves oblong, generally longer than broad; no laminae of insertion nor sutural laminae; apical area of the inside highly developed.*

It was only with some hesitation that I placed these curious fossils, of which there are at least two species, amongst the Gastropoda as a genus of the Chitonidæ. Led astray by some superficial points of resemblance I at first mistook them for one of the aberrant group of the Brachiopoda, the Trimerellidæ, and accordingly sent the material I then could dispose of to Mr DAVIDSON, when he jointly with Prof. KING was working out a Monograph on that group. They described the only form which was then known as *Chelodes Bergmani*<sup>1)</sup>, stating that it was none of the Trimerellidæ, but that it rather should be considered as belonging »to a section of the Coelenterates, represented by *Calceola* and *Goniophyllum*». The authors do not expressly say whether it should be regarded as the polyparium itself or as the operculum, but it seems most likely, that they have thought the last to be the case. There is, however, no coral in the Silurian formation of Gotland that possibly could have been provided with an operculum of so peculiar a shape. The form of the calyx at its aperture is generally circular or polyëdric, never assuming such an outline as *Chelodes* shows.

There is not the least doubt that these questionable fossils belong to the same genus as those which BARRANDE in the third volume of his grand work »Système Silurien de la Bohême p. 175, pl. 16 fig. 19—28 has figured and named *Chiton Bohe-micus*. Besides this there are several other palæozoic fossils of almost the same shape, which have also been referred to the genus *Chiton*. Closely related to the Silurian ones are some detached plates, which KIRKBY has described and figured with some hesitation

<sup>1)</sup> Qu. Journal Geol. Soc. 1874, p. 167.

as belonging to his *Chiton? cordatus*<sup>1)</sup>. It may now be questioned whether all these similar fossils truly be remains of Chitons or not. What most strongly militated against their belonging to that family of Gastropoda was the circumstance that they are all entirely wanting the characteristic two apophyses or sutural laminae which are situated in the anterior margin of the plate and believed to be present in all recent Chitons and in almost all the palæozoic ones described by DE KONINCK, RYCKHOLT, KIRKBY, BAILY, SALTER and SANDBERGER. In the Gotland specimens and, as far as one is able to judge from the figures and descriptions of BARRANDE and KIRKBY, also in the Bohemian and the supposed median plates of *Chiton? cordatus* there is not the least trace of there ever having been any apophyses. Nor does the elongate shape of the plates, generally longer than broad or often of the same height as breadth, agree with the transverse form of the plates so common amongst the recent and fossil Chitons. As KIRKBY remarks (Qu. Journ. Geol. Soc. vol. 15 p. 617) there is, however, one of the recent Chitons, *Ch. hastatus* Sow.<sup>2)</sup>, in which the intermediate plates bear a close resemblance to the palæozoic ones. Moreover, in the recent genus *Leptochiton* CARPENTER, now confined to the arctic and temperate seas, there is an approach to the plates in the palæozoic Chitonidæ as they are without any laminae of insertion, but mostly provided with sutural laminae<sup>3)</sup>.

On the inside of the plates of *Chelodes* there is also a feature, which is by far not so prominent in *Chiton*. At the pointed posterior end of the inside is a large triangular area, covered by transverse, parallel, curved lines of growth. In *Chelodes Bergmani*, for instance, it occupies a little more than half the length of the plate. A similar, I should be inclined to say a homologous, area is seen on quite the corresponding place in the more recent Chitons, although it there in most of the transverse plates is restricted to a narrow stripe. In others again it occupies nearly a third of the total length of the plate. It seems hardly to have received all the attention it deserves, even not by such an accurate monographist as MIDDENDORFF. It is evidently with this part of the interior surface that the plates posteriorly overlap each other and which consequently is not covered by the tissues of the animal. By the continued growth of the plate this area must be enlarged, when the soft tissues retire and a new line of growth is added to it. The mode of formation of the interior apical area of *Chelodes* has in all probability been the same, although it is enormously more developed than in most Chitons, perhaps only having its counterpart in *Chit. hastatus*.

Excepting the Chitons there are no other shell-covered animals with which *Chelodes* may be compared than the *Lepadidæ*. Amongst the numerous valves, which form the integument of the *Lepadidæ* there are only two or three regularly formed, whilst all the others are more or less oblique. There is indeed some similarity be-

<sup>1)</sup> »On the permian Chitonidæ». Qu. Journ. Geol. Soc. vol. 15 (1859) p. 616, pl. 16 figs. 25—26 and also in the Geological Magazine vol. 4, p. 341, pl. 16 figs 11a—11b, where KIRKBY and J. YOUNG describe the Chitons from the Carboniferous strata of Yorkshire and Western Scotland.

<sup>2)</sup> REEVE *Conchologia Iconica*, vol. IV, pl. 25 fig. 166 and plate showing details of sculpture, enlarged fig. 166.

<sup>3)</sup> DALL, H. W., the results of the recent investigations into the Natural Hist. of the Chitonidæ. Smithsonian Miscellaneous Collection, vol. XX, p. 193.

tween the valve which DARWIN calls rostrum<sup>1)</sup> and *Chelodes*. This is evident if we for instance compare the rostra of the genus *Scalpellum* DARWIN, *Lepadidæ* pl. VI, figs. 6a, 7a, 8a, and amongst the fossil ones *Pollicipes Nilssoni* DARWIN, *Fossil Lepadidæ*, Pl. III fig. 11 d, and it seems indeed very likely that some of them really have been mistaken for Chitons and figured by KIRKBY in the paper cited above. The general outline is almost the same and on the inside there is also an apical area, composed of concentric lines of growth. This area seems, however, not to have been formed in the same manner. In the *Chitonidæ* and consequently also in *Chelodes* its superior or youngest margin is always elevated above the upper or distal part of the interior face, as is also the whole area; in the *Lepadidæ* again the area is generally lower than the other surface. If *Chelodes* were a *Cirrhipedian*, it would be in the highest degree strange if only one valve, the regularly formed rostrum, had been preserved and not a single one of the others, which are at least six in number, but in some species much above hundred.

A quite different conjecture as to the nature of this fossil is given by IHERING in his paper on *Aptychus*<sup>2)</sup>. He there, page 70, says »that it is at least to me highly probable that what BARRANDE has described as the plates of Chitons, in the reality are Aptychs of Silurian dibranchiate Cephalopoda». He continues, that if they are derived from Chitons, they can be interpreted only as the final plates and it is strange if only these were preserved of all eight plates. Against this is to be remarked first that the plates figured both by BARRANDE and by me are not all identical, but of different orders, secondly that in the recent *Chiton hastatus* the plates are quite as acuminate and elongated relatively as in the Silurian ones. Moreover, the conformation of the inside, which was unknown to IHERING, removes these fossils from *Aptychus*. As to the microscopical structure, on which IHERING justly lays so much stress, there is unfortunately no guidance to be had, as the chief mass of the very thick plates of *Chelodes* has been converted into clear, transparent calcareous spar.

What, for the rest, adduces me to range *Chelodes*, at least provisionally, with the *Chitonidæ*, notwithstanding all that has been said to prove its similarity with other groups, is the circumstance that the exterior ornamentation of the plates is in complete accordance with that of the *Chitonidæ*. Moreover, there is at least one ascertained instance, in which valves of the palæozoic Chitons, also wanting apophyses, have been found in their *original* position. In the specimen of *Chiton Grayanus*, drawn on plate I fig. 1 of DE KONINCK'S »*Deux espèces siluriennes de Chiton*», there are five valves in juxtaposition.

But if we now are to conclude that *Chelodes* is one of the *Chitonids*, it shows so great differences from the others, that it cannot belong to the genus *Chiton* proper, where BARRANDE placed it, but must form a genus of its own. Of all the palæozoic subgenera, no less than 13 created within the last twenty years, there is one, *Sagmaplaxus* OEHLERT<sup>3)</sup>, which so nearly coincides with *Chelodes* that both may be con-

<sup>1)</sup> DARWIN Monograph of *Cirrhipedia*. *Lepadidæ*. Ray Soc.

<sup>2)</sup> Die Aptychen als Beweismittel für die Dibranchiatennatur der Ammoniten. N. Jahrb. für Mineralogie etc. 1881, 1 Bd Heft 1, p. 44.

<sup>3)</sup> Documents pour servir à l'étude des Faunes dévoniennes dans l'ouest de France in Mém. Soc. Géol. de France 3:me Sér. tome II, p. 15, pl. II, fig. 3, 3 a, 3 b.



sidered as ranging very near to each other. The author says expressly »il n'existe pas d'apophyses d'insertion à la partie antérieure». Its area is also described as large as that in *Chelodes*. *Sagmaplaxus* occurs in the »Dévonien inférieur de la Sarthe» and can indeed be said to be a more developed descendant of *Chelodes*. It is by far larger and longer than the latter.

### 1. *Chelodes Bergmani* DAVIDSON & KING.

Pl. II figs 1—8.

*Chelodes Bergmani* 1874 DAV. & K. On the Trimerellidæ etc. Qu. Journ. Geol. Soc. vol. XXX, p. 167, pl. 18, fig. 14—14 a—d.

Plates of conical outline, anterior margin straight or slightly emarginated or even convex, lateral margins continuing nearly parallel a little below the middle, then suddenly converging to form the acute posterior apex. Surface somewhat weathered, shows faint traces of punctuate ornamentation on the transverse lines of growth. These are most conspicuous near the lateral margins and they are parallel with the anterior margin of the plate. In a transverse section the plate has the shape of a crescent, being evenly arched, without any sinuosity on the back. The inside of the plate is divided in two parts, of which the posterior, occupying exactly half the total length, consists of the slightly excavated apical area. The transverse, gently arched lines of growth resemble narrow, low ridges or callosities, they are very numerous and dense and the whole area is raised a little above the anterior part of the valve. This is longitudinally divided in two portions by a well marked sinus, towards which the sides gently slope. This anterior surface is smooth, showing only indistinct traces of muscular impressions towards the lateral margins, being near the sinus coarsely and longitudinally wrinkled. All around the lateral margins of the interior surface there runs an elevated narrow border, formed, as it were, by the bending over of the exterior shell stratum. The plate is at its thickest in the median part and thins off towards the apex.

Height 20 millim., breadth 13 millim.; thickness in the middle 5 millim., at the apex 1,5 millim.

Two specimens have been found in the uppermost limestone of Klinteberg and a single plate in the oolite quarry near Gannvik in Grötlingbo.

### 2. *Chelodes Gotlandicus* n.

Pl. II figs. 9—27.

Plates cordate, with anterior margin deeply emarginated, posterior apex acuminate, lateral lines, combining anterior margin and apex, gently curved. The plates are generally longer than broad, much varying, as may be seen by the dimensions given below, some even being transverse. They have consequently been placed in different positions of the series. They are much more elevated along the median line of the back, than in the former species and the sides are more sloping. In a transverse sec-

tion (fig. 23) they form a nearly right angle. The surface is deeply grooved by transverse ridges, coinciding with the lines of growth and separated from each other through narrow interstices. They exactly follow the same direction as the outlines of the anterior margin, being bent backwards at the lateral margins, then forwards and on the middle of the back again backwards, thus forming a sigmoid line. They are most conspicuous near the margins. There is a central area formed by two lateral, longitudinal grooves, which run nearer to the lateral margin than to the central ridge and converge towards the posterior apex. These grooves are conspicuous in a few specimens, being effaced by corrosion in the others. The exterior surface is moreover ornamented by numerous, minute wartlets, which are closely set in regular, transverse rows (fig. 15). On the inside of the valves there is seen, first the posterior apical area, which is of highly varying width, in some occupying nearly half the length of the surface, in others only a fourth (fig. 25) just as in a recent *Chiton*, of which a figure is given on plate II, fig. 28. Owing to the state of conservation of the specimens, the lines of growth are more obscure than in the former species. The whole inside is longitudinally divided into two halves by a deep sinus; the sides being more scooped out at the apical area, the side parts of the anterior surface being more tumid. No traces of muscular impressions are visible.

Specimen A height 18 millim., breadth 14 millim., B h. 11 millim., br. 12 millim., C h. 18 millim., br. 11 millim. In a specimen of 14 millim. in length, the greatest thickness of the plate is 3 millim.

This species is more common than the preceding and has been found in several specimens at Grötlingbo in the oolite quarry near Gannviken, in the sandstone of Bursvik, in the oolite near Rone and also in several detached plates in the limestone above »Kälens qvarn» near Wisby.

## Fam. II. PATELLIDÆ D'ORBIGNY.

### Gen. TRYBLIDIUM LINDSTRÖM.

Syn. 1836. *Metoptoma* PHILLIPS p. p. Geol. of Yorkshire pt. 2 p. 223.

1880. *Tryblidium* LDM apud ANGELIN & LINDSTRÖM Fragmenta Silurica p. 15.

*Shell patelliform, obovate, anteriorly acuminate, posteriorly enlarged, forming a very low cone. Apex anterior, nearly marginal, with only very little area beneath. Margin of the ovate aperture arched, so that the animal, when fixed, was not entirely hidden beneath its shell. Muscular scars in six, disconnected pairs, arranged in an oblong circle, open or nearly so towards the front part of the shell. Intimate structure of the shell somewhat resembling that of the recent Patella, being composed of thin strata of polygonous cells.*

This new genus, which I at first described in ANGELINS and my work »Fragmenta Silurica» p. 15, had by some palæontologists long been considered as belonging to the

brachiopoda, though they did not publish their opinion. When we, however, compare one of the species, *Tr. unguis*, with recent forms of the genus *Patella*, it is quite evident that it both on exterior and interior grounds should be numbered amongst the Gastropoda and especially in the family of the Patellidæ. In plate I, fig. 38 there is delineated a recent species of the subgenus *Nacella* ADAMS from Foua, which as to its exterior shape, sculpture and colouring as nearly as possible resembles *Tr. unguis* fig. 33. And again if we turn to the interior muscular scars and compare figures 30 and 37 on the same plate with *Patella cochlear* L. fig. 32, there is, if we except some differences in the details, the same disposition of the six or seven pairs of those impressions. The species of this Silurian genus *Tryblidium*, and especially, such a form as *Tr. unguis* may then be added to the so called persistent types of HUXLEY, which as the *Lingulæ* and *Crania* amongst the Brachiopoda and *Calostylis* amongst the Corals have continued till our time with small or insignificant modifications in their structure. It is intermediate between the recent genera *Olana* and *Nacella*.

In the Silurian species the scars are disconnected and deep, the more so in the oldest form, »*Patella antiquissima*, from the Swedish Lower Silurian, being approached, though separated, in the Upper Silurian species. In the recent *Patellæ*, the scars are in most species nearly connected, though it, especially on their inner margin, is possible to discern how they have been independent. This is the more evident, when we turn to the animal itself, where muscular pairs of variable number in the same species, from six to nine, are distinctly detached and free at least partially and do not form a continuous ring as in the *Scutellidæ*. As in *Tryblidium* the foremost pair is also the largest with the recent *Patellæ*, but there is the great distinction that both these last muscles of the living *Patellæ* are united through a narrow stripe of muscular tissue, forming an arched curve, also visible as a scar on the shell, whereas in *Tryblidium* the narrow stripes which are emitted from the large, foremost scars do not unite, but leave an open space between them. Characteristic to the foremost pair in *Tryblidium* is also the large appendiculated scar on their inner margin, of a peculiar reticulation, described more in detail below in *Trybl. unguis*. The change in this respect from the older to the recent *Patellæ* has thus consisted in the concentration of the once detached and entirely independent muscular scars.

In the »Palæozoic Fossils of Canada» BILLINGS has described a species of *Metoptoma*, *M. Hyrie*, p. 87, fig. 79, which comes near to *Tryblidium unguis* as far as may be judged by the exterior appearance. It is evident that BILLINGS in the cited work has enclosed within that genus too many species which do not show the characters given by its author PHILLIPS in »*Geology of Yorkshire*» pt. 2, p. 223 and that consequently only some of them are true *Metoptomæ*. MEEK and WORTHEN<sup>1)</sup> make the adequate remark, that later authors have given to that genus a greater extension than PHILLIPS intended. The new genus which I have proposed, differs from *Metoptoma* in wanting the broad truncated area below the apex. The muscular scars also differentiate these two genera, as there in *Metoptoma*, for inst. *M. pileus* PHILLIPS, according to DE

<sup>1)</sup> Proc. Acad. Nat. Sc. Philadelphia, 1866, p. 266.

KONINCK in *Descript. Anim. foss. de Belgique Suppl.*, p. 685, pl. 58, fig. 1, exists a coherent muscular scar, horse shoe shaped, with the apex of the shell towards its hind side<sup>1</sup>), whereas in *Tryblidium* there are six pairs of detached scars, and the apex anterior.

From the uppermost beds of the Lower Silurian rocks of Esthonia, at Borkholm, I have seen specimens of two species belonging to this genus, true forerunners to the two Upper Silurian ones; of these one can scarcely be distinguished from *Tr. unguis*, the other again very closely resembles *Tr. reticulatum*. From Raiküll in Esthonia, in FRIEDRICH SCHMIDTS stratum G 3, at the base of his Upper Silurian there occurs also a third species, allied to *Tr. unguis*, but regularly, transversally imbricated by equidistant lines of growth, and of an almost elliptical outline.

Mr I. F. WHITEAVES, of the Geol. Survey of Canada, has recently<sup>2</sup>) described a »*Tryblidium Canadense*» from the Guelph formation of Canada. In respect to its exterior shape it might well be united with the *Tryblidia*, though it is more elevated, but the figures of pl. V, f. 1 & 1a show a narrow, continuous ring of muscular impression, quite unlike what prevails in the other *Tryblidia* and, moreover, there are below the apex two oval depressions different from anything seen in the *Tryblidia*. Till these points are cleared up, the Canadian species can only with hesitation be placed in that genus. WHITEAVES also thinks that *Metoptoma Niobe*, *M. Nycteis*, *M. Eubule*, *M. Erato* and *M. Hyrie* BILLINGS are typical species of *Tryblidium*. This can, however, not be finally settled, before the muscular impressions shall have been discovered.

*Metoptoma Erato* BILLINGS »*Palæozoic Fossils of Canada*» vol. 1 p. 39, is near to *Tr. unguis*, but probably identical with the Esthonian species, as it is derived from the Lower Silurian stratum called »Black River Limestone». Nearly allied to this genus is also the Lower Silurian »*Patella antiquissima*» described by HISINGER and formerly found at Borenhult in the *Retiolites* shale. In outward shape it reminds of *Palæacmæa* HALL, and it is also like several of the *Metoptomæ*, but the six pairs of most beautifully preserved muscular scars place it near *Tryblidium*.

As to the first appearance of this group within the palæozoic era IHERING says in his »*Anatomie und Phylogenie der Mollusken*», p. 82, »ist doch so viel sicher, dass die palæozoischen Patelloideen Tecturiden waren», and further: »in der Primordialfauna sind schon die Tecturiden und Lepetiden vertreten», and he seems to confound the *Patellidæ* with the *Patelloideæ*, as he numbers *Patella vulgata* amongst them, nor does he anywhere mention the occurrence of the *Patellidæ*. But through the occurrence of the *Tryblidia* and other kindred genera, already present in the Lower Silurian we find, that the *Patellidæ* were also represented by numerous, well developed shells and consequently that both families, the *Tecturidæ* and *Patellidæ* coexisted.

<sup>1</sup>) NICHOLSON again in his *Handbook of Palæontology* II p. 34 says that in *Metoptoma* »the muscular scars consist of a number of disconnected cavities».

<sup>2</sup>) *Geol. & Natural History Survey of Canada. Palæozoic Fossils*, vol. III, pt 1, pp. 30—31, 1884.

1. *Tryblidium reticulatum* LINDSTR.

Pl. I figs. 25—31, pl. III figs. 1—5.

*Tr. reticulatum* 1880. LINDST. in ANGELIN & LINDSTRÖM *Fragmenta Silurica* p. 15, tab. X, fig. 7—16, tab. XIX, fig. 9—12.

Shell much depressed and generally more flat than the following. Apex obtuse, erect, with a narrow, area-like zone between itself and the margin of the shell. Outline of the shell, when seen from above obovate, anteriorly acuminate, enlarged towards the posterior margin. The surface is ornamented by a series of thick, transverse and concentric, elevated laminae, which in the anterior, third part of the shell intercross with each other and thus form an elegant network, but in the other two thirds of the surface are parallel, wavy, thin at the edges, thickened towards their base, and evidently formed by the margins of the shell bending upwards. In the oldest part, corresponding to the shell of the young, the callous, transverse lines are very fine and crowded. Around the apex there is almost always an oblong space more or less exfoliated. The exterior stratum of the shell is there worn away, making the interior yellow stratum alone visible. Sometimes there is the false appearance as of a foramen, which has been filled up again, but this is evidently owing to imperfect corrosion.

The aperture is obovate, the margins very thick, forming a callous border. When seen from the side the line formed by the margin is an elongated curve or an arch, highest along the middle of the shell and sinking towards both ends. The foot of the animal, when resting on its basis, must then have been left uncovered along the sides. On the interior surface, which is very smooth and almost glossy, there is a dark coloured circle, formed by six pairs of muscular scars, of which the foremost are the largest and nearly connected by narrow appendages, like stripes, almost as in the recent *Olana cochlear*. See plate I figs. 30, 32. Each separate scar is more elevated towards its curved interior margin and at its exterior margin they are lobate or lacerated. The foremost pair is the largest, composed as it were, of several parts, of which the innermost is elongated, elliptical, the exterior one irregularly square; from its anterior margin there projects, from each pair, a narrow stripe; these stripes do not unite, but leave between them a short space. The central surface, enclosed by the muscular ring, is excavated in shallow, arched depressions all along the interior border of the scars, being situated in the interspaces between these. The scars themselves are separated through narrow projections from the enclosed surface. Sometimes there are large concentric callosities<sup>1)</sup> due to the irregular growth of the margin, which cross the central field.

There are specimens still retaining traces of the original colour of the shell in dark longitudinal stripes, distinctly conspicuous on the other dull surface (f. 29).

As to its intimate structure the shell consists of two distinct strata, of which the exterior one easily peels off and the interior, in specimens from certain localities, is the only one left on the nucleus of the shell. The exterior stratum is thick, attaining as much as 5 millimeters in some parts. It consists of very thin laminae which seem

<sup>1)</sup> *Fragm. Silur. pl. XIX fig. 9.*

to be composed of prismatic cells. Near the apex this outer stratum is entirely prismatic. It is generally of a whitish hue, contrasting with the interior one, which is yellow. The latter is very thin, consisting of minute lamellæ of an apparently prismatic structure. A singularity in structure is that figured on pl. III f. 4, a longitudinal section, showing the extremely thin lamellæ perforated, as it were, by narrow tubes. These cannot, as the following, be extraneous, later formed organisms, but must have originated at the same time as the laminae of the shell, as it is clearly seen that these laminae are bent exactly where the tubes are situated.

Almost the whole exterior stratum is closely perforated by what seems to me to be a different, parasitic organism. When seen with a pocket lens of sufficient power the surface is pitted by a number of irregularly placed, cream-coloured points (pl. III f. 5) which are somewhat elevated above the surface. In a thin, vertical section these white dots are seen to prolong downwards through the lamellæ of the shell as tubes which generally branch or anastomose so as to form three or four or even more branchlets (pl. III f. 1), all filled with the same uniform cream-coloured matter. In a transverse section they are also remarked to subdivide and to form openings of stellulate appearance (pl. III f. 2). Similar fossil and recent organisms have been found already long before. DUNCAN<sup>1)</sup> has described some small microscopic organisms, which penetrate the corals of the Devonian and Silurian times. KÖLLIKER<sup>2)</sup> has also more in full described a great number of such minute, parasitic forms from several invertebrate animals. Thus he mentions nine species of Gastropoda with perforated shells and he makes the same conclusion as WEDL before him, that this is due to fungous growth or to the mycelium of microscopic fungi. The white radiating tubuli in the shell-substance of *Trybl. reticulatum* make the impression of having been at first open and then to have been filled with limestone of another kind. In the nearly related species from Esthonia no such tubes are visible.

Length 40 millim., breadth 25 mill., height from margin of aperture 8 millim.

Found in the northern strata of Gotland, in Fårö at Lansa, Lutterhorn, in the limestone of Wialmsudd near Fårösund, Svarfvare huk, in the canal at Westöös in Hall and in the uppermost limestone beds of Slite. It belongs only to the higher limestone beds of Gotland, possibly beginning at the top of b. In the Lower Silurian of Esthonia at Borkholm, F. SCHMIDT'S stage 3, a variety of this species has been found, only distinguished by its thinner shell and finer reticulation, the interspaces between the callosities of the surface being nearly of the same, small size over the whole shell.

## 2. *Tryblidium unguis* LINDST.

Pl. I figs. 33—37, pl. XIX fig. 2.

*Tryblidium unguis* 1880. LINDST. in ANGELIN & LM *Fragmenta Silurica* p. 16, pl. II, fig. 10—14, excl. fig. 15.

Shell of obovate outline, anteriorly acuminate, posteriorly expanded, with the greatest breadth somewhat behind the median, transverse axis of the shell. It is re-

<sup>1)</sup> On some unicellular Algæ parasitic within Silurian and Tertiary Corals. *Qu. Journ. Geol. Soc.* 1876, p. 205.

<sup>2)</sup> Ueber das ausgebreitete Vorkommen von pflanzlichen Parasiten in den Hartgebilden niederer Thiere. *Zeitschrift f. wissensch. Zoologie* 10r Bd 1860, p. 215.

gularly and moderately convex, being most elevated near the median transverse axis. The apex is close to the anterior margin and only very little prominent. The surface of the shell is covered with thread fine ornamental lines parallel to the regular concentric lines of growth, somewhat interrupted by deeper sulci. It is generally even excepting some wavy, irregular, shallow, longitudinal furrows. The aperture is oval with comparatively thin margins, somewhat reflexed outwards. When seen from the side it forms a moderately elevated arch, being highest near the median line of the shell. The central space of the interior surface is surrounded by an oval ring of six pairs of muscular scars, open anteriorly. The posterior ones are narrow and elongate, the middle ones are transversally broad and much enlarged towards the margin of the shell. The surface of these pairs is smooth or only partially scrobiculated. The uppermost pair is more complicated and consists, as in the kindred species, of a more shallow, elongated interior portion, and of a larger exterior one, from the inner corner of which there projects a narrow sinuous groove, directed obliquely upwards and leaving a small, smooth space between itself and the opposite similar one. The lower, interior part of this upper, muscular scar is pearshaped, wide below, with a narrow, stalklike neck upwards and its surface is finely reticulated by shallow pits and intervening ridges. Some dark, narrow streaks are directed from the enclosed central space of the shell towards the interstices between the muscular scars. The whole central part of the shell inside the scars and to their outer edges is of dark colour, while the outer border is lighter. Near the apex there is on the inside a little oval depression or pit, which quite resembles a scar, filled up, as if there had been a foramen. But I think it is in reality only the mark of the outlines of the initial shell, where now the apex is seen on the outside. The shell is very thin, scarcely exceeding 0,5 millim. in thickness and composed of thin, glossy lamellæ, which are not perforated by any parasite. The largest specimen has been found at Stor Wede in Follingbo and has attained a length of 67 millim., breadth of 51 and height of 15 mill.

This species has nearly the same geographical distribution as the former. It has been found in several specimens in Fårö at Lutterhorn, Lansa and Norsholm, in Svarfvareruk, the canal near Westöös in Hall, Westkinde, Häftingsklint, Lummelund, Stor Wede in Follingbo, the limestone cliffs near Wisby and Kyrkberget in Wisby. It has only been found in the strata *b* and *c* or the upper and lower limestone and never in the shale of *a*. This is rather unexpected as the same species or at least a nearly allied variety, as mentioned above, has been found in the Lower Silurian strata of Esthonia at Borkholm and also in the Upper Silurian at Koik, in the »Jördensche Schicht». These are only a little more elongate and not so enlarged as the specimens from Gotland. In the Lower Silurian of Canada there occurs a *Metoptoma Hyrie*, of which BILLINGS, Pal. Foss. Canada p. 87, has described a cast which also perhaps on closer examination may be found to be identical. *Met.-Erato* of the same author, l. c. p. 39 and Report Progr. Geol. Survey of Canada 1863 p. 145, f. 95, can scarcely, as to outward shape, be distinguished from the Gotland species, only the distance from the beak to the margin is longer in the Canadian.

3. *Tryblidium? radiatum* n.

Pl. XVIII fig. 1, 2.

Shell oval, much elevatedly conical, the greatest height lying near the middle of the longitudinal axis. The apex anterior, truncated, curved as to lean forwards over the anterior margin of the aperture. The shell between the apex and the margin is consequently much concave. The apertural border is straight and horizontal. The surface is covered by fine, closely packed, radiating striæ and a few concentric lines of growth. The shell has been thick, as may be seen by a few fragments which are left along the borders. The general shape of this shell has led me to place it in this genus, with the other species of which it corresponds as to its outline. This is, however, more elevated like a *Helcion*.

Diameter from the apex to the hind edge 24 mill. The transverse diameter 20 millim. Height from the rim of the aperture 15 millim. Length of the aperture 23 mill.

Only a single specimen has been found in the crystalline limestone of Wialmsudd near Fårösund.

## Fam. III. TECTURIDÆ ADAMS.

## Gen. PALÆACMÆA HALL.

1873. 23d Rep. on the State Cab. of N. York p. 242.

*Shell patelliform, aperture oblongate, exterior surface concentrically wrinkled, on the interior surface near the top a wreath of muscular impressions, nearly coherent.*

It is only provisionally that the Gotland species, described below, can be placed within this genus. It is chiefly in consequence of its outward shape, which most resembles that of *Palæacmæa*. In HALL'S specimens the muscular markings are unknown. The Patelloid shells which are now and then found in the older palæozoic strata belong probably to several different genera. The »Patella» antiquissima from the Lower Silurian of Sweden is nearly related to *Tryblidium* through its series of six pairs of detached muscular scars. The typical species of *Metoptoma*, which as DE KONINCK has shown have a coherent muscular band and consequently cannot, as HALL l. c. has hinted, be plates of a *Chiton*, agree with *Lepetopsis* in the conformation of this band. In the Red Orthoceratite limestone of Öland at Wickleby Hr von SCHMALENSEE has found a specimen resembling a *Metoptoma* and another form probably belonging to the same generic group of which WHITFIELD has given figures in *Geology of Wisconsin*, vol. IV pl' 3 f. 15, 17, 18, but which scarcely can belong to *Metoptoma* as he assumes. The



oldest Gastropod known in Sweden is *Metoptoma Barrandei* LINNÆSSON from the Cambrian strata of Scania, in the lower portion of the zone of *Paradoxides Tessini*.

### *Palæacmæa? solarium* n.

Pl. XIX fig. 3, 4.

Shell patelliform, regularly acuminate, apex nearly median or slightly anterior, the outline oblongate from above. Outside of the shell smooth, only concentrically wrinkled at regular distances by larger elevated ridges, the interstices between them being finely striated by parallel lines. Interiorly there is around the apex a narrow circle of detached muscular scars, visible on the nucleus as delineated in the figure. Height 3 millims., length 6 mm., breadth 4 mm.

Hitherto two specimens have been found in the red, conchiferous limestone of Sandarfve kulle.

## Fam. IV. CALYPTRÆIDÆ BRODERIP.

### Gen. *PLATYCERAS* CONRAD.

- 1809 *Helicites* MARTIN Petref. Derbyensia, pl. 40 fig. 43.  
 1810 *Capulus* MONTFORT Conch. System. II, 54; though not intended by him for fossil species, it was adopted for such by DE KONINCK Anim. Foss. de Belgique, 331.  
 1812 *Pileopsis* LAMARCK adopted by SOWERBY Min. Conchol. vol. VI pl. 607, 223.  
 1823 *Actita* FISCHER VON WALDHEIM Mém. Soc. Imp. Naturalistes de Moscou VI, 234.  
 1828 *Turbinites* HISJINGER Anteckningar IV, 221.  
 1840 *Platyceras* CONRAD Ann. Rep. Geol. Surv. N. York, 205.  
 1841 *Acroculia* (rectius *Acrocylia*) PHILLIPS Pal. Foss. of Cornwall, 93.  
 1842 *Platystoma* (rectius *Platystoma*) CONRAD Journ. Acad. Nat. Sc. Philad., 275.  
 1843 *Orthonychia* HALL Rept. 4th Distr. N. York Geol. Survey, 172.  
 1844 *Naticopsis* MAC COY p. p. Synops. Carb. Foss. Ireland, 33.  
 1859 *Strophostylus* HALL 12th Rept. State Cab. N. York, 20.  
 1859 *Igoceras* HALL Pal. N. York vol. III, 330.  
 1868 *Exogyroceras* MEEK & WORTHEN Geol. Survey Illinois, vol. III, 508.  
 1878 *Capreolus* R. ETHERIDGE SR. (lapsu!) Qu. Journ. Geol. Soc., vol. 34, 603.

*Shell globose or naticiform with small, depressed or only moderately prominent spire, last whorl enormously developed, globose or transversally protracted and elongated. Aperture circular or oval, outer lip reflected and enlarged into a thin laminar edge, which in well preserved specimens is persistent during the continued growth of the shell and gives the exterior surface a characteristic ornamentation of projecting, thin lamina. The inner lip of the aperture much varying; sometimes with twisted (»Strophostylus»), sometimes thin and smooth columella (»Platyceras»). No operculum has ever been found.*

In justification of the above list of synonymous genera the following statements of the opinions of various authors upon this matter may be adduced. The earliest description of any fossil belonging to this group is in MARTINS *Petrificata Derbyensia*

plate 40 fig. 34, where he names a Carboniferous species as *Helicites auricularis*. Next him FISCHER VON WALDHEIM comes, who in 1823 in a list on the genera of Gastropoda gives *Actita* as identical with *Capulus* and *Pileopsis*. This is in a treatise called »*Adversaria zoologica*» Fasciculus III in the *Mém. de la Soc. impér. des Nat. de Moscou* vol. VI p. 234. That he therein also included the palæozoic species is evident, when he later in a paper of FAHRENKOHLE in »*Bull. de Moscou*» 1844 p. 802 describes an *Actita Münsteriana* from the Carboniferous limestone of Moscow. If FISCHER really intended this genus for the palæozoic forms alone, his name ought to have the priority against the later, as *Platyceras*, but it is by his first publication evident that he gave his genus quite as wide limits as already had been given to *Capulus* and *Pileopsis*. *Actita* then must be considered only as a synonym. In 1828 HISINGER in his *Anteckningar*, pt. 4, p. 221 mentions a *Turbinites*, which he also figures, and this is the same which he later, 1837, in »*Lethæa*» named *Pileopsis cornuta*. In respect of the genus he follows the elder SOWERBY, who 1835 in his *Mineral Conchology* placed the English Carboniferous species in the genus *Pileopsis*. When CONRAD in 1840 had founded his genus *Platyceras* for the palæozoic fossils of this group and PHILLIPS in 1841 his genus *Acroculia*<sup>1)</sup> for the same, the subsequent American authors sided with their countryman, and the English ones with their, in spite of the former name having the priority and that with such a tenacity that it lasted until 1851 when S. P. WOODWARD in his *Manual* accepted *Platyceras* instead of *Acroculia*. Besides, the opinions of the authors were divided between accepting the older genera *Capulus* or *Pileopsis*. DE KONINCK is the first who insisted on adopting the genus *Capulus* of MONTFORT for the palæozoic species and especially those of the Carboniferous formation. Since MEEK and WORTHEN in 1866<sup>2)</sup> announced that they had discovered horseshoe shaped muscular scars on casts of two species, *Platyceras subplicatum* and *Pl. infundibulum*, almost all authors were unanimous to range these fossils with *Capulus*. MEEK and WORTHEN, however, expressed as their opinion that these fossils »probably» are »distinct from the existing genus *Capulus*», but that they are more nearly allied to that group than is generally supposed to be the case. Moreover it may be questioned whether *Plat. subplicatum* and kindred really belong to the same genus as the Silurian ones. It has been found only in casts. As to the other species, of which only one specimen has been found, the last mentioned authors themselves seem to hesitate with placing it amongst the *Platycerata*. I have myself studied the interior surface of several specimens of *Platyceras æquilaterum* from the Burlington beds, without finding in them the least trace of any muscular scars. Nor have I been able to find any muscular impressions in the numerous specimens of the Silurian forms which I have examined. But this can, however, not be conclusive as to the deficiency of the muscular scars in the palæozoic species, because even in recent or tertiary *Capuli* the muscular impressions are very faint and in many specimens not discernible, owing to the glossy surface of the shell. It must then be very difficult and a thing of rare occurrence to detect them in specimens from palæozoic strata. Even if granted that these shells were provided with

<sup>1)</sup> Or *Acrocyllia* as it ought to be written according to the derivation.

<sup>2)</sup> Proceedings Acad. Nat. Sc. Philadelphia 1866 p. 262.

muscular scars as in *Capulus*, the globular, low or high spired forms which almost insensibly merge into each other through numerous gradations unite them all at least the Silurian ones, in one genus, which although probably a near ally to *Capulus*, still must be considered as distinct. In accordance with HALL and the American authors I retain the genus *Platyceras* for the Silurian species. But I also think it proper to unite within its limits the genera *Platystoma* and *Strophostylus*. These, as may be seen by the following comparison, are indeed not much differentiated. According to the diagnosis given by HALL<sup>1)</sup> they are thus characterized:

<i>Platyceras.</i>	<i>Platystoma.</i>	<i>Strophostylus.</i>
»Shell depressed, subglobose, subovoid or obliquely subconical. Spire small, volutions few, sometimes <i>free</i> and sometimes contiguous <i>without columella</i> , aperture, more or less expanded, often campanulate and sometimes with the lip reflexed: peristome entire or sinuous».	»Shell subglobose; spire short; aperture very large suborbicular, dilated; labrum joining the body whorl at right angles to the axis of the shell» CONRAD; »having columella, columellar lip thickened.» HALL.	»Shell subglobose or ovoid-globose. Spire small, with a large ventricose body-whorl; outer lip thin, not reflected; <i>columella twisted or spirally grooved within</i> , not reflected; umbilicus none: aperture somewhat round-ovate or transversely broad oval.»

Consequently, the chief differences are that in *Platyceras* there is no columella and in *Strophostylus* a twisted columella and *Platystoma* is nearly related to *Strophostylus*. In the latest volume of »*Palaeontology of New-York*», vol. V pt. II p. 129, HALL seems to hesitate about the distinction of the two first genera. »*Platystoma*, he writes, »is in some species scarcely separable from *Platyceras* by any persistent characters». BARROIS and other later authors agree with HALL in this point. But *Strophostylus* is also not tenable as the twisting in the columellar part of the reflexed lip is seen in specimens which else agree with *Platyceras*. Pl. II fig. 37—38. Even if *Platystoma* did not coincide entirely, as it seems to me, with *Platyceras*, this name could not be retained, as it has been preoccupied already several times before<sup>2)</sup>. If we now turn our attention to the numerous figures given by HALL and to specimens from North America, we cannot fail to remark the extreme amount of variation, through which the forms are mixed up with each other. It is indeed very difficult to find any difference between the reflexed lip along the body whorl in *Platyceras* and *Platystoma* and the so called »twisted columella» in *Strophostylus*, which is in uninterrupted continuation with the outer lip and has no such separate callosity as in *Natica* for instance. Moreover, in many of the specimens figured on plate XI, vol. V pt. II of the *Palaeontology of N. Y.* the »columella» is neither twisted nor grooved. In con-

<sup>1)</sup> Pal. of N.-York, vol. III pp. 299, 303, 309.

<sup>2)</sup> 1753 *Platystoma* KLEIN (= *Helix*, *Ampularia*, *Natica* & *Nerita*).

1803 *Platystoma* MEIGEN a dipterous insect.

1829 *Platystoma* AGASSIZ a fossil fish,

and moreover LAUBE in his work »*Gastropoden der Hallstätter Schichten 1855*», has also named a new genus of his *Platystoma*.

sequence of what now has been adduced I cannot but consider *Strophostylus* also as identical with *Platyceras*.

Besides, the highly variable and proteic forms of this genus have been ranged within many other genera of which some are enumerated here below.

*Exogyroceras* a subgenus proposed by MEEK and WORTHEN in 1868, Geol. Survey of Illinois vol. III p. 509 for shells with a sinistral spire and obscure columella.

*Igoceras* HALL. Established by HALL in 1859 in Pal. of New-York, vol. III p. 330. It differs from the straight *Platycerata* (*Orthonychia*) only in having the surface cancellated and it can consequently not be retained on so trifling a distinction.

*Natica* ADANSON. Both PICTET and D'ORBIGNY think that this genus occurs in the Silurian formation, but such species as *Natica parva*, *Natica spirata* or *Wenlockensis* (Sow. Sil. System pl. 5 & 12 and D'ORBIGNY Prodr. I p. 29) are true *Platycerata*. It is possible that also some of the Bohemian *Naticæ*, *N. gregaria* for instance, belong to this group.

*Nerita* L. is employed by SOWERBY in the Silurian System for the most common *Platyceras*.

*Orthonychia* HALL Rept. 4th distr. N.-York Geol. Survey p. 172 is a subgenus, created for the straight *Platycerata*, forming an elongate cone, with small spire and the ultimate part very large. In the 12th Report N.-York State Cab. p. 18 HALL declares that a renewed examination has not shown any reliable characters, by which they may be separated from *Platyceras*. MEEK and WORTHEN, however, retain this name and it might perhaps be advisable to do so for all those species which are invariably straight or scalaroid.

Then there may be some few species which belong to this group, but have been placed with the genera *Holopea*, *Isonema*, *Naticopsis*. Professor FERD. ROEMER placed one of the forms of *Pl. cornutum* in the genus *Cyclonema*.

D'ORBIGNY made use of *Stomatia* for one of the Lower Silurian *Platycerata*. Prodr. I p. 29: In how far the genus *Poly(o)stomella* of R. ETHERIDGE jr<sup>1)</sup> can be considered as related to *Platyceras*, I must leave undecided as I have not seen any specimens belonging to it. On the other hand it is likely that some fossils have been ranged with *Platyceras*, which in reality do not belong there, as for inst. some of SANDBERGER's<sup>2)</sup>.

The chief difficulties in the study of this genus are the dissimilar state of preservation of the exterior ornamentation of the shell and the almost incredible variations in its shape and growth. Some authors, as MORRIS in Qu. Journ. Geol. Soc. vol. 5 p. 332, write of a sinus in the outer lip of »*Acroculia*» nearly in the same sense as the remarkable one in the *Pleurotomaridæ*. But besides that every sign of it is often wanting in most specimens, there is by no means in those provided with it such a great regularity as in the *Pleurotomaridæ*, as there is only a wavy line, sometimes in the *Orthonychidæ* several, corresponding with the indentures in the apertural margin. If there is more than one sinus there are also quite as many wavy bands. These are,

<sup>1)</sup> Proc. Roy. Phys. Soc. Edinburgh. 1880 vol. 5 p. 163.

<sup>2)</sup> Versteiner. Nassaus. pl. XXVI fig. 18, Cap. psittacinus.

however, not bordered by elevated lines as in the Pleurotomaridæ, they resemble more what is seen in the recent *Ianthinæ*, which also sometimes exhibit such notches.

Probably much in consequence of this slight resemblance with the last mentioned group, some authors have given *Platyceras* (= *Platystoma*) its systematic place with the *Ianthinæ*. HALL in the fifth vol., 2d part of Pal. of New-York, has signed the plates on the *Platycerata* as *Ianthinidæ* for *Platystoma* and *Strophostylus*, and *Platyceridæ* for *Platyceras*, but in the descriptive letterpress he is willing to unite all three genera into one genus. The thin and fragile shell of *Ianthina* is not corresponded by the thick and heavy one in *Platyceras*. Other authors, again, as STOLICZKA<sup>1)</sup> and WAA-GEN<sup>2)</sup> see the affinity of the *Platycerata* with *Velutina*, to which several of them show some resemblance in the exterior shape of the shell. *Platyceras* may, however, as has been shown above, most fitly be ranked with the *Capulidæ*, with which they also share the peculiarity in habit of fixing themselves closely with the aperture to the surface of other marine animals, especially *Crinoids*.

In Sweden the oldest *Platycerata* found are from the beds of the *Leptæna* limestone of Dalecarlia, from where five different species have been described<sup>3)</sup>. At least two of the Gotlandic species are also found in the Upper Silurian of Scania. The shells of this genus have been the most common of all *Gastropoda* in the palæozoic seas. While in the Silurian epoch *Platyceras cornutum* and others of spirally coiled forms were prevalent, in the Devonian of Harz and North America and still more so in the Carboniferous strata, especially the North American, the straight forms which constitute the subgenus *Orthonychia* are most abundant.

The Gotland species may be arranged as follows:

I. *Platyceras* proper, with spire coiled of three or four whorls and almost entirely or nearly contiguous with the body whorl.

1. *Pl. cornutum* HIS.
2. *Pl. cornutum*, var. *loricatum* n.
3. *Pl. prototypum* PHILLIPS. <sup>4)</sup>
4. *Pl. disciforme* n.

II. *Orthonychia* spire diminutive or evanescent, shell straight, tubular.

5. *Pl. enorme* n.
6. *Pl. cyathinum* n.

### 1. *Platyceras cornutum* HISINGER.

Pl. II figs. 29—51, pl. III figs. 6—9, 19—26.

<i>Turbinites.</i>	1828. HISINGER Anteckn. IV, 221, tab. VI f. 6.
<i>Pileopsis cornuta.</i>	1837. HISINGER Lethæa Suecica, 41, pl. XII f. 11
	1848. BRONN Nomenclator, 973.
<i>Pileopsis sulcata.</i>	1837. HISINGER Lethæa, 41, pl. XII f. 12.
	1848. BRONN Nomenclator, 974.

<sup>1)</sup> Cretaceous Fossils of India p. 319.

<sup>2)</sup> Salt-Range Fossils p. 103.

<sup>3)</sup> ANGELIN & LINDSTRÖM. Fragm. Sil. p. 14.

<sup>4)</sup> By inadvertence this species was named *P. spiratum* Sow. in the list, page 16.

- ? *Natica glaucinoides*. 1839. SOW. Sil. Syst., 603, pl. 3 f. 4.  
1843. MORRIS Catal. Brit. Foss. 1st Ed. 154.
- Natica parva*. 1839. SOW. Sil. Syst. 612, pl. 5 fig. 24.  
1843. MORRIS Catal. 153.  
1848. BRONN Nomencl. 786.  
1848. PHILLIPS Mem. Geol. Survey, II, 259.  
1854. MORRIS Catal. 2d Ed. 263.  
1854. SALTER in MURCHISON Siluria 2d Ed., pl. XXV f. 1.
- Pilcopsis vetustis* (? = *vetustatis*). 1839. SOW. Sil. Syst. 616.  
*Nerita haliotis*. 1839. SOW. Sil. Syst. 625, pl. 12 f. 16.  
1843. MORRIS Catal. 154.  
1848. BRONN Nomencl. 805.  
1862. MAC COY Sil. Foss. Ireland, 13.
- Capulus neritoides* var. *sulcata*. 1848. BRONN Nomencl. 217.  
*Natica subparva*. 1850. D'ORBIGNY Prodr. 29.  
*Capulus haliotis*. 1850. Id. l. c. 31.  
1854. MORRIS Catal. Ed. 2, 239.  
1855. MAC COY Pal. Foss. 290.  
1857. GIEBEL Zeitschr. f. gesammte Naturwiss., 165.
- Capulus euomphaloides*. 1852. MAC COY A. N. H. ser. 2. vol. 10, 196.  
1854. MORRIS Catal. 2d Ed. 239.  
1855. MAC COY Pal. Foss. 290, pl. 1 K, f. 39.
- Platystoma niagarensis* (= c). 1852. HALL Pal. of N. York vol. II, 287, pl. 60 f. 1.  
1860. F. ROEMER Tennessee, 75, tab. V f. 15.
- Acroculia haliotis*. 1854. SALTER Siluria 2d Ed. 230 } Pl. 24 f. 9.  
1859. Id. Siluria 3d Ed. 548 }  
1871. BAILY Figures of charact. Brit. Fossils, part. III, 64, pl. XXI f. 12.  
1873. SALTER Cambridge Fossils, 89, 154.  
1874. ALTH Galizien, 31.
- Capulus Brauni*. 1857. GIEBEL Zeitschr. gesammt. N. W. 167; according to him HISINGER's *Pil. cornuta* is the same as MÜNSTER's *Cap. Brauni*. Now, even if it could be proved that they were identical, this latter species was created some years later than HISINGER's and it would be contrary to all rules of equity and priority to abolish the older name.
- Capulus sulcatus*. 1857. GIEBEL l. c. 166.
- Acroculia cornuta*. 1867. }  
*Acroc. sulcata*. 1867. } LINDSTRÖM Nomina fossilium Gotl. 23.
- Acroculia euomphaloides*. 1873. SALTER Cambr. Foss. 171.  
*Naticopsis parva*. 1873. Id. l. c. 185.

Shell of highly variable shape, naticiform with prominent spire, neritoid with depressed spire or planorbiform with sunk spire. Generally transverse or broader than high, with the body whorl enormously developed. The ornamentation of the outside is characteristic. It is very difficult to find specimens, which exhibit it sufficiently clearly. They have mostly been subjected to the tear and wear on the shore before being imbedded or suffered from corrosion or also been changed after their fossilization. The ornamentation is of the same pattern in all, only changing in minor details. It changes with the age of the shell, different in the young and the adult or on the spire and the last whorls. It consists of two sets of lines, which intersect each other. There are delicate, wavy, longitudinal lines, interrupted by the often irregular lines of growth and other elevated lines. On the spire, pl. II figs. 30—31, the longitudinal lines are threadfine, elevated, with interstices many times surpassing their breadth and at regular distances they are interrupted by the transverse lines. On the body whorl near its middle line they have increased in size, with minute, microscopical lines between the large transverse ones. On the inferior side the longitudinal lines are large, broad,

densely set, as it were, in groups of two or three with smooth interstices. They are wavy or interrupted in their continuity by the transverse lines. As is seen on pl. II f. 36, they form minute, steplike gradations or, as it were, terraces, each of the uppermost ones lying a little higher, than the succeeding inferior. The transverse lines form a sigmoid bend when they, more or less crowded, more or less prominent, continue from the suture to the umbilical side. The coarser ones which in most instances represent the outlines of former apertural lips are wavy or notched by two or three angular slits. On the spire they end towards the suture as a thin and sharp lamina, which bridges over the suture to the next whorl.

The spire is short in the most common variety, depressed and, as stated, even sunk in specimens which are planorbiform. The whorls vary in number from three and a half to four and a half. The last one is sometimes so much enlarged and widened, that it surpasses the spire with the lower rim of the aperture. The suture is tolerably deep.

There is a tendency in the body whorl to grow out free, without any connection with the older whorls, as is manifested in several specimens delineated on plate II. In fig. 48 it is just beginning to free itself, in figs. 50, 51 it is disconnected for a longer distance and tubular and in figs. 47 & 49 the whorls are nearly uncoiled. This is an approach to what is permanent in the younger Devonian and Carboniferous species and also in the Silurian *Orthonychia*. This peculiarity in the formation of the shell is what the German authors call »Skalaridenbildung», and may be found amongst several recent shells, where the last whorl as in *Vermetus* is free and tubular. Scalarid shells live together with normally coiled of the same species, and races, varieties or even new species may take their origin from them if they prevail and persist. Thus resembling forms of analogous formation may arise or be repeated in genera which are not in the least related.

The aperture is oval, oblique or transverse, its margins thin or thickened, the columellar lip reflexed or in some specimens only in a small degree hiding the umbilical fissure. Sometimes it is so much developed that it completely covers the umbilicus, and thins out against the whorl, pl. II fig. 29. In some this lip, pl. II f. 37, 38, is thick and twisted and shows thus the characters of the genus *Strophostylus*. The exterior lip is regularly bent, sinuose or lobate. In pl. II fig. 32 and still more so in pl. III fig. 6 there are instances given of a highly sinuose aperture. In fig. 6 it is wrinkled and bent in several creases and folds. This is probably owing to the circumstance that they have been fixed to the shelly surface of some other marine animal and long time enough to have moulded the aperture according to the sculpture of this substratum. As is the case with the English and American specimens of this species and also with *Platycerata* from the Carboniferous formation of North America, these shells are sometimes found fixed on the perisome of Crinoids, as for inst. on *Periechocrinus*. When such sinuosities occur in the outer lip there is formed on the median line of the body whorl what in a distant manner reminds of the slit band of the *Pleurotomaria*. It consists of the wavy lines of growth on the former site of a sinus. In others, as in the specimen which is the original type of HISINGER'S *Aeroculia sulcata*

(pl. II fig. 52), there are at irregular intervals longitudinal, revolving grooves one or even as many as three and the surface with its lines of growth assumes a scaly or imbricate appearance. In one variety from the lowest shale beds of Wisby there is regularly a groove and an elevated ridge around the umbilicus.

In another form of the aperture there are large tonguelike lobes (pl. II fig. 41 & 42), giving not only the aperture, but also the shell an irregular shape.

On the inner side there are, as can best be seen through the casts (pl. II figs. 44 & 45), large transverse ridges or weals especially in the last volution and which are seldom seen on the outside. Although I have carefully searched for muscular scars on the inside of many well preserved specimens, I have never succeeded in finding such. On the inside of the body whorl a pocket lens reveals a peculiarly streaked surface of bifurcated and sinuous or branching lines with jagged borders in faint relieve on a dark surface. Pl. III fig. 23. A horizontal, thin section, made deeper below this surface presents the mottled appearance figured on plate III figs. 25—26. Vertical sections of the shell, magnified through the microscope are seen in plate III figs. 19—22. Of these fig. 22 shows three distinct strata, the outermost very thin, the median one composed of transparent prisms, the innermost, which is the thickest, is darkened through interspersed, small, black grains, which probably have been added during the process of fossilization. In other sections this stratum is composed, figs. 19—20, of angular lines of growth, resembling those which are seen in Pl. prototypum.

Dimensions of the specimen figured pl. II fig. 32—33. Height 21 mm., breadth 24 millim. Spec. figs. 39—40 height 30 millim., breadth 32 millim. Specim. figs. 34—35 height 15 millim., breadth 15 millim., height of spire 5 millim. Largest specimen, from Lindeklint, 42 mill. in height, 41 mm. in breadth.

This, the most common of all Silurian Gastropoda of Gotland, has been found almost everywhere, and in all strata between Hoburg and the northernmost point of Fårö. The largest specimens are as a rule found in the higher strata, as in the red limestone of Sandarfve kulle and Linde. The old truth that species which are widely spread and very rich in individuals, also are highly variable and as a rule even have a long duration in geological time, holds in the fullest sense good with this species. The first impression one gets when glancing at the bewildering dissimilarity of forms delineated as *Platyceras cornutum* on the plates II and III is that we have to deal with a great many different not only genera but also species, and the above list of synonyms shows indeed how the opinions of the authors run in many different directions. But by patiently comparing a large number of well preserved specimens from the same locality, the conviction forces itself upon the mind, however reluctant it may be, that they all belong to the same species. Variable as many of the Silurian Gastropoda are, this is the most variable of them all. It is difficult to decide whether this species is one of those plastic groups which truly may be called the main source of several different new specific forms or if it be one of those mocking species which easily assume the shape and features of others, often not at all related.

The most common of the Gotland forms is that which resembles SOWERBY'S *Nerita haliotis*. It seldom attains so large a size as the English specimens, but it enti-



rely agrees with it in shape and ornamentation. Another common form is similar to *Capulus cuomphaloides* of MAC COY. There cannot be much doubt that when the various American species of *Platyceras*, *Platystoma* and *Strophostylus* have been sufficiently thoroughly examined, they may prove to contain many identical forms. Specimens sent to me from Mr S. A. MILLER in Cincinnati as *Platystoma niagarensis*, do not in any sensible degree differ from certain varieties of *Platyceras cornutum*. This, however, in the European strata never attains such a great size as the American ones.

As to the geological duration of this species it seems to have continued also during the Devonian epoch, as it probably is identical with or nearly related to the Devonian *Pileopsis prisca* GOLDF. p. p.

## 2. *Platyceras cornutum*, var. *loricatum* n.

Pl. II, figs. 53—57.

Shell planorbiform, spire depressed or hidden within the volutions of the large and tumid body whorl. Surface imbricated by transverse, wavy laminae which project in a thin edge, fig. 58, above the surface, and include thickset, threadfine longitudinal lines. The transverse lamellae are more distantiated near the aperture than on the spire. The whorls are three or at the highest three and a half, rapidly decreasing in width towards the apex. The aperture is oval or lobate, forming grooves which continue on the body whorl. The sinuosities of the aperture are seen a long way up this whorl through the wavy lines of growth. The inner lip is straight, not reflexed. The spire is often so sunk as to be nearer the umbilical side of the shell than the apical. Height 8 millim., breadth 12 millim., in another specimen height 9 millim., breadth, 15 millim.

This variety which by transitional specimens is linked to the preceding, has been found near Nya Slitegårds in Dalhem, and in the limestone of Klinteberg.

## 3. *Platyceras prototypum* PHILLIPS.

Pl. III fig. 10—18.

<i>Nerita spirata?</i> var.	1839.	SOW. Sil. Syst., 625, pl. 12 f. 15.	
	1843.	MORRIS Catal. 154.	
	1848.	BRONN Nomenclat., 806.	
<i>Nerita prototypa</i>	1848.	PHILLIPS Mem. Geol. Surv. II, 358.	
	1854.	MORRIS Catal. 2d Ed., 264.	
<i>Natica Wenlockensis</i>	1850.	D'ORB. Prodr., 29.	
<i>Acroculia prototypa</i>	1854.	SALTER in Siluria 2d Ed., 230	} pl. 24 f. 8.
	1859.	Id. ib. 3d Ed., 548	
	1871.	BAILY Figures of Charact. Brit. Fossils pt III 64, pl. XXI f. 11.	
	1873.	SALTER Catal. Cambridge Foss., 154.	
<i>Strophostylus cyclostoma</i>	1864.	HALL p. p. Transact. Albany Instit. vol. IV, 218.	
<i>Cyclonema brevispira</i>	1876.	FERD. ROEMER Leth. Geogn. Taf. 14 fig. 14.	

Shell naticiform, globose, with prominent acuminate spire. The ornamentation nearly of the same pattern as in *Platyceras cornutum*, only finer and denser. There are the same sort of graduated, wavy, longitudinal lines, and elevated, threadfine trans-

verse lines. The grooves formed by these are deeper in the specimens from Sandarfve, than from Wisby. In the specimens from Klinteberg, figs. 10, 10a, the sculpture is only discernible on the apex. On the body whorl it is quite obliterated and covered by coarse transverse lines of growth. The whorls are five, tumid and globose, the body whorl being many times larger than the preceding ones. The suture is deep and narrow. The aperture is oval, longer than broad. The lips are continuous all round the aperture in the adult, pl. III figs. 10, 13; fig. 11 probably still young. The margins of the aperture are widely reflexed, so as to give it a trumpet-shaped form. As seen in figures 10a, 13 & 14, the aperture is thickened through the accumulation of the lamellar lips. Especially this is evident in specimens from the fine-grained limestone of Sandarfve kulle in which a great number of apertural lamellæ are preserved. Pl. III fig. 17. There are in this instance no less than seventeen such reflexed, apertural lamellæ left behind in their old place during the progressive growth of the shell. Seen through a microscope they show angular strata of calcareous spar.

Height 23 millim., breadth 26 millim.

This species has been found in many specimens in the shale of Wisby, but especially in the uppermost limestone beds of Sandarfve kulle, Klinteberg and Lilla Carlsö. There are specimens from Lansa in Fårö and from Follingbo, more largesized and with lower, blunt spire, which possibly may belong to this species, but the surface is too corroded to show any sculpture and the aperture is obscured.

Specimens sent from Mr S. A. MILLER in Cincinnati as *Strophostylus cyclostoma* agree perfectly as to the ornamentation, but I cannot find the form of the aperture in them.

#### 4. *Platyceras disciforme* n.

Pl. II figs. 73—78, pl. XIX fig. 5.

Shell diseshaped or flat; whorls three and a half or four, the last free and without any connection with the others. The dorsal or exterior part of the whorls is thin and almost sharpened, the opposite part being much higher. The spire of the three connected whorls is low and not visible above the other shell. The last whorl is enormously large, widening at the point where it becomes free, from 7 millim. to 28 millim. at the aperture. The aperture is of a shape between elliptic and triangular, narrow at its exterior lip, then widening and at highest near the median line, the interior lip so much reflexed as to touch the back of the spire. The surface is wrinkled by transverse undulating lines of growth which are bent forwards toward the aperture more at the dorsal side than at the opposite. There are moreover delicate, longitudinal, threadfine striæ somewhat wavy and interrupted where they are crossed by the transverse lines.

Height at the columellar side of the aperture 15 mill., breadth 39 millim. In all six specimens have been found in the sandstone of Hoburg, and a few also in the superjacent limestone of Nackshejd and Klef in Wamlingbo and Sundre.

5. *Platyceras enorme* n.

Pl. II figs 59—72.

*Theca anceps* 1859. FR. SCHMIDT (nec PHILLIPS) Geologie der Insel Gotland, Archiv Naturk. Estlands Bd II, 442.  
*Theca sp.* 1867. LINDSTRÖM Nomina, 23.

Shell straight, cylindrical, with a diminutive spire of one and a half whorls. Many specimens are curved as a crescent or a bow. The last whorl is considerably developed and large and the spire has dwindled to a mere appendage to it. In its general shape the shell thus resembles a diminutive *Lituite*. The surface is covered by transverse, sinuous striae, the edges of which in the best preserved specimens project as thin reflexed lamellæ with smaller ones between them. Pl. II f. 72. These are intersected by fine, longitudinal lines, interrupted by the transverse ones as seen in fig. 71. The aperture, figs 66, 67, is oval or circular with thin lips, often sinuous or wavy. Length 17 millim., diameter at the aperture 8 millim. From the shale at Djupvik in Eksta, Rikvide in När, in the sandstone of Bursvik, in the oolitic beds of Hafdhem, Näs and Bursvik, and in the limestone beds at Hammar in Kräklingbo, Klinteberg and Länna near Slite, from which last locality the Mineral Cabinet of the University of Upsala has obtained specimens, collected by Professor P. T. CLEVE.

This species and the following belong to that group of the *Platycerata*, which J. HALL has called *Orthonychia* and which is so prevalent both in the Devonian and the Carboniferous limestone strata.

6. *Platyceras cyathinum* n.

Pl. VII fig. 22.

Shell conical, nearly straight without spire of whorls, rapidly increasing in width, spirally twisted in two bends. Surface concentrically striated by fine transverse lines of growth and wrinkled in the same direction. Aperture circular with thin edges. Shell thick, consisting of several strata, glossy, opaque with only faint traces of prisms.

Length of the single specimen found 30 millim., breadth of aperture 20 millim., at the apex 2 millim.

Only one specimen has hitherto been found in the Crinoidal limestone of Follingbo.

This species is related to the Bohemian *Capulus anguinus* BARRANDE and kindred.

## Fam. V. BELLEROPHONTIDÆ MAC COY.

*Shell globular or discoid, symmetrical or slightly deviating from the discoid plan, aperture widened with an angular slit in its dorsal or superior edge, forming by conti-*

nued growth a slit band, which assumes the shape of an elevated keel or also a sunk, shallow groove; its inferior margin covering a part of the back of the preceding volution.

Table of the genera:

A) Slit band entire, continuous without any openings.

1. Shell globular, involute, apertural lips wide, trumpet shaped. Slit band broad, sunk.

**Bellerophon** MONTFORT.

2. Shell disciform, laterally compressed, aperture hastate, whorls in several species not involute, free and not contiguous. Slit band elevated, often forming a sharpened keel.

**Cyrtolites** CONRAD<sup>1)</sup>

B) Slit band always elevated, perforated by a series of oblong openings. Aperture many times wider than the volutions, ornamental lines spiral. Shell discoid, involute.

**Tremanotus** HALL.

As to the systematic place of this family every one conversant with the conchological literature is aware that there are few palæozoic genera on which the opinions of the authors have been more divided and differed more widely. For a succinct survey of these varying opinions it is enough to refer to the works of DE KONINCK<sup>2)</sup>, MEEK<sup>3)</sup> and WAAGEN<sup>4)</sup>, where a relation is given in full. Bellerophon has been placed amongst the Cephalopoda by its first discoverer HÜPSCH, by its denominator MONTFORT, by DE FRANCE, MAC COY, PHILLIPS, PORTLOCK and CHENU. It has been considered as one of the Heteropoda by SOWERBY, D'ORBIGNY, BRONN, DESHAYES, D'ARCHIAC and VERNEUIL<sup>5)</sup> PHILLIPI<sup>6)</sup>, EICHWALD, OWEN<sup>7)</sup>, SALTER, WOODWARD<sup>8)</sup> and ADAMS. It has been numbered amongst the Gastropoda by BLAINVILLE and VALENCIENNES (as related to *Acera* and *Bulla*), FLEMING (as *Actæon*), DE KONINCK and PICTET (to *Emarginula* »comme un lien perdu entre les *Emarginules* et les *Pleurotomaires*»), JAMES HALL, SANDBERGER, (joining them with *Pleurotomaria* through *Porcellia*), MEEK and WORTHEN. Among the most recent authors STOLICZKA<sup>9)</sup> hesitates between placing Bellerophon in the Heteropoda, Opisthobranchiata and Cephalopoda. IHERING<sup>10)</sup> denies the affinity of the Bellerophons to the recent Heteropoda and places them in a family of their own, quite

<sup>1)</sup> A new generic type, intermediate between Bellerophon and Cyrtolites is probably formed by the species named *B. norvegicus* by BRÖGGER in his »Silurischen Etagen», p. 53.

<sup>2)</sup> Animaux fossiles de la Belgique p. 334.

<sup>3)</sup> On the affinities of the Bellerophontidæ in Proc. Chicago Ac. Sc. Vol. I, p. 9.

<sup>4)</sup> Palæontol. Indica. Ser. XIII p. 126.

<sup>5)</sup> Geol. Transactions vol. VI, p. 325.

<sup>6)</sup> Handbuch der Malacol. p. 285.

<sup>7)</sup> Palæontology p. 72.

<sup>8)</sup> Manual of Shells p. 201 to Atlantidæ, but in the Supplement edited by R. TATE in 1868 it is placed as a subfamily to the Pleurotomariæ amongst the Haliotidæ.

<sup>9)</sup> Palæontologia Indica. V. Gastrop. p. 393.

<sup>10)</sup> Nervensyst. der Mollusken p. 143.

as MAC COY already had done before him. But there is no reason to couple them with the Capulidæ as IHERING does, when he thinks that Carinaropsis is the connecting link. This genus is no doubt composed of incongruous elements, some being real Bellerophons, others Capulidæ or even Patellidæ. The remark of STOLICZKA that the Lepetidæ are near to Cyrtolites (»Some of the species of Anisomion exhibit a great relation to species of the palæozoic Cyrtolites, like *C? expansus*»), loses all its foundation, as it is evident that *Cyrtolites expansus* of HALL is no *Cyrtolites*, but a *Platyceras*.

MEEK (l. c.) lays, as it is quite right to do, much stress on the affinity of *Tremanotus* with *Bellerophon* and *Bucania* on the one side and with *Haliotis* and *Pleurotomaria* on the other. He concludes: »In other words it indicates for the family a position near the *Fissurellidæ* and *Haliotidæ*, and between these groups and the *Pleurotomaridæ*».

WAAGEN (l. c. p. 130) holds the opinion that a more or less close affinity of the *Bellerophontidæ* to the *Pleurotomaridæ* is highly probable. What makes the *Bellerophons* approach the *Pleurotomariæ* is a tendency observed amongst some to grow somewhat obliquely, thus nearing to the conical spiral. In accordance with DE KONINCK<sup>1)</sup> as this author formerly has stated, I do not think it advisable as WAAGEN has done, to place within this group such forms, which, although resembling the *Bellerophons* in the general form of the shell, do not show the least trace of apertural sinus nor of any slit band. DE KONINCK holds that such are young *Goniatites* and it is remarkable that in the Silurian formation, where no *Goniatites* are found, also such *Bellerophon*-like shells without any slit band are wanting. Such forms are comprehended in the new genera, which WAAGEN (l. c.) has proposed under the names *Warthia*, *Mogulia* and *Stachella*. The same is also the case with MEEK's *Bucanella* and MAC COY's *Euphemus*, though DE KONINCK and WAAGEN have again adopted the last genus. The slit band must indeed be considered as one of the most important, if not *the* most prominent character of the shell itself. Still it is very difficult absolutely to decide this as well as other cases of affinity amongst the palæozoic shells, as there may be other genera as for inst. *Scissurella*, with a distinct slit band on the shell, without any affinity between the animal itself and that of *Pleurotomaria*.

For my own part, I feel inclined to follow the precedence of MEEK and accept the *Bellerophontidæ* as most nearly related to *Haliotis*, a view in which DE KONINCK also in his last work participates. This view is strengthened by the similarities which are offered by *Tremanotus* with its perforated slit band and the sculpture of the surface which in so eminent a degree reminds of that of *Haliotis*. This position, however, cannot but remain hypothetical, as no more valid grounds taken from interior resemblances and homologies between the soft parts of the animals can be gained. Nor is there anything in the microscopic structure of the shell that either corroborates or contradicts such views. Not the least trace of any nacreous stratum has been found in the Gotlandic *Bellerophontidæ*.

<sup>1)</sup> Mem. de la Soc. Roy. d. Sc. de Liège. 1878, p. 340. Fossiles paléozoïques de la Nouvelle-Galles du Sud.

Gen. **BELLEROPHON** MONTFORT.

- Syn. 1781 *Nautilites* HÜPSCH p. p. Naturgeschichte des Niederdeutshl. I, 23, pl. III f. 20—23.  
 1808 *Bellerophon* MONTFORT Conchyl. Systematique, I, 50, 51.  
 1812 *Ellipsolithes* SOWERBY p. p. (non MONTF.) Min. Conch. vol. 1, 81.  
 1825 *Bellerophus* BLAINVILLE («mala emendatio» HERMANSEN) Man. de Conchyliologie, 4.  
 1847 *Bucania* HALL p. p. Pal. N. Y. vol. 1, 32.  
 1847 *Carinaropsis* HALL p. p. Pal. N. Y. vol. 1, 183.  
 1849 *Vasulites* HERMANSEN (non MONTF.) Ind. Gen. Malac. Primordia II, 677. See below.  
 1861 *Phragmostoma* HALL 14 Rep. N. Y. State Cab., 94.  
 1882 *Waagenia* DE KONINCK Notice sur la famille des Bellerophontidæ, Ann. Soc. Géol. de Belgique IX, 14.  
 This name being already given away by NEUMAYR it was changed by DE KONINCK into the following.  
 1883 *Waagenella* DE KONINCK Faune Carbonif. Belg. II pt. IV. Explic. des planches, pl. 38.

*Shell globose, involute, with the whorls in the same plan or nearly so, concave on the umbilical side as well as on the apical one, so that no distinction can be made between them. Aperture circular or oval, suddenly much enlarged, lips thin, continuous, interior or columellar lip covering the back of the second convolution. The slit band is always distinct, originating from a deep notch in the middle of the exterior lip; it is in several species much varying, being elevated as a keel on the last convolution, sunk as a channel or a flat band lower down on the older whorls. It is covered with quite the same sort of semilunar, backwards curved wavelets as are seen in all Pleurotomariæ. The umbilicus is in the small specimens very large and open and is in the older ones covered and hidden beneath the reflexed margin of the aperture. In some, however, it continues uncovered or open. The exterior ornamentation of the shell consists of transverse striæ, which often are crossed by longitudinal ones. Moreover there is a peculiar feature, observed in Gotland specimens, consisting in a series of thin laminae, which are nothing but the continuation of the lines of growth. They are gently curved outwards and are most crowded and perfect in the umbilical tube, where they have also been best protected against fracture. These laminae may as in Tremanotus, each in its turn, have formed the successive apertures and then been partly absorbed, partly abraded and only preserved where they were protected.*

In explanation of the synonyms given above the following remarks may serve. *Ellipsolithes* Sow. in Mineral Conchology, vol. I pp. 81, 83, 84 is not to be confounded with MONTFORTS genus of the same name which only contains Polythalamia. That of SOWERBY consists of one species of Nautilus, one of Goniatites, and one of Bellerophon (*B. ovatus*) according to his own emendation in Min. Conch. vol. 5 p. 107. But MORRIS, Cat. Brit. Foss. p. 302, regards them all as Cephalopods. *Bucania* HALL Pal. N. York vol. 1 p. 32 is chiefly distinguished thereby that the aperture is dorsally abruptly expanded and that the volutions are all visible in the umbilicus. In the fourth volume of Pal. N. York HALL seems to have abandoned his opinion on the distinction of this genus and includes it amongst the Bellerophons. The wide aperture is moreover common with most of the Bellerophons and as to the uncovered and large umbilicus DESHAYES remarks in the Journal de Conchyliologie vol. I p. 205 »l'existence de l'ombilic est un caractère indifférent», and not of importance enough to

be of value as generic distinction. Equally unimportant is the character added by DE KONINCK and WAAGEN that the shell is provided with longitudinal or spiral striæ, which cross the transverse ones. *Carinaropsis* HALL Pal. N. York vol. I p. 183 consists of Gastropoda belonging to different genera. *Carin. carinata* in all probability is a Bellerophon of the large, compressed species, while *C. patelliformis* and *C. orbiculatus* are evidently Patellid shells. *Phragmostoma* HALL 14 Rept. N. York St. Cab. p. 94 is also likely to be a broad, compressed Bellerophon. *Waagenia* DE KONINCK Ann. Soc. Géol. de Belgique 1882 p. 14, is distinguished only by callosities around the umbilical region. HERMANNSEN in his Index<sup>1)</sup> has *Vasulites* as a synonym of Bellerophon, but no such generic name is found in the book cited<sup>2)</sup> by him. MONTFORT in his Conchyliologie systématique<sup>3)</sup> himself cites *B. vasulites* from Hist. Naturelle des Mollusques, though only as a specific name.

Various efforts have been made by some authors to arrange the species of Bellerophon in different groups. DE KONINCK in his older work<sup>4)</sup> and STACHE<sup>5)</sup> both propose two series, one characterized by an elevated dorsal keel, the other by a sunk slit band. But as it is evident, that generally in young specimens the slit band is sunk and in older specimens of the same species becomes an elevated keel and when moreover this change can be traced in the same specimen, this characteristic is not to be maintained. Nor is it possible to apply the differences, which lie in an open or closed umbilicus as this character is changing in one and the same specimen. It seems to be of more avail to group the different species, at least the Silurian ones, according to the pattern of the ornamentation. A good characteristic of several species is found in the size of the angle, in which the transverse striæ join the slit band, as well the manner in which they continue towards the sides. There is in very small specimens, of *B. latevittatus* especially, a peculiar feature in a strong transverse groove (étrangement) on the nucleus near the expanded apertural border. It reminds highly of what is seen in the small individuals of the *Goniatites*. But as similar grooves or necks are seen in other Gastropoda, as for inst. in *Platyceras* and *Euomphalus*, it needs not point to a Cephalopodan affinity of the Bellerophons as some authors have thought. This transverse sulcus is quite as deep in the middle of the shell as on the sides.

As to the geological history of this genus in Sweden, it may be remarked that the oldest specimens are already present in the Inferior Gray Orthoceratite limestone at Kongs Norrby, from where three different species have been found, and in the Superior Red Orthoceratite Limestone at Skarpåsen, both localities in Ostrogothia. Specimens have also been collected in almost all Lower Silurian regions of Sweden as Öland and Dalecarlia. I have not been able to identify with certainty a single species of the Gotland Bellerophons with those from other Silurian strata, excepting *B. trilobatus*. In the shale beds at Westergarn some few, badly preserved specimens have been found

1) Vol. II p. 677.

2) DENYS-MONTFORT Hist. Nat. des Moll. . . . suite à l'Hist. N. de Buffon et Soumni. Vol. IV p. 298.

3) Vol. I p. 51. Bellerophon vasulites.

4) Anim. foss. de Belgique p. 338.

5) Jahrbuch der Geol. Reichsanstalt 1877, № 3, p. 297.

of a species with considerably enlarged aperture and narrow whorls, representing the division of Bellerophons named Phragmostoma, which are of such frequent occurrence in the Upper Silurian shale beds of Scania. But they are too obscure for identification.

Conspectus of the Species:

- I. Shell only with transverse striæ, radiating in pinnate arrangement from the slit band:
  - 1 *B. sphæra* n.
  - 2 *B. fasciatus* n.
  - 3 *B. globulus* n.
  - 4 *B. tænia* n.
  - 5 *B. fastigiatus* n.
  - 6 *B. tubulosus* n.
- II. Shell with longitudinal striæ or furrows intersecting the transverse ones (= *Bucania* WAAGEN and DE KONINCK).
  - 7 *B. squamosus* n.
  - 8 *B. Eiseni* n.
  - 9 *B. elegantulus* n.
  - 10 *B. latevittatus* n.
  - 11 *B. gemma* n.
  - 12 *B. pilula* n.
- III. Shell divided through two longitudinal grooves.
  - 13 *B. trilobatus* Sow.

1. *Bellerophon sphæra* n.

Pl. III figs. 35—38, pl. V figs. 1—16, pl. VII fig. 9.

Shell globular, extremely thin. Surface ornamented by closely set, transverse striæ, which abut upon the slit band in an acute angle of  $45^\circ$  and curve gently outward in a bow, the convexity of which is directed towards the aperture. There is some variation, as shown in the figures, with larger, smooth intervals between the striæ. Some faint longitudinal striæ crossing them are visible in several specimens. In well preserved shells and through sections in the umbilicus it is evident that many of the transverse striæ have continued as free, outwardly bent, thin laminae. They have been especially crowded in the umbilicus, where they also are most completely preserved, imbedded in the soft shale. Several figures are given on plate V, showing details in natural size and magnified. Their length amounts to two millimeters and sometimes more. Where they have been well protected they stand out in relief as narrow hooks. These lamellæ have probably, each in its turn, been the apertural border of the widely expanded mouth.

The whorls are five and a half, much rounded, and, as seen in transverse sections, from two to three times as broad as high. The last whorl is much expanded near the aperture, with the slit band elevated as a blunt keel. The aperture is large, transversally obovate, the lips rather thick, the inner lip bent down as to hide the whorl



on which it rests. The umbilicus is wide and open in the young specimens; in the older it becomes by degrees more and more narrow, and is at last so concealed by the large corners of the aperture and the interior lips, which have grown over it, that only a little space is left open.

As far as may be judged by the direction of the lines of growth there has been a deep and acuminate sinus in the outer lip. The slit band is comparatively narrow and sunk between two faintly elevated lines and covered by distantiated crescent shaped lines of growth. On the last whorl it changes into an elevated keel, on which every trace of the crescent shaped lines of growth is effaced. The height of this keel sometimes amounts to more than one millimeter above the surface of the whorl.

The thickness of the shell is much variable, generally thin, excepting along the interior corners of the aperture, where it covers the umbilicus and is several millimeters thick. The shell, in a thin section under the microscope, shows very thin, wavy lamellæ, through which clearer spaces or tubes vertically penetrate, pl. VII f. 9.

Colonies of a bryozoan, a *Ceramopora*, have often covered large specimens of this shell with their luxuriant growth and in all probability destroyed the shell, which has been dissolved, as only a cast of its surface is left on the calcareous basis of the *Ceramopora*.

Largest diameter 96 millim., breadth of aperture 65 millim., height of the same 55 millim., diameter of umbilicus 15 millim.

This shell has been found very common in the lowest shale near Wisby, in the superjacent limestone beds at Wisby and Martebo and also in the shale beds at Petesvik.

## 2. *Bellerophon fasciatus* n.

Pl. VI figs. 13—14.

Shell globular, the transverse striae of the surface are in regular distances, with smooth, equal, band like interstices. They join the slit band in an angle of  $66^\circ$  and then stand out from the band nearly horizontally. The slit band is sunk and narrow. There are only three whorls visible, but probably they are at least four. The aperture is cordate, the exterior or superior margin with an acute angle and the interior one arched. Seen from the aperture the shell presents an obovate outline. The umbilicus is closed by a fold of the margin of the lowest apertural corner.

Of all the Gotland *Bellerophons* this is most nearly related to *Bell. sphaera*, but differs through its obovate outline and the transverse striae. Height 25 millim., breadth 16 millim., height of aperture 10 millim., breadth 16 millim.

Only four specimens have been found in the middle limestone beds (b) and the lowest part of c, near Wisby and Kyrkberget in Wisby.

## 3. *Bellerophon globulus* n.

Pl. V figs. 25—34.

Shell of somewhat variable form, globular, ovate or elliptical in outline, surface of a dark, glossy hue, almost smooth, with extremely fine, densely packed transverse striae, which

join the slit band at an angle of  $38^\circ$ ; they bend outwards towards the sides and again converge towards the umbilicus. The slit band forms an elevated keel with a flat top, on each side bordered by a fine line and wavy with the minute and delicate lines of growth. Whorls four and a half, regularly increasing in width, twice as large as high and consequently not so narrow as in *Bell. sphaera*. Shell thick and as common in this genus, at thickest around the umbilicus and at the inferior corners of the aperture. The last whorl, when seen from the side, is straight or only faintly curved, and its apertural and dorsal contours are nearly parallel, f. 26. In my specimens, which are not quite complete, the aperture is longer than the rest of the shell. The inferior corners of the aperture near the umbilicus, where the shell is at thickest, are rounded or cylindrical and completely hide the umbilicus, which in young specimens is open. Diamet. 20 millims., breadth at the fragmentary aperture 17 millims., height of the aperture 7 millim.

Occurs in the shale beds of Eksta at Djupvik and in Fröjel. It is nearly related to *Bell. sphaera*, but differs by having the umbilicus entirely covered by a fold of the reflexed border of the aperture. The shell is moreover thicker and the direction of the transverse striae and their angle when joining the slit band quite different.

#### 4. *Bellerophon tænia* n.

Pl. VI figs. 22—25, pl. VII figs. 4—5.

Shell discoid with six much compressed and thin whorls, transverse, nearly elliptical in their section, twice as broad as high, their dorsal side only a little convex, in many nearly flat, the lateral angles very thin and acute. All whorls are visible on the umbilical as well as on the apical side. The only specimen which shows some fragments of the expanded aperture makes it not clear whether there has been an open or closed umbilicus, but it seems likely that it has been more narrow than may be judged of by its wideness in the other samples. At the aperture, which seems to have been quite as large as in *Bell. sphaera*, the shell attains its greatest thickness and consists of several strata. On other parts, where fragments of it still are seen, it is very thin. The transverse striae of the surface are nearly straight or only faintly curved in an angle of  $68^\circ$  near the slit band. This band is narrow and only a little elevated between two sharp-edged lines. Height 60 millim., breadth of aperture 60 millim., breadth of the last whorl near the aperture 28 millim., height 19 millim. Occurs in the lower limestone beds at Östergarn and Ardre, and also on the shore of Hammar in Kräklingbo, and in the soft gray limestone of Lindeklint and Fröjel.

#### 5. *Bellerophon fastigiatus* n.

Pl. VI, figs. 1—10.

Shell rather more discoid than globular, aperture transverse and triangular in outline, the base being only slightly arched. It is incomplete, the margins broken off and

fragmentary. Whorls five, transverse, carinated on the dorsal side. Umbilicus open and large with steep borders. The transversal striae of the surface crowded, joining the slit band in an acute angle of  $32^\circ$ , they are bent outwards and backwards to the umbilicus. In several specimens there is an indistinct carina on both sides of the slit band and parallel to it, placed at the point where the transverse striae are bending backwards. The slit band is elevated, flat on its top, finely and transversally sculptured, somewhat concave along its median line and bordered on each side by two thinedged lines.

This species makes somehow an approach to the genus *Cyrtolites* by its acuminate dorsal side, its wide umbilicus and its laterally compressed whorls. Height 13 millim., breadth 10 millim., diameter of umbilicus 4 millim., height of aperture 5 millim.

Several specimens have been found in the shale at Djupvik in Eksta.

From the shale beds of Djupvik in Eksta some specimens of *Bellerophon* have been found along with the former, the affinities and exterior characters of which have been obscured through their bad conservation. But when sectioned they exhibit a peculiar deviation from the other *Bellerophons* in being evidently asymmetric or having the whorls inclining nearer to the apical side, thus making an approach to a conical-spiral volution. In this respect they coincide with the new genus *Stachella*, which WÄGGEN has instituted, and which chiefly is distinguished through its asymmetric whorls. On plate VI the figures 11, 12 give an idea of these shells.

## 6. *Bellerophon tubulosus* n.

Pl. XIX fig. 6—11.

Shell globular or sphaeroidal, with five whorls, thin, excepting around the umbilical region. Surface ornamented with narrow, transverse stripes which meet the slit band in an angle of  $44^\circ$ . They are elevated at their superior edge, the more so near the umbilicus, where they also are more numerous. Parallel with this edge they are finely striated. The slit band is narrow and the crescents of growth indistinct and distantiated. The aperture is semicircular and its superior lip is slightly angular. The lips are thin; their inferior side corners are prolonged in earlike lappets, curved like hooks inwards against the very narrow umbilical opening without closing it. During continued growth a tubular space is thus enclosed between the outside of the inferior borders of the aperture and the hooklike, lateral prolongations of the shell. Where they end they are, moreover, convoluted and directed backwards from the aperture. All around these peculiar umbilical tubes the shelly matter has been deposited to an amount, many times surpassing the thin shell on the dorsal side. In one specimen, fig. 6, there is a trace of a dark colour band around the covered umbilicus. H. 22 mill., breadth 16 mill.

A few specimens have been obtained from the superior limestone near Wisby at Kälens qvarn and inside that town on Kyrkberget. As to shape and ornamentation this species somewhat resembles *B. fasciatus*, though this is more angular on the su-

perior edge of the dorsal side and has no tubes. As to these *B. tubulosus* comes near to *B. elegantulus* where the enclosed spaces are more narrow.

### 7. *Bellerophon squamosus* n.

Pl. V figs. 17—24.

Shell globular, somewhat compressed, the last whorl much enlarged towards the aperture. Whorls four, rapidly increasing in size, of elliptical section, the last one subcordate with dorsal keel. Outlines of aperture nearly circular, deeply indented in the midst of the exterior lip. Lateral and inferior borders smooth and gently curved. Umbilicus open and only partially concealed through the inferior corners of the aperture, which have grown down outside the same. The transverse lines of growth are imbricated and project as irregularly curved lamellæ, standing out much in relief with their edges. These edges are extremely thin, as may be gathered from a section drawn figs. 23—24, pl. V, and, moreover, much irregularly grown in many curvatures. At the base they regularly join the slit band in an angle of  $58^\circ$ . The interstices are finely striated by minute ornamental lines, parallel to the lines of growth and longitudinally grooved. The spaces between the equidistant grooves are gently arched. Where the grooves meet the transverse laminae, they are a little indented and hence form a wavy line. The slit band is narrow, but distinct, situated between two elevated lines, somewhat sinuous and more prominent on the last whorl than elsewhere. Height 45 millim., breadth and height of aperture 38 millim.

Found in several specimens at Lutterhorn and Lansa in Fårö, Sändvik at Fårösund and on Kyrkberget in Wisby.

### 8. *Bellerophon Eiseni* n.

Pl. VI figs. 19—21.

Shell globular with enlarged aperture, as far as visible without laterally bent margins. Sculpture of the shell very characteristic, consisting of some eight to ten shallow, longitudinal grooves on both sides of the slit band and parallel with it, forming, as it were, a broad median zone, occupying nearly a third of the dorsal surface. On both sides of it there are no traces at all of any longitudinal sculpture. These lines are crossed by fine and closely set transverse lines, which occupy the whole surface and meet the slit band almost rectangularly, being only very slightly curved towards the aperture. The umbilicus seems to have been open. The slit band which is not well preserved has probably formed an elevated keel on the body whorl. Height 20 millim., breadth 36 millim., the umbilicus nearly 5 millim.

Only one fragmentary specimen was discovered by Dr G. EISEN in the hard crystalline limestone at Wialmsudd near Fårösund in the parish of Bunge.

9. *Bellerophon elegantulus* n.

Pl. VI figs. 15—18.

Shell thick, globular, umbilicus closed by a convoluted thick fold of the inferior apertural lip. A little above this fold, there is a transverse groove, partitioned off from the aperture of the shell through a new fold or process which joins the inner surface of the aperture. Exterior surface ornamented with regularly distantiated transverse lines of growth, which meet the slit band in a very acute angle of  $29^\circ$ , then spread in an arched curve towards the sides. The interstices are densely and longitudinally wrinkled, as seen in the enlarged figures, giving the surface a finely cancellated appearance. Slit band narrow and moderately elevated with rare, crescent formed wavelets. Height 11 millims; width of aperture 12 millim., height of the same 7 millim.

One specimen has been obtained from the middle limestone bands near Wisby.

10. *Bellerophon latevittatus* n.

Pl. VI figs. 26—28, pl. VII figs. 6—8.

Shell globular, with expanded, transverse aperture. In the only specimen with the shell preserved the height of the aperture is contained nearly four times in its breadth. In casts of other specimens, which are almost entire, it is evident that the exterior lip has been thin and enlarged. Some two millimeters further inside it is provided with a thick transverse callosity or fold, which continues past the upper side of the umbilicus, along the exterior sides of the aperture, where it disappears. This callosity gives to the casts a strange appearance, in a certain way reminding of what is seen in the young *Goniatites*. But the same kind of callosity also occurs amongst other *Gastropoda* as for instance *Platyceras cornutum*. The interior or lower lip of the aperture seems to have been divided in two lobes, as in young specimens of the Carboniferous *Bell. decussatus* from Tournai. The umbilicus is open. The ornamentation of the surface consists of closely set, elevated, transverse lines, which meet the slit band nearly rectangularly. They are closely and longitudinally wrinkled. The slit band is relatively the largest, which any of the Gotlandic species is provided with, excepting *B. gemma*, being 1 millim. in breadth on a total diameter of the shell of 4 millim. It is elevated but flat. Height 7 millims., breadth at umbilicus 6 millim., at the aperture 10 mm., height of aperture 7 mm.

Four specimens have been found in the lowest shale beds near Wisby and also at Östergarn.

This species comes near to *Bell. latefasciatus* SANDBERGER, Verstein. des Rheinischen Schichtensystems, pl. 22 fig. 4.

11. *Bellerophon gemma* n.

Pl. XIX fig. 12—14.

Shell globular, last whorl rather rapidly expanding, in section broadly transverse or elliptical, inclining to crescent shape. The umbilicus is narrow and open. The ornamentation, which cannot be plainly seen without a strong lens, consists of a large slit band, covered by the same sort of densely crowded lines which decorate the sides and join the slit band in an angle of  $63^\circ$ . They are longitudinally streaked with elevated wrinkles, larger towards the opening and attenuated backwards. H. 5 mm., breadth at the aperture 6 mm. Only a single specimen has hitherto been found in the shales of Wisby. Another specimen in good preservation from the red limestone of Sandarfve kulle comes near to the preceding, but differs in the slit band not being elevated, only at the same level with the other surface, and also in the ornamental lines being more arched.

12. *Bellerophon pilula* n.

Pl. VI figs. 29—30.

Shell globular, aperture, as far as preserved, transverse, crescent shaped, more than four times as broad as high. Umbilicus open. Surface covered by a fine network of minute, elevated, longitudinal and transverse lines, which enclose regular, quadratic spaces. The slit band indistinct. Height 3 millim., breadth 2 millim.

Found in the oldest shale at Djupvik in Eksta.

13. *Bellerophon trilobatus* SOWERBY p. p.

Pl. IV figs. 13—15.

- Bellerophon trilobatus.* 1839. SOWERBY in Sil. Syst., 604. pl. 3 fig. 16.  
 1840. D'ORBIGNY II. Nat. Cephalop., 209, pl. 7 fig. 24—27. Pl. 8 figs. 13 is also cited, but in the copy of the work, to which I have had access there is no plate 8. Perhaps it has never been published.  
 1850. D'ORB. Prodr. I, 31.  
 1854. MORRIS Cat. Brit. Foss., 288.  
 1855. MAC COY Brit. Pal. Foss., 311.  
 1856. SANDBERGER Verstein. des Rhein. Schichtensyst., 177, pl. 22 f., 1—3.  
 1867. SALTER Siluria 3d Ed, 534, pl. 34 f. 9.  
 1873. Id. Catal. Cambr. Museum, 97, 192.

Shell involute, with three or four broadly and transversally flattened whorls, which are elliptical in section, and their height contained nearly three times in their breadth. The dorsal surface is divided in three different longitudinal fields through two deep grooves near the sides. The median field is at least of double the size of the lateral ones. As the specimens exist only in casts, there are no vestiges of the shell itself and it is even doubtful whether it really belongs to this genus as

never any trace of the slit band has been found. Of the three varieties which SANDBERGER (l. c.) has described, his *B. tumidus* comes most near to the Gotlandic form. As to the shape it also agrees with the figure given by SOWERBY in Silurian System, although it is larger than his. The figure given by D'ORBIGNY is altogether different. *Bucania trilobata* CONRAD<sup>1)</sup> may also belong to this species. Largest diameter 18 millim., breadth of aperture 22 mm.; height of aperture 9 millim., diameter of umbilicus 3 mm.

It occurs in the shales of Petesvik in Habblingbo and of Wisby and in the oolite and sandstone of Bursvik.

### Gen. **CYRTOLITES** CONRAD.

- Synonyms. 1838. *Cyrtolites* CONRAD Ann. Rep. N. Y. Cab., 118.  
 1838. *Phragmolithes* CONRAD p. p. ibid., 119.  
 ? 1839. *Ditæopus* RAFINESQUE Bull. Soc. Géol. de France, vol. X, 378.  
 1845. *Microceras* HALL Sillim. Journ., vol. 48, 294.  
 1866. *Tropidiscus* MEEK Proceed. Chicago Acad. Sci., vol. 1, 9.  
 1880. *Tropidodiscus* WAAGEN (emendatio) Palæont. Indica XIII, 131.  
 1882. *Tropidoeyclus* DE KONINCK Ann. Soc. Géol. de Belgique IX, 12.

*Shell discoid, laterally compressed, involute or with free, not contiguous whorls, umbilicus open and double, aperture elongate and lanceolate. A dorsal keel originates from a sinus or slit in the superior border of the aperture and continues more or less elevated, the interior lip having its form moulded according to the whorl on which it rests.*

In spite of all what has been stated<sup>2)</sup> to the contrary, there can be no doubt, nor mistake about the type species of this genus and what its first authors meant thereby. This type is *C. ornatus*, first named and shortly described by CONRAD in the Annual Report of the Geol. Survey of New York 1838 p. 118 and then again more in full described and figured by HALL in Palæontology of N. York vol. I p. 308 pl. 84 f. 1. There has been almost no dissension amongst the American authors as to this genus. It is of no avail that both CONRAD and HALL a few years later united with the first species other fossils, which are no Gastropoda at all, being in reality Cephalopoda, probably *Cyrtocerata*.<sup>3)</sup> The first described type must here, as always in similar cases, be the guiding one, around which to group related species and from which dissimilar ones are to be discarded. The other coëval genus, *Phragmolithes* of CONRAD, also coincides with *Cyrtolites*, as has been shown by HALL in Pal. of N. York vol. I. p. 188, and in which some lines of growth had been interpreted as septa. *Ditæopus* of RAFINESQUE is a most obscure fossil, but may possibly be only a form of *Cyrtolites*. *Microceras* HALL is doubtfully described as septate, but MEEK has in Pal. of Ohio vol.

<sup>1)</sup> HALL Pal. N. York, vol. 2 p. 13, 93. — *Planorbis trilobatus* Geol. Rep. N. Y., 1838 p. 113.

<sup>2)</sup> DE KONINCK Faune Carbonif. II, IV, p. 293. — WAAGEN Palæont. Indica, Salt Range Foss. p. 132.

<sup>3)</sup> CONRAD Journal. Acad. N. Sc. Philadelphia vol. 8 p. 270 (*C. trentonensis*). HALL Pal. of N. Y. I. p. 188.

1 p. 147 shown that it in no essential characters differs from *Cyrtolites*. *Tropidiscus* MEEK, or *Tropidodiscus* as the name has been emendated by WAAGEN, is one of those forms in which the whorls are more numerous and involute than the others and the dorsal carina thin. As the name had already been preoccupied for a recent shell of the Planorbidae, DE KONINCK has instead proposed *Tropidocyclus*, but this as well as the former ones must be regarded only as synonyms to *Cyrtolites*. *Porcellia Verneuli* D'ORB., DE KON. Faune Carbonifère, II, pt IV, 288, belongs probably also to the genus *Cyrtolites*.

There is some difference as to the involution and number of the whorls, and as to the size and sculpture of the dorsal carina. But the common compressed, discoid, shape and the form of the aperture, which as to its details is nearly alike in all, are sufficient grounds to unite them in the same genus.

The geological range of its species is limited in Sweden to the Upper Silurian formation of Gotland from where five species are known in the shale and sandstone beds, and three in the superjacent limestone, one species being common to both. Abroad *Cyrtolites* continued as far as now is known in both the Devonian and Carboniferous formations. In North America several species are found already in the Lower Silurian.

Conspectus of the species:

- I. Whorls free or scarcely contiguous, few in number.
  1. *C. lamellifer* n.
  2. *C. pharetra* n.
- II. Shell with contiguous whorls, numerous, disciform.
  3. *C. arrosus* n.
  4. *C. obliquus* n.
  5. *C. euryomphalus* n.
  6. *C. discus* n.
  7. *C. orbiculus* n.

### 1. *Cyrtolites lamellifer* n.

Pl. VI figs. 31—38.

Shell laterally compressed, along the median line of the sides somewhat tumid and thence elliptic in a transverse section. The surface is transversally ridged by a succession of regularly distantiated, outstanding lamellæ, wide apart at the dorsal side, converging towards the ventral side and most of them meeting. They stand out, slightly bent against the aperture of the shell (figs. 34, 37), looking like hooks when seen edgewise. They are about fifteen and represent the successive apertural borders. They are crossed by regular, elevated longitudinal striæ nearly of equal size, separated by interspaces of the same width. Rectangularly to them, minute threadfine ornamental lines are running. The dorsal keel or the slit band is moderately elevated and in direct continuation of a deep tongue shaped slit in the middle of the superior lip of the aperture. The slit band is even and consists of small arched lines (figs. 32, 38),



with their curves directed backwards. A great many of them are direct continuations of the lateral, projecting lamellæ, which thus run without interruption all around the shell. The whorls are in the most perfect specimens two and a half, open, disjointed. In some, as that delineated in figure 34, there is only one and a half whorls, the shell resembling a *Cyrtoceras*. The aperture is elliptical, acuminate towards the dorsal and ventral sides. The middle of the inferior lip is elevated into a small, vaulted saddle. It does not, however, repose on the back of the preceding whorl as in the other species. On the ventral side of the shell quite opposite to the slit band, there is a shallow groove running down towards the apex. Diameter of the aperture 20 millim. in the fragment of a very large specimen. A complete specimen is 11 millim. at the aperture, the transverse diam. of the aperture is 6 millim., total length 18 millim.

This beautiful shell has been found in several specimens in the limestone beds (b) in the neighbourhood of Wisby and towards the north as far as Lickershamn.

## 2. *Cyrtolites pharetra* n.

Pl. VI figs. 39—51.

Shell discoid, compressed, tumid along the middle line of the sides. The ornamentation consists in straight, equally distantiated sulci with blunt edges, but in an obtuse angle, directed forwards, near the back; they give to the surface an imbricated appearance and they converge towards the ventral side. They continue without interruption around the shell, forming at the dorsal carina a sinus backwards and downwards. The spaces between the sulci are smooth or slightly striated by fine, longitudinal lines. There are traces of longitudinal colour bands, alternately dark and light of unequal largeness, as represented in fig. 39. The whorls are two and a half, free and disjointed, rapidly increasing in width (fig. 45). The dorsal carina is low, almost vanishing near the aperture, gradually increasing in height backwards and also becoming more narrow. The aperture is ovate or in some approaching to circular, its interior lip reclines on the back of the nearest whorl and is, at the point of contact, bent in a small saddle. Corresponding to this a groove runs on the outside of the shell to the apex. The slit in the superior lip is shallow and broad. Length 15 millim., longest diam. of the aperture 9 millim., transverse diam. 6 millim.

Only found in the shale at Djupvik in Eksta from where several specimens are preserved in the State Museum at Stockholm.

## 3. *Cyrtolites arrosus* n.

Pl. VI figs. 52—53.

Shell discoid, tumid, involute, whorls three and a half, rapidly increasing in size. Surface with fine, transverse, regularly curved lamellar lines, with serrulated edges, as shown in fig. 53. The aperture is oval, the slit seems to have been deep

and the saddle of the interior lip is large. The keel is blunt to judge by the cast of it. Height of the shell 33 millim., breadth 23 millim. Height of aperture 20 millim., breadth of same 15 millim.

Only one specimen has hitherto been found in the limestone of Martebo.

#### 4. *Cyrtolites obliquus* n.

Pl. VI figs. 54—55.

Shell discoid, a little obliquely involute, terete; ornamental striæ most minute, closely set, with denticulated edges, dorsal carina blunt and narrow. Whorls three and a half. Diameter of the fragmentary shell 3 millims. From the sandstone of Bursvik.

#### 5. *Cyrtolites euryomphalus* n.

Pl. VII figs. 10—15.

Shell discoid, involute, surface smooth, rather glossy, ornamented with regularly distantiated lines, elevated, giving the surface an imbricated appearance. Along the interior edge of the whorls there runs a narrow ridge, on which the transverse lines swell in a minute nodule. From this ridge the surface falls off abruptly towards the centre of the shell. The whorls are four and a half, gradually increasing in width, contiguous. The aperture is broader than long, nearly pentagonal, with the dorsal carina forming a tongue-like processus from the superior edge. The slit band is much prominent, flat on its outer edge and covered with distantiated, crescent shaped lines of growth. Diameter 5 millim., breadth of aperture 3 millim.; height 2 millim.; diameter of space enclosed within the interior ridge 2 millim. From the shale at Djupvik in Eksta. Some twenty specimens known. A corroded specimen has also been obtained from the sandstone of Bursvik.

#### 6. *Cyrtolites discus* n.

Pl. VII figs. 18—21.

Shell discoid or lenticular, slightly tumid, surface with linear, elevated, transverse striæ, curved gently backwards on the dorsal side, regularly distantiated and having between them much finer, minute lines. Whorls four, gradually increasing, the last one partially free. Aperture triangular, lower lip nearly straight, horizontal, lateral margins faintly curved, converging at the narrow dorsal slit. Slit band narrow, elevated, blunt, not much prominent, covered with small crescent shaped lines of growth.

Largest diameter 7 millim., breadth 3 millim.

The original specimen, which belongs to the Museum of the Geological Survey of Sweden, has been found in the sandstone of Bursvik. Later, another specimen has been found in the middle limestone beds near Wisby. This is more smooth without any smaller lines between the large transverse striæ.

It is distinguished from the following through its fewer and broader whorls, through its lower and blunt slit band and its triangular aperture.

### 7. *Cyrtolites orbiculus* n.

Pl. VII figs. 16—17.

Shell discoid, involute with all whorls contiguous. Surface with distantiated, threadfine, elevated, transverse lines, gently curved backwards, the interstices being smooth or indistinctly finely striated. The whorls are five and a half, at highest near their inner edge, which sinks vertically to the deep suture. Aperture broadly lanceolate. Slit band a thin, prominent keel more elevated than in any other Gotland species of this genus.

Largest diameter 13 millim; thickness 4 millim. at the aperture. Only one specimen has hitherto been found in the shale of Djupvik in Eksta.

### Gen. *TREMANOTUS* HALL.

1864 *Tremanotus* HALL Extract of 18th Rept. St. Cab. N. York p. 43.

1868 *Gyrotrema* BARRANDE, according to BIGSBY Thes. Silur. p. 167 and also to letters from M. BARRANDE himself.

*Shell discoid, involute, whorls tumid, visible both from the umbilical and apical side, consequently with large, open, double umbilicus; aperture with greatly expanded and enlarged lips, the slit very shallow, continuing in a narrow keel, which is perforated by a number of oval apertures. These have subsequently been closed with shelly matter.*

This genus was founded by JAMES HALL, as is stated by MEEK<sup>1)</sup>, in an Extract from the 18th Report of Regents N. York. St. Cab. p. 43, which was issued in 1864, but this extract was never published along with the rest of the 18th Report<sup>2)</sup>, being only in 1868 joined to the first edition of the 20th Report, with the date 1865 printed on the sheet wherein the said description is contained. It seems, however, not to be any valid grounds to follow HALL in placing it as a subgenus to *Porecellia*, a genus which belongs to a much later period and has a deep slit in the exterior lip and a slit band quite as in *Pleurotomaria*, but without apertures and, moreover, obliquely spiral. *Tremanotus* is indeed quite as much different from this genus as from all other *Bellerophonitidæ*, excepting *Tubina* and possibly also *Salpingostoma*, in the presence of the apertures on the dorsal keel. It resembles, as to the expanded aperture, some of the species of *Bucania*, which genus, as it has been limited by its founder HALL in the Pal. of N. York vol. I, contains many heterogenous forms, of which several ones are extant only in obscure casts. Amongst other genera, *Tubina* BARRANDE<sup>3)</sup> is related

<sup>1)</sup> MEEK Proc. Chicago Ac. Sc. 1865, vol. I. p. 10.

<sup>2)</sup> Issued in 1865.

<sup>3)</sup> OWEN Palæontology 1860 p. 71 fig. 71, 8 and also named thus on labels in collections sent from Prag.

through the rows of apertures along the back and the sides, which, however, are prolonged into curved, spine like tubes. It seems also that *Salpingostoma* FERD. ROEMER, Leth. Geogn., Ed. 1876, Taf. 5 fig. 12, is related through its enlarged aperture and an elongated slit on the back of the last whorl. S. A. MILLER in his Supplement to the Catalogue of American Palaeozoic Fossils p. 304, says that »*Tremanotus* is a synonym for *Bucania*. The supposed openings on the east represent the spines upon the back of the anterior part of the last whorl of the shell». But this cannot be the case, as the smallest specimens already are provided with these apertures, which during the continued growth of the shell become hidden under the overlying whorls. There are no signs that the borders of the apertures have been formed through spines or tubes having been broken from them, they are even and smooth and resemble nothing more than those seen in the recent *Haliotis*. The peculiar ornamentation of longitudinal, coarse lines also augments the probability that both are nearly related to each other. This must, however, be left as an open question as there are no connecting links, the *Tremanoti* disappearing with the Silurian era and *Haliotis* at the earliest found in the Miocene strata.

This genus first appears in the Lower Silurian strata of Öland from the Chas-mops limestone of which island, at Böda, the Swedish State Museum possesses fragments of a *Tremanotus* closely related to *Tr. longitudinalis*, if not identical.

In the strata of Gotland two species occur:

1. *Tr. longitudinalis* with whorls of circular section;
2. *Tr. compressus* with whorls of elliptical section.

### 1. *Tremanotus longitudinalis* n.

Pl. III f. 39, 40, pl. IV f. 1—7.

Syn.: *Bellerophon dilatatus* 1867. LINDSTRÖM (nec Sow.) Nomina fossil. Gotlandiae p. 23. It may be that this species is identical with SOWERBY'S *B. dilatatus* Sow. Sil. Syst. p. 627 pl. XII figs. 23, 24. According to M'COYS more elaborate description in Palaeoz. Fossils p. 309 this species has spiral lines, but as in neither work any mention is made of apertures on the dorsal keel, I cannot refer my specimens to the English ones.

Shell thin, discoid, whorls four, visible on both sides, evenly rounded, cylindrical and of circular outline in transverse section. Aperture considerably enlarged, with anterior or outer lip turned up as seen in fig. 3 pl. IV, without any slit, only with a shallow indenture from which a small groove continues on the inside. Where fragments are left of the inner stratum of the shell, as at the inner lip of fig. 1 pl. IV it is smooth with only faint striæ and the lip is so much reflexed that it covers more than two thirds of the whorl on which it reclines. As this interior stratum often has been destroyed, there is on the aperture commonly only seen the impression of the outer side. The radiating striæ all around the aperture, seen in the same figure 1, are impressions of the exterior surface which have been uncovered. The innermost opening in the middle of the apertural expansion is transverse or somewhat triangularly cordate, pointed towards the outer lip and broad on the opposite side. The

outer side is ornamented by longitudinal, elevated bands, of unequal size, large and narrow, as it were, in pairs with larger interspaces. They are not quite parallel with the median axis and spreading toward the aperture in a sort of pinnate arrangement, new ones being intercalated from the dorsal keel. These bands are interrupted by transverse, sinuose, sunk lines, in older and worn specimens much reminding of the fringed sutural lines of the Ammonites. As seen in figs. 4 and 6 pl. IV these interruptions are very evident along the transverse lines and it is indeed a new set of longitudinal bands which starts in the front of such transversals. These are, as may clearly be seen through fig. 39 pl. III, the edges of the old expanded apertures, which in perfect and intact specimens must have projected as imbricated lamellæ, the one beyond the other, as in some of the Cyrtolites.

Along the median line of the dorsal side an elevated, narrow keel is stretching, corresponding with the groove on the inside; at some distance from the superior margin of the outer lip there is a row of elongated, elliptical apertures with elevated borders. These apertures continue for a while open and become further down on the spire closed with shelly matter as in *Haliotis*.

Longitudinal axis of aperture 94 millim., transverse diam. of same 95 millim., diameter of last whorl near the aperture 31 millim. Distance from the edge of the outer lip to the opposite end of the whorl 115 millim.

This, one of the largest of our Silurian shells, has been found in many places on Gotland. In the oldest shale beds from Halls huk, along the shores north and south of Wisby, in the shale of Djupvik in Eksta, Petesvik in Habblingbo and further inland in the shales of Wisne myr in Fardhem, and also in the sandstone of Bursvik. The superjacent limestone and oolite beds also contain it. It has been found in these beds at the canal near Westöös in Hall, in Martebo, around Wisby, in a section near Stjernarfve in Eksta, in the limestone near Lau church and the oolite of Bursvik. From the uppermost limestone strata it has been obtained at Lutterhorn in Fårö, Martebo, Kälens qvarn near Wisby, the upper limestone of Slite, Wialmsudd at Fårösund and at Fröjelklint. It occurs almost always in casts, only a few specimens having been found with the shell, which is very thin.

Among nearly related species *Treman. trigonostoma* HALL and WHITFIELD Geol. Surv. Ohio, vol. II p. 146, pl. VIII f. 5 resembles *Tr. longitudinalis* in a high degree.

## 2. *Tremanotus compressus* n.

Pl. IV figs. 8—12.

Shell discoid, involute, whorls five, transverse with the lateral diameter largest. In a section the whorls are of an elliptical outline. In the nuclei, which have been found, nothing is left of the expanded aperture. There are faint traces of longitudinal lines. The apertures on the dorsal keel are smaller, more regular and closer set than in the preceding species, elliptical or ovate. Largest diameter 34 millim. Breadth

of largest whorl at the aperture 32 millim. Height of the same 18 millim. Occurs in the limestone beds of Östergarn, but only as nuclei, also at Hammaren in Kräklingbo.

Amongst formerly known species, *Bellerophon Aymestrensis* Sow. Sil. syst. p. 616, pl. 6 fig. 12 seems to be nearest related to this species, but there are no apertures on its back, as far as the evidence goes.

#### Fam. VI. PLEUROTOMARIDÆ D'ORBIGNY.

Since DALL in the Bulletin of the Museum of Comparative Zoology, vol. IX, № 2 (1881) p. 77 and following, made known the results of his researches on the structure of the animals of two different species of *Pleurotomaria*, dredged up from the depths of the Mexican Gulf there are more valid grounds than before to attribute to the members of that large genus an independent position in a family of their own. *Scissurella* which had long been considered as the only living representative of the *Pleurotomaridæ*, must henceforth be separated from them and receive its place with the *Trochidæ*, while *Pleurotomaria*, according to DALL «stands nearest the *Trochidæ*, with features recalling the *Haliotidæ*». This same opinion had indeed also been pronounced by some other zoologists previous to DALL'S researches on the animals themselves, as by CLAUS, though he includes *Scissurella* in this group.

It is, however, very difficult, on various grounds, to draw the exact limits in respect to several of the palæozoic forms and to tell with certainty, which are belonging to this family and which are not. It must be borne in mind that there are several shells, besides the *Pleurotomariæ* and belonging to quite different families, which are provided with a slit in the exterior lip and a slit band, as nearly as possible resembling that of *Pleurotomaria*. *Scissurella*, for inst., is provided with a similar band and also *Emarginula*, in both of which the organization of the animals is different from that of *Pleurotomaria*. In the *Bellerophontidæ* there also occurs a slit band, which in many of them, though not in all species, is formed upon the same plan as in *Pleurotomaria*.

The peculiarity in the structure of the body, which has caused the deep slit, may, no doubt, be shared by several other *Gastropoda*, else dissimilar, but in them originating only a shallow notch, as sometimes, not typical, in certain specimens of *Platyceras* or typical in all species of several genera, as in the next family, the *Euomphalidæ* or in the large genus *Pleurotoma* or in *Siliquaria*. In none of these, however, the peculiar slit band is marked by distinct crescent-formed lines of growth or lamellæ, sometimes attaining an enormous development and enclosed within two or even more distinct elevated lines or lamellæ.

The nacreous shell of the true *Pleurotomariæ* is still preserved in a great majority of the Silurian species which are described further on. There must rest some doubt concerning those, in which the nacre is not left behind, but which else in all details are like the *Pleurotomaridæ* and which, provisionally at least, may be included in this family.

According to the definition first given by DE FRANCE all those palæozoic species, which have the characteristic, broad slit which by and by during continued growth is filled up and changed into the equally characteristic slit band, are numbered amongst them. This family is thus made to contain the following eight palæozoic genera, viz. Pleurotomaria, Murchisonia, Odontomaria, Brilonella, Porecellia, Catantostoma, Polytremaria and Trochotomaria. Of these only two, Pleurotomaria and Murchisonia, are represented through species in the Silurian formation of Gotland, but in such a large number that they make up nearly a third of the whole fauna of Gastropoda.

The limits between this family and the following, that of the Euomphalidæ, are somewhat obscured through such forms as Pleuronotus (Euomph.) Decewi, in which there is an approach to the formation of a complete slit band, in connection with a general form of the shell as in Euomphalus. It is although questionable whether one of the specimens<sup>1)</sup> figured by JAMES HALL and in which the slit band is most prominent really belongs to the same species or to Euomphalus at all.

There are also some shells which have been placed in this family, though they sometimes exhibit a change of a regular and distinct slit band into the simple, notched, angulate rib, such as is characteristic of the Euomphali. Pleurotom. planorbis HIS. for instance thus forms in a certain degree a connecting link between both families. But in consequence of such structural variations some confusion has been unavoidable and some uncertainty ensued which genera are to belong to this or the following family. Moreover, genera, which do not at all show the characteristic features, have been placed amongst the Pleurotomaridæ, and, again, others, which of necessity must be numbered with them have been excluded. An attempt to clear up this somehow is made further down, when the respective genera are treated.

### Gen. PLEUROTOMARIA DE FRANCE.

- 1810<sup>?</sup> *Hercoles* MONTFORT p. p. Conchyl. System. II, 274.  
 1810 *Anatomus* MONTF. p. p. ibid. 278.  
 1821 *Pleurotomaria* DE FRANCE in FÉRUSSAC Tableaux Systématiques, p. XXXIV.  
 1823 *Scissurella* D'ORBIGNY p. p. Mém. Soc. H. N. Par. vol. 1, 340.  
 1825 *Pleurotomarium* BLAINVILLE Malacologie, 429.  
 1837 *Inachus* HIS. p. p. Leth. Suec., 37.  
 1837 *Ptychomphalus* L. AGASSIZ Gross-Britanniens Mineral. Conch. 23, 222.  
 1842 *Scalites* CONRAD p. p. in EMMON'S Geol. Rept. 312.  
 1847 *Rhaphistoma* HALL Pal. N.-York I, 28.  
 1859 *Helicotoma* SALTER Figures and Descript. of Canadian Organic Remains, Dec. I, 10.  
 1876 *Euomphalopterus* FERD. ROEMER Leth. Geogn. Ed. 4. 1:e Theil, Taf. 14 fig. 9.  
 1883 *Gosseletia* DE KONINCK Faune Carbonif. Belg. II, pt. 4, 28.  
 1883 *Agnesia* ID. Ibid. 99.  
 1883 *Luciella* ID. Ibid. 107.  
 1883 *Mourlonia* ID. Ibid. 245.

*Shell of varying shape, trochiform, turbinated, discoid or globular, with a broad angular slit near the middle of the exterior lip, continued on the whorls by a band, which is bordered by one or two elevated lines on each side and towards which the trans-*

<sup>1)</sup> Pal. of N.-York, vol. V, pt. II, pl. 29 fig. 7.

*verse striæ of the upper and lower moiety of the whorls converge in direction backwards. In most well preserved specimens the shell is nacreous. In some species there is a tendency to fill up the apex of the shell with solid calcareous matter or even to partition off the apex by imperforated tabulæ or diaphragms.*

Rich as this genus is in a great number of variously formed species, ranging in time from the basis of the Lower Silurians through all the Palæozoic formations with well nigh 500 species, it is conceivable, that many attempts have been made to divide and subdivide it in generic groups of a second order or even only in divisions of wider or more narrow circumscription. Before attempting to make any such divisions for the Gotlandic species, it may be convenient to take a review of older groupings or of genera which may be considered as synonymic.

As to the claims of DE FRANCE as the first author of Pleurotomaria, it cannot any longer, as DALL thinks, be doubted that DE FRANCE really must be regarded as the author and by almost unanimous consent also has been acknowledged as such. DALL again (Preliminary Rept. on the Mollusca, Bullet. Mus. Comp. Zool. Vol. IX n:o 2 p. 78) considers, that SOWERBY who was the first to publish its characters, is the real author and that his name has to replace that of DE FRANCE. But the case stands as follows. The name Pleurotomaria is printed for the first time in FÉRUSSAC'S Tableaux Systématiques<sup>1)</sup>, earlier than June 1821 and in December the same year it was characterized by SOWERBY in his Mineral Conchology vol. III p. 139, pl. 278. In 1823 FÉRUSSAC in a Note to the Memoir of D'ORBIGNY on Scissurella in the »Mémoires de la Soc. d'Hist. Nat. de Paris», vol. I p. 340, says on Pleurotomaria that »ce genre est connu depuis longtemps des Naturalistes de Paris et son nom est déjà imprimé dans plusieurs ouvrages». He does not name any body else but De FRANCE as the author. Moreover, JAMES SOWERBY himself before 1825, when the last pages of his »Genera of Recent and Fossil Shells» were published, in the descriptive letterpress to pl. 205, where Pleurotomaria is figured, expressly states that he considered DE FRANCE as the author, in saying »the Pleurotomaria of DE FRANCE», never mentioning himself as the author or making any claims as such and even not referring to his own previous description in the Mineral Conchology.

Prominent amongst the synonymic genera is Ptychomphalus L. AGASSIZ founded on a shell from the Mountain Limestone, *Helicina compressa* Sow. It should deviate from the others in the possession of a callosity on the umbilical centre. But DE KONINCK in his last work on the Carboniferous Fauna of Belgium includes in Ptychomphalus the majority of the Belgian Pleurotomariæ of that period, 59 species, and does not accept the genus Pleurotomaria at all, on the ground that the first species described by DE FRANCE have a wide umbilicus. Now the absence or presence of an umbilicus cannot, as DESHAYES<sup>2)</sup> long ago has remarked, have any influence on the

<sup>1)</sup> Tableaux Systématiques des Animaux Mollusques classés en familles naturelles, p. XXXIV. The second part of this work, »Tableau Systématique de la Famille des Limaces» bears on its title page the date »Juin 1821». The preceding pages i—xlviij, where Pleurotomaria is catalogued, are, consequently, still older.

<sup>2)</sup> Journal de Conchyliologie I p. 209.



creation of new genera, when it is known how this character varies in one and the same species and that, moreover, a single character seldom is so important as to distinguish a genus. Amongst the species of *Ptychomphalus*, established by DE KONINCK there are several without any callosity at all, and also others where a narrow umbilicus is seen. Of the other new genera, ranked by DE KONINCK with the *Pleurotomaridæ*, such genera as *Baylea*, *Worthenia*, *Rhineoderma* do not show the least trace of any slit band to judge from the figures, the descriptions and in some instances by such specimens of them as I have seen. The genus *Agnesia* again seems to have been founded only on the distinction of its being sinistral, but as it in other details agrees with *Pleurotomaria* and sinistral as well as dextral specimens occur within the same species of *Pleurotomaria*, as, for inst., *Pl. decussata* SANDBERGER (*Versteiner. d. Rheinischen Schichtensystems* p. 197, tab. 24 f. 2), there seems not to be valid grounds to create a new genus out of it. The same may be said in reference to *Gosseletia*<sup>1)</sup>, *Mourlonia* and *Luciella* as none of them has such prominent or permanent characters as to entitle them to any generic distinction from *Pleurotomaria*.

FERD. ROEMER'S *Euomphalopterus*, however aberrant, is nothing but an extreme form of *Pleurotomaria*, as will be shown further down. The extraordinary development of the slit band is shared by some species which have hitherto been placed within the incongruous genus *Eccyliomphalus*, as for inst. *Ecc. alatus* FERD. ROEMER. His *Odontomaria*, *Leth. geogn. 4:th Ed. 1 Th. Taf. 29 fig. 10*, of which he says that it »begreift gewissermassen abgerollte *Pleurotomarien*«, is, as it, however, must be conceded, more straight than any other. As further instances of such *Pleurotomaridæ* may also be cited *Pleurotomaria centrifuga* F. AD. ROEMER, *Verstein. des Harzgebirges* p. 22, *Taf. VII fig. 11*<sup>2)</sup>. But, as FERD. ROEMER himself long ago remarked<sup>3)</sup>, the formation of scalarid shells can only have a subordinate value as a generic characteristic, as there are involute or evolute specimens belonging to the same species as we shall see in the description of *Pleurotomaria qualteriata*. The same peculiarity in the growth of the shell occurs also, as is already shown, in *Platyceras* and even in *Euomphalus*, without there being any grounds to ascribe to it specific, so much the less any generic value.

The genera *Scalites*, *Rhaphistoma* and *Helicotoma* are founded chiefly on American fossils and belong to the group of *Pl. qualteriata*, having the whorls on the apical side more or less flat and even; the slit band situated on the acute outstanding angle, which is formed where the apical and the umbilical sides meet. Most authors seem now to agree that all are identical and coincide with *Pleurotomaria*.

<sup>1)</sup> This name has already been employed by CH. BARROIS in 1881 for a lamellibranchiate; *Ann. Soc. Géol. du Nord*, VIII, p. 176.

<sup>2)</sup> *Pleurotomaria extensa* HEIDENHAIN *Graptolithführende Diluv.* p. 18, *Taf. 1 f. 10* (= *Bellerophon evolutus* HAUPT *Taf. III f. 13*) is perhaps only an *Euomphalus*.

<sup>3)</sup> *Lethæa geognostica*, Ed. 3, vol. I, p. 455. »Es kann jedoch jener Umstand wohl kaum zur Aufstellung einer eigenen Gattung genügen, da sehr verschiedene Gasteropoden-Gattungen (z. B. auch *Helix*) deren Umgänge regelmässig verbunden sind, ausnahmsweise zuweilen in Folge noch nicht näher erforschter Einwirkungen frei werden. In keinem Falle dürfen solche Arten von *Euomphalus* getrennt werden, bei welchen jene Trennung der Umgänge nicht stets, sondern nur vorherrschend sich findet.»

Besides the above enumerated genera, which have been exclusively, or almost so, instituted for the reception of species of *Pleurotomaria*, other genera, which have nothing in common with that genus, shelter a few true *Pleurotomariæ*, but have not been placed in the list of synonyms, as their authors did not intend them for *Pleurotomariæ*. So, for inst. *Pleurotomaria elliptica* HIS. has been by DE KONINCK included in the Trochoid genus *Flemingia*, established by him, but such instances are mentioned further down in the descriptions and synonyms of the species.

It must be conceded that the limits between this genus and *Murchisonia* are very difficult to draw, a wide field being given to arbitrary individual opinions through the vagueness attributed to the chief character of *Murchisonia*, viz. the length of its spire. It may, nevertheless be practically useful to distinguish such *Pleurotomariæ*, which have a long, slender spire of more than six, beadlike whorls (= *Hormotoma* SALTER) as *Murchisonia*. In them the nacreous nature of the shell is not so evident as in *Pleurotomaria* proper. The nature of the *Pleurotomarian* shell as nacreous has been much contested, but it admits of no doubt through several Gotlandic specimens, which still retain the pearly coating interiorly.

The character of the slit in the Silurian species is rather deviating from what commonly is represented as its form in secondary and more recent formations. The lips are in these straight cut and the borders of the slit parallel, but in the Silurian ones the slit forms an acute angle and the borders are diverging. In some the slit is linear, as in *Pleurotom. æquilatera*. As to the slit band, one of the most characteristic features in this genus, it deserves more than a passing attention. It is in almost all instances hemmed in by at least two, parallel, elevated lines, one to each side, always distinct. The band itself is of a varying breadth, linear as in *Pleur. gradata*, pl. VII, fig. 26, or large, relatively, as in *Pleurotomaria exquisita*, pl. XI fig. 3. The usual ornamentation consists in crescent-formed lines of growth, pl. IX, figs. 2, 4, 6, 15 etc., with the concavity towards the aperture. These crescents are sometimes crossed by longitudinal lines as in *Pl. claustrata* pl. VII f. 31, 34, *Pl. glandiformis*, *Pl. biformis*, pl. VII f. 42 or by a longitudinal ridge as in a whole group of *Pleurotomaria* with *Pl. bicincta* pl. VIII figs. 19, 21, 22, 23 as their type. In *Pl. limata*, pl. X figs. 14—16, the lamellæ of growth have a most extraordinary appearance being thin, prominent, bent forward, imbricated and in their midst divided through an ovate indenture. The bordering lines are either very low, of middling size or developed to an enormous length as lamellæ. There can be discerned certain gradations, by which the extreme development in *Pl. alata* is connected with the others. In *Pl. claustrata*, pl. VII f. 32, both the bordering lines project so much as to transform the slit band into a deep groove around the shell. In *Pl. limata*, pl. X fig. 8, 14, they stand forth and form a sharp keel around the shell. A magnified section of it is represented in pl. X fig. 14, being included in soft limestone, whereby the most delicate parts are preserved. The cusps inside are sections of the crescentic lamellæ of growth being cut obliquely. In pl. X fig. 17 a cloven, aliform slit band is figured. The moieties of two lamellæ are seen in their length from the broad, scooped out basis to the pointed apex. In pl. X figs. 27, 31, 37, details are given of the slit band of *Pl. alata* showing it, in fig. 27

(nat. size and magnified) sectioned transversally and the lamellæ of growth as in the former species, riblike with smooth interstices, directed obliquely outward, towards the aperture of the shell. In fig. 30 the slit band is sectioned along its whole breadth in a line from the whorl outwards, intersecting some ten lamellæ of growth obliquely. Section fig. 31 is taken parallel to the exterior border, showing the apices of eleven of the elongated crescent-shaped lines of growth. The same large development also obtains in some other species which form the division »Alatæ» and of which several instances are given on plate XI. This extraordinary increase of the slit band might at the first look be regarded as a derived feature that attained such dimensions in the Upper Silurian times. But on finding shells as low down in the series as in the Lower Gray Orthoceratite limestone with a quite identical slit band one might as well ask whether there not has been a regress from the development of this band to what we find prevailing in a reduced shape during later geological periods. As we are not in possession of materials ample enough from still older strata, we are not able fairly to build any conclusion on this point. The aliform slit band is easily distinguished from other lamellar expansions, such as are found in some Trochi and others, by a section, through which the interior compartments become visible, whereas in the latter shells the interior is compact.

The character of the slit band varies in the selfsame specimen of some species, as for instance in *Pl. elliptica* and it changes its nature and shape during continued growth quite as is the case with the Bellerophons.

Another peculiarity amongst some of the Pleurotomariæ is that the apex has been either filled up with a solid mass of calcareous matter or has been subdivided in several small compartments through imperforated diaphragms or tabulæ. This peculiarity they share with *Murchisonia*, *Loxonema* and *Euomphalus*, amongst which it is common. At the same time this tendency is often accompanied by the formation of a scalarid shell.

Species of *Pleurotomaria* are already found in the Lower Red Orthoceratite limestone of Sweden, beginning with *Pleurotomaria qualteriata*. *Pleurotomaria elliptica* HISINGER also is found in the Upper Gray Orthoceratite Limestone of Sweden. But it was in the Upper Silurian seas, in the strata, which now make up the chief mass of Gotland that this genus attained a considerable development in no less than 39 species and varieties of changing aspect and ornamentation. These species may most conveniently be subdivided in groups, according to their agreement as to the chief characteristic, the slit band, along with which feature several peculiarities follow in the general form of the shell, its ornamentation, the position of the band on the whorls etc. I propose then to range the Gotlandic species in the following groups taking the form and ornamentation of the slit band as the principal ground of division.

I. **MULTICARINATÆ.** Slit band accompanied on each side by one or two lines, crescents crossed by several longitudinal lines.

1. *Pl. scutulata* n.
2. *Pl. gradata* n.

3. *Pl. Linnarssoni* n.
  4. *Pl. voluta* n.
  5. *Pl. claustrata* n.
  6. *Pl. glandiformis* n.
  7. *Pl. biformis*.
  8. *Pl. latezonata*.
  9. *Pl. Hindei* n.
  10. *Pl. Holmi* n.
  11. *Pl. Wisbyensis*.
- II. **CRISPÆ.** Slit band with distantiated, sharp edged, regular crescents and smooth interstices. Shell ornamented by many keels.
12. *Pl. Lloydii* Sow.
  13. *Pl. dolium* n.
  14. *Pl. laqueata* n.
  15. *Pl. tubulosa* n.
- III. **FASTIGIATÆ.** Slit band forming a blunt, elevated ridge, crescents flat, oblique, densely packed; shell finely striated transversally.
16. *Pl. robusta* n.
  17. *Pl. lævissima* n.
  18. *Pl. elliptica* HALL.
  19. *Pl. bicincta* HALL.
  20. *Pl. qualteriata* SCHLOTH.
- IV. **SIMPLICES.** Slit band narrow, plain, with small, regular crescents, shell surface simply, transversally striated.
21. *Pl. valida* n.
  22. *Pl. Othemensis* n.
  23. *Pl. comata* n.
  24. *Pl. æquilatera* WAHLENBERG.
- V. **INCISÆ.** Slit band with large, lamellar crescents which are divided in their middle. Shell richly ornamented.
25. *Pl. labrosa* HALL.
  26. *Pl. limata* nom. nov.
- VI. **ALATÆ.** Slit band forming a large, thinedged keel all around the shell, both the bordering lines of the slit band being widened and having developed into thin lamellæ, which have coalesced with their edges enclosing the crescents of growth.
27. *Pl. replicata* n.
  28. *Pl. alata* WAHLENBERG.
  29. *Pl. alata*, var. *subcarinata* n.
  30. *Pl. alata*, var. *opposita* n.

- 31. *Pl. prætexta* n.
- 32. *Pl. togata* n.
- 33. *Pl. frenata* n.
- 34. *Pl. undulans* n.
- 35. *Pl. Marklini* n.
- 36. *Pl. cirrhosa* n.

VII. **PLANORBIFORMES.** Shell discoid, slit band situated on the apical side near the suture, narrow, much variable to its sculpture. *Schizostoma* BRONN p. p.

- 37. *Pl. planorbis* HIS.
- 38. *Pl. helicina* n.

VIII. **NATICOIDEÆ.** Shell globose, slit band larger than in any other division, at a level with the other surface, ornamentation of the shell of microscopic, oblique lines, also crossing the slit band. Only one species known.

- 39. *Pl. exquisita* n.

#### Divisio I. **MULTICARINATÆ.**

##### 1. ***Pleurotomaria scutulata*** n.

Pl. VII, figs. 23—25, 28, 29, 30.

Shell conical, turbinated, whorls eight and a half, globose or rounded, separated from each other through a deep suture, spire acuminate. Slit band situated exactly on the middle line of the free body whorl and close to the suture on the superior, visible part of the other whorls. It is narrow, somewhat concave and with dense, regularly curved crescents and one or two faint longitudinal lines crossing them. The enclosing lines are sharp edged. The slit band is on both sides environed by a belt of different ornamentation than the other surface and this belt is enclosed by one prominent line on each side. Within this area there are fine longitudinal and transverse lines crossing and above the uppermost line there is also a broad space equally ornamented. This median belt with its central slit band projects as a ridge all around the shell (fig. 25). On each side of the belt there is a longitudinal slight concavity. The ornamentation of the other surface consists of fine cross lines of equal size, forming nodules where they meet and enclosing small squares and rhombs. The aperture is large and nearly ovate. The columellar lip is reflexed and bent a little round the umbilicus, which is large and funnelshaped.

Height 20 millim., breadth 17 millim. Aperture 11 millim. in height, breadth 9 millim. Apical angle 80°.

This elegant shell occurs in the limestone of Samsugn in Othem, at Stor Wede in Follingbo and at Kyrkberget in Wisby. There is some variability in its shape, with more slender spire (angle 55°) from Follingbo or quite the reverse, 85°, depressed, as those from Samsugn.

2. *Pleurotomaria gradata* n.

Pl. VII figs. 26—27.

Shell conical, trochiform, spire blunt, broad, whorls eight with regularly straight, sloping sides of faint convexity, abruptly bent along the superior suture through the vertical and almost even zone around the slit band. This band is central on the body whorl and remarkable as being one of the narrowest amongst all the Silurian *Pleurotomariæ* and perhaps amongst all known. It is reduced to a narrow fissure, a mere fraction of a millimetre and thin as a knife edge. It continues open a long way round the body whorl and the next, and then at last is filled up. But owing to its narrowness it is impossible to discern any crescents on it. Like the related, preceding one, the slit band is enclosed within a separate zone, differently ornamented from the other surface and bordered by a narrow line on each side. In this median field there are only transverse lines crossed by a few, obscure, longitudinal ones. On some distance a blunt ridge is running on each side. The ornamentation of the whorls consists of somewhat distantiated, transverse lines, connected by more narrow spiral ones and parallel to the slit band; in the interstices microscopically minute transverse lines are seen. The belt around the slit band does not form any prominent ridge as in the former species, but rather a somewhat concave or straight facet on the whorl. The suture is shallow. The aperture is rather more broad than high, its columellar lip is strongly reflexed around the open umbilicus.

Height 22 millim., breadth 20 millim. Apical angle  $69^\circ$ . Another specimen has 24 millim. in height and 23 mill. in breadth. Found in numerous specimens in the limestone of Sandarfve kulle and also in the gray limestone of Linde kulle.

OEHLERT has described a *Pl. Virensis* from the Lower Devonian of France, and this comes near to our species through its ornamentation and the slit band, though its spire is lower.

3. *Pleurotomaria Linnarssoni* n.

Pl. XX fig. 21—24.

Shell small, discoid, spire moderately prominent, whorls six, increasing in size slowly and proportionately. They are adorned with a delicate network, on the apical side consisting of intercrossing striæ of which the transverse ones are directed backwards in an acute angle against the slit band. At the intercrossing of these lines small nodules are formed giving the surface a prickly appearance, with small pits in the interstices. The slit band is placed below a narrow keel which divides the shell exactly in two halves. It is exceedingly narrow and accompanied on both sides by longitudinal lines, which are more prominent than the others. On the umbilical side the whorls are more ventricose than on the opposite and also similarly ornamented. The aperture is circular and the umbilicus is large and open. H. 4 mill., br. 8 mill.

A dozen specimens have been found in the red limestone of Sandarfve kulle and a few also in Linde klint. Through its ornamentation and its slit band it is nearest allied to *Pl. gradata* from the same localities.

#### 4. *Pleurotomaria voluta* n.

Pl. XIX fig. 25—29.

Shell discoid, tumid, with slightly prominent spire. Whorls eight, of regular increase. The shell is on both the apical and umbilical side decorated with sharp, sigmoid transverse lines curved towards the aperture near the suture and backwards near the slit band. They are crossed by finer, longitudinal lines, forming minute tubercles where they meet. The section of the whorls is nearly ovate, high, arched above, flattened below. The belt of the slit band is situated much beneath the middle line of the body whorl and divides the flattened surface of the shell from the more tumid. It is relatively large and is crossed by some longitudinal lines. The slit band itself cannot be discerned through the bad preservation of exactly this part.

Through its general form and as far as can be judged in the conformation of the zone of the slit band this species comes near to the preceding, from which it, however, is sufficiently, distinct by its greater tumidity, its ornamentation and wider umbilicus. Height 4 mill., br. 11 mill., diameter of umbilicus 6 mill.

Two specimens have been found in the red and gray limestone beds of Sandarfve kulle.

#### 5. *Pleurotomaria claustrata* n.

Pl. VII f. 31—36.

Shell conical, trochoid, whorls seven or eight, gently convex, forming an acute angle at the oblique slit band, which is placed somewhat above the median line of the whorls. Its surface is almost flat, sloping inward, towards the columellar axis of the shell, larger than in any other species of its group, bordered by two outstanding lamellar edges, as seen in sections, fig. 32 and 36. The crescents are large, distantiated and intersected by at least ten longitudinal lines. On the surface of the shell there are fine, transverse, backwards directed striæ, with interstices nearly five times as large as them, and partitioned off by small striæ, distantiated, parallel with the slit band, causing a likeness with a ladder, as they are enclosed within their interstices and not connected with each other in continuous longitudinal lines. If seen with a lens they, at least in some parts of the shell, continue uninterrupted over the transverse lines, fig. 35. The aperture is transverse, the columellar lip reflexed around the narrow, but open and funnel shaped umbilicus.

Height 15 millim., br. 18 millim. Apical angle  $85^{\circ}$ . Specimens have been found at Lickershamn, Samsugn, Follingbo, Kyrkberget in Wisby and Snäckgårdet near that town.

6. *Pleurotomaria glandiformis* n.

Pl. VII fig. 37—38.

Shell elongatedly conical, turbinated, with seven convex whorls. The slit band is placed a little above the middle line of the body whorl, relatively more narrow than in the preceding species or nearly half that size. In the other whorls it is situated a little below the superior suture. The bordering lines are not so prominent as in the preceding. The crescents are nearly alike, distantiated, regular, crossed by two or three longitudinal lines. The surface on both sides of the band has a regular, cancellated ornamentation by equal sized lines, which at their crossing point form a little, elevated nodule. Suture deep. Aperture elongate, higher than broad, umbilicus narrow, but open.

Height 19 mill., breadth 15 mill. Aperture in height 8 mill., br. 7 millim. Apical angle  $56^{\circ}$ .

It has been found in many specimens in the red limestone of Sandarfve kulle, a few in the gray limestone and also in the neighbouring Linde klint.

This species is very nearly related to the preceding one, having the slit band formed on almost the same type, but it differs through the ornamentation of the surface where small nodules are formed at the crossing point, as well as in the shape of the shell and the whorls, which are angular in the former and evenly rounded in this species.

7. *Pleurotomaria biformis* n.

Pl. VII fig. 39—42.

Shell broadly conical, turbinated, with seven tumid whorls, four times as broad as high and having the slit band a little below the middle line of the body whorl and midway between the upper suture and the median, transverse line of the other whorls. It is much concave, forming a shallow groove around the shell, with sharp, elevated borders on both sides. The crescents are fine, narrow, densely packed, more curved than in the others and crossed by numerous, equally fine, longitudinal streaks. As seen by the fig. 42 the ornamentation is widely dissimilar above and beneath the slit band, being imbricate and crossbarred above, and with two different sets of striæ below: one consisting of coarse, irregular and distantiated transverse wrinkles, in their direction corresponding with those above the band, though meeting the slit band in a more acute angle, the other crossing these obliquely, nearly parallel with the slit band. They are microscopically minute and remind of those which cover the whole shell of *Pleurot. exquisita*. There is besides on the whorls an obtuse ridge beneath the slit band, parallel with it and close above the suture the whorl ends in a somewhat nodular ridge or string. The aperture is nearly circular. The umbilicus is narrow and open, on its distal side enclosed by a low ridge, which emanates from the back of the columellar lip, on its proximal side it is hemmed in by the basis of this lip, which is enlarged as a broad lamella and nearly hides the umbilicus, when seen from above.



Height 23 millim., br. 20 millim. The aperture has in height 13 millim., in breadth 10 mill. Apical angle  $69^\circ$ . A specimen from Wisby is 29 millim. high and at largest 25 mill. Apical angle  $71^\circ$ .

This species has been found in six specimens in the shale at Djupvik in Eksta and in fifteen specimens in the same shale bed near Wisby; from the later locality nuclei mostly have been collected. A single specimen from the middle limestone stratum near Wisby belongs probably also to this species, as well as two badly preserved specimens from Kälens Qvarn, north of Wisby.

### 8. *Pleurotomaria latezonata* n.<sup>1)</sup>

Pl. X fig. 1.

Shell conical, turbinated, with five tumid whorls and fragments of the sixth or the body whorl. Slit band situated on the middle of the free whorl or near the superior suture in the lower ones. In its ornamentation it resembles much that of the preceding species, but it is not so much concave or scooped out, the crescents are not so much curved, rather thicker or coarser. The ornamentation below this band consists in crossbarred striæ, with a few larger, longitudinal ribs. The suture is deep. The shape of the aperture and the umbilicus cannot be ascertained as the shell is broken in those parts.

Height 7 millim., breadth 6 millim. Apical angle  $77^\circ$ . Only one specimen has been found in the middle limestone of Wisby (b).

It comes near to the preceding species through its slit band, but the shape and ornamentation of the whorls differ, being in this species thrice as broad as high and in the former nearly four times as broad as high.

### 9. *Pleurotomaria Hindei* n.

Pl. XIX f. 15—16.

Shell turbinated with seven tumid, transverse whorls, of which the body whorl is more than double the size of the others and nearly double as broad as high. The slit band, which is situated a little below the median line of the body whorl and near the upper suture in the other whorls, is broad, with thick, projecting margins and covered with regularly curved crescents of growth. There are some faint traces of longitudinal lines crossing them. The surface below the slit band is evenly rounded, nearly flattened out. There are minute, longitudinal, as well as transverse striæ of equal size forming regular squares and at their meeting point there seems to have been a small gibbosity, causing a prickly surface. The umbilical surface is corroded, but, as discernible on some patches, has had the same sculpture. The aperture is nearly circular, the outer lip thin, the inner one reflexed as to form a little tube along the narrow umbilicus and broadly enlarged at its basis. H. 15 mill., br. 13 mill.

<sup>1)</sup> I was not aware that a *Pleurot. latifasciata* MAC COY already existed, when I had named this species *Pl. latifasciata* on page 18.

A single specimen found in the limestone at Samsugn in Othem. The form of the slit band and the sculpture of the surface unite it with the »Multicarinata» and especially with *Pl. scutulata* from which it is distinguished through the different slit band.

#### 10. *Pleurotomaria Holmi* n.

Pl. XIX fig. 18—20.

Shell conical, turbinated with seven ventricose whorls, body whorl of the same size as the others taken together, all nearly thrice as broad as high. The slit band is situated a little below the median line of the body whorl and exactly on the median line of the other whorls. It is large, projecting, with convex surface. As far as can be made out on the much corroded band, the crescents are regular and distantiated. The ornamentation on both sides consists in thin, exert, transverse and longitudinal lines, closely set, forming a dense network with indistinct nodules at the crossing point. The transverse lines have a sigmoid direction and are regularly curved backwards close to the slit band. Below the slit band there is a sharp edged ridge near the suture and above that band a slight bulging out of the surface as a callosity is seen in some specimens. The aperture is circular, and the umbilicus is narrow. H. 15 mill., br. 12 mill.

A few specimens have been found in the middle limestone near Wisby. From the limestone at Slite a small shell (Pl. XIX f. 17) has been obtained nearly resembling the former as to its shape and the prominent slit band. This is, however, placed exactly on the median line of the body whorl and the ornamentation seems to consist only of transverse striae. H. 5 mill., br. 5 mill.

#### 11. *Pleurotomaria Wisbyensis* n.

Pl. XVIII fig. 50—51.

Shell rather depressedly conical, turbinated, with six ventricose whorls separated by a shallow suture, the apex obtuse and spire short of five whorls, together smaller than the body whorl. The slit band is placed somewhat above the middle line of the body whorl and is hidden from view in the smaller whorls. It is prominent and convex as to its surface. The ornamentation below the slit band is of the common reticulate crossbar pattern, the longitudinal lines being stronger than the transverse ones. The same sort of sculpture seems to have occupied the umbilical surface, but is mostly effaced. The aperture is circular with thin lips. The umbilicus is deep and wide, and defined through a sharp, abrupt edge. H. 10 mill. br. 10 mm. Largest specimen from Samsugn has h. 15 mm., br. 13 mm.

Four specimens have been found in the superior limestone on Kyrkberget in Wisby and one in the quarries of Samsugn in Othem. It is only in consequence of its reticulate sculpture this shell has been placed with the *Multicarinata*, and its position must be affirmed through the find of more complete specimens.

## Divisio II. CRISPÆ.

12. *Pleurotomaria Lloydii* SOWERBY.

Pl. VII fig. 43—49, pl. VIII fig. 1.

- Pleurotomaria Lloydii* 1839 Sow. in Sil. Syst. II, 619, pl. 8 f. 14.  
 1843 MORRIS Catal. Brit. Foss. 1 Ed., 158.  
*Murchisonia Lloydii* 1841 ARCHIAC & VERNEUIL Bull. Soc. Geol., 160.  
 1848 BRONN Nomenclator, 748.  
 1850 D'ORBIGNY Prodrome I, 31.  
 1854 MORRIS Catal., 259.  
 1855 MAC COY Palæozoic Fossils, 293.  
 1867 SALTER Siluria, 532.

Shell turbinated, whorls six or seven, ventricose. The slit band is situated exactly on the middle line of the body whorl and a little below the upper suture of the other whorls. It is broad, elevated, with an even surface and, as far as can be made out from the not quite complete specimens, covered with distantiated crescents and smooth interspaces. Above the slit band there are some twelve longitudinal ridges of equal size and parallel to them smaller, threadfine lines, both crossed by fine, distantiated transverse lines. Beneath the slit band the longitudinal ridges are not so numerous, four at the highest and much unequal. Near the suture the transverse lines are thicker than higher up. The apex of the shell has been filled up with solid, calcareous matter and the lowest whorl of the nucleus ends consequently in a blunt point. The aperture is large and obliquely ovate (Pl. VII f. 43). The umbilicus is narrow and open.

Widely spread as this shell is, it seems to be much variable and there are many Gotland specimens, which only hesitatingly and provisionally can be referred to *P. Lloydii*, as the English species according to the figure given by SOWERBY is more elongated and the whorls by far not so ventricose as in the former. MAC COY l. c. also says that he has not seen specimens of the same length as in SOWERBY's figure. His descriptions nearly agree with the Swedish specimens.

The variety from the shale beds near Wisby (Pl. VII figs 46—49) has still more ventricose whorls and the parts around the slit band not so much angularly prominent as in those from the other localities and it may rank as a well distinct variety.

Next, there is a depressed, short form, chiefly found as nuclei with indistinct impressions of sculpture and with the body whorl nearly elliptical in a longitudinal section. A few specimens of this, concerning which it for the present cannot be decided, whether it is a variety or an independent species, has been found at Westergarn, in Östergarn at Gannviken and Grogarn, and in Ardre. Its dimensions are: height 32 millim., breadth 31 mm. apical angle 87°.

The typical specimens of *P. Lloydii* attain a height of 49 millim., breadth of 34 mill., apical angle 56°.

It has chiefly been found in the shale beds at Wisby, Follingbo, Westergarn, Djupvik in Eksta, Habblingbo, Alfva saw mill, Qvinnegårda in Hafdhem, the canal from

Wisne myr in Fardhem, Östergarn, Stor Myr in Rute, but also in the limestone beds of Fårö, Medebys in Hall, Wisby Kyrkberg, Djupvik in Kräklingbo. It very seldom is found but in nuclei. In some instances the interior nacreous coating is retained as in specimens from Östergarn.

*Pl. percarinata* HALL Pal. N. Y. Vol. I p. 177 pl. 38 fig. 4 resembles somewhat this species.

### 13. *Pleurotomaria dolium* n.

Pl. IX fig. 1—3.

Shell turbinated, rotundate, with the body whorl much in excess of the other three whorls. Slit band situated a little below the middle line of the body whorl, large, scooped out as to form a regular groove around the shell with somewhat outstanding borders. The crescents are regular, wide apart, with prominent lamellar edge and smooth interstices. The ornamentation above the band consists in two or three obtuse longitudinal ridges, a little nodular where they are crossed by the fine transverse lines, which are obliquely lamellar near the slit band. Beneath this band there is only a single sharpened ridge, halfway between the band and the suture, and oblique, closely set, narrow, transverse lines. Suture very shallow. The aperture is nearly circular, no umbilicus can be discerned.

Height 6 millim., breadth 5 millim., body whorl nearly 4 millim. in length. Apical angle  $77^{\circ}$ .

Only one specimen has been found in the sandstone of Bursvik. It comes near to the smaller specimens of *Pl. Lloydii* (Pl. VII fig. 43, 44) but is easily distinguished through its broad slit band, its want of umbilicus and the form of the whorls.

### 14. *Pleurotomaria laqueata* n.

Pl. IX fig. 4—6.

Shell turbinated, whorls five, ventricose. The slit band more than a millimeter in breadth, convex, is situated a little beneath the median line of the whorls, ornamented with laminated or, as it were, imbricated crescents. It is bordered by two sharp edged lines, one on each side, and with jagged outside. On each side of this band there is a varying number of parallel, elevated, longitudinal ridges. In one specimen there is only one beneath the band and one above. In another specimen there are three ridges above the slit band and one below. All these ridges are crossed by transverse, lamellar striae with thin, elevated edges and directed obliquely against the slit band, which they do not cross. Suture shallow. The aperture is oval with the columellar lip thick, reflexed, without any umbilicus.

There is some variation as to the distance and number of the transverse striae, which lie imbricated with lamellar edges and through their varying position giving the surface a more or less fine striation.

Height 25 millim., width of body whorl 17 millim. Height of aperture 12 millim. Width of body whorl in a fragmentary specimen 23 millim.

A few specimens have been found in the uppermost limestone of Klinteberg, Fröjel and Wisby (b. c.).

### 15. *Pleurotomaria tubulosa* n.

Pl. IX fig. 7—10.

Shell turbinated, with ventricose whorls, of which only the body whorl and part of the next are left, in the only specimen, which has been found. The slit band is placed somewhat beneath the median line of the body whorl, relatively narrow, prominent and much convex, the crescents much more distantiated than in any one of the other Silurian *Pleurotomariæ* and continue backwards as a narrow tube, which is overlapped by the next crescent, the whole thus forming a tube in tube system. The band is bordered by low lines and these and the direction of the striæ against it distinguish it from the nearly alike keels above and below. There are three narrow and prominent keels above the slit band and one beneath the same. When crossing them the transverse, ornamental lines are lifted upwards and obliquely backwards, more strongly in some of them, than in others. These stronger transverse lines of growth are in a peculiar manner accompanied by smaller ones in the interspaces between the keels, diverging in an acute angle from their side or in gentle curves forming with them an ovale, as is shown in the details of figures 9 and 10. These lamellate, transverse lines continue also across the suture, which is shallow, and they are thus connected with the lamellæ of the adjoining whorl. The surface between these large ridges is finely, transversally striated. On the umbilical surface the coarser striæ interlace and form a sort of network, with large meshes. There is no open umbilicus, and the aperture seems to have been obovate. Height 26 millim. breadth 25 mill.

Only one specimen from Hammarudd in Kräklingbo.

### Divisio III. FASTIGIATÆ.

### 16. *Pleurotomaria robusta* n.

Pl. VIII, fig. 2—7.

Shell globular, consisting of six highly ventricose whorls, gradually ascending in an angle approaching more or less to a right angle, 82—90°. Surface nearly smooth or with very fine, transverse striæ grouped in larger bands. Slit band nearly on the middle line of the body whorl and near the upper suture in the other whorls. It is enclosed within two fine, neatly defined lines. A little below its median line it has an obtuse ridge, thus nearer to the inferior border, and the band consequently standing out from the surface in an angle, the sides of which are a little concave. The cre-

scents are thickly set, oblique, with their largest bend coinciding with the median ridge. Above the slit band some faint longitudinal striæ are seen, intersected by distantiated, transverse ones. Beneath the band there runs an angular keel. The surface is for the rest almost glossy and shining. The suture is deep. The aperture is large, transverse, the columellar lip is thick, strongly reflexed and nearly hiding the opening of the umbilicus, which continues in an oblique direction inwards.

The specimens are generally much worn or obscured by corrosion and by foreign bodies, which have grown on the surface and it is consequently difficult to get a clear idea of its appearance. On the nucleus the impression of the slit band forms an angular, projecting keel. Height 55 millim., breadth at the base 55 millim., aperture 30 mill.

Several specimens have been obtained from the shale beds of Djupvik in Eksta, and Petesvik in Habblingbö.

### 17. *Pleurotomaria robusta* var. *lævissima* n.

Pl. VIII fig. 8—9.

Shell globular, with six whorls, slit band placed exactly on the middle of the whorl, ornamented with the most delicate crescents and moreover with a narrow ridge more median than in the former. The band is for the rest, not so much angularly elevated, rather square cut, as seen in the section. The surface on both sides of the band is smooth and glossy, with only few obscure spiral bands and with scarcely perceptible, transverse sinuous striæ. The suture is shallow. The aperture is circular, the interior lip thin, reflexed around the umbilicus which is narrow and open. Height 17 millim., breadth 19 millim., height of aperture 11 millim.

Found in the shale of Djupvik in Eksta.

### 18. *Pleurotomaria elliptica* Hrs.

Pl. VIII fig. 10—14.

<i>Trochus ellipticus</i>	1829. HISINGER Tabl. ed. 1, 11.
	1831. Id. Anteckn. V, II, tab. 2 fig. 2, 2, 2,
	1831. Id. Tabl. ed. 2, 9.
	1837. Id. Leth. 35, tab. 11 fig. 1 a—b.
	1841. Id. Förteckning öfver en geognostisk och petrifikatsamling från Sverige och Norrige, 61.
	1843. PORTLOCK Geol. Rep. Londonderry, 414, pl. 31 f. 1, very doubtful.
	1848. BRONN Nomenclator, 1300.
<i>Turbo antiquissimus</i>	1840. EICHWALD Sil. Schichtensyst. Estlands, 119.
	1842. Id. Urwelt Russlands, 2, 53, tab. 2 f. 7.
<i>Turbo ellipticus</i>	1846. Id. Bullet. Moseou, XIX, 104.
<i>Pleurotomaria elliptica</i>	1858. FRIEDR. SCHMIDT Silurform. Estlands, 203.
	1867. TÖRNQUIST Lagerföljden i Dalarnes Undersiluriska bildningar, 19.
	1876. FERD. ROEMER Leth. geogn. 4 Ed. Atlas, 1 Thl. pl. 5, f. 3.
	1880. ANGELIN & LINDSTRÖM Fragmenta silurica, 13, tab. XV, fig. 8.
<i>Pleurotomaria antiquissima</i>	1860. EICHWALD Leth. Rossica I, II, 1168, pl. 42 f. 17 a b.
<i>Pleurotomaria subconica</i>	1865. KJERULF (nec HALL) Veiviser 7, fig. 15.
<i>Flemingia elliptica</i>	1882. DE KONINCK Faune II, pt. 3, 94.

Shell largely conical, trochiform, with ten gently convex whorls, angular at the shallow suture where the slit band is placed in the older whorls, being median in the free body whorl. It is comparatively large, with a longitudinal ridge above the middle line, not far from the superior border. This, however, as may be gathered from the figures 10, 12, 14, varies, the ridge being nearest the central line in specimen fig. 14, which is from the Lower Silurian of Öland at Lerkaka, and more prominent than in any one of the others. In specimen figure 10, the ridge of the slit band is placed nearer to the superior border than in the others and is only very little prominent. The crescents are consequently more or less oblique, as their greatest curve coincides with this ridge. They are densely set, fine, thicker at the ridge and thinning out towards the borders. The surface on both sides of the ridge is a little scooped out, as seen in the profiles delineated. This median ridge does not, however, continue all the way round, but ceases in the vicinity of the aperture, as seen in fig. 10, upper detail, where the large slit band is only obscurely hemmed in by bordering lines and covered with regularly curved crescents. The slit is angular, tongue shaped with evenly curved sides. On the nucleus the slit band has made an impression as a shallow groove. The thin shell which seldom is preserved entire, is covered by fine striæ, which meet the slit band as usual in a highly acute angle. At their basis, near the suture they are more apart and form band like plaits. The aperture is transverse, with the exterior lip thin and sharp and the interior lip regularly reflexed, but not so much as to hide the narrow and open umbilicus. Length 30 millim., breadth at the basis 26 mill., apical angle  $71^{\circ}$ .

Only two specimens have been found in Gotland; one, fig. 10, in a detached block from the Norderstrand near Wisby, the other, fig. 12, from Östergarn. As to the derivation of the former, it is questionable whether it really has been included in a Gotland rock and rather not has been found in an erratic block, of which some, spread over Gotland, contain Lower Silurian fossils. The specimen from Östergarn seems indeed, to judge from the rock, to have been found in the Upper Silurian strata of that locality.

There cannot be any doubt that this species is the same as that so named by HISINGER. The original specimens of this author are contained in his own collection, now in the Palæontological Department of the Swedish State Museum and consist of two badly preserved nuclei from Dalecarlia, without any traces left of the shell. One of them, a little compressed from the sides, is the original specimen to his figures in »Anteckningar» pt. 5, two of which have been copied in the »Lethæa Suecica». Later, several complete specimens have been found in strata of Öland, contemporaneous with the former. As can be seen on the plate VIII to this work, fig. 14, the Öland specimen has only trifling deviations in the character of the slit band, such as only can be expected in a species of so wide a geological range. There exists then, as I suppose, no necessity to subdivide this species into new ones, as some later authors seem inclined to do by always citing »Pleur. elliptica His. sp.» There may at the utmost be mutations. The oldest known mutation is from the Upper Gray Orthocera-

tite limestone of Dalecarlia and Öland. It has almost the same general form as the Gotlandic one, the ornamentation is quite the same, the slit band is different by the longitudinal ridge, though still above the median line of the band, being placed nearer to it than in any other of the later mutations, where it is placed higher. In the specimen from Wisby (fig. 10) the ridge is placed at the highest and in the next from Östergarn it is midway between the position in the two former. There are, of course, in this, as in almost all other species of shells individual variations as to the greater or smaller convexity of the whorls, the size of the apical angle, of very little importance as to the specific distinction. Thus I think that *Pl. subconica* KJERULF may without hesitation be placed in this species. It is not at all identical with *Pl. subconica* HALL, as this author expressly states, that it is »cancellated», whereas the Norwegian shell only is transversally striated. *Murchisonia Hercyniæ* BILLINGS, Palæoz. Foss. Canada p. 158 f. 141, comes also near to *Pl. elliptica*, but is more elongated, with more acute apical angle, and may possibly be only a variety of this. *Pl. elliptica* GOLDFUSS Petrif. Germ. p. 50, pl. 178 fig. 4, is not at all related to our species. It is a sinistral and longitudinally carinated, Devonian species, only found as nucleus. DE KONINCK led by the general, exterior shape thinks, in his Faune Carbonif. de Belgique II pt. 3, p. 94 that »*Trochus ellipticus* HISINGER» ought »probablement» to be placed in his genus *Flemingia*, but this cannot be so, since the slit band has been demonstrated in this species.

In some specimens, as that from Wisby and that figured by FERD. ROEMER from the Lower Silurian, there is the peculiarity, that the impression of the slit band on the nucleus is a shallow groove, while it in all other specimens is a distinct keel or at least not so much grooved. The geological range of this species in Sweden is then, according to the statements, given above, from the Upper Gray Orthoceratite limestone included, through the Chasmops limestone into the Upper Silurian shale beds of Gotland.

### 19. *Pleurotomaria bicincta* HALL.

Pl. VIII fig. 15—25.

- ? *Pleurotomaria angulata* 1838 SOW. in Sil. Syst., 641 pl. 21 f. 20 (not identical with *Pl. angulata* MAC COY Sil. Foss. Ireland, 16, pl. I f. 17).  
*Murchisonia bicincta* <sup>1)</sup> 1847 HALL Pal. N. York vol. I, 177 pl. 38 fig. 5 a—h.  
 1850 SALTER Geol. Survey of Canada, Organic Rem., Dec. I, 19, pl. IV f. 5—6.  
*Turbo* sp. »probably new» 1851 SALTER Qu. Journ. Geol. Soc. vol. VIII, 178, pl. IX f. 15.  
*Pleurotomaria* sp. 1858 FR. SCHMIDT Estland, 202.  
 ? *Pleurotomaria latifasciata* 1862 MAC COY Synops. Silur. Foss. of Ireland, 15, tab. I f. 16.  
*Trochonema* (*Eunema*) *fatua* 1868 HALL 20:th Rep. N. York State Cab., 345, pl. 15 f. 7—8. Revised. Ed. 394, tab. 15, fig. 7—8.  
*Trochonema rectilatera* 1872 HALL & WHITFIELD 24:th Rep. N. York State Cab., 193, figured in the 27:th Rept. pl. 13 f. 4—5.

Shell conical, turbinated with five or six whorls. Each whorl is moderately convex and shows, when free, three different faces, the inferior one, sloping against the

<sup>1)</sup> *Murchisonia bicincta*? MEEK & WORTHEN Geol. Illinois vol. III, 317 pl. 3 f. 4 is too obscure to be with any certainty regarded as this species.



central axis, is near the suture swelling in a narrow obtuse ridge, the median face is parallel to the axis of the shell, and the superior one is moderately convex sloping outwards. The median face is confined within the characteristic two longitudinal ridges, which are more or less prominent in the different specimens. Of these ridges the largest or second one from above is the slit band, as may be learned through a closer inspection and by the direction of the ornamental striæ of the surface on each side of it. As seen in the figures, especially in fig. 23, it is distinctly separated from the other surface by bordering lines. It is formed on the same plan as in the preceding species, of oblique, dense crescents, the obliquity of which is influenced by the position of the longitudinal ridge. This ridge varies as to its position more than in any other species of this division, being placed in the middle of the band (fig. 19, 21) or near the superior border (fig. 22) or quite on the contrary near the inferior border (fig. 23). Its variations as to the size may also be perceived from inspection of such extremes as figs. 19 and 22.

The surface is densely covered by transverse, fine, elevated striæ, which are directed backwards from the suture in an elegant curve. Above the slit band they continue nearly vertically and again above the uppermost ridge curve backwards. There is some variation as to their fineness and proximity, of which figures are given. From Gothemshammar there is a peculiar variety (figs. 24—25) agreeing in all particulars with the described specimen, but being provided with a ridge beneath the slit band, midway between this and the suture. The aperture is elongated, nearly twice as long as broad, the exterior lip angular, thin and sharp, the inner lip reflexed in a large, smooth fold, which is often scooped out longitudinally and entirely covers the umbilicus.

The nucleus is strangely globose in the older whorls, only angular in the body whorl, and a thin covering of a nacreous stratum is left behind on it.

Dimensions. Largest specimen 65 millim. in height, 35 mill. in breadth, apical angle 62°.

	Height.	Breadth.	Apical angle.
Specim. fig. 15	45 mm.	33 mm.	78°.
— 18	45 »	39 »	87°.
— 24	10 »	6 »	62°.

By this and many other instances may be found how little reliance can be put on the size of the apical angle as a specific character. This beautiful and characteristic shell has been found in several specimens in many localities of Gotland, in Fårö at Lanså, at Slite in the shale beds and the superimposed limestone, Gothemshammar, Östergarn, Ardre, Samsugn in Othem, Martebo, in the limestone of Wisby, at Stor Wede in Follingbo, Krokstade in Tofta, Westergarn, Djupvik in Eksta and in a section between Stjernarfve and Lefvede, on the shore of Kyllé, in the canal near Atlingbo church.

This species has a geological range from the Lower Silurian strata of Borkholm in Esthonia, through the Upper Silurian into the Upper Helderberg strata of the Devonian group. *Turbo bicingulata* F. A. ROEMER Palæontogr. vol. 3 pl. V fig. 20 from the Devonian of the Harz mountains is probably also identical. Its geographical distribution is equally wide, as it besides Sweden occurs in N. America, Scotland,

Ireland and Russia. It is consequently one of the most characteristic Gastropods of the Silurian formation. That there should be a great amount of variation in a form of such wide a horizontal and vertical distribution is nothing more than could be expected. As the figures show, there are elongated and short forms. The variety from Esthonia, fig. 17, is the shortest and more coarsely striated, the body whorl nearly double the size as the others. Its height is 28 millim., its breadth 30 mm. The specimens from the limestone of Slite, figs. 18, 19, are also short and broad reminding of the Devonian form which HALL and WHITFIELD have called *Trochonema rectilatera*.

## 20. *Pleurotomaria qualteriata* SCHLOTHEIM.

Pl. XIII fig. 15—16.

<i>Helicites qualteriatus</i>	1820. SCHLOTH. Petref. Kunde, 103.
	1822. Id. Nachträge, 61, tab. XI f. 3 a—c.
<i>Solarium? petropolitanum</i>	1830. PANDER Beiträge zur Geogn. Russlands, 150, tab. I f. 3 a—3 b, tab. 28 f. 14.
<i>Euomphalus qualteriatus</i>	1834. GOLDFUSS in KLÖDEN, Versteiner. Mark Brandenburgs, 155.
	1835. BRONN Leth. Geogn. 1:c Aufl. Bd I, 94, Taf. II f. 1 a, b.
	1840. EICHWALD Schichtensyst. Estlands, 115.
	1844. GOLDFUSS Petrefacta Germaniæ III, 81, tab. 189 f. 3.
	1845. VERNEUIL Russia, vol. 2, 333, tab. 23 f. 1 a—b, 2 a—b.
	1848. SALTER Memoirs Geol. Survey II, I, 356, pl. XIV f. 7.
	1858. FRIEDR. SCHMIDT Geol. Estlands, 206.
	1865. KJERULF Veiviser, 7
	1867. TÖRNQUIST Lagerföljden i Dalarne, 19.
	1869. KARSTEN Versteinerungen . . . in Schleswig und Holstein. 43, tab. 14 fig. 9 a—b.
	1880. ANGELIN & LINDSTRÖM p. p. Fragmenta Silurica, 12, tab. XV f. 10, 11 (excl. fig. 12—14).
<i>Pleurotomaria lenticularis</i>	1843. CONRAD in EMMONS Geol. N. York pt. II, 392—393 f. 101,2 & 102. Pl. lenticularis HALL Pal. N. Y. vol. I, 172 is quite different.
<i>Euomphalus qualteriatus</i>	1848. BRONN Nomencl., 480.
	1854. FERD. ROEMER Leth. geognostica ed. 3, I, 1, 459, tab. 2, f. 1 a—b.
	1860. EICHWALD p. p. Lethæa rossica I, II, 114.
<i>Straparollus qualterianus</i>	1850. D'ORBIGNY Prodr. I, 6.
<i>Straparollus pseudoqualteriatus</i>	1850. Id. Ibid. I, 30.
<i>Rhaphistoma qualteriatum</i>	1859. SALTER Canad. Organic Remains, Dec. I, 13.
<i>?Ophileta Ottawensis</i>	1860. BILLINGS Canadian Naturalist, 166, fig. 9—10.

Shell discoid with short, flat spire of five and a half whorls. The apical side is gently convex or nearly flat and the sutures are very shallow. The whorls are on the umbilical side more convex, increasing in height and convexity near the umbilicus, which is large and open.

The angle formed by the slit band is interposed between the umbilical and apical sides and is highly acute, of 30°. Its limits are designated through the converging threadfine ornamental lines of the surface which for the rest is smooth. The slit band is at largest on the apical side and there separated from the other surface through no distinct bordering lines. The crescents are fine and indistinct.

As may be perceived from the dimensions given below, the Gotland mutation of this species is more discoid than the older, which are relatively higher in their last whorl.

The Gotland specimens are only nuclei and consequently the details of the surface have been taken from Lower Silurian specimens of nearly the same form.

In the oldest shale beds near Wisby six specimens or nuclei have been found in situ and thus there is certainty that they have not been transported. As may be seen through the dimensions given, they are more flat than those from the Lower Silurian strata. Largest diameter 43 millim., height 15 millim. Breadth of the largest whorl 16 millim., height of the same 11 mill., while in one of the Lower Silurian ones the largest whorl near the aperture is 18 millim. in breadth and in height 13 mill. A specimen from Borkholm in Esthonia has the aperture of 18 mill. in height and 20 mill. in breadth. Specimens which nearest resemble this are first met with in the uppermost strata of the Lower Red Orthoceratite limestone from Källa in Öland. It then occurs in numerous specimens in the Lower and Upper Gray Orthoceratite limestone of Dalecarlia and Öland and also of other provinces, and returns again in the uppermost limestone strata of the Lower Silurian. Coëval with this species there lived at least one nearly allied species and two others which have been rather confounded with them. The characters of all four are shortly given below, in order in some way to clear up the distinctive features of these very common fossils.

1. *Pleurot. gualteriata* SCHLOTII. 1820, with flat, horizontal or faintly convex apex, slit band largest on the apical side, only discernible through the direction of the sculptural lines.

As to the quaint name of this species it seems that SCHLOTHEIM, when he compares it with *Helix gualteriana*, had intended to name it *gualteriana* or *gualteriata*, but that through some error the *g* had been changed into a *q*. He, nevertheless, retained the later, without giving any clue to its derivation.

2. *Pleurot. obvallata* WAHLENBERG 1818 (Petref. Svec. p. 73 tab. IV fig. 1—2) with prominent apex of steplike whorls, slit band (pl. XIII fig. 18) large on the apical side, narrow on the umbilical side; in its centre with densely packed crescents, nearly resembling those of *Pleur. bicincta*. This species is more common than the former and it has, in the same way, filled up the apex with solid calcareous matter. It is found in the Lower and Upper Gray Orthoceratite Limestone of Öland and Dalecarlia. Then there are two other species which belong to a quite different type, as they have the slit band built upon the same plan as prevails in the Division of the *Alata*.

1. *Pleurot. marginata* EICHWALD. This forms the transition to the next extreme species. It is large, with six ventricose, contiguous whorls, on the apical side sunken in a wide, open funnel, their inner face abruptly sloping inwards. The slit band on the inferior edge of the whorls is thin, lamellar, and winglike. The surface is finely, transversally striated, on the umbilical side there are broad plaits. It occurs in the Lower and Upper Gray Orthoceratite limestone of Öland. A variety, with the youngest whorls uncoiled, belongs also to this species and occurs in the youngest limestone beds of Öland. There are several diaphragms in the apex of this shell. This species is related to the Canadian *Ophileta* as it has been described by SALTER in »Canad. Organ. Remains». Dec. 1 p. 16, through the slit band is more developed in *Pl. marginata*.

1. *Pleurot. sp.* (= ? *Eccyliomphalus alatus* ROEMER, ? *Helicites centrifugus* WAHLENBERG, see also Pl. XV, fig. 12—14 in »Fragmenta Silurica»). This is a smaller species than the former, more uncoiled and tending to complete scalarid formation. The inside of the whorls is not so steep as in *Pl. marginata* and the funnel formed on the apical side not so regular as in that. The sculpture is more distinct of coarse transverse lines and the slit band is more prominently alate or laminae than in them. This occurs in the Lower Gray Orthoceratite limestone, in the Upper Red and Upper Gray Orthoceratite limestone and also in the Chasmops limestone of Öland.

It is of such forms as this, that the genus *Eccyliomphalus* has been built up, commingled with others, as evolute *Euomphali*. To elucidate their distribution in time the following table may serve.

	Lower Red Orthoc. Limestone.	Lower Gray Orthoc. Limestone.	Upper Red Orthoc. Limestone.	Upper Gray Orthoc. Limestone.	Chasmops Limestone.	Youngest Limestone of Öland.	Leptæna Limestone of Dalecarlia.	Shale of Gotland.
1 <i>Pl. quatterata</i> SCHL. ....	*	*		*		?		*
2 <i>Pl. obvallata</i> WAHL. ....		*		*				
3 <i>Pl. marginata</i> EICHW. ....		*		*		*		
4 <i>Pl. sp.</i> <sup>1)</sup> .....		*	*	*	*	*		

#### Divisio IV. SIMPLICES.

#### 21. *Pleurotomaria valida* n.

Pl. IX fig. 11—13.

Shell elongate, turbinated, with seven or seven and a half whorls, which are ventricose, the superior ones forming an obtuse angle midway between the median line of the whorl and the suture where the slit band is situated.

The whorl is almost flat beneath the slit band sloping suddenly inwards towards the suture. There are only some slight traces left of the sculpture of this uncommonly thick shell, and it consists in transverse striæ. The slit band is very large, nearly 4 mill. across, the height of the whorl being 27 mill. The aperture is oblong and the columellar lip thick and reflexed, so as to hide the umbilicus of which there is no trace, as the columella is solid. The shell seems to have been much exposed and weathered before it was enclosed in the limestone.

It has been found in a hard, crystalline limestone near Lillugn in a wood between the parishes of Ardre and Alskog. *Pl. inflata* MAC COY, Sil. Foss. of Ireland p. 15 pl. 1 f. 15, somewhat resembles this shell in form.

<sup>1)</sup> *Pl. replicata*, nearly related to this, is found in the Gotland shale.

This is the largest of the Gotlandic *Pleurotomaria*, attaining a length of 1,03 decimeter and a width of 60 millim. The thickness of the shell near the umbilicus is 5 millim. and in the body whorl of the largest specimen 6 m. m.

## 22. *Pleurotomaria Othemensis* n.

Pl. IX fig. 14—16.

Shell elongate, turriculate, with seven ventricose whorls, which form an obtuse angle along their median line, where the slit band is situated. This band is relatively large, with convex surface, covered with regular, distantiated crescents. It is hemmed in by two much projecting lamellæ which grow out in converging direction. The ornamentation is only transverse, of lamellæ, with a peculiar wavy or broadly indented edge. The aperture is ovate, the outer lip thin, with the broad slit in the middle, the inner lip a little more thickened, reflexed around the narrow umbilicus. H. 34 mill., br. 25 mill. Apical angle 63°. It has been found in several specimens in the richly fossiliferous limestone of Samsugn in Othem. It might at first have been taken for a variety of the former. But its more narrow slit band, placed on the median line of the whorls, which are more angular than in *Pl. valida*, and its peculiar ornamentation sufficiently distinguish it as an independent species.

## 23. *Pleurotomaria comata* n.

Pl. IX fig. 18—19.

Shell regularly turbinated with seven ventricose whorls. Slit band placed on the median line of the body whorl, high up near the suture on the lower whorls, concave, with the bordering lines only slightly projecting, crescents microscopically minute, crowded. The ornamentation of the surface consists in densely packed, nearly straight, threadfine lines. Aperture ovate, umbilicus open, narrow. Length 9 millim., breadth 7 millim. Apical angle 64°.

Occurs in the shale of Djupvik, from where the State Museum at Stockholm has obtained several specimens.

It is nearly related to the preceding, but differs through more globose whorls, the higher position of the slit band and the sculpture of that band, as well as that of the surface.

## 24. *Pleurotomaria æquilatera* WAHLENBERG.

Pl. IX fig. 20—29.

*Helicites æquilaterus* 1818. WAHLENBERG *Petrif. Svec.*, 73<sup>1)</sup>.  
1828. HISING. *Anteckn.* IV, 237.

<sup>1)</sup> The date of most of the species published by WAHLENBERG must be changed to 1818 instead of 1821, as so often has been used. His memoir »Petrificata Telluris Svecana» in the eighth volume of the »Acta

<i>Delphinula æquilatera</i>	1829.	HISINGER Tableau Ed. 1, 10,
	1831.	Id. Tableau Ed. 2, 8.
	1831.	Id. Anteckn. 5, 113.
<i>Euomphalus æquilaterus</i>	1837.	Id. Lethæa, 36, tab. XI f. 8.
	1841.	Id. Förteckning, 55.
<i>Pleurotomaria æquilatera</i>	1848.	BRONN Nomenclator, 1012.
<i>Straparollus æquilaterus</i>	1850.	D'ORBIGNY Prodr. 1, 29.

Shell globular or disciform, with short spire of seven whorls, resembling those of an *Helix*. The slit band is only a little below the middle of the body whorl, and close to the suture, near the upper border of the other whorls. It is narrow and open for a long way from the aperture on the body whorl. Its surface is even and the bordering lines are lamellar, projecting. No definite sculpture is discernible owing to its considerable narrowness. The surface of the shell is sculptured with fine, recurved transversal lines. The whorls are somewhat flattened below the slit band, rounded on the umbilical surface. The aperture is transversally oval, the umbilicus wide, and all whorls visible. Diameter 45 millim., height 20 millim.

Occurs in the shale beds (a) at Wisby, in the limestone of Samsugn in Othem, Stor Wede at Follingbo, Westöös in Hall, Kyrkberget of Wisby, Kälens Qvarn near Wisby, the hill of Bara, Wialmsudd at Färösund and also Färö, Lutterhorn and Stor Myr in Rute. The Mineralogical Cabinet of the University of Upsala has a specimen collected by Professor P. T. CLEVE in the limestone of Slite.

There exists a great variability in this shell, especially as to the width of the umbilicus and the height of the spire as remarkable through the figures of the typical specimen of WAHLENBERG, which has been kindly lent from the Mineralogical Cabinet of Upsala, with its low spire and flattened whorls to these globose shells delineated in the figs. 26 and 27. Through the former, fig. 20—22, there can be no doubt of what WAHLENBERG really meant by his species. But there is no reason with him and HISINGER to suppose that it also has been found in the Lower Silurian. I have not seen a single specimen from that formation appertaining to this species. In HISINGER's own collection there are specimens from Holmestrand in Norway, badly preserved, and by him called *Euomph. æquilaterus*. One specimen, the best, may possibly belong to this species. In the same collection there are also specimens from Gotland called *Euomph. æquilaterus*. They are five, much worn specimens of *Oriostoma discors* from Kapellshamn and one specimen of *Pleurotomaria undulans*. EICHWALD, Leth. Rossica I, II, 1170, adopts also this species, but the identification is questionable, as well as that of KJERULF in Veiviser p. 24.

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Societatis Regiæ Scientiarum» was indeed printed already in 1818, as WAHLENBERG himself says in the beginning of the »Additamenta» to that memoir, page 293 of the same volume. The statement there given is: »Postquam anno 1818 impressa fuerat Commentatio de Petrificatis Svecanis» etc. The memoir had also been early enough distributed by its author to some geologists, as can be perceived by what BRONGNIART says in his »Crustacés fossiles» (1822) p. 2, viz. » . . . M. WAHLENBERG, dont le travail . . . n'est venu à ma connaissance qu'en 1819». But on the title page of volume VIII, containing the collected memoirs and papers, the year 1821 is printed, as it was not issued complete before that year.

Divisio V. **INCISÆ.**25. **Pleurotomaria labrosa** J. HALL.

Pl. IX figs. 30—38.

<i>Pleurot. labrosa</i>	1859. J. HALL Pal. N. York vol. III, 339, pl. 66 f. 1—5, pl. 67 f. 6.
<i>Pleurot. balteata</i>	1867. LINDSTRÖM (not PHILLIPS) Nomina foss. Gotl., 23.
<i>Pleurot. labrosa</i> var. <i>occidens</i>	1868. J. HALL 20:th Rep. N. York St. Cab. 1:st Ed. 343.
<i>Pleurot. occidens</i>	1868. HALL 20:th Rep. 1:st Ed. 364, pl. 15 (6) fig. 11—12.
	1868. Id. 20:th Rep. Revised Ed., 392, pl. XV f. 11—12, pl. XXV f. 9—10.
	1875. HALL & WHITFIELD Geol. Survey of Ohio, vol. II, 142, pl. 8 f. 2.
	1877. OEHLERT Bull. Soc. Geol., 585, pl. IX f. 6, 6 a.
	1877. MILLER American Fossils, 160.

Shell turbinated, with a short spire and the body whorl enlarged many times the size of the other whorls. Whorls five, almost flat or horizontal beneath the large and prominent slit band, above it convex and ventricose. This band is situated beneath the median line of the whorls, it is oblique with the surface directed downwards; the thin and sharp edges (fig. 35) transform it into a deep groove, somewhat wavy in its course (fig. 33). The crescents (fig. 34) are thin, deeply incised lamellæ, concentrically striated, obliquely hiding behind each other. The inferior, flat side of the whorls is transversally striated by crowded lines of growth, which are crossed by a several elevated, longitudinal striæ in some specimens, while they are completely wanting in others. The superior moiety of the whorls is ornamented by a number of spiral ribs, which together with the longitudinal lines form a regular, cancellated trellis work. There are also finer transverse striæ. The slit in the aperture continues open for a long distance. The aperture is rather rhomboidal and angular in the four corners, below, above and at the sides, in the lowest corner acuminate. The exterior lip is thin and sharp, the interior or columellar border thick, smooth and callous, folded back tightly against the body whorl, so that no umbilicus is visible. Height 48 millim., breadth 45 mill., longitudinal diameter of the aperture 35 mill., transverse diam. 30 mill.

It occurs in the soft shale at Wisby, at Westergarn, where the most numerous specimens have been found, Stora Carlsö, Ejmunds, in the canal between Atlingbo church and Hogrän, Klints in Boge and Lansa in Fårö. It does not occur in the limestone beds above the shale.

This species is interesting in consequence of its being one of the few which continue in the Devonian formation. It was first described by HALL from that formation and OEHLERT later also found it in the oldest Devonian strata of the north of France. Its geographical range is also great, as it has been found in England, besides in N. America and France. In England it has been found in the Wenlock Strata at Walsall according to a specimen in the Museum of Practical Geology in London, of

which Dr G. J. HINDE kindly has sent me a cast to compare. It has often been confounded with *Pleurot. balteata* PHILLIPS which is a quite different species, as I have learnt also through a cast kindly sent from Dr HINDE.

## 26. *Pleurotomaria limata* nom. nov.

Pl. X fig. 2—17.

- Euomphalus carinatus* 1839. SOWERBY in Sil. Syst., 616, pl. 6 f. 10.  
 1843. MORRIS Catal. Brit. Fossils Ed. 1, 144.  
 1847. MURCHISON Silurian Rocks of Sweden, Qu. Journ. Geol. Soc. Lond., 29, 49.  
 1854. MORRIS Catal. 2:d Ed., 247.  
 1867. SALTER Siluria 3:d Ed., 531, pl. 24 f. 11.  
 1873. Id. Catal. Cambridge Foss., 157.  
*Straparollus carinatus* 1850. D'ORB. Prodr. I, 29.

Shell globular with short spire or turbinated with elongated spire and ventricose whorls. The former variety, figs 2—6, is from the southern localities of Gotland, mentioned below, the later, figs. 7, 8, 10, from the northern ones. The slit band is placed a little above the middle line or exactly on it in the body whorl, near the upper suture on the other whorls. As to its course it follows not always the same line, but deviates from it obliquely as seen in figure 7. It is much prominent, more so than in any one of the preceding and nearly as much as in the following. Details of it are given in figs. 14—17. The crescents are of a most peculiar shape, figs. 15—16, being lamellæ divided into two lobes through a large, oval slit widening backwards. The two lobes are of unequal size, the lower one usually larger. The deep groove in the midst between them is longitudinally as well as concentrically striated. These lamellæ have grown longer in the same proportion as both the bordering edges have changed and, as seen in the longitudinal section fig. 17, become elongated as thin lamellæ, directed obliquely towards the aperture and thinning out near the outer margin. The slit band thus attains to a large size and in some as much as five millim. in a transverse line. See fig. 12. In fig. 14 there is an enlarged transverse section, in which two pairs of the lobes have been cut through.

The depressed variety has five whorls, sloping in an acute angle to the slit band. The aperture is transversally ovate, broader than high. The surface is richly sculptured by a great number of spiral lines, varying from three to ten or more, crossed by lines parallel with the lines of growth. Beneath the slit band the spiral lines are more numerous and close, forming with the transverse lines a fine trellis work of minute meshes and points, nearly alike the surface of a fine polishing file, fig. 3, 13. The umbilicus is either open as to show all whorls, fig. 6, or partially concealed through the acute angle formed by the interior lip of the aperture, f. 3.

The elongated variety, figs. 7—12, from the northern localities of Gotland is turbinated with longer spire and ventricose whorls. There is usually only one spiral ridge above the slit band, seldom two, but much prominent. Beneath the slit band there is a varying number from a single longitudinal line to quite as many as in the



former variety. The shell consists of two strata of which the interior one is smooth and glossy. The aperture is obliquely ovate, higher than broad and the umbilicus narrow. In some, fig. 7, 8, the suture is very deep. The slit band is also placed lower, than in the former, where it is close to the suture on the smaller whorls. Dimensions of the lower form: height 32 milim., width 55 mill., height of aperture 15 millim. The elongated variety has in height 32 millim., breadth 35 mill., aperture 21 mm.

The shorter variety is found at Klinteberg and Lilla Carlsö in the limestone beds, in the shale beds at Wisby, Gnisvärd, Westergarn and Stora Carlsö. The elongated form is found in the limestone beds of Wisby, Lickershamn, in the canal near Westöös in Hall, Samsugn in Othem, Lännaberget near Slite, Wialmsudd in Bunge, Lutterhorn in Fårö, Kälens Qvarn, Kristklint in the bay of Kapellshamn.

*Pleurotomaria crenulata* MAC COY, Palæoz. Fossils p. 291, pl. I K. f. 45, may also be referable to this species, but I cannot be sure of it through the description and figure alone. There cannot be any doubt left that this species really is the *E. carinatus* of SOW. since MURCHISON says he also found it in Gotland and, above all, since I have had occasion to see a cast of the original specimen of SOWERBY in the Mus. of the Geol. Soc. of London from the Aymestry Limestone at Aymestry.

MURCHISON says in the »Postscript» to the paper on the Silurian Rocks of Sweden: »Mr SOWERBY is responsible for the *E. carinatus*, which is distinct from *Inachus sulcatus* HISINGER.» This statement, even if the figure in the Silurian System did not show the identity, must suffice to dispel the identification of this shell with *Inachus costatus* or *centrifugus* as MORRIS l. c. and BRONN Nomenclator p. 478, have it.

I have been obliged to give this species a new name, as there already before exists a *Pleurotomaria carinata* Sow. 1834, Mineral Conch. p. 247.

## Divisio VI. ALATÆ

(*Euomphalopterus* F. ROEMER.)

### 27. *Pleurotomaria replicata* n.

Pl. XIII fig. 39—44.

Shell evolute, with lowly sunk spire, whorls three and a half, wide apart. Slit band situated on the lower and exterior edge of the trigonal whorls, consequently directed downwards towards the apical side, as usual with so many *Pleurotomariæ* having this band winglike or expanded. Like that in *Pl. alata* it is enormously widened, figs 42—43, into an aliform lamina, nearly as long across as the widest diameter of the whorl. The crescents closely set, elongated as lamellæ, directed outwards towards the aperture. In a section across the band, fig. 43, more than twelve crescents may be seen cut across. A section along the exterior edge of the aliform band reveals, fig. 44, the extreme, thin outlines of the much distantiated crescents. A section of the whorls, fig. 39, gives the figure of a nearly isoscele triangle, the short basal line of

which is the sloping, interior umbilical side and the both equal sides are the exterior and the apical sides. There is thus a narrow ridge running along the middle of the umbilical side, being in older whorls as thin as a knife edge. The ornamentation consists of transversal, regularly distantiated, narrow lines, somewhat wavy and enclosing between them numerous, minute lines, parallel with them. When reaching the wing of the slit band they are bent in a gentle curve backwards. On the umbilical side the sculpture is more coarse and consists of imbricated lamellæ.

Length of whorl and slit band near the aperture 21 millim. Length of slit band alone 10 millim. Breadth of whorl near the aperture 10 millim.

Only one specimen has hitherto been found in a detached stone on the shale beds near Wisby, which probably, as far as can be judged by the rock, belongs to the Upper Silurian of Gotland and the oldest shale.

This species is related to *Eccyliomphalus alatus* FERD. ROEMER Leth. Geogn. 1876, tab. 5 fig. 5, in which, however, *the apical spire is elevated into an apex on the umbilical side*, the slit band is shorter and the section of the whorls is rather more oval than triangular. *E. alatus* or a nearly related species also occurs in the Upper Red Orthoceratite limestone of Öland, while another, which comes near to *Pleurotomaria replicata*, has been found in the Upper Gray limestone of Dalecarlia. These fossils have been numbered with *Eccyliomphalus*, but I shall further down attempt to show that this genus cannot be retained, as it contains either evolute *Pleurotomariæ* as this species and kindred, or evolute *Euomphali*, the peculiarity of the uncoiled whorls being in no way any characteristic sufficient enough for generic distinction, when taken alone. This *Pl. replicata* is a direct development from such forms as those described with *Pl. qualteriata* and connects them with the group *Alatæ*, being probably in genetic connection with the fourth of these *Qualteriataæ*.

## 28. *Pleurotomaria alata* WAHLENBERG.

Pl. X, fig. 18—32.

Cornu Ammonis lævis vestigium. 1730 BROMELL, Lithogr. Svec. in Act. liter. Scient. Svec. p. 31.

<i>Turbinites alatus</i>	1818. WAHLENBERG Petref. Svec., 69. tab. III f. 6—8.
	1828. HISINGER Anteckn. IV, 221, 237.
<i>Turbo alatus</i>	1821. KÖNIG Icones fossilium sectiles, pl. IX fig. 107.
<i>Delphinula alata</i>	1829. HISINGER Tableau ed. 1, 10.
	1831. Id. Anteckn. V, 113.
	1831. Id. Tabl. ed. 2, 8.
<i>Euomphalus alatus</i>	1829. BRONGNIART Tableau des terrains, 428.
	1837. HISINGER Lethæa, 36, tab. XI f. 7 a—b.
	1839. ANGELIN Museum Palæontologicum Scandinav. N:o 30.
	1839. SOWERBY Sil. Syst., 631, pl. 13 f. 28.
	1841. HISINGER Förteckn., 55.
	1843. MORRIS Brit. Fossils, Ed. 1, 144.
	1847. MURCHISON Quart. Journ. Geol. Soc., 29.
	1848. BRONN Nomenclator, 478.
	1848. PHILLIPS Mem. Geol. Survey II, 1, 356.

- Euomphalus alatus* 1854. MORRIS Brit. Fossils Ed. 2, 247.  
 1855. PICTET Traité de Pal. III, 155, pl. LXII f. 12.  
 1862. MAC COY Synopsis Sil. Foss. Ireland, 13.  
 1867. SALTER Siluria 3 Ed., 531, pl. 25 f. 4.  
 1867. LINDSTRÖM Nomina foss. Gotl., 23.  
 1867. QUENSTEDT Handbuch der Petrefaktenkunde, 506, tab. 45 f. 64.  
 1868. BIGSBY Thesaurus Siluricus, 153.  
 ? 1871. BAILY Figures of Characteristic British Fossils pt. III, pl. 21 f. 7 (scarcely).  
 1873. SALTER Cat. Cambr. Mus., 157.  
 1882. QUENSTEDT Petrefaktenkunde Deutschlands 1:c Abth. 7:c Bd., 327, tab. 197 f. 41
- Schizostoma alatum* 1842. D'ARCHIAC & VERN. Trans. Geol. Soc. Lond. 2:d Ser. vol. VI, 365.
- Straparollus alatus* 1850. D'ORBIGNY Prodr. I, 29.
- Pleurotomaria alata* 1858. FR. SCHMIDT Esthland, 201.
- Euomphalopterus alatus* 1876. FERD. ROEMER Leth. Geogn. tab. 14 f. 9.a—9 b.

Shell turbinate, spire broad and short, consisting of six or seven tubular whorls, circular in section, fig. 29. The slit band is placed above the median line of the whorl, nearly on a level with the upper edge of the aperture. This large, lamellar slit band, which is built on an exactly homologous plan with that of *Pleur. replicata* and *Pl. limata*, occupies a belt around the shell, which on the last whorl attains a length across of 12 millm. in the largest specimens, the whole diameter being 50 mm. It is directed at first obliquely upwards, fig. 29, 30, and turns at the exterior edge abruptly downwards in a curve, which sometimes has the appearance of a hook, f. 30, 32. Along its outermost margins this lamina is in some specimens folded in undulations f. 24. If this large slit band be split in two halves along its median line, it is found on each side to consist of two thin strata (f. 27) the exterior one transversally striated on its surface and the interior one quite smooth and transparent. Within these are enclosed the crescentic laminae and through their development the space between the bordering laminae seems to be divided into a number of narrow compartments (fig. 27, the enlarged portion). They are wider apart near their exterior ends and converging towards the whorls. When the slit band is sectioned transversally across these crescents the appearance shown in fig. 30 is produced. The curved outlines of ten obliquely sectioned, crescentic lamellae are seen in the dark shale between the bordering edges of the slit band. These enclosing lamellae are in direct continuation with the exterior darker stratum of the shell, composed of minute, angular laminae. Within this exterior stratum another of clear crystalline calcite lies, often retaining a nacreous lustre. There are absolutely no communications, nor perforations or tubes between the interior cavity of the whorls and the spaces separating the crescentic lamellae of the slitband as FERD. ROEMER has supposed. The interior cavity is closed as in other *Pleurotomariae*. Along the exterior edge of the slit band, fig. 31, the ends of the crescents are discerned, especially when a little cut; the thin edges of the band are usually broken on the older whorls, f. 22.

The umbilical side of the shell is nearly cup shaped, being hemmed in around the edges by the high, turned up slit band and sunk towards the umbilicus, around which there is an elevation.

The surface is only transversally striated, the striae running straight down to the slit band and, chiefly on the umbilical side, directed *towards* the aperture and

at the very edge of the laminal slit band turning back *from* the aperture, quite as is the case in all Pleurotomariæ with transverse striæ on the surface. The smallness of the apertural slit in this and similar species causes this dissimilarity from the other Pleurotomariæ. Around the umbilicus a small ridge is running, a little knotty where the transverse lines cross it. On the spire the transverse lines are more distantiated, elevated, and formed by the lines of growth. The aperture is circular, the lips sharp and thin, not reflexed, the exterior one extending into a triangular appendix, a narrow groove, representing the sinus or the slit, which here is reduced to a minimum. The umbilical side of the aperture is deeply insinuated, almost as much as in some of the Devonian shells which D'ARCHIAC and VERNEUIL have placed in the genus Schizostoma, Sch. radiata for instance, but which probably are different from BRONN'S Schizostoma. The umbilicus is very wide and open and all whorls are seen to the bottom of the umbilical funnel. On the umbilical side of the slit band there are in some specimens discerned two or three darker spiral bands, a little deepened in the shell, somewhat reminding of rests of colour bands.

Largest specimen 26 millim. in height, 51 millim. in breadth. Another specimen attains 18 millim. in height, 35 millim. in breadth, the umbilicus has 9 millim. in diameter and the slit band is 7 mill. wide across.

This characteristic species has been found in numerous specimens in almost all strata of Gotland, in the shale beds of Wisby, Westergarn and Slite, in the limestone of Lutterhorn and Lansa of Färö, of Slite, Samsugn in Othem, Klinteberg, Westöös in Hall, Kylley, Kälens Qvarn, Stora Carlsö, the canal of Atlingbo.

This species has by FERD. ROEMER been made the type of a new genus Euomphalopterus, which is characterized by tubular perforations through the lamellar edge, which surrounds the shell, and also penetrate through the walls of the shell into the interior of the whorls. But, as stated above, there do not exist any such perforations in the walls of this shell and the tubes are, as shown above, nothing but the spaces between the lamellar crescents of the slit band. Nor has ever any operculum been found to this species<sup>1)</sup> or to other Pleurotomariæ. There is consequently, not any reason to place this in a new genus, at the highest this and the following ones may form a subgenus to Pleurotomaria.

## 29. *Pleurotomaria alata* var. *subcarinata*.

Pl. X fig. 33—37.

This small variety differs chiefly in having an obtuse ridge beneath the slit band, and where it runs, the whorls are angular, while in *Pl. alata*, figs. 18, 19, the whorls are rounded on the corresponding surface. There is a revolving ridge around the umbilicus in this, as well as in the principal form, though not in all specimens. There is no reason to consider this as more than a variety of the former, as there are some

<sup>1)</sup> See ZITTEL Handbuch der Palæontologie Bd. 1, 2 Abth. p. 206, where he describes an operculum of Euomphalopterus, but which in reality belongs to some Oriostoma.

few specimens of *Pl. alata*, fig. 28, which also show a very faint rib nearly on the same place as in the variety. Height 8 millim.; breadth 16 mill.

From Djupvik in Eksta, Lingsarfve in Näs, Fårö, Westergarn and in the oolitic limestone of Bursvik.

### 30. *Pleurotomaria alata* var. *opposita* n.

Pl. X. fig. 38—40.

Shell trochiform, broader than high, spire of five or six whorls, more ventricose than in the preceding varieties of the species. Slit band situated a little above the median line of the whorls. Beneath the band, near the suture, a narrow keel is seen and there is none around the umbilicus. This variety is best distinguished by the direction of the transverse striæ, which, as seen in fig. 39, are more prominent and elevated than in the others and are obliquely turned *against* the aperture, quite opposite to what obtains in most of the other *Pleurotomaria*. The ends of the larger striæ radiate in an expanded brush of minute striæ, fig. 40. In the preceding forms the striæ meet the slit band either rectangularly or directed backwards. Height 7 mill., breadth 13 mill.

From the shale at Petesvik in Habblingbo.

### 31. *Pleurotomaria prætexta* n.

Pl. XI fig. 1—7.

Shell trochiform, moderately elongated, with six whorls, which are convex and evenly rounded below, the umbilical side almost flat. The keel formed by the slit band is broad, near its junction with the whorls on both sides ornamented with a strongly prominent, spiral ridge, on which the transverse striæ form nodules. The band is placed a little above the median line of the body whorl and on the other whorls high up, close to the suture. As seen in fig. 5 its interior crescentic lamellæ are very closely packed, elongated and reach obliquely forwards to the margin of the keel. This margin, fig. 6, is sometimes folded in a number of small wavelets, nearly as in *Pl. undulans* though more regularly. The transverse striæ of the surface are approached, although at regular distances, and have some smaller, parallel ones in the interstices. The aperture is circular and a little angular in its interior corner and the umbilicus open and narrow. Height 13 mill., breadth 16 mill., aperture 6 millim., umbilicus 3 millim.

Occurs in the lowest shale beds near Wisby.

This species is nearly related to *Pl. alata*, from which it is readily distinguished by the elevated ridges near the edge of the slit band.

### 32. *Pleurotomaria togata* n.

Pl. XI fig. 8—13.

Shell trochiform of seven angular whorls, slit band thick and short, fig. 13, placed above the median line of the body whorl and close below the suture in the

other whorls. It shows in the margin, fig. 12, the ends of the enclosed crescents, which are formed upon the same plan as in the other »Alata». In a transversal section, fig. 13, the uncommonly thick shell substance of the bordering lines encloses a most narrow slit band. Beneath the slit band an angular ridge is seen and below that the wall slopes abruptly inwards to the suture. The surface is transversally divided into large sinuous folds, the interstices being streaked with minute, parallel lines, fig. 12. The umbilical side, fig. 10, is comparatively smooth and glossy, the transverse lines being most conspicuous near the margin, where, a little inwards, a blunt rib runs parallel with it, corresponding to a similar one on the lower side, though not so distinct. Another ridge, more distinct, encircles the umbilicus, which is open, but narrow. The aperture is circular as well as the section of the whorls, the lips are thin and sharp-edged without being reflexed.

Dimensions of the specimen figured: height 12 millim., breadth 20 mill., aperture 7 mill.

Several species are found in the shale beds of Wisby and Petesvik in Habblingbo.

### 33. *Pleurotomaria frenata* n.

Pl. XI fig. 14.

Shell turbinate of five ventricose whorls. Slit band situated only a little above the median line of the whorls, its keel is short, of triangular section, with broad base of plaited folds, fig. 14, with angular ends. The crescents of the band are as wide apart at their ends as in the other species. The surface on both sides is covered by fine, minute striæ, wavy and interlacing, forming a reticulate surface like that of the next species. The striæ are directed towards the aperture and turn backwards only on the slit band. The aperture is regularly circular with thin, sharp lips, the umbilicus is open.

Dimensions. Height 19 millim., breadth 26 mill., aperture 11 millim. Five specimens have been found in the shale beds near Wisby.

This species is intermediate between *Pleurot. prætexta* and *Pleur. undulans*, uniting a slit band like that of the former with an ornamentation resembling that of the latter.

### 34. *Pleurotomaria undulans* n.

Pl. XI. fig. 15—23.

*Euomph. æquilaterus* 1867. LINDSTR. Nomina, 23.

Shell helicoid, thin and fragile, and consequently usually crushed and distorted, spire short, whorls six, ventricose. Slit band situated nearly on the middle line of the body whorl, on the other whorls close to the upper suture, which it covers, very narrow and often enlarged into a thin lamina, which is bent and folded into a succession of irregular waves, as delineated in the figures. Its interior structure coincides entirely with that

of the others in this group. Fig. 23 represents it sectioned across with some ten crescentic lamellæ obliquely cut, and fig. 22 is a section rectangular to the former. In fig. 21 a magnified portion of a cloven band is delineated, where in the interior the elongated, crescentic lamellæ are directed obliquely, diverging outwards. The whorls are beneath the slit band rounded and covered by fine, threadlike, elevated striæ, equally distantiated. Above the slit band the transverse striæ are still finer and more numerous and a little sinuous. The striæ are directed towards the aperture till they reach the slit band lamina, on which they turn backwards. The aperture is transversally ovate, almost twice as broad as high and the lips thin and sharp. The umbilicus is open and measures nearly a third part of the diameter. Some specimens still retain the nacreous lustre very vividly on the nucleus. A nucleus, fig. 20, shows traces of a ridge around the umbilicus, which, however, has not been observed on the outside of the more complete specimens. But this, as well as similar impressions on the inferior surface of the whorls may be due to the crushing of the specimen. Height 20 millim., breadth 28 mill., breadth of the umbilicus 9 mill. in a shell having 25 millim. in a transverse line.

Found in the shale and limestone in the vicinity of Wisby, and also in south along the coast in the shale at Gnisvärd and Westergarn and in north as far as the shale of Halls huk.

### 35. *Pleurotomaria Marklini* n.

Pl. XI, f. 24—26.

Shell trochiform, nearly flat on the umbilical side. Whorls six with even sides. Slit band placed a little above the median line of the whorls, thin and folded in irregular wavy curves. The sculpture consists in transverse, oblique lines, which on the umbilical side are coarse, callous ridges. Aperture obliquely ovate, umbilicus open, but narrow. Height 14 mill., br. 18 millim, aperture in height 6 mill., breadth 7 mill.

Three specimens have been found in the limestone of Klinteberg and the figured one is from the Marklinian Collection in Upsala.

### 36. *Pleurotomaria cirrhosa* n.

Pl. XI f. 27—29. pl. XII fig. 1—3.

Shell large, trochiform, nearly flat on the umbilical side, whorls seven, moderately convex. Slit band situated a little above the median line of the whorls, forming an extremely thin lamina with narrow edge. It is folded regularly and transversally by grooves parallel with the transverse striæ and in the older whorls its broken margins have coalesced with the surface of the next younger whorl. The ornamentation on both sides of the band consists of gently curved striæ, turning backwards from the aperture and meeting in an acute angle at the slit band. The interstices between the striæ are crossed by short, irregular, unconnected lines between which the surface

is deepened, and thence having a pitted aspect. The aperture is obliquely elliptical, broader than high. The lips seem to have been thin, not reflexed. The umbilicus is open and wide and all whorls are visible inside.

Height 55 mill., breadth 1,1 decim. Body whorl near the aperturè 52 mill. across.

About eight specimens of this large shell have been found in the lower limestone strata of Östergarn and a smaller in the uppermost limestone of Linde klint.

As the specimens found are mostly nuclei and only few traces or shreds of the shell are left, there may be some doubt if this species belongs to *Pleurotomaria*. But the direction of the transverse striæ seem to warrant such a supposition, even if there is no certain evidence in the section of the very thin slit band lamella, pl. XI fig. 28.

## Divisio VII. PLANORBIFORMES.

### 37. *Pleurotomaria planorbis* HISINGER.

Pl. XIX fig. 30—39.

- |                               |       |  |
|-------------------------------|-------|--|
| <i>Turbinites centrifugus</i> | 1828. | HISINGER (not WAHLENBERG). Anteckn. IV, 221, 237, tab. VI f. 2.                    |
| <i>Helicites? centrifugus</i> | 1828. | Id. Ibid. in the explan. of the figures.   |
| <i>Euomphalus centrifugus</i> | 1829. | Id. Tableau, ed. 1, 10.  |
|                               | 1831. | Id. Anteckn. V, 114, tab. 1 fig. d.  |
|                               | 1831. | Id. Tableau, 9.  |
|                               | 1848. | BRONN. Nomenclator, 478.   |
|                               | 1854. | MORRIS. Catal. Brit. Foss. Sec. Ed., 247.  |
|                               | 1855. | MAC COY. Palæozoic Fossils, 297.   |
|                               | 1867. | SALTER, Siluria, 231, 531.   |
|                               | 1873. | Id. Catal. Camb. Foss., 156, 172.  |
|                               | 1876. | FERD. ROEMER, Lethæa Geogn. Taf. 14 f. 13.   |
| <i>Euomphalus substriatus</i> | 1829. | HISINGER Tableau ed. 1, 11.  |
|                               | 1831. | Id. Anteckn. V., 114. Tab. 1 fig. e.   |
|                               | 1831. | Id. Tableau ed. 2, 9.  |
| <i>Centrifugus planorbis</i>  | 1835. | HISINGER, according to BRONN Leth. geogn. Ed. 1, Bd. 1, 97.                        |
|                               | 1848. | BRONN Nomenclator, 256.  |
| <i>Inachus sulcatus</i>       | 1837. | HIS. Lethæa Suec., 38, tab. XII f. 1 a—c.  |
|                               | 1841. | Id. Förteckn., 55.   |
|                               | 1867. | LINDSTR. Nomina, 29.   |
|                               | 1882. | QUENSTEDT Petrefaktenkunde Deutschlands 1c Abtheil. 7r Bd., 395, tab. 200 fig. 81. |
| <i>Straparollus sulcatus</i>  | 1850. | D'ORBIGNY Prodr., 30.  |

Shell disciform, with five whorls, rapidly increasing in size in the following ratio.

Body whorl 22 mill., in breadth.

2	11	»	»
3	5	»	»
4	3	»	»
5	2	»	»

The slit is at first large and broad and forms, where it ends, a narrow, acute angle. It, as well as its continuation, the slit band, is situated on the apical side of the shell, close to the suture as in the following species. It is comparatively narrow, elevated above the surface as a thin string and included only by the straight edges of the shell, though in a few instances there are obscure traces of bordering lines.



The crescents vary as to their shape, as may be seen by the figures, being commonly dense, regular and distantiated or thick and oblique with the greatest bend near the outer lip. But then there are specimens showing, at least for some distance, an angularity in the transverse striæ instead of the slit band, a conformation quite resembling that which prevails amongst the *Euomphalidæ* and of which also traces are seen in some of the *Murchisoniæ*.

The whorls are nearly tubular or quite as much rounded on the umbilical as on the apical side although they in some instances seem to be somewhat more flattened on the umbilical side. On the apical side there are on the body whorl about fourteen narrow, longitudinal keels, alternately larger and smaller. The uppermost one, which separates both faces, is the largest of all, blunt and horizontally outstanding. These keels are crossed by regular, elevated, threadlike striæ, between which are others still more minute and fine. These meet the slit band on both sides as usual in an acute angle directed backwards. On the umbilical side there are dense, fine, transversal striæ, bent in a great curve backwards, and then, near the keel, forwards. In some specimens there are as many as seven low, only slightly, elevated, longitudinal keels, which are more distinct in the young specimens than in the older ones. In these usually no keels at all are visible.

The three oldest whorls are filled with an organic deposit of a solid, calcareous mass, ending in a concave surface, without any sign of diaphragms. In most specimens this apex is often deciduous. The interior whorls are tightly enclosed by the exterior ones, the longitudinal keels of all being interlocked with each other in the interstitial grooves. The whorls have never been found disjointed, though this seems to have been the impression of HISINGER, probably owing its origin to the observation of the nucleus alone, when the uncommonly thick shell had been removed.

The aperture is circular, approaching to transversally elliptic, its outer lip being more prominent and protruding, sloping inwards in a gentle sigmoid insinuation.

Greatest diameter 66 millim. Height of body whorl 22 millim.

This shell has been found chiefly in the lowest, marly shale beds of Gotland, in numerous specimens, well preserved, at Grogarn and other places of Östergarn, in the limestone beds of Ardre, and also in the shale of Fardhem, Wisne myr, on which the limestone beds of Sandarfve and Linde repose. From the limestone strata of Östergarn a single specimen has been obtained.

HISINGER and BRONN considered this very characteristic shell so much distinct from the so called *Euomphali*, with which it commonly had been placed, as to create for its reception new genera. It seems that the former in a letter to BRONN in 1835 proposed to name it *Centrifugus*<sup>1)</sup> led by a mistaken notion that this fossil was identical with the *Turbinites centrifugus* of WAHLENBERG<sup>2)</sup>, which cannot be the case, as that shell rather, as far as can be judged, is either a *Pleurotomaria* of the evolute form or an evolute *Euomphalus*, of which both genera there have been specimens found in the *Orthoceratite Limestone* of Dalecarlia, the only stratum from which WAHLENBERG cites

<sup>1)</sup> Nomenclator p. 256.

<sup>2)</sup> *Petrificata Telluris Svecanæ* p. 71.

his *Centrifugus*. He does not anywhere mention it as found in Gotland. I cannot, however, find that HISINGER himself ever in his published writings made any use of the generic name *Centrifugus*. It occurs only with BRONN for the first time in *Lethæa geognostica* ed. 1, Bd I p. 97, which part of the volume was published already in 1835 as may be concluded by referring to the half yearly Catalogue of the German booksellers for that year. This genus included *Centrif. costatus* His., the type specimen of which is kept in the Cabinet of the School at Wisby and certainly is the shell of a Cephalopodan, probably a *Trochoceras*. The second species which BRONN names, *C. planorbis*, is identical with the *sulcatus* of HISINGER as can be seen by BRONN'S Nomenclator p. 256<sup>1)</sup>. But already in 1837 in the *Lethæa Suecica* HISINGER gave it the name *Inachus*. As this name in 1798 had been bestowed on a crustacean by FABRICIUS, it could not be retained even if the fossil did form an independent genus. The presence of the characteristic slit band, which has not been before observed<sup>2)</sup>, at once settles the question of its systematic place. It must, however, be conceded, as has been pointed out above in the description, that there are some features in the position and structure of the band, which remind of *Euomphalus*. It seems that DE KONINCK, *Faune Carbonif. de Belgique* II, partie III p. 107, intended to give this species the generic name *Polytropis* instead of *Inachus*, but as he is citing *Euomph. dicors* as the typical species, the name *Polytropis* must be identified with *Oriostoma*, of which see below.

In 1831 HISINGER gave the figure of his *Euomph. substriatus*, *Anteckningar* V, tab. I fig. e, which as far as can be seen, without access to the unknown type specimen, is a species of *Trochoceras* found at Fårö. He, however, in the *Lethæa* unites this form with *In. sulcatus*, giving it as the umbilical side. Now a glance on the cited tab. I fig. d & e, is convincing that both d and e are apical sides of different shells and he must himself have been aware thereof, as the latter figure in the *Lethæa* is drawn in a reversed position, so as to match the apical side.

*Euomphalus carinatus*, SOWERBY, identical with the *Pleurotomaria* described above as *P. limata*, has also by some English authors been confounded with *Pl. planorbis*, but it is certainly distinct from it as MURCHISON<sup>3)</sup> also conceded and as has been more particularly stated above.

### 38. *Pleurotomaria helicina* n.

Pl. XI figs. 34—37.

Shell discoid, with short, nearly flat spire of five whorls. The slit band is large, placed beneath the median line of the body whorl, hidden from view on the other whorls through the covering, lower edge of the next whorls. The crescents are obscure, distantiated. The surface is smooth and glossy with some few, indistinct transverse grooves and lines of growth, which are curved backwards. The aperture is nearly

<sup>1)</sup> »HISINGER 1835 in litteris» he says l. c.

<sup>2)</sup> In QUENSTEDT'S *Petrefaktenkunde Deutschlands* 1:e Abth. 7:r Bd. pl. 200 f. 81 a good delineation shows the slit band, but this has not been remarked by him in the letterpress.

<sup>3)</sup> *Qu. Journ. Geol. Soc.* 1847 in the Postscript p. 1 to »Silurian Rocks of Sweden».

circular with thin lips. The peristome is interrupted. The umbilicus is open and wide, showing all the interior whorls. It is accompanied by a spiral groove near the interior border of the whorls.

Height 5 millim., breadth 16 mill.

Occurs plentifully in the shale beds of Djupvik in Eksta and has also been found in a few specimens in the shale of Wisby.

As to its depressed spire and the position of the slit band this species resembles very much some Devonian Schizostomata figured by GOLDFUSS in his *Petref. Germaniæ*, plate 188 figs 4--6.

#### Divisio VIII. NATICOIDEÆ.

#### 39. *Pleurotomaria exquisita* n.

Pl. XI, figs. 30--33.

Shell ovato-globose, naticoid, glossy, with five ventricose whorls, of which the body whorl many times surpasses the others in size. The slit band is situated above the median line of the body whorl and is in the others completely hidden under the covering lower edge of the superjacent whorl. It is comparatively large, on a level with the other surface and enclosed by a fine, distinct line on each side and crossed by irregularly distantiated, linear crescents, which are a little oblique, fig. 32. Some three or four shallow grooves run rectangularly to these along the median line of the band. The transverse lines of growth are bent in curves directed from the aperture backwards, those above the slit band being more curved than the others. In the opposite direction, obliquely crossing them, almost microscopically minute striæ are seen, on both sides of the slit band, as well as on this band. Those above the slit band do not cross its superior bordering line, but follow it in a highly acute angle, densely packed. They are sinuous and bifurcated. Those on the slit band are in direct continuation with those below, which are sinuous without bifurcation, more distantiated and more oblique. The suture is so shallow, that the whorls on both sides of it form nearly an even line. The aperture is obliquely elongated, longer than broad, the lips are thin, the inner one reflexed around the umbilicus, which is of moderate size.

Dimensions: height 9 millim., breadth nearly 10 mm.

This beautiful little shell, one of the most remarkable through its peculiar ornamentation, has been found in numerous specimens in the shale beds of Djupvik in Eksta. There is probably also a specimen from the shale of Wisby.

#### Gen. **MURCHISONIA** D'ARCHIAC & VERNEUIL.

1841. *Murchisonia* D'ARCHIAC & VERN. Bull. Soc. Geol. XII p. 154.

1859. *Hormotoma* SALTER Canad. Organ. Remains Dec. I p. 18.

*Shell elongated turriculate, whorls numerous, slowly increasing in size, oldest whorls filled with organic deposit of calcareous matter. Slit band and ornamentation as in Pleurotomaria. Nacreous lustre not observed.*

It is very difficult to find any characteristics wherewith to distinguish those forms called *Murchisonia* in a ready manner from *Pleurotomaria*. According to the authors of this genus the aperture should be »terminée à sa base par un canal très court ou tronqué». But in several *Pleurotomariæ* the superior corner of the aperture may also be seen to be protracted in an angle. *SALTER* in *Canad. Org. Remains*, vol. I p. 18 divides this genus in *Murchisonia* proper with acutely carinated whorls and *Hormotoma* with beaded, rounded whorls and rounded aperture. But while then in the former genus many *Pleurotomariæ* with broad spire have been included, it is more practical with *BRÖNN* to include all banded shells with elongated and slender spire of many whorls whether carinated and ornamented or plain, in *Murchisonia* and consider it as a subgenus merely to *Pleurotomaria*.

This genus occurs as early as in the Bala limestone of the Cambrian formation, according to *SALTER*, *Catal. Cambr. Foss.* p. 68, and continued through all Palæozoic formations, while in the Mesozoic ones no such elongated *Pleurotomariæ* are known with any degree of certainty. With us in Sweden they are scarce in the Lower Silurian, a large species, related to the Esthonian *M. insignis* *EICHW.*, having been found in a few specimens at Gräsgård and Segersta in Öland in the uppermost limestone beds. In the Upper Silurian, again, of Gotland they are numerous and especially there are nuclei of such elongately whorled forms, which also may be *Loxonemata*, filling the strata in several places. Of some species the shell has always been destroyed and they are known only by the impression of it in the rock. This is very strange as the shell of the nearly related *Pleurotomariæ* is often well preserved in the same strata. The slit band is built upon the same plan as in *Pleurotomaria*. In *Murchis. deflexa* there is a peculiar deviation, as described in detail further down, when the superior margin attains so large a development that it, in its downward growth, hides the band. In *M. attenuata* the slit band is changed, on the body whorl, into a ridge, on which the apex of the angular transverse lines rests, quite as in the *Euomphalidæ*.

As there, at least in the first division of this genus, is a certain similar uniformity prevailing in the ornamentation of the shell, the position of the slit band, the shape and the size of the whorls, these will be the chief characteristics for distinguishing the various species. The genus may be fitly divided in two groups.

#### Divisio I. SIMPLICES.

Ornamentation uniform of backwards directed striæ meeting the generally large slit band in an acute angle; position of the band and shape and size of the whorls giving the characteristics.

1. *M. cingulata* *Hrs.*
2. *M. cava* n.
3. *M. moniliformis* n.
4. *M. obtusangula* n.
5. *M. subplicata* n.
6. *M. compressa* n.

7. *M. attenuata* HIS.  
8. *M. paradoxa* n.

Divisio II. ORNATÆ.

Shell more or less richly ornated, slit band enclosed by one or more variously sculptured bordering lines. Almost all very small species.

9. *M. crispa* n.  
10. *M. munda* n.  
11. *M. tortuosa* n.  
12. *M. imbricata* n.  
13. *M. cancellata* n.  
14. *M. cochleata* n.  
15. *M. deflexa* n.

Divisio I. SIMPLICES.

1. *Murchisonia cingulata* HIS.

Pl. XII fig. 9—10.

?*Turbinites lævis major* etc. 1738 BROMELL Lithogr. Svec. in Acta Lit. Sveciæ vol. III p. 37.

- Turritella cingulata* 1829. HISINGER p. p. Tableau ed. 1, 11.  
1831. ID. p. p. Anteckn. V, 115, tab. II f. 1.  
1831. ID. p. p. Tableau ed. 2, 9.  
1837. ID. p. p. Lethæa, 39, tab. XII, f. 6 a.  
1841. ID. Förteckning, 56<sup>1)</sup>.  
*Murchisonia cingulata* 1841. D'ARCHIAC & VERNEUIL Bull. Soc. Géol. de France vol. XII, 159.  
1867. LINDSTRÖM Nomina, 23.  
*Terebra? sinuosa* 1848. SALTER Mem. Geol. Survey II pt. 1, 357, pl. 14 f. 2.

Again, the following synonyms do not belong to this species.

- Murchisonia cingulata* M'COY Palæozoic Fossils, 293.  
SALTER Cambr. Catal., 172.  
M'COY Sil. Foss. Ireland, 6.  
KJERULF Veiviser, 29.  
MURCH. VERN. & KEYS. Russia, vol. II, 339.  
KRAUSE Zeitschr. d. deutsch. Geol. Ges. 1877, 22.  
KIESOW Ueber silurische und devonische Geschiebe Westpreussens 1884, 58.  
*Pleurotomaria cingulata* BUCH Beitr. zur Gebirgskunde von Russland, 116.  
EICHWALD Leth. rossica I, 2, 1166, pl. 43 f. 2.

Shell elongate, turreted, rather slowly increasing, whorls seven, almost conical, slightly ventricose and with shallow suture. Slit band 3 millims. wide, situated above the middle of the body whorl and on the other whorls near the upper suture, at a level with the surface of the shell, the crescents small and narrow, very dense. The ornamental lines are transversal, uniform, dense, turned in a highly acute angle towards the slit band. The aperture is ovate, higher than broad. The umbilicus is very narrow and nearly hidden by a reflexion of the columellar lip.

<sup>1)</sup> In a foot-note to this HISINGER added: (*Pleurotomaria?*)

Height 63 mill., width of body whorl 28 mill., width of smallest whorl 7 mill. Height of aperture 19 mill., width of the same 15 mill. Apical angle  $36^{\circ}$ .

The original specimen of HISINGER, now figured anew, pl. XII f. 9, has been found by him in a detached stone near the church of Gothem. The rock is a variety of oolite, peculiar to a quarry at the base of Bara backe and consequently there cannot be any doubt of its being derived from that place. Quite similar specimens have been found in the gritty limestone near Gothems hammar. Those from neighbouring quarries in Hörsne are also nearly allied, though there is some little difference as to the relative size of the whorls.

Fragments of a fine specimen have been obtained from the canal near Westöös in Hall. Nuclei which in all probability belong to this species to judge from their shape, have been found in the hard shale of Petesvik in Habblingbo. They are larger than those from Gothem measuring as much as 35 mill. in width of the body whorl. The Museum of Copenhagen has specimens from Näs.

## 2. *Murchisonia cava* n.

Pl. XII fig. 4.

Shell cylindrical, turreted, whorls, only six left in the fragmentary specimens, ventricose, rather angular near the slit band. This is narrow, situated exactly on the middle of the body whorl and near the upper suture in the other whorls, more deeply excavated than in any other species of its group, the crescents oblique, distantiated. Aperture ovate. Dimensions of specimen from Djupvik in Eksta: h. 51 mm., br. 28 mm. Specimens have been obtained from Martebo, Djupvik in Eksta, Hörsne and the limestone near Wisby.

## 3. *Murchisonia moniliformis* n.

Pl. XII fig. 5-6.

Shell tapering, turreted, narrow in proportion to its length. Whorls eleven, globose, with deep suture, rapidly increasing in size. Slit band nearly in the middle of the whorls or a little above it, slightly concave. Aperture ovate, with lips much reflexed both near the columella and in the superior border. Umbilicus hidden through the reflexion of the columellar lip.

Length 36 millim., breadth 11 mill., apical angle  $22^{\circ}$ .

From the sandstone and the oolite of Bursvik, where it is common.

## 4. *Murchisonia obtusangula* n.

Pl. XII fig. 7, 11, 12.

Shell turreted, moderately tapering, with twelve ventricose whorls widened on the middle in an obtuse angle, where the elevated slit band is situated. The aperture ovate. The umbilicus is hidden through a fold of the columellar lip. Ornamentation in this and the two preceding species almost the same as in *M. cingulata*.

Height 30 mill., br. 10 mill. Apical angle  $29^{\circ}$ .

The typical specimens are derived from the limestone beds of Kyrkberget (Rackarbacken) in Wisby. Others are from Lummelund, Samsugn in Othem, Lutterhorn in Fårö, and some specimens from Wialmsudd may perhaps also belong here. Those from Samsugn, fig. 11—12, are much altered through corrosion and in some there is a false appearance as if the slit band were lineated longitudinally, but this may on closer inspection and comparison be traced to changes after the fossilization. These specimens, however, are somewhat less angular than those from the other localities.

### 5. *Murchisonia subplicata* n.

Pl. XII fig. 8.

Shell short and thick in comparison with its congeners. Whorls nine, slowly increasing, widened on the middle into an obtuse ridge where the shallow slit band is placed. The inferior border of the whorls is folded into a callous ridge, which overlies and partially covers the deep and narrow suture. The aperture is ovate, the inner lip reflexed and the umbilicus a narrow fissure.

Height 27 millim., breadth 21 mill., apical angle 35°.

In all, six specimens have been obtained from Lummelund in the superior limestone.

### 6. *Murchisonia compressa* n.

Pl. XII fig. 15—19.

- »*Turritella?* (*Turbo* L.)» 1828. HISINGER Anteckningar IV, 221, tab. VI f. 3.  
*Turritella cingulata* 1831. Id. p. p. Anteckn. V, 115, tab. II f. 1 (nucleus).  
 1837. Id. p. p. Lethæa Suec., 39, tab. XII fig. 6 b.  
 »Stenkärnor af Turriteller» 1841. Id. Förteckning, 56.

Shell elongately turriculate, with slowly tapering whorls, only moderately ventricose, numerous — as many as 18 have been numbered in one specimen. The ratio of the increase in the whorls is in this species much slower than in any other, the breadth augmenting much faster than the height, as is made evident through the following comparative table of the dimensions of the whorls in five species.

	<i>M. cingulata.</i>		<i>M. cava.</i>		<i>M. compressa.</i>		<i>M. attenuata.</i>		<i>M. obtusangula.</i>			
	Height of whorls.	Breadth.	H.	Br.	H.	Br.	Two specimens.		H.	Br.		
							Spec. A.	Spec. B.				
							II.	Br.	II.	Br.		
Body whorl	17 mm.	31 mm.	12 mm.	22 mm.	9 mm.	20 mm.	17 mm.	20 mm.	18 mm.	22 mm.	7 mm.	11 mm.
2	12 »	25 »	10 »	19 »	8 »	18 »	12 »	15 »	17 »	18 »	6 »	9 »
3	10 »	18 »	8 »	15 »	7 »	17 »	10 »	12 »	12 »	14 »	4 »	8 »
4	7 »	14 »	—	—	7 »	15 »	6 »	10 »	9 »	11 »	3 »	6 »
5	—	—	—	—	6 »	13 »	5 »	—	6 »	—	3 »	5 »
6	—	—	—	—	5 »	12 »	—	—	—	—	2 »	4 »
7	—	—	—	—	5 »	10 »	—	—	—	—	2 »	3 »
8	—	—	—	—	4 »	9 »	—	—	—	—	1 »	2 »
9	—	—	—	—	4 »	8 »	—	—	—	—	—	—
10	—	—	—	—	3 »	7 »	—	—	—	—	—	—
11	—	—	—	—	3 »	6 »	—	—	—	—	—	—
12	—	—	—	—	3 »	6 »	—	—	—	—	—	—

The apex of the spire is in all specimens, which have been investigated, filled up with solid calcareous spar of a brownish colour, without any trace of transverse diaphragmata. The nuclei have a glossy surface and look as if the interior walls of the shell had been porcellanous. The slit band is prominent a little above the middle of the whorls, it is narrow and slightly concave along its median line. The aperture is rather obovate approaching to the circular. The umbilicus seems to have been large and open as shown by longitudinal sections when there is no compact columella (fig. 18), but an open tubular axis interiorly.

Very frequent in the inferior limestone of Östergarn at Grogarn and Katt-hammarsvik, but almost only as nuclei, on which traces of the sculpture of the shell are visible. It has also been found in the neighbouring strata of Kräklingbo and Ardre, and it is probable that some nuclei from the limestone of Wisby belong to this species.

Height 80 millim., breadth 21 mill., apical angle 22°.

This common species has usually been confounded with *Murch. cingulata*, as HISINGER himself did, till he in his »Förteckning öfver Svenska petrificater», edited 1841, p. 56, separates it from *M. cingulata*, without giving it any new name.

## 7. *Murchisonia attenuata* HISINGER.

Pl. XII fig. 20—24.

*Turbinis marini* nucleus lapideus lævis etc. BROMELL Act. Lit. Suec. 1738 vol. III p. 37.

*Turritella attenuata* 1840. HIS. Leth. Suec. Supplem. Secundum, 4. tab. 37 f. 7.

1841. ID. Förteckning, 56.

1848. BRONN Nomenclator, 1331.

*Murchisonia attenuata* 1867. LINDSTRÖM Nomina foss. Gotl., 23 (nec. *Murchisonia attenuata* HALL 1856, Trans. Albany Instit. vol. IV, 27).

Shell elongate, whorls seven in the most complete specimens, though there have certainly been many more. The whorls are ventricose, nearly as long as broad, somewhat angular where the slit band is projecting. This band is narrow, placed a little below the median line of the body whorl and quite on the middle line of the other whorls. It has an even surface, fig. 24 section, the crescents are regular, fig. 23. But near the aperture in large specimens the transverse ornamental striæ above and beneath are confluent with the band without any separating or bordering lines and it continues only as an elevated ridge, sometimes not clearly distinct from the surface. In this feature it shows relations to such genera as *Euomphalus* and *Loxonema* (for inst. pl. XV fig. 9) and also to *Pleurot. planorbis* HIS. The shallow suture crosses the longitudinal axis in a line more oblique than in the other species. There is no umbilicus and the aperture is oblong, the uppermost corner acuminated, its columellar lip thin, reflexed. Height 51 millim., width of body whorl 18 millim.



The original specimen of HISINGER is from Östergarn from where lately more specimens have been obtained, and quite similar ones are very common in the lowest shale near Wisby. It has also been found in the limestone of GothemsHAMMAR, in the shale beds and limestone of Slite, on Furillen, in Follingbo and in the limestone at Kälens Qvarn.

### 8. *Murchisonia paradoxa* n.

Pl. XXI fig. 1—3.

Shell cylindrical, turreted, slowly increasing in width, whorls seven in the best preserved of two fragmentary specimens. The slit band is situated a little above the median line of the whorls, it is elevated, with a flat surface, crescents regular, dense, placed obliquely on the band which is crossing the axis of the shell in a highly acute angle. The whorls which are of equal breadth and height, are of an only slightly convex outline, though a little more bulging out in one of the specimens. They are adorned with minute transverse lines of the same pattern as in *M. attenuata* and *M. cingulata*. The uppermost margin of the whorls is at first constricted by a shallow groove, then widened in a stringlike rib, which covers the basis of the overlying whorls. The state of preservation of the specimens prohibits to ascertain the shape of the aperture and the umbilicus. Height of most complete specimen 36 mm., br. 10 mm.

Rate of growth of the whorls:

	H.	Br.
1	10 mm.	10 mm.
2	8 »	9 »
3	7 »	8 »
4	5 »	7 »
5	5 »	6 »
6	4 »	5 »

Two specimens have been obtained from the gray limestone of Lindeklint.

## Divisio II. ORNATÆ.

### 9. *Murchisonia crispa* n.

Pl. XII fig. 13—14.

Shell turriculate, obese, thick, with six ventricose whorls which at their lowest edge near the suture are constricted, forming a narrow vertical belt. The slit band is placed much beneath the middle line of the whorls, a little above the suture. It is not distinctly separated from the other surface through bordering lines and the crescents are in direct continuation with the transversal lines. These are distantiated, lamellar, imbricated. The slit is well preserved, short and tongue shaped. No um-

bilicus is visible and the aperture is ovate. Height 21 millim., breadth 12 millim. Apical angle 38°.

It has been found in the coralliferous limestone of Lindeklint and Sandarfve kulle, one specimen from each locality.

#### 10. *Murchisonia munda* n.

Pl. XIII fig. 6.

Shell turriculate, terete, with eight short, ventricose whorls, twice as broad as high. The narrow, ropelike slit band forms a prominent angle a little below the median line of the body whorl and a little above the same line in the other whorls. It is hemmed in by two distinct lines and its surface is prominent and convex, the crescents are distantiated, smooth, lamellar and imbricated, quite as in that group of the *Pleurotomariæ*, which has been called *Crispæ*. In this feature the four first species of the *Murchisoniæ ornatae* are similar. Above the band, and parallel with it, a small ridge runs on the body whorl. The surface is transversally striated by gently undulating, lamellar, densely placed lines, imbricated as it were. For the rest the shell is quite smooth without any longitudinal or transverse striae. The aperture is nearly obliquely elliptic and the columellar lip thin and reflexed, hiding the umbilicus.

Height nearly 6 millim., breadth 3 millim.

A few specimens found in the marly strata of the upper limestone of Slite.

It comes near to the preceding species as to the ornamentation, though this is much finer in *M. munda*.

#### 11. *Murchisonia tortuosa* n.

Pl. XIII fig. 4, 5, 13, 14.

Shell turriculate, of nine ventricose whorls, nearly twice as broad as high, angulated a little below the middle of the whorls, where the chordlike slit band is placed. This band is narrow, convex and outstanding, composed of nearly tubular and lamellar crescents, which cover each other successively, in an imbricating way. The lowest part of the whorls is abruptly bent in towards the suture in a face, whereby the suture is uncommonly deep. There is a low ridge between the slit band and the umbilicus parallel with the former. In one specimen, fig. 13 there are also two or three low ridges on both sides of the slit band. The ornamentation consists for the rest in transverse, sinuous, lamellar striae. On the umbilical part there is also much variation, in some a succession of concentric ridges, cut by striae, which are sinuous, as in fig. 14, or in others, as in fig. 5, only transverse striae and concentric ones near the edges. H. 11 mm., br. 6 mill.

The aperture is ovate, the inner lip reflexed and hiding the umbilicus.

Only two specimens have been found, one from the crinoidal limestone of Stor Wede in Follingbo and the other variety from a limestone ridge near the church of Burs.

## 12. *Murchisonia imbricata* n.

Pl. XIII fig. 7—12.

Shell turriculate, elongate and slender, fig. 7, or short and terete, fig. 8; whorls nine, broader than high. The slit band is prominent as a sharp edge, nearly on the middle of all whorls or a little above. It is narrow, the crescents are long, protracted and tube shaped, slender at their origin beneath the next preceding and slowly widening till they form an erect, somewhat reflexed edge, fig. 11, 12. This form of the crescents very much reminds of that in *Pleurotomaria tubulosa*, pl. IX f. 8, though the crescents are more narrow and elongate in *Murchisonia imbricata*. The same sort of slit band also distinguishes this species from the two nearly related, preceding ones. In the two varieties, fig. 7, 8, the ornamentation of the surface is thus far dissimilar, that it is finer in the elongated form, than in the other. There are in both transverse, oblique striæ, somewhat elevated and lamellar at their edges and thence causing an imbricated appearance. They are crossed by a low and narrow ridge above the slit band on the body whorl and by a more prominent, sharp ridge on all whorls near the suture, which is very deep. On the umbilical side the striæ are finer and closer. The aperture is nearly circular and its columellar lip reflexed, though not so much as to hide the narrow umbilicus. H. 5 millim. br. 2 mill.

This little, beautiful shell occurs plentifully in the marly seams of the upper limestone of Lotsbacken in Slite and a few specimens have also been found in the limestone near Kå lens Qvarn and both in the red and gray limestone of Sandarfve kulle.

## 13. *Murchisonia cancellata* n.

Pl. XIII fig. 1.

Shell turriculate, with eight transverse whorls of greater breadth than height, angulated on the middle, where the slit band is situated. This band is enclosed within two longitudinal, sharply projecting lines on each side and these again have between them a narrow concave belt, streaked with short, oblique lines. The slit band proper is thus very narrow, concave, the crescents of so small a size as not to be distinguishable. The other shell surface is cancellated by transverse and longitudinal threads of equal size, though somewhat unequally distantiated. The aperture is nearly ovate, the umbilicus is larger than in the others. Height of the most complete specimen 8 mill., br. 4 mill.

Some specimens have been found in the red limestone of Sandarfve kulle. From this locality there is also a variety with more ventricose whorls, which seems to have been larger.

14. *Murchisonia cochleata* n.

Pl. XIII fig. 2—3.

Shell turriculate, slender and tapering with twelve or thirteen whorls, much angulated and prominent along the median line. The sides of the whorls on both sides of the slit band are rather much more concave than in any of the preceding species, and constricted into a vertical ring near the lower suture. The slit band is prominently convex, hemmed in only by the uneven edges of the surface, and covered by very unequal, regularly curved crescents of which some prominent are mingled with fainter. The ornamentation on both sides consists of transverse, much curved, elevated sulci, remote, the interstices striped with minute striæ. On some distance from the slit band three or four elevated ridges are crossing them; the largest is placed at highest above the band, encircling the umbilical surface. On this same surface there are several others, low, concentric ridges, which are crossed by finer and more closer striæ. The aperture is nearly circular and the columellar lip largely reflexed, widened in a broad lamina near its superior corner and hiding the opening of the umbilicus. The suture is distinct and slightly impressed. H. 18 millim. br. 8 millim.

This species has been found in some 30 specimens in the red limestone of Sandarfve kulle and also a few from the limestone of Katthammarsvik in Östergarn.

15. *Murchisonia deflexa* n.

Pl. XX fig. 1—6.

Shell turriculate, with nine transverse, tumid whorls, carinated through many sharp, longitudinal keels. The whorls rapidly increase in size in the following regular proportion:

	H.	Br.
1 or body whorl,	4 mill.	8 mill.
2	3 »	6 »
3	2 »	4 »
4	1,5 »	3 »

the breadth thus increasing exactly in the double ratio of the height. A longitudinal section of the whorls gives an oval, nearly pyriform outline, broadest above and narrow below. The slit band, the greatest peculiarity of this species, is situated a little above the median line of the whorls. It is a narrow and excavated groove, covered with oblique crescents. Its superior, bordering line has grown out in a vaulted lamella, which is bent down over the band so much that it completely hides it and its surface only can be seen where this lamella is broken. This superior lamella is thin and sharp edged, like a claw in the section, the inferior bordering line again is short, blunt and horizontal. As seen in the section, fig. 6, the slit continues open along half the body whorl. The surface on both sides of the slit band is delicately and finely cancellated by lines of which the transversal ones above the slit band curve backwards only

on the very edge of the covering lamella. Those below the band form a large curve, directed forwards with its greatest convexity and with its upper end at the slit band bent backwards. The transverse lines are nearly thrice as large as the longitudinal ones and, where they meet, a thick, blunt nodule is formed. Above the slit band there are two longitudinal keels and one smaller around the umbilicus. Close below the slit band a sharp longitudinal keel is running and the lowest edge of the whorl is widened into a narrow ridge, which covers the much impressed suture. A great peculiarity, which has not been observed in any other species of the Murchisoniæ, nor in any other gastropodan shell of the Silurian formation, consists in two interior, longitudinal keels, of which one narrow and thin, follows the inner wall of the outer side of the shell from the lower corner of the outer apertural lip, where it is placed a little below the lowest keel. It continues on the same level through the whole shell, as may be seen in the longitudinal section, given in fig. 6. On the nucleus this ridge has of course occasioned an impression as a narrow groove, fig 4. The other keel runs higher up near the top of the whorls on their umbilical side and corresponds with the narrow ridge, which is visible around the umbilicus. These may in some way be regarded as formations homologous with the continuous ridges which interiorly cover the walls of the Nerinææ.

The aperture is large, obovate, its outer lip is thin, the inner is lamellar, reflexed and at broadest in its superior corner. The umbilicus is narrow, where it opens, and continues downwards as a hollow axis.

The shell has in many specimens, especially on the interior side, an intense ochraceous yellow colour, but whether this is due to later mineral agencies or to its retaining anything of the original colouring is uncertain. H. 12 mill., br. 8 mill. Height of aperture 4 mill., br. 4 mill.

In all, nine specimens have been found of this curious shell in the gray limestone of Linde klint, on its northernmost side, and also a few specimens on Sandarfve kulle in the gray and red limestone.

## Fam. VII. EUOMPHALIDÆ DE KONINCK.

*Shell discoid or turriculate, on the apical side or on the middle of the body whorl provided with a shallow notch in the outer lip, in continuation of which there runs on the surface of the whorls a slender, elevated ridge, on which the transverse striæ are forming a small angle, directed backwards without any resemblance with a true slit band. The apex of the shell is commonly filled with solid calcareous matter of an organic deposit or even divided in various compartments through transverse, imperforated diaphragmata.*

In adopting the name given by DE KONINCK<sup>1)</sup> to this family it is in a much more restricted sense than he intended and such genera as Straparolus, Straparollina, Maclurea and Rhaphistoma are according to the definition given above not to be included. The shells of this family, of which only the genera Euomphalus, *sensu strictiori*, and Loxonema

<sup>1)</sup> Faune du Calcaire Carbonif. de la Belgique, II, III p. 107.

are Silurian, have a slit in the lower edge of the exterior lip, much more shallow than that of the Pleurotomaridæ and nearly alike that in *Pleurotoma* and also in *Turritella*<sup>1)</sup>. During the growth this slit is never changed into a real slit band as in the Pleurotomaridæ, at the highest there is a narrow ridge, where the lines of growth are curved backwards. When we see how mollusca, in other respects dissimilar, are provided with this slit in their shell, it is indeed very questionable whether the Loxonemata only on that ground are so nearly related to the genus *Euomphalus* as to be included in the same family as here proposed. There may, however, be added the similarity in the consolidated apex, and they may thus, at least provisionally, be regarded as related and *Loxonema* in a certain way to hold the same position to *Euomphalus* as *Murchisonia* holds to *Pleurotomaria*.

Gen. **EUOMPHALUS** SOWERBY p. p.

1814 *Euomphalus* Sow. p. p. Mineral Conch. I, 97.

1833 *Bifrontia* DESHAYES p. p. Descr. Coqu. foss. des environs de Paris, 221.

1835 *Schizostoma* BRÖNN Lethæa Geogn. Ed. 1, 95.

1843 *Eccyliomphalus* PORTLOCK p. p. Report Geol. of Londonderry, 411.

*Shell discoid with contiguous or disjointed whorls; on the apical side of the aperture a shallow and obtuse slit or sinus is situated, the traces of which are seen on the whorls as a more or less elevated ridge, towards which the lines of growth are turning their apical angle. The apex of the shell is filled with a solid calcareous deposition of organic origin and is often subdivided through transverse diaphragms.*

After the detailed expositions of the affinities of this genus as given by DE KONINCK in his latest grand work and by STOLICZKA<sup>2)</sup>, WAAGEN<sup>3)</sup> and ETHERIDGE JR<sup>4)</sup> only a few remarks need be added, chiefly to show the standing point in this question of J. SOWERBY and DESHAYES, the conchologists who have most essentially influenced the opinion of others.

When JAMES SOWERBY in February 1814 published his new genus *Euomphalus* in № IX of the Mineral Conchology p. 97, he founded it on such species as *Euomph. pentangulatus*, *catillus* and *nodosus*, all provided with the small notch in the corner of the aperture on the apical side and a ridge in connection with it on the surface of the whorls. But already in April the same year he joined with them in that very genus others as *E. discors*, *rugosus* etc., which do not share in the peculiarity of conformation, distinctive of the former. Consequently, when we are to fix the characters of *Euomphalus* it must be in the original conception of its author. Next, the opinions of DESHAYES are of great importance, as most of the subsequent authors seem to have followed him. In 1830<sup>5)</sup> he did not accept *Euomphalus* as an independent genus, but

<sup>1)</sup> BOOGE WATSON Mollusca of the Challenger Exp. in Journ. Linn. Soc., Zoology, vol. 15, p. 220.

<sup>2)</sup> Paleontologia Indica V, p. 247.

<sup>3)</sup> Pal. Ind. XIII p. 86.

<sup>4)</sup> Ann. mag. N. H. 5th Ser. vol. 5, p. 480.

<sup>5)</sup> Encycl. Method., Hist. Nat. d. Vers, vol. II p. 162.

creates a section of it in *Solarium*, comprising all the three, first original species of SOWERBY. The later species, viz. *E. discors*, *rugosus* and *funatus* he says belong to *Turbo*, and others again to *Delphinula*. He then quite rightly distinguished the true *Euomphali* from the others and in all probability assigned to the *E. discors* etc. their true place.

In the same work he in 1832<sup>1)</sup> identifies *Straparolus* of MONTFORT with *Euomphalus* or *Solarium*. As the confusion in this respect has originated with him and as most of the later authors have participated his views, it may be as well, here at once to try to clear up this matter. MONTFORT established, as is well known, his genus *Straparolus*<sup>2)</sup> in 1810, taking *Str. Dionysii* as the typical species. On comparing specimens of this shell with specimens of *E. pentangulatus* or *E. catillus* it must, however, be evident that they cannot possibly be regarded as of the same genus. In *Straparolus* the shell has rounded, tubular whorls without the least trace of ridges, only with some faint, longitudinal stripes and the transverse striæ are not angular, as in *Euomphalus*, in *Euomphalus* again the whorls are angular and provided with the distinctive ridge on the apical side. It is, moreover, highly questionable whether *Straparolus* is identical with those Silurian shells which formerly were confounded with *Euomphalus*, as *E. discors* etc. These have in the present memoir, in consequence of the nacreous structure of the shell and the characteristic opercula been placed amongst the *Turbinidæ* and in the genus *Oriostoma*. No opercula have ever been found belonging either to *Euomphalus sensu strict.* or to *Straparolus* nor are they nacreous. If it steadily is kept in view that *Straparolus* not at all is identical with *Euomphalus s. str.* and scarcely with *Oriostoma*, a great deal of difficulties will be overcome.

A change is made in 1833<sup>3)</sup> by DESHAYES thus far that he creates a new genus *Bifrontia* and in this he ranges *E. catillus*, while the other two species are left with *Solarium* as before. It cannot be denied, that there is a certain resemblance between such shells as the Gotlandic *E. tuba* and DESHAYES' *Bifrontia ammonoides* and *B. Deshayesii*<sup>4)</sup> and likewise amongst recent shells, *Omalaxis (Bifrontia) supranitida* WOOD has a shape that reminds of that of the palæozoic.

In his last great work<sup>5)</sup> he maintains *Euomphalus* as a genus distinct from *Solarium*, though belonging to the same family. He is further (l. c. p. 678) willing to accept BRONN's *Schizostoma* for *E. catillus*. As to the last mentioned genus, established with *E. catillus* as type, it was rejected by FERD. ROEMER<sup>6)</sup>, who regards the indented curvature of the aperture too insignificant as a generic character. It may, however, be questioned whether this genus ought not to be retained for such Devonian species

<sup>1)</sup> Vol. III p. 986.

<sup>2)</sup> *Conchyliologie System.* II, 174.

<sup>3)</sup> *Description des Coquilles foss. des Environs de Paris* II p. 221. This work is dated 1824 on the title page, but it was published in small parts and it lasted till 1839 before it was completed. According to HERMANNSEN *Indic. Generum*, *Bifrontia* was published in 1833.

<sup>4)</sup> *Anim. sans vertèbres dans le Bassin de Paris*, II pl. 26 f. 22—28.

<sup>5)</sup> *Anim. sans vertèbr. dans le bassin de Paris.* Vol. II, 660.

<sup>6)</sup> *Leth. Geogn.* 3:e Aufl. 1 Bd, 456.

as *Schizostoma Puzosii* and *Sch. radiatum*, which are of a type entirely different from *E. catillus*.

To sum up the chief results now gained, I believe:

1:o) that *Euomphalus* is to be maintained in the sense which SOWERBY at first gave it.

2:o) that *Straparolus*, as well as *Oriostoma* must be removed from *Euomphalus* as not identical with it and belonging to different families, *Oriostoma* being one of the *Turbinidæ*.

3:o) that of the Silurian shells *Euomphalus* along with *Loxonema* must be regarded as members of the family of the *Euomphalidæ* DE KON. p. p. and

4:o) that this is to have its systematic place next to the *Pleurotomariidæ*, as there are forms linking both together.

*Eccyliomphalus*, the only remaining synonymic genus, the identity of which with *Phanerotinus* is doubtful, comprised, when first established, two species and the author, PORTLOCK, lays stress on »its great resemblance to an unrolled *Euomphalus*». And, in fact, these species come near to such as our *E. Gotlandicus* and *E. triquetrus*. But by and by quite different shells were introduced into it. *Eccyl. alatus* FERD. ROEMER, concerning which species see above at page 110, is an instance of the adventitious forms. This genus has thus come to contain species of evolute *Euomphali* and likewise evolute *Pleurotomariæ*. It must, consequently, be broken up, and its species be distributed in these genera. Both the typical species are *Euomphali*.

The genus *Euomphalus* has a wide geological range. In Sweden the oldest specimens have been found as deep down in the Lower Silurian as in the Lower Gray Orthoceratite limestone of Dalecarlia, from where the specimen, delineated on pl. XIII fig. 36—38 has been derived. It is evolute, with three widely separated whorls of circular section, the aperture angulated in its lowest corner, where the large and distinct slit, fig. 36, is situated. The ridge in continuation of this runs very sharp along the whole apical side of the whorls. The ornamentation consists of imbricated, transverse striae, curved back in an acute angle, where they cross the apical ridge. The oldest whorls on the visible part of the apex is divided in chambers through at least four transverse diaphragmata. I have named this interesting species *Euomphalus Angelini* in remembrance of the indefatigable and gifted man, Professor N. P. ANGELIN who devoted his life to the investigation and elucidation of the palæontology of Scandinavia.

Next in order of time we find a *Euomph. obtusangulus*<sup>1)</sup> which resembles the Upper Silurian *E. Walmstedti* and *E. præcursor*, in the Leptæna limestone of Dalecarlia. In the Upper Silurian of Gotland there are five species, besides fragments indicating others. It is well known that there have been several species found both in the Devonian and Carboniferous formations especially in the later, where the genus seems to have attained its culmen. Whether the *Euomphali* had continued during the Mesozoic times is uncertain. They have, it is true, been recorded as occurring in the Triassic Rocks of Austria<sup>2)</sup>. But the form of these presumed *Euomphali* does, certainly

<sup>1)</sup> ANGELIN & LINDSTRÖM. *Fragmenta Silurica* p. 12 pl. XVII f. 19—20.

<sup>2)</sup> See the works of KLIPSTEIN and LAUBE.



not harmonize with that of the palæozoic *Euomphali*. As STOLICZKA has shown<sup>1)</sup>, most of the Jurassic forms belong to the genus *Discohelix*, of which there probably already is a representative in the Devonian strata of Nassau<sup>2)</sup>. It is possible that this genus has continued during the Tertiary times and still survives in the Mediterranean and Atlantic seas.

As to the species here described in this genus, *E. tuba* n. may be only provisionally included in it, as it deviates somewhat in its form and possibly rather is an *Oriostoma*. On the other hand, it must by future researches be decided whether *Oriostoma angulatum* WAHLENBERG rather not is an *Euomphalus*.

### 1. *Euomphalus Gotlandicus* n.

Pl. XIII fig. 19—31.

Shell disciform, involute or disjointed, at the highest with five whorls. These are cylindrical and nearly triangular in section, the slit and its concomitant ridge being on the apical side. The oldest mutation or variety, which occurs in the shale beds, has only the nucleus left and is generally involute (figs. 19—22) with a wide and open umbilicus showing all whorls. The aperture is in the best specimens triangular, the ridge forming an angle, the outer lip thin, a little reflexed outwards. The tendency to disjoint can be traced in specimens where the whorls are coiled in, but have some free space between them, to those where they are quite uncoiled as in figs. 23—25. From the same geological horizon the specimens figured in figs 30—31 have also been obtained. In the uppermost limestone strata near Wisby hitherto only uncoiled specimens have been found as shown in figures 26—29. In them the aperture is more triangular than in the involute forms from Wisby *a*. The ornamentation of the surface is nearly alike in all, consisting of thin, transverse threads bent in an angular line curved backwards from the apertural slit. This slit is situated nearly in the middle of the lower edge of the aperture and forms a highly obtuse angle. The three oldest whorls are filled with solid calcareous deposit, figs. 22, 29, and the uppermost surface of this stratum is deeply concave.

H. 20 mill., br. 42 mill. of involute specimen.

H. 15 mill., br. 39 mill. of uncoiled specimen.

The involute variety is found in great numbers in the lowest shale near Wisby, and also at Westergarn and Stormyr in Rute. The uncoiled variety is found in the same localities and moreover in the uppermost limestone beds of Kyrkberget in Wisby and at Kålens Qvarn, Hogrån, the shore of Slite, Weskinde.

From the shale of Wisby some nuclei have been obtained in all particulars resembling the common involute one, excepting in having some slight longitudinal ridges along the apical side. They are, however, not in a sufficiently good state of preservation for description and delineation.

<sup>1)</sup> Gastropoden der Hierlatz Schichten. Sitzungsberichten der Ak. Wiss. Wien, Bd 43, 1, p. 180.

<sup>2)</sup> *Euomphalus rota* SANDB. Nassau p. 212, pl. 25 f. 5.

2. **Euomphalus triquetrus** n.

Pl. XIII, fig. 32—35.

Shell discoid, of triangular section, with four whorls, of which the older are contiguous and the body whorl free through almost its whole length, rapidly widening, much more so than in *E. Gotlandicus* and it is broadly expanded at the aperture. The three smaller whorls, which form the apex, are filled with a homogenous, calcareous deposit, only interrupted by a transverse diaphragma in the second whorl. On the interior side of the umbilical surface the nucleus of the body whorl has a shallow, longitudinal groove, being the impression of some internal ridge. The umbilical side is the largest, nearly flat, and the two other shorter sides meet in an obtuse angle on the apical side. The aperture is transversally triangular, broader than high, the inferior corner acuminate. It is oblique and the superior lip more prominent than the inferior one. The notch in the inferior lip is broadly triangular, fig. 35, and deeper than in the preceding species. H. of aperture 16 mm., br. 22 mm., diameter of the shell 51 mm.

Specimens have been obtained from the shale and limestone of Slite, from Boge, Westkinde and Hogrån.

3. **Euomphalus tuba** n.

Pl. XVIII fig. 6—8.

Shell globular, with a low, though prominent spire and four tubular whorls. They are ventricose, with slightly elevated ridge in continuation of the apertural indentation. The suture is deep and the whorls sink much abruptly towards it. The ornamentation consists in narrow longitudinal threads, which are crossed by indistinct, transverse lines of growth, coarser and finer, forming an obtuse angle in the same line as the slit is situated. The aperture is circular and the lips thin, the umbilicus is narrow, but open.

H. 7 millim., br. 10 m.

A single specimen from the limestone of Samsugn in Othem. A nucleus from Martebo of larger dimensions may possibly also belong to this species.

4. **Euomphalus præcursor** n.

Pl. XVIII, fig. 9—11.

Shell discoid, spire moderately prominent, of five whorls, rapidly increasing in size, the body whorl in breadth surpassing all the others. The narrow characteristic keel is seen a little below its median line, having inside it towards the suture a flat surface. On the umbilical side of the body whorl there is a narrow, sharp keel nearer

to the umbilicus than the exterior margin, on the inside of which a scooped out belt is formed, being bordered by a sharp edge where the umbilicus begins. The striation on the surface is only transversal, slightly bent in a sinus where it crosses the keel. The striæ are narrow, elevated and thread like. The aperture is transversally ovate, the umbilicus rather narrow. H. 6 mm., br. 17 mm., diameter of umbilicus 5 mm. Another specimen: H. 5 mm., br. 11 mm., umbilicus 3 mm. Two specimens from the shale of Wisby. From Dalhemså, near Nya Slitegårds, the museum possesses a single specimen, which perhaps is only a variety of this species. It is, however, different in not having the inferior keel so prominent and the whorls are convex, not flat between the keel and the suture. On the umbilical side it is more conformed to the former.

The shape and sculpture of *E. præcursor* remind of the far larger species from younger palæozoic formations.

### 5. *Euomphalus Walmstedti* n.

Pl. XVIII fig. 12—14.

Shell discoid, spire on a level with the body whorl, whorls seven. On the apical side a blunt ridge is running longitudinally and the surface of the whorl inside it and the suture is sloping towards the suture or even a little scooped out. The median line of the whorl, on the dividing line of the apical and umbilical side, is obtusely carinated. A little inside the longitudinal axis of the umbilical side there is a sharp, narrow keel, from which the side slopes gently inward. A narrow, sharply defined groove marks the suture on the umbilical side. The transverse striation, the only one extant, is extremely fine and the striæ are slightly angulated when crossing the inferior ridge. The aperture is transversally ovate, angulated, the umbilicus wide and open. H. 4 mm., br. 13 mm., umbilicus 4 mm. Several specimens have been obtained from the red limestone of Sandarfve kulle. There are also specimens from Samsugn in Othem and Klinteberg, which probably are only varieties of this species. They have the whorls more rounded and the keels blunt or nearly evanescent. The wider umbilicus and the conformation of the whorls around it, as well as the quite different striation, distinguish this species from the former.

### Gen. *LOXONEMA* PHILLIPS.

1841 *Loxonema* PHILL. Palæozoic Foss. Cornwall, p. 98.

*Shell turriculate, with long, slender spire of ventricose whorls; a shallow indenture occurs in the exterior lip of the aperture. The lines of growth and also the ornamental ones are bent in an obtuse angle, the apex of which is situated in a line with the apertural indentation. The axis is solid and the oldest whorls are filled with an organic deposit of homogenous calcite as in the preceding genus.*

Of the species first included within this genus almost all have the characteristic features of »the oblique prominent thread like striæ which cover the surface in all the typical species» and as also the etymology of the name implies. In spite of such expressly given characteristics by the first author later naturalists have placed within the limits of this genus shells which are ornamented in a quite different manner, and rather should be regarded as belonging to other genera. Only such shells, in which the ornamental striæ form an angle along the median line of the whorls or near that line conformably to the first typical species, should be placed here.

*Michelia* of AD. FERD. ROEMER<sup>1)</sup> comprises shells with nearly the same ornamentation as in *Loxonema*, but with whorls and spire more like those in *Trochus* or *Terebra*.

Species of *Loxonema* have been found in the Silurian and Devonian formations.

A few have also been found in the Carboniferous limestone, though a great many have been introduced in this genus without showing the distinctive characteristics. But of all those described as *Loxonema* by LAUBE<sup>2)</sup> from the Triassic strata of St. Cassian not a single one can be regarded as appertaining to that genus.

In the Silurian of Gotland five species have been found, differing from each other in the shape and relative size of the whorls as well as in the position of the insinuation and the character of the angular striæ.

### 1. *Loxonema sinuosum* SOWERBY.

Pl. XV fig. 1—5, 7.

<i>Terebra? sinuosa</i>	1839. SOWERBY in Sil. Syst. 619 tab. 8, fig. 15 (not SALTER in Mem. Geol. Survey II, I, 357, pl. 14 f. 2, which is = <i>Murch. cingulata</i> HIS., <i>Loxonema sinuosa</i> PHILLIPS Pal. Foss. Cornwall 99 pl. 38 f. 182 is a Devonian species distinct from the Silurian and has to be renamed as it is of later date).
<i>Loxonema sinuosum</i>	1848. BRONN Nomenclator, 670.
	1850. D'ORBIGNY Prodrôme I, 29.
	1854. MORRIS Catal. Brit. Foss. Ed. 2, 255.
	1859. SALTER Siluria 3 Ed., 549 tab. 24 f. 3.
	1873. ID. Catal. Cambr. Foss., 172.
<i>Holopella (obsoleta</i> Sow. aff.)	1867. LINDSTRÖM Nomina, 23.

Shell elongate, turriculate, with eight whorls, which are transverse, broader than high, ventricose, constricted in a narrow belt close at the suture and the lowest edge of the whorl hiding and covering the suture. Suture crossing the axis of the shell in a very acute angle. The surface is covered by very fine, elevated lines, which are bent in a nearly rectangular curve, along a line somewhat below the transverse median axis of the whorl corresponding with the position of the obtuse indentation of the aperture. The striæ are finest on the body whorl, being more and more coarse and changed into elevated, angular ridges on the older whorls. The aperture is ovate, the columellar lip having besides it only a narrow, umbilical fissure open, which is

<sup>1)</sup> Palæontographica Bd. 3, p. 73.

<sup>2)</sup> Denkschriften der Ak. d. Wiss. zu Wien 1868 Zweite Abth., p. 60.

completely closed in the interior, the columella being solid, fig. 4. The apex is a homogenous mass of calcareous spar, fig. 4, and consequently the nuclei, fig. 5, are ending in an obtuse truncation. H. 24 millim., width of body whorl 12 millim.

Size of the whorls in two specimens.

Whorls.	Spec. A.		Whorls.	Spec. B.	
	H.	Br.		H.	Br.
1	8 mm.	12 mm.	1	8 mm.	12 mm.
2	5 »	9 »	2	5 »	9 »
3	5 »	6 »	3	4 »	7 »
4	3 »	5 »	4	3 »	5 »

Very common in the shale at Djupvik in Eksta and also in few specimens from Wisby.

## 2. *Loxonema attenuatum* n.

Pl. XVIII fig. 3—5.

Shell elongated, turriculate, of 8–9 whorls, nearly as high as broad and in some specimens exactly so, moderately ventricose or even approaching to a cylindrical shape with straight sides, a little constricted around the inferior edge and slightly covering the shallow suture. The apex of the angular and very fine striæ is situated a little higher than those of the preceding species or near the median line. The corrosion of the surface has caused a false appearance as of a slit band. The aperture is longer than broad, oval, the interior lip broad and reflexed; no umbilicus is visible. Length of a fragment 27 millim., breadth of body whorl 9 mill., probable length of complete specimen 35 mill. Dimensions of whorls in four specimens:

A, whorls.	H.	Br.	B, whorls.	H.	Br.	C, whorls.	H.	Br.	D, whorls.	H.	Br.
1	10 mm.	11 mm.	1	8 mm.	10 mm.	1	9 mm.	9 mm.	1	wanting.	
2	7 »	8 »	2	6 »	8 »	2	7 »	7 »	2	7 mm.	8 mm.
3	5 »	6 »	3	4 »	—	3	5 »	5 »	3	5 »	6 »
			4	3 »	—				4	4 »	4 »
									5	3 »	3 »

Nine specimens have been found in the limestone of Samsugn in Othem.

A fragment of a large *Loxonema* from Follingbo somewhat reminds of this species but cannot be defined with certainty.

## 3. *Loxonema intumescens* n.

Pl. XV fig. 6.

Shell turriculate, with a slowly tapering spire, of which six whorls are left. These are ventricose, larger than high in the following ratio.

Whorls.	H.	Br.
1 .....	10	14
2 .....	7	11
3 .....	5	8
4 .....	4	6
5 .....	3	5
6 .....	2	4

The increase is consequently more rapid in the youngest whorls. The suture is moderately deep and the whorls are regularly rounded down to it, without any constriction. The apices of the angular striae are placed on the middle of the whorls and resemble those of *Lox. sinuosum*. H. 32 millim., br. 14 mm.

Only one specimen has been found in the upper limestone near Wisby and there are also some from Westergarn.

#### 4. *Loxonema strangulatum* n.

Pl. XV fig. 8—10.

Shell turriculate, long and slender, of at least six whorls. As may be seen by the dimensions, given below, the whorls are of nearly double the height against the width. They are only moderately ventricose, as to appear almost cylindrical, the suture is oblique, more so than in the other Gotland species. The lowest part of the whorls is constricted in a rather broad belt just above the suture. The ornamentation consists of the usual striae, bent backwards on the middle of the whorls in a sharp rectangular sinus.

Height of longest specimen from Östergarn 47 millim., br. 8 mill. Height of second whorl in the Klinteberg specimen figured 8 millim., breadth 5 millim.

Found in the limestone of Östergarn and Klinteberg.

#### 5. *Loxonema? fasciatum* n.

Pl. XV fig. 11, pl. XX fig. 7.

Shell slender, elongate, turriculate, with about 16 slightly convex whorls, glossy, though covered with exceedingly minute transverse striae, which are curved backwards in an angle. The apex of this angle is obliquely arched and taken together the apices of all striae form, exactly above the median line of the whorl near the upper suture, a relatively large band, somewhat resembling the slit band in *Murchisonia*, as for instance *M. crispa*. It is however not clearly defined from the ambient surface, through bordering lines and the species may, untill further information is gained, be left with *Loxonema*. The whorls are a little longer than broad. The aperture is ovate. H. 13 millim., br. 2 mm.

A few specimens have been found in the red limestone of Sandarfve kulle.

## Fam. VIII. TROCHIDÆ D'ORB.

## Gen. TROCHUS L.

1758 *Trochus* L. Syst. Nat. ed. X, 756.

1879 *Palæotrochus* J. HALL Pal. N. York vol. V pt. II, 133.

1881 *Flemingia* DE KONINCK Faune II, III, 94.

1882 *Eotrochus* WHITFIELD Bullet. N:o 3 of American Museum of Natural History p. 77.

It is with great diffidence the following species have been described as belonging to the old genus *Trochus*. The only reason for placing them there is the general exterior shape of the shell, it having not been possible to find any evidences from the microscopic structure of the shell nor from any traces of a nacreous stratum or an operculum. On the other hand, there are so many genera of shells which have persisted from the Silurian age through all the following and still continue, and it may therefore not be thought an impossibility that also the *Trochi* existed already in the Silurian times. Moreover, it is generally adopted that species of *Trochus* have been found in the Devonian rocks, where they, however, as well as in the Carboniferous limestones, not are numerous. Most of these palæozoic *Trochi* are nearest allied to that division, where the inner lip is thin or only slightly thickened, and the umbilical side flat. A few, as *Tr. profundus* and *Tr. cavus*<sup>1)</sup> evidently belong to a section of Palæozoic *Trochi*, out of which WHITFIELD (l. c.) has established his genus *Eotrochus*. They have exactly the same cup shaped conformation of the umbilical side, which has led some authors<sup>2)</sup> to place similar ones from the Jurassic formations with the *Phoridae* in the genus *Onustus*. I think, however, that the Palæozoic may, at least for the present, be retained in *Trochus*. On comparing the beautiful figures of *Tr. lamellosus* for instance in D'ORBIGNY'S Pal. Française, Terr. Jurass. pl. 311 fig. 11—13, the remarkable similarity with the Silurian *Tr. cavus* and *profundus* is evident. There is in all the same cup shaped umbilical surface, the thin, lamellar border around it and the open umbilicus. There are no traces of any nacreous stratum. The columella, probably solid in some, is in many replaced by a wide, open, funnel shaped axis. The apex of the whorls is filled up with a calcareous deposit.

Sixteen species have been discovered in the limestone beds of Gotland, none having hitherto been found in the subjacent shales. These species may be divided into the following groups.

- I. **TRANSVERSI**, transversally ornamented by oblique lines.
  1. *Tr. Gotlandicus* n.
  2. *Tr. fulminatus* n.
  3. *Tr. mollis* n.

<sup>1)</sup> Probably also *Tr. Stuxbergi* and *undulans*.

<sup>2)</sup> HUDLESTON Contributions to the Pal. of the Yorkshire Oolites. Geol. Mag. 1884, p. 293.

4. *Tr. Stuxbergi* n.
5. *Tr. undulans* n.
6. *Tr. profundus* n.
7. *Tr. cavus* n.
8. *Tr. Lundgreni* n.
9. *Tr. Kolmodini* n.

II. **CARINATI** with longitudinal keels.

10. *Tr. Dalli* n.
11. *Tr. Wisbyensis* n.
12. *Tr. lamellosus* n.

III. **INCISI** with angulately impressed suture.

13. *Tr. incisus* n.
14. *Tr. gyrans* n.
15. *Tr. densestriatus* n.

IV. **SPINOSI** with spiny processes along the suture.

16. *Tr. astraliiformis* n.

No species has as yet been found in the Lower Silurian beds of Sweden.

Div. I. **TRANSVERSI.**

1. ***Trochus Gotlandicus*** n.

Pl. XIV fig. 1—11.

Shell broadly conical, sides even, only slightly convex, whorls seven, transversally striated by the oblique, backwards directed, lamellar, wavy lines of growth, which overlap each other and consequently give the surface an imbricated appearance. They vary finer (fig. 1) or coarser (fig. 6). Where the umbilical and apical faces of the last whorl meet they form an acute angle which often is prolonged into a horizontal, solid keel. The umbilical surface is nearly flat, smooth, striated by minute, dense lines. The aperture is oblique, almost triangular. The outer lip is thin and sharp, the inner lip reflexed. The umbilicus is closed and there is a marked circular depression around it, defined by a narrow, thread like ridge. The columella is solid. The suture is shallow, often covered by the lamellar keel of the preceding whorls, and the outlines of the different whorls run in a continued profil without any interruption. The apex of the shell is filled up with solid calcareous matter. A peculiar reticulated structure is shown, fig. 9, in thin, transparent cuts of the shell.

H. 18 mill., br. 35 millim.

It occurs plentifully at Lansa and Lutterhorn on Fårö, in the limestone of Slite, Hall near Westöös, in the coast all along the shore from Lickershamn to Wisby. A single nucleus has been found in the shale near Wisby and probably belongs to this species.



## 2. *Trochus fulminatus* n.

Pl. XIV fig. 12—13.

Shell small, broadly conical with five ventricose whorls and deep suture. The ornamentation is peculiar and characteristic. The distantiated, transverse lines are a little below the middle of the whorls suddenly bent in an obtuse angle, thus forming, as it were, a lower field of striae on the belt next above the suture. The aperture is transversally obovate, the lips thin, the umbilicus closed and the central part of the umbilical face deeply depressed and surrounded by a low ridge. H. 10 millim., br. 10 mm.

A few specimens of this characteristic little shell have been found in a white crystalline limestone north of Wisby, along the shore of Westkinde and Lummelund.

## 3. *Trochus mollis* n.

Pl. XIV fig. 14—17.

Shell large, broadly conical, of six tumid whorls, which are only obtusely carinated between the apical and the umbilical surfaces. The sculpture differs totally from that of the preceding ones and consists only in microscopically minute, transverse striae, very regularly distantiated from each other. The aperture is obliquely elliptical, the outer lip thin and sharp, the interior lip strongly reflexed or thickened. The umbilicus is almost hidden through it and is only discerned as a narrow slit.

H. 21 millim., br. 27 millim.

Some specimens have been found in the limestone of Klinteberg and Samsugn, and also in Lilla Carlsö, from where the Mineralogical Museum of Copenhagen has obtained a specimen.

## 4. *Trochus Stuxbergi* n.

Pl. XIV fig. 59—69.

Shell small, obtusely conical of five or six whorls, which are ventricose, most tumid near their inferior edge and the sides above nearly vertical. The ornamentation consists of sigmoid, obliquely transverse, laminar striae. The umbilical and the apical sides are separated through a horizontal ridge, the extreme, thin margins of which are much broken and jagged and are left behind in their old place on the older whorls, having coalesced with the shell. The thin edges of this ridge form an upwards directed rim around the umbilical surface giving it a saucer-shaped appearance, elevated in the centre around the narrow, but completely open umbilicus. The aperture is circular or obovate, fig. 59. The outer lip is, when entire, thin, but thickens towards its uppermost corner, where the horizontal ridge is situated. H. 11 mill., br. 13 mm. Another specimen h. 7 mill., br. 9 mill.

Several specimens have been obtained from Klinteberg and Samsugn, and also from Kyrkberget in Wisby.

It reminds, as to the ornamentation, of *Trochus Gotlandicus*, but the transverse striae are more straight in that species and sigmoid in *Tr. Stuxbergi*, moreover the umbilical side and the shape of the whorls is quite different in both.

### 5. *Trochus undulans* n.

Pl. XVI fig. 8—10.

Shell small, obtusely conical of five tumid whorls, bulging out near their inferior part and with the sides above straight and vertical, whence the body whorl acquires a cup shaped appearance or also they are of a concave outline, fig. 8. The oblique, transverse lamellæ of growth are distantiated, and have their projecting edges much wavy and folded in a great number of sinuosities, quite peculiar to this species. The umbilical side is nearly flat, in the centre excavated into a deep funnel, on the bottom of which the opening of the narrow umbilicus is seen. The horizontal ridge which all around borders this surface is thin and wavy. The aperture is circular, enclosed within thick lips, the outer one being especially large and in its uppermost corner angulated.

H. 8 mill., br. 12 mill.

Only three specimens have been found, two from the upper limestone beds of Slite and the third from Samsugn in Othem.

### 6. *Trochus profundus* n.

Pl. XVI fig. 11—13.

Shell of moderate size, broadly conical with large periphery of the umbilical side and short spire. Six whorls of somewhat concave contour. The ornamentation consists of oblique, transverse striae or rather steplike gradations following each other at wider distances than the striae in the preceding species. When seen in a section, cutting them transversally they have a serrated appearance. The umbilical side is quite smooth and glossy, excavated or cup-shaped, through the large, very thin, upwards directed borders, which encircle the upper side of the whorls and the aperture. This



Longitudinal section  
of *Trochus profundus*,  
natural size.

is circular and lies at some distance inside the border of the shell. A shallow, curved groove in direct continuation with the aperture, indicates the place the animal occupied when protruding itself from the shell. The outer lip is thin and sharp, the interior one thicker and straight. The umbilicus is open and wide; the axis is open as seen in the annexed woodcut. H. 13 mm., br. 16 mm.

Two specimens have been found in the limestone of Samsugn in Othem. In this, as well as in the following species and *Tr. Stuxbergi* and *Tr. undulans*, the

formation of the umbilical side in some way reminds of the appearance of the same side in *Trochita* and *Galerus*, but perhaps more so of that in *Onustus* or *Phorus* (f. inst. Ph. exutus). Their great accordance with such Jurassic forms as *Trochus lamellosus* D'ORBIGNY is also already above indicated. There is also a Lower Silurian genus *Clisospira*, first described by BILLINGS in Canada, and also found in the beds of the red *Trinucleus* shale of Östergötland, nearly allied to these forms.

### 7. *Trochus cavus* n.

Pl. XVIII fig. 15—17.

Shell broadly conical, with a large periphery of the umbilical side and obtuse apex. Whorls five or six, of faintly concave outline, transversally striated, striæ gently arched, distantiated with smooth interstices. Section of whorls transversally elliptic. The suture is completely hidden by the superior borders of the whorls, which have coalesced with the younger whorls and thus form an even apex. The umbilical side is a deep, cup shaped hollow, more like that of a *Phorus* than that of the preceding. The encircling borders of the shell are higher and thinner. In a shell of 17 millim. in length there is a vertical height of 10 millim. for this umbilical hollow. Its surface is almost smooth, only with indistinct, transverse striæ. The bottom, a gently elevated belt around the umbilicus, is formed by the upper side of the body whorl, which is more flat and expanded than in *Tr. profundus*. It is separated from the thin lips of the border through a slightly elevated, narrow, annular stripe. The aperture is ovate, lips thin and sharp, the umbilicus is open and wide. Height 9 millim, br. 20 mm. Another specimen h. 14 mm., br. 22 mm. Fragment of a large specimen 30 mm. in breadth.

Some specimens have been obtained in the red and gray limestone beds of the hills of Linde and Sandarfve.

### 8. *Trochus Lundgreni* n.

Pl. XIV fig. 46—53.

Shell large, broadly conical, whorls eight, rapidly increasing, slightly convex, superior border enlarged into a broad lamellar ridge, horizontally outstanding and separating the umbilical surface from the apical. This ridge is visible on all whorls and projecting beneath the shallow suture. As seen in the magnified section of this ridge, fig. 52, its interior cavity has been divided through about five, transverse diaphragms. On looking at fig. 47 and the magnified corner of the aperture, it can be questioned whether these apparent interior, transverse diaphragms are not rather to be regarded as the sections of several such apertural edges, as seen in fig. 47, formed inside each other, every new one smaller than its predecessors. In fig. 53, showing a weathered edge, there are also some such apertural corners brought forward. The ornamentation consists of narrow oblique sigmoid striæ. On the slightly convex

umbilical side the striae are still finer. The aperture is nearly circular, only widened into a small angular wing in the superior corner. The outer lip is thin and narrow, the inner lip strong, reflexed back towards the umbilicus and partially concealing it. The columella is open for a little more than half its total length, solid towards the apex. The shell which is thickest around the narrow but open axis, consists of two distinct layers of which the interior one is dark and transparent, the exterior pale and opaque. H. 26 mm., br. 38 mm.

It occurs at Samsugn in Othem, from where some twenty specimens have been found and also in the limestone of Lutterhorn in Fårö, where a smaller and more conical variety occurs.

### 9. *Trochus Kolmodini* n.

Pl. XIV fig. 32—34.

Shell elongated, acuminate conical, of six whorls, with slightly concave outline. The ornamentation consists in lines of growth regularly curved backwards and equally distantiated, their edges elevated into a fine and sharp lamina. The interstices are smooth. The umbilical side is flattened and finely striated. An obtuse angle is formed between it and the apical side. The suture is acutely impressed and deep. The aperture is transversally elliptical, the outer lip thin and sharp, the inner lip folded back and hiding the umbilicus. H. 12 millim., br. 10 mill.

A single, but complete specimen has been obtained from the limestone of Stor Wede in Föllingbo.

## Divisio II. CARINATI.

### 10. *Trochus Dalli* n.

Pl. XIV, fig. 18—21.

Shell turbinated, ventricose, with five whorls, which are minutely and densely striated. Along the middle of the whorls there are two longitudinal ridges close to each other, not much prominent, softly convex; the aperture is circular, outer lip thin, inner lip reflexed along its entire length and hiding the umbilicus. The suture is moderately deep. H. 13 mill., br. 15 mill. Specimen, fig. 21, is of a variety with broader whorls.

Several specimens have been found in the limestone of Kyrkberget in Wisby.

### 11. *Trochus Wisbyensis*.

Pl. XIV fig. 35—43, 45.

Shell of much variable shape, obtusely or elongately conical, with long tapering spire; whorls six or seven, ventricose and broader than high. The ornamentation is

also highly variable, transversally oblique lines running either uniformly as in fig. 36 and 39 or distantiated and elevated at their edges into thin lamellæ. In a longitudinal direction there are in most specimens (fig. 36, 40) two keels on both sides of the middle of each whorl, much distant from each other. In others again, as specimen fig. 39, there is only one ridge, the uppermost one, and in such as fig. 41, 43 there are no less than three keels, a third placed just above the suture. A fourth is following the outer edge of the umbilical surface, fig. 42. The aperture is transversally oblongate, with thin lips, of which the inner one is reflexed and hides the umbilicus. H. 23 mill., br. 19 mill.

From the limestone of Kyrkberget in Wisby, where many specimens have been found, from Samsugn in Othem, from the limestone of Ar, and from Lutterhorn in Fårö.

## 12. *Trochus lamellosus* n.

Pl. XIV fig. 44, pl. XV fig. 52—54.

This species differs from the preceding chiefly in the ornamentation. The transverse lines are much distantiated and elevated at their edges to projecting laminae. At the suture they intercross with the pointed continuations from the striæ of the next whorl. It has been found in the canal near Westöös in Hall. H. 12 mm., br. 10 mm.

Another extreme form of this species has been found in the limestone of Samsugn in Othem by Professor P. T. CLEVE, the only specimen of which belongs to the Mineral Cabinet of the University of Upsala and has been delineated on plate XV fig. 52—54. It is elongate, turriculate of seven whorls, which taper rather rapidly towards the apex. On the body whorl there are two longitudinal keels as in the former, having between them an excavated zone. The uppermost keel of the lower whorls is almost hidden, coinciding with the suture and partially covered by the lowermost border of the following whorl. There are distantiated, transverse lines running obliquely and by being folded in projecting thin laminae they form the keels. The aperture is obliquely elliptical and the interior lip which is thin, nearly hides the umbilicus, of which only a narrow slit is to be seen. The umbilical side is almost flat, covered by densely set, transverse, thin laminae. H. 13 mill., br. 9 mill.

## Divisio III. *INCISI*.

### 13. *Trochus incisus* n.

Pl. XIV fig. 22—31.

Shell regularly conical of six gradually increasing whorls evenly sloping, with slight concavity or even in some specimens of convex outlines. Body whorl ventricose with the umbilical side moderately convex, a narrow slightly elevated keel

encircling its middle line. This keel is situated just below the suture in the older whorls, which are hidden as to their upper part. The surface is striated by oblique, exquisitely fine, a little serrulated lines, directed backwards. The deeply incised suture is most characteristic though there are variations as to its depth. For instance a shell from Follingbo, fig. 19, same locality as fig. 26—27, has rather no incision at the suture or one only very shallow, the inferior border of each whorl beginning further down on the next preceding. The aperture is circular, the outer lip thin, the inner lip reflexed. The umbilicus is narrow, but open. H. 17 mill., br. 17 mill. Length of aperture 9 mill., width 10 mill. Several specimens have been found at Kyrkberget in Wisby, Samsugn in Othem, Stor Wede in Follingbo; from Lickershamn there are specimens in the Mineralogical Museum of Copenhagen.

#### 14. *Trochus gyrans* n.

Pl. XVIII, fig. 18—20.

Shell regularly conical of eight tumid whorls, which are carinated along their median line and just above the suture form a horizontal, flat surface like a narrow band along the inferior part of the whorls, bordered upwards by a narrow ridge. The sculpture consists in fine striæ, which are somewhat more irregular than in the preceding. The aperture is circular and the outer lip thin, the inner one thickened and there is the appearance of a sinus where both lips meet at the lower end of the aperture. The structure of the umbilicus is peculiar. It is a wide, funnelshaped opening, limited partially by the inner lip and partially by a sharply defined wall, which is encircled by a narrow ridge and is continued spirally down to the more narrow and deeper opening. H. 19 millim., br. 15 mill.

Two specimens have been found on Kyrkberget in Wisby together with the preceding, to which it is nearly related. It differs, however, chiefly through its peculiar and characteristic umbilicus.

#### 15. *Trochus densestriatus* n.

Pl. XVIII fig. 21—23.

Shell minute, elongately conical of six whorls with slightly concave outline. Beneath the shallow suture there is a low, elevated ring around the upper edge of the whorls, which on the body whorl is situated exactly where the apical and the umbilical surfaces meet. There are regular, dense, microscopically fine streaks, running nearly vertical on the whorls, slightly arched. The aperture is rather obovate and the lips thin and sharp, the outer one bent inwards and the inner one narrowly reflexed, no umbilicus is visible. H. 5 millim., br. 3 mill. Four specimens have been collected in an earthy, bituminous limestone at Hessle in Östergarn.

It comes near to *Tr. incisus*, but is sufficiently well distinguished through its peculiar striation and the angular aperture.

16. *Trochus astraliiformis* n.

Pl. XIV fig. 54—58.

Shell conical, tapering to a narrow apex from a broad body whorl. Eight whorls. Their upper border lacerated, as it were, by thick, spinous projections, the base of which completely conceals the adjoining suture. These processes are formed by reflexed folds of the successive lines of growth, as may best be seen on the umbilical surface of the shell. A little beneath this edge there is a longitudinal bulging out of the whorls. Between the lines of growth the convex surface of the shell is smooth or most finely, transversally striated. The aperture is nearly circular, apiculated in the superior corner, the lips thick and reflexed, the umbilicus is scarcely visible. The sculpture of the umbilical side consists in thick and coarse callous lines of growth at a regular distance from each other. H. 12 millim., br. 18 mill. A few specimens have been collected at Klinteberg.

## Fam. IX. UMBONIDÆ ADAMS.

Gen. *PYCNOMPHALUS* n.<sup>1)</sup>

*Shell thick, trochiform or globose, the inner lip of the aperture with a thick callosity, which like a ridge surrounds the umbilicus.*

This genus has been placed amongst the Umbonidæ in consequence of the callosity, which encloses the wide umbilicus. Most of the other genera have the umbilicus completely covered by a far larger callosity as in *Umbonium* (= *Rotella*).

There is a genus *Rotellina* DE KONINCK Faune II, III p. 92 from the Carboniferous formation of Belgium, which according to the figure given, seems to agree nearly with our, but as the descriptive letterpress expressly states that there is no umbilicus, I have not been sure of the identity and could not refer the Gotland species to it.

*Pitonellus* MONTFORT has also been placed with the Umbonidæ, but they have the umbilicus completely covered up. The same is also the case with *Umbonium heliciforme* GOLDFUSS from Paffrath.

As to the identity of this genus with *Platyschisma* see below in *Pychn. acutus*.

Of the genus *Pycnomphalus* I have found the following three species in Gotland.

1. *Pycnomphalus obesus* n.

Pl. XV fig. 64—67.

Shell helicoid, with five ventricose whorls in a short spire. There are no ornaments excepting some indistinct, transverse lines, which are curved backwards. The aperture is circular, the outer lip thin, the inner lip thickened through an accumulation of the shelly matter, nearly five times as thick as in the outer lip. The umbilicus

<sup>1)</sup> *Πυχνός*, dense, thick, *ὀμφαλός*, umbilicus.

is open, narrow at its mouth, most widened in the midst of the shell. The columellar tube is consequently of unequal width, being more narrow where the callosities are opposite, and widening below them and in consequence its contours form zigzag lines as shown in fig. 65. H. 16 millim., br. 23 millim.

Found in the limestone of Wialmsudd near Fårösund and at Lansa in Fårö.

## 2. *Pycnomphalus acutus* n.

Pl. XVI fig. 1—6.

?*Platyschisma helicites* Sow. Siluria 4th Ed. pl. 34 f. 14—15.

Shell, trochiform with short spire of seven whorls. The surface is covered by fine, densely set, equal striæ, meeting in an acute angle from both the apical and the umbilical sides, where the sharp, dividing keel is projecting on the median line of the whorls. At regular distances there are deeper or more distinct transverse furrows, dividing the small striæ in narrow fields. The umbilicus is open and much wider than in the preceding species. The aperture is transversally elliptical. The outer lip widened into a prominent angular apex, forming the keel, the inner lip thickened in its upper part, nearly thrice as thick as the outer lip. A very indistinct spiral line accompanies the keel on its inferior side. H. 10 millim., br. 25 mill. Several specimens have been found in the Trimerella limestone of Wialmsudd together with *P. obesus*. It has also been found in the shales of Westergarn and Djupvik in Eksta and in the limestone of Östergarn, Ardre, Wisby (Kyrkberget) and Nyhamn in Lummelund.

It is possible, that this species is identical with the Silurian *Platyschisma helicites* Sow. Sil. Syst. But I have not been able with any certainty to make out this identity, as there are such conflicting opinions in the fourth Edition of Siluria, where on page 162 a figure of it is given, quite different from that on plate 34 fig. 14—15. Both can hardly represent the same species. The first figure rather resembles a variety of *Euomphalus Walmstedti*, and the second, again, which, however, consists of mere nuclei, seems to coincide more with *P. acutus*. But if this be the case, that species cannot be retained in the genus *Platyschisma*, as it is expressly stated that this genus has »a very wide, shallow sinus in the middle of the outer lip»<sup>1)</sup>. There is not the least trace of any sinus in the Gotland specimens.

## 3. *Pycnomphalus trochiformis* n.

Pl. XVI fig. 7.

Shell large, broadly conical, of at least seven whorls, slowly increasing in height<sup>2)</sup>. Sides even, without any convexity, of rectilinear outline. Surface of the only specimen

<sup>1)</sup> MAC COY Pal. Foss. p. 533.

<sup>2)</sup> The ratio of increase in the only specimen is:

Whorls.	Height.	Breadth.
1	8	31
2	6	26
3	5	20
4	4	14
5	3	10.



extant so much weathered, that no sculpture can be discerned, excepting some indistinct, crescent formed transversal lines. Along the upper border of the whorls a narrow, slightly elevated string is seen, being the uncovered portion of the acuminate ridge, that divides the apical side from the umbilical. The latter is almost flat. The aperture is transversally elliptical and the umbilicus wide, surrounded by the elevated callosity, which emanates from the thickening of the inner lip. H. 28 millim.; br. 32 mill. Only one specimen is known, belonging to the collection of the school of Wisby, derived probably from the upper limestone near that town.

### Fam X. TURBINIDÆ ALDER.

In following the precedence of S. P. WOODWARD<sup>1)</sup> and partly also of ZITTEL<sup>2)</sup> I place the following five genera within this family. Some of the shells, which I have comprised within the genus *Oriostoma*, have by DESHAYES and most authors after him been numbered with the *Solariidæ*. One of the latest authors, STOLICZKA<sup>3)</sup>, does it on account of the presumed similarity of its operculum to that of *Torinia* and the more so to that of *Omalaxis*, with which recent genus also some of the palæozoic forms have been regarded as identical. But besides, that nearly similar forms of opercula also occur in other families, as the *Siliquariæ*, the *Vermetidæ* and the *Turritellidæ*, there is another circumstance which makes it probable that the palæozoic shells under consideration cannot belong to the *Solariidæ*. It consists namely in the important feature that several of its species have retained the most evident traces of a nacreous layer, both in the genus *Oriostoma* as well as in *Cyclonema*. Moreover the operculum is solid and shelly not chitinous as in the former genera. These genera, which thus closer agree with the *Turbinidæ* than with the *Scalariidæ* are the following.

*Oriostoma* MUNIER-CHALMAS, with short spire, surface richly ornamented by longitudinal carinæ, crossed by variously sculptured, transverse striae. Operculum conical, solid and shelly with narrow coils. Umbilicus large and open.

*Cyclonema* HALL, with high spire, ornamentation of fine, slightly prominent longitudinal keels, crossed by equally fine, transversal striae. Operculum depressedly conical with large coils and hollow inside. No umbilicus or a very narrow one.

*Trochonema* SALTER, turbinate, whorls angular through several distantiated sharp keels, umbilicus large, open.

*Eunema* SALTER, small, turriculated, with one or several narrow keels and other sculpture, umbilicus closed.

*Craspedostoma* n. gen., shell globose, naticoid, with the lips widened to a broad frame around the aperture, lower end of interior lip enlarged into an aliform appendix.

1) Manual of Moll. 2d Ed. 263.

2) Handb. Palæont. 1,2, 187.

3) Palæontologia Indica V, 249.

Gen. **ORIOSTOMA** MUNIER-CHALMAS.

- 1814 *Euomphalus* SOW. p. p. Min. Conch. vol. 1, 97.  
 1864 *Omphalotrochus* MEEK. Rep:t. Geol. Survey of California, Palaeont. vol. I, 16.  
 1876 *Oriostoma* MUN.-CHALMAS Journal de Conchyliologie vol. XVI, 103.  
 1881 *Polytropis* DE KONINCK Faune Carbonif. II,III 107.

*Shell discoid, with short spire, rarely high, whorls tubular, ventricose, joined, seldom a little disjointed near the aperture, longitudinally sculptured with prominent keels, aperture with thin lips without any sinus, generally continuous, umbilicus wide and open. In several species the nacreous lustre of the interior shell strata is retained on the nucleus. The operculum is calcareous and solid, on the inner side smooth with a thick, elevated rim around the margins, outside conical, sometimes higher than broad, covered by a number of spiral coils ornamented with exceedingly thin lines. Mostly large shells, but some species also small.*

Besides the above, in the list of synonyms enumerated genera, which have exclusively or almost so been applied to the species of this genus, there is also a number of other genera, in which some of them have been included as in *Turbo* by PICTET, *Delphinula* by HISINGER and others, *Trochilites* and *Helicites* by SCHLOTHEIM, *Turbinites* by WAHLENBERG and SCHLOTHEIM. *Straparolus* MONTFORT might, according to several authors, embrace species of this genus, but the first species described are not known to have had any operculum and their ornamentation differs. If we strictly confine ourselves to the species, which SOWERBY, when he at first established his genus *Euomphalus*, included into it, we must find that later created species such as *E. discors*, *E. rugosus*, *E. funatus* etc. essentially differ from the former in having an entire aperture without any slit as in those, which form the genus *Euomphalus sensu strictiori* and must be ranged near the *Pleurotomaridæ*. *Delphinula*, employed by HISINGER, is now applied to species from later formations and generally regarded as a synonym for *Omalaxis*, which has a chitinous operculum. *Omphalotrochus* MEEK may in some degree be related to or even contain species of this group, but the name indicates an affinity, which is not borne out by the evidence given by the operculum of the Silurian specimens. *Polytropis* DE KON. seems, to judge of the expressions of this author, at first to have been intended instead of *Inachus* (*In. sulcatus* His. is a *Pleurotomaria*), but DE KONINCK then cites *Euomph. discors* as the typical species and consequently the name is synonymous with *Oriostoma*. The Devonian *Oriostomata* lately described by OEHLERT, as far as I am able to judge by specimens kindly sent from him, belong to the same generic group as the Silurian, which formerly had been confounded with the *Euomphali* and both consequently must be placed in the same genus *Oriostoma*. The Devonian species however are all small and no operculum has as yet been found with them.

The distinction between *Oriostoma* and *Cyclonema*, the next genus, is not quite as clear as desirable, when the operculum is wanting. When an *Oriostoma* varies in having a long spire, it nearly resembles a *Cyclonema*, but these never have the umbilicus as large as the former.

In certain species of *Oriostoma*, which have a single longitudinal keel near the suture, there is at first sight some resemblance with species of *Euomphalus*, but the apertural sinus is here reduced to a short notch, which through the folding of the aperture originates the keels. These notches never attain to such large dimensions as the sinus in the *Euomphalidæ* and moreover they disappear in the body whorl of many.

The shells of this genus are amongst the most common in the Silurian strata of Gotland and through their large numbers they offer a great variety of forms, which make it a most difficult task to distinguish specific groups neatly from each other. The great variability of the ornamentation and the almost imperceptible passages from one form to another highly increase this difficulty. The oldest notions of the Swedish *Oriostomata* are those given by BROMELL in his *Lithographia* p. 32, 36, where several are described under the name of *Cornu Ammonis*, but only one clearly enough to be identified, viz. *N<sup>o</sup> 21*, »Ejusdem generis *Nerititæ majores*» which is *Oriostoma sculptum*.

In the Lower Silurian formation of Sweden hitherto not a single species has been found belonging to this genus. In Gotland the following sixteen species and varieties have been detected and they may be divided in two groups.

A) with spire moderately prominent and the umbilicus deep and open.

1. *Oriostoma discors* Sow.
2.     »     var. *rugosum* Sow.
3. *O. contrarium* n.
4. *O. globosum* SCHLOTH.
5. *O.     »     var. sculptum* Sow.
6. *O. coronatum* n.
7. *O. acutum* n.
8. *O. Wisbyense* n.
9. *O. angulifer* n.
10. *O. Roemeri* n.
11. *O. helicinum* n.
12. *O. alatum* n.

B) with short spire and planorbiform shell, the whorls on the umbilical side quite as much visible as on the apical one.

13. *Oriostoma angulatum* WAHLENBERG.
14. *O. lineatum* n.
15. *O. nitidissimum* n.
16. *O. dispar* n.

Besides these species there is evidence of at least three species more through their opercula, described below, but as no shell has been found to match them, they must for the present be left undetermined.

### 1. *Oriostoma discors* Sow.

Pl. XVI fig. 20—36, pl. XVII fig. 1—5.

*Euomphalus discors* 1814. Sow. *Min. Conch.* vol. I, 113, pl. 52 f. 1.  
1837. AGASSIZ in SOWERBY *Gross Brit. Mineral Conch.* 61, tab. 36.

	1839. SOW. Sil. System, 626 pl. 12 f. 18.
	1843. MORRIS Catal. Brit. Foss., 144.
	1847. MURCHISON Qu. Journ. Geol. Soc., 29.
	1848. BRONN Nomenclator, 479.
	1854. MORRIS Catal. 2d Ed. 247.
	1855. MAC COY Palæoz. Foss. 298.
	1858. FR. SCHMIDT Estland, 204.
	1859. SALTER in Siluria 3d Ed. 548, pl. 24. f. 12.
	1867. LINDSTRÖM Nomina, 23.
	1873. SALTER Catal. Cambr., 156.
<i>Turbinites cornu arietis</i>	1818. WAHLENBERG Petref. Suec., 68, pl. III fig. 9, 10.
	1828. HIS. Anteckn. IV, 257.
<i>Delphinula cornu arietis</i>	1829. HIS. Tabl. 10.
	1831. Id. Tabl. ed. 2, 8.
	1831. Id. Anteckn. V, 113.
<i>Euomphalus cornu arietis</i>	1837. Id. Leth. Suec., 36, tab. XI fig. 6.
	1841. Id. Förteckn., 55.
	1848. BRONN Nomencl., 479.
	1858. FR. SCHMIDT Estland, 204.
	1867. LINDSTRÖM Nomina, 23.
<i>Straparollus discors</i>	1850. D'ORBIGNY Prodr. I, 29.
<i>Turbo cornu arietis</i>	1850. Id. ibid., 30.
<i>Polytropis discors</i>	1881. DE KON. Faune Carbon. Belgique. II, III, 107.

Shell discoid, spire short, or, in the variety called *E. cornu arietis* by WAHLENBERG, prominent, with six whorls, which are carinated on their inferior surface by blunt, longitudinal keels of varying number and prominence, from three to eight in the typical form. In the elongated variety there are three on the inferior surface, but as many as eight on the umbilical one. The surface slopes from the lowest keel towards the suture which is shallow. The keels are crossed by narrow, transverse, undulated lines of growth, giving the surface an imbricated appearance. The transverse striæ of the umbilical surface are curved sigmoidally and have grown out into thin, prominent lamellæ. The great amount of variation as to the ornamentation in these shells may be gathered from the numerous figures given. The aperture is transverse, its superior margin sigmoidally bent, the outer lip thin and notched or angulated where the keels are formed, the inner lip is thick. The umbilicus is wide and open and all whorls are visible. H. 23 mill. br. 73 mill.

It occurs at Lansa on Fårö, at Wialmsudd on Fårösund; in the upper limestone beds of Wisby and in the shale of Wisby and most plentifully at Westergarn.

In the variety »cornu arietis» the umbilicus is relatively less wide and the course of the striæ on the umbilical surface is more straightly directed backwards. The aperture is also more circular. H. 28 mill., br. 39 mm. Largest diameter of the aperture 16 mill. It has been found at Lansa and Lutterhorn in Fårö, also at Alnäse by Prof. P. T. CLEVE, in the crystalline limestone of Wialmsudd, in the canal near Westöös in Hall, Samsugn in Othem, Follingbo, Bara, Kristklint in Kapellshamn, Hörsne, Martebo, in Kyrkberget in Wisby, at Walve ref, Westergarn and Klinteberg, thus chiefly in the higher strata. The rule holds good in these, as in so many others, that the spiral ridges are more prominent in small specimens or on the old whorls of the larger ones and are apt to disappear on the larger and younger whorls.

The variety figured pl. XVII f. 4 is in some way a transitional form to the following.

## 2. *Oriostoma discors* Sow. var. *rugosum* Sow.

Pl. XVII fig. 5—10.

- |                                 |   |
|---------------------------------|---|
| <i>Delphinula</i>               | 1811. PARKINSON Org. Rem. III, 77, pl. VI f. 7—8.   |
| <i>Euomphalus rugosus</i>       | 1814. SOW. Min. Conch. I, 113, pl. 52 f. 2.   |
|                                 | 1839. Id. Sil. Syst., 626, pl. 12 f. 19.  |
|                                 | 1843. MORRIS CATAL., 145.   |
|                                 | 1847. MURCHISON Qu. Journ. Geol. Soc., 29.  |
|                                 | 1848. BRONN Nomenclator, 481.   |
|                                 | 1854. MORRIS Catal. 2d Ed., 248.  |
|                                 | 1855. MAC COY Palæoz. Foss., 298.   |
|                                 | 1867. SALTER Siluria, Ed. 4, 532, pl. 24 f. 13.   |
|                                 | 1871. BAILY Charact. Br. Foss. pl. 21 f. 8.   |
|                                 | 1873. SALTER Catal. Cambr. Foss. 157.   |
| <i>Euomph. angulosus</i>        | 1814. SOWERBY Min. Conch. vol. I, 114, pl. 52 f. 3.   |
| <i>Helicites catenulatus</i>    | 1818. WAHLENB. Petref. Suec., 72.   |
|                                 | 1828. His. Anteckn. IV, 237.  |
| <i>Delphinula catenulata</i>    | 1829. Id. Tableau ed. 1, 10.  |
|                                 | 1831. Id. Tabl. ed. 2, 8.   |
|                                 | 1831. Id. Anteckn. V, 114, tab. 1 fig. a.   |
| <i>Euomphalus catenulatus</i>   | 1837. Id. Lethæa. 37, tab. XI f. 9.   |
|                                 | 1840. Id. Förteckn., 55.  |
|                                 | 1858. Fr. SCHMIDT Esthland, 204.  |
|                                 | 1867. LINDSTRÖM Nomina, 23.   |
|                                 | 1876. FERD. ROEMER, Leth. Geogn. pl. 14 f. 8.   |
|                                 | 1883. QUENSTEDT Petrefaktenkunde Deutschlands, 1e Abth. 7r Bd, 397, pl. 200 f. 90<br>(not fig. 91). |
| <i>Straparollus rugosus</i>     | 1850. D'ORB. Prodr. I, 29.  |
| <i>Straparollus catenulatus</i> | 1850. Id. Ibid. 30.   |

Shell nearly discoidal, spire only a little prominent or turbinated, whorls six, carinated by eight or ten longitudinal keels, interrupted on pretty equal distances by large, sinuous lines of growth, which are elevated in a backwards reflexed fold at the point where they meet the keels, giving in their totality an imbricate or roughly scaly appearance to the surface. Between the larger lines, which are much distantiated, the surface is sculptured by minute lines, parallel with them. The umbilicus is open and the aperture circular with a continuous peristome of thin lips. H. 37 mill., br. 68 mill. The lips of the aperture are much unequal, the exterior one being prominent, the interior, deeply insinuated, especially at its superior corner, the distance between both amounting to 28 millim. in one of the largest specimens. It occurs frequently, though not so common as the former, in Fårö, at Wialmsudd, Samsugn in Othem, Lännaberg in Slite, Möner in Boge, Stor Wede in Follingbo, Martebo, Kälens Qvarn and Galgberget near Wisby, in the shale beds of that town, Östergarn both in the shale and the limestone, Ardre, Bara hill, Linde, Klinteberg and Fröjel.

The range of variability is very wide within this group. Along with shells of short spire, long spired or turbinate shells occur, and together with those of rare transverse imbrication, there are others which have it dense. The specimens from Östergarn and Klinteberg are commonly almost disciform, those from Samsugn with long spire and

transverse imbrication dense. The oldest form from the lowest beds of the marly shale of Wisby (Pl. XVII f. 5—7) is turbinate, with only three longitudinal keels and a low one around the umbilicus. The ornamentation is for the rest the same.

This *Or. rugosum* differs from *Or. discors* in the more distantiated, transverse laminae and in their folds being considerably reflexed backwards on the keels. Such a variety of *O. discors* as that figured pl. XVII f. 1—2, connects both.

### 3. *Oriostoma contrarium* n.

Pl. XX fig. 8—15.

Shell sinistral, turbinate, with six terete whorls. The apex is sunken and the extreme tip is hidden beneath the next whorls, fig. 15. The surface is transversally and obliquely striated by regularly distantiated lamellar ribs, often dividing in two and again uniting, a little wavy in their edge, which is sharp and thin. They are curved sigmoidally upwards towards the umbilicus. The aperture is obliquely ovate or even circular with thin lips and continuous peristome. The inferior part of the exterior lip is folded in and thus narrowing the aperture. The umbilicus is wide and large. It is defined by a narrow ridge, which is most prominent in young or small specimens, fig. 13, indistinct or only as a swelling in the older. The shell substance is thick, especially in the body whorl. Owing to the different state of preservation the aspect of the surface varies, being corroded in some and only the basal lines of the lamellæ left, fig. 14. H. 24 millim., br. 41 millim. Another specimen has in h. 24 mill., br. 23 mill.

It has been obtained from the shale of Wisby, from the limestone beds of Lanså and Lutterhorn in Fårö, Wialmsudd, Samsugn in Othem, the canal of Westöös in Hall, Kyrkberget in Wisby and Hoburg.

### 4. *Oriostoma globosum* SCHLOTHEIM.

Pl. XVII, fig. 24, 25, 29—31, pl. XVIII, fig. 24, pl. XX, fig. 16.

- |                             |       |   |
|-----------------------------|-------|---|
| ? <i>Valvata sulcata</i>    | 1776. | WALCH, der Naturforscher, Neuntes Stück, 278, tab. IV f. 5.   |
| <i>Delphinula</i>           | 1811. | PARKINSON Organic Remains, 78, tab. V. f. 18.   |
| <i>Trochilites globosus</i> | 1820. | SCHLOTHEIM Petrefactenkunde, 162.   |
| <i>Euomphalus funatus</i>   | 1823. | SOWERBY Miner. Conch. vol. V, 71, tab. 450 f. 1 & 2.  |
|                             | 1839. | Id. Sil. Syst., 626 pl. 12 f. 20.   |
|                             | 1843. | MORRIS Cat. Brit Foss., 144.  |
|                             | 1848. | BRONN Nomenclator, 479.   |
|                             | 1849. | BROWN Illustrations of the fossil Conchology of Great Britain and Ireland, 81, pl. XLII figs. 24, 25. |
|                             | 1854. | MORRIS Catal. 2d Ed. 248.   |
|                             | 1855. | MAC COY Pal. Foss., 298.  |
|                             | 1858. | FR. SCHMIDT Geol. Estl., 202.   |
|                             | 1862. | M'COY Sil. Foss. of Ireland, 13.  |
|                             | 1867. | SALTER Sil. ed. 4, 531, pl. 25 fig. 3.  |
|                             | 1871. | BAILY Charact. Brit. Fossils, pl. 21 f. 9a, 9b.   |
|                             | 1873. | SALTER Catal. Cambr. Foss., 90, 157.  |

<i>Skenea funata</i>	1828.	FLEMING Brit. Anim., 314.
<i>Delphinula subsulcata</i>	1829.	HIS. Tableau ed. 1, 10.
	1831.	Id. Anteckn. V, 114, tab. I f. bb.
	1831.	Id. Tabl. ed. 2, 8.
<i>Euomphalus subsulcatus</i>	1837.	HIS. Leth., 37, tab XI fig. 10.
	1840.	Id. Förteckn. 55.
	1867.	LINDSTR. Nomina, 23.
<i>Straparollus subsulcatus</i>	1850.	D'ORB. Prodr., 30.
<i>Turbo funatus</i>	1850.	Id. Ibid. 30.

Shell moderately elongated, globular, with six ventricose whorls. The longitudinal carinae vary in a high degree as to their number, size and ornamentation according to the different localities and to the size of the specimens. On the body whorl there may be as many as 14, of which those on the apical side are the largest. As a rule it holds good that each alternate keel is of the same size, one more narrow, sometimes scarcely perceptible, being situated between a larger one. Each keel is composed by a succession of imbricated, more or less crowded folds, which at the outer lip have the aspect of shallow notches. The smaller longitudinal striae are thread fine, seldom imbricated. Sometimes there are two of equal size beside each other. In young specimens the keels are smooth, not imbricated. The interspaces are crossed by transverse lines, fine and coarse. In a variety from Hammarudd in Kräklingbo the keels are low and sharp and the lines of growth continue more sharply defined than in the typical forms, at regular distances. The same variety also occurs in Fårö.

The aperture is circular, the lips are thin, the umbilicus is very narrow but deep and confined within a sharp and prominent keel, outside which there is one still larger, with a broad groove, scooped out between them. In several specimens the nacreous lustre is still preserved on the nucleus, where the shell has peeled off. H. 37 mill., br. 53 mill.

The operculum, which has been found *in situ* in some instances, is disciform and of a perfectly circular outline. See fig. 24. Its inner surface is bordered by an elevated, narrow edge, section magnified pl. XVII f. 25. Inside this edge the smooth surface is more or less excavated near the centre, for the rest it is flat. The exterior surface is more or less elevated near the centre in an obtuse top, having, when seen from the side, a faintly concave outline. The different relations in size may be found from the following dimensions. Operculum from Westergarn: height 4 mill., diameter 13 mill. Operculum from the hill of Sandarfve: h. 4 mill. diamet. 14 mill.

In the sculpture of the spiral lines they all nearly agree with those figured on pl. XVII fig. 25 and pl. XVIII f. 24. These are very tightly wound and their spirality is evident only by following one of them, else they look as if concentric. They are at least twenty whorls. The surface of these coils is obliquely crossed by a great number of smaller, also elevated lines or coils; the uppermost are highest and more prominent, the others decreasing regularly. This peculiar ornamentation is best shown in thin sections, enlarged under the microscope as seen in the figure 24 pl. XVIII. It is then evident that the spiral coils form narrow ridges, which are nearly vertical to the diameter of the operculum and that the ornamental lines are most numerous on the lower surface of the coil, the uppermost being largest and more wide apart. As

to its chief mass the operculum consists of a compact, dull, gray limestone nearest the outside, but the interior mass is converted into clear, crystalline calcareous spar and distinct lines in this indicate special strata of growth of which it is made up.

As seen in fig. 25 pl. XVII thin and narrow coils are alternating with larger and the partitions are more deeply cut, than in any of the other forms of opercula and the lobes directed vertically.

*O. globosum* has been found in the shale beds of Wisby, Westergarn, Stora Carlsö, Petesvik, Burge in Fardhem, at the canal from Wisne myr, Ejmunds å, Slite, Hall, Lutterhorn and Lansa on Fårö, Hammar in Kräklingbo, in the limestone beds of Gothemshammar, Ganthem, Rute, Wialmsudd, Samsugn, Martebo, Hörsne, Klinteberg, Lilla Carlsö and Sandarfve kulle, Fröjel.

The operculum has been found in the shale of Wisby, Follingbo, Sandarfve kulle, Eksta (Djupvik), Westergarn, Linde klint and Slite.

It seems that this common and widely spread shell has been first described by WALCH as cited above, when he writes »Von der versteinten valuata sulcata des RUMPHS.» »Das Original des gegenwärtigen kommt... mit der unter Num. 5 daselbst (in RUMPH'S work) befindlichen valuata sulcata sehr genau überein. Das Petrefact ist aus dem Mecklenburgischen, weiss von Farbe und hart versteint». The accompanying figure may well be accepted as representing *Or. globosum*. Through the liberality of Professors BEYRICH and DAMES of Berlin I have had for inspection the very original specimen of SCHLOTHEIM'S *Trochil. globosus*, which is kept along with his other collections in the Museum of the University of Berlin. On the original label is written »aus Gothland in Überg (angs) Kalkstein». It is badly preserved, to a great part imbedded in the rock, a ball of limestone from the shale beds, possibly of Wisby or Stora Carlsö. It belongs to a variety with only few keels on the umbilical side and the transverse striæ much distantiated. It is indeed quite the same which later by SOWERBY was named *E. funatus*, which name, although long used, must give way for the older of SCHLOTHEIM.

I cannot decide whether *Euomph. funatus* EICHWALD *Leth. rossica* I, 2 p. 1152 belongs to this species or not.

### 5. *Oriostoma globosum*, var. *sculptum* SOWERBY.

Pl. XVII fig. 41—42.

*Nerititæ majores, striati et juxta longitudinem spirarum quasi sulcati*, BROMELL 1738 Lithogr. Suec. p. 36.

- |                            |       |   |
|----------------------------|-------|---|
| <i>Delphinula funata</i>   | 1829. | HIS. Tabl. ed. 1, 10.   |
|                            | 1831. | Id. Ibid. ed. 2, 8.   |
|                            | 1831. | Id. Anteckn. V, 114.  |
| <i>Euomphalus funatus</i>  | 1837. | Id. <i>Lethæa</i> , 37, but not the figures pl. XI fig. 11, which are copied from SOWERBY'S <i>E. funatus</i> <i>Min. Conch.</i> pl. 450. |
|                            | 1840. | Id. <i>Förteckn.</i> , 55.  |
| <i>Euomphalus sculptus</i> | 1839. | Sow. in <i>Sil. Syst.</i> , 626, pl. 12 fig. 17.  |
|                            | 1843. | MORRIS <i>Catal. Brit. Foss.</i> 145.   |
|                            | 1848. | BRONN <i>Nomencl.</i> 481.  |
|                            | 1854. | MORRIS <i>Catal. Brit. Foss.</i> , 248.   |



- Euomphalus sculptus* 1855. MAC COY Palæoz. Foss. 299.  
 1862. Id. Sil. Foss. Ireland, 14.  
 1867. SALTER Siluria 4th Ed. 532, pl. 9 f. 27, pl. 25. f. 2.  
 1873. Id. Catal. Cambr., 90, 157.  
*Turbo momus* 1850. D'ORB. Prodr., 50.  
*Euomphalus lautus* M. COY, Sil. Foss. Ireland, 14, pl. 1 fig. 12 belongs possibly also to this species.

Shell with short or only slightly prominent spire of five ventricose whorls. The surface is covered by numerous, closely set, revolving lines, alternately large and narrow, the larger attaining twice the size of the lesser. They are generally so densely packed that there is no space left between them. The transverse lines of growth form on them crescent shaped notches, one for each line. The aperture is circular, the lips are thin and the umbilicus is narrow and open. H. 34 mill., br. 44 mill.

There are so many transitional forms, connecting this species with the former that it is indeed a necessity to merge them into one and same species. In Siluria, 3d Ed. p. 236 SALTER says that *Eu. sculptus* »appears to be only a variety of *Eu. funatus*». R. ETHERIDGE jr (Ann. Mag. N. H. 5th Ser. vol, 7 p. 31) also inclines to regard both forms as identical, though his opinion that »*sculptus*» may only be the young condition of *Eu. funatus* cannot be upheld, as we have specimens of *sculptus* quite as large as »*funatus*». Moreover the opercula are not different. I have such from Djupvik in Eksta and they only slightly differ from that figured on Pl. XVII f. 25. The dimensions are in one specimen: height 3 mill., diam. 9 mill.

The chief distinguishing feature of this *Or. sculptum* from *Or. globosum* is the great number of its revolving keels, which in some specimens amount to as many as fifty. Through their proximity or their distance many gradations in sculpture arise. The same is the consequence of the different fineness or coarseness of the transverse striæ. In some these striæ are prominent and distantiated, in others fine, perhaps corroded, the first coinciding with the presence of distantiated revolving keels, the later with the narrow and numerous keels. But however dissimilar in sculpture, they all have the same operculum and around the narrow umbilicus there are two elevated keels as in *Or. globosum*. The more globose shells have a greater number of keels, closely crowded and there is consequently a continuation of frills on the surface.

In specimens from the same locality the amount of variation, especially in the sculpture of the revolving keels, is very great, nay, even in the same specimen sculptured keels alternate with almost smooth ones. But these, especially in the »*sculptum*» forms, show a very fine and microscopically minute, transverse ornamentation, which of course is through corrosion destroyed in exposed localities and thus causing a smooth surface. Of the »*sculptum*» group there may be thus discerned at least two minor subdivisions.

1. The shell has no less than fifty longitudinal keels, but in common with the other varieties a belt near the suture without any revolving keels and in the wide and deep umbilicus, environed by keels. This has been found in the canal near Westöös in Hall, at Fårösund, and in some specimens at Samsugn, Othem. A nearly similar variety occurs in the shale of Djupvik in Eksta and Wisby, with some 25 longitudinal

ridges and more finished sculpture than in the former. Also found at Lansa and Lutterhorn in Fårö, Sändvik at Fårösund, Klinteberg and the shales of Stora Carlsö.

2. There is an intermediate variety between this sculptum and *Or. globosum* from Martebo, and from the marly limestone beds above the shales of Eksta and also Lilla Carlsö. It has the ridges distant on the apical surface, crowded on the umbilical, thus combining both the *funatus* and *sculptus* characters in the same specimen. This has also been found in Martebo, Samsugn, Slite, Medebys in Hall, Sproge and Hoburg.

Although HISINGER copied SOWERBY'S figures of *E. funatus*, as seen by comparing their figures<sup>1)</sup>, he, in his own collection, partly gave that name to the shell which SOWERBY later denominated as *Eu. sculptus*. The English authors refer to »*sculptus*» specimens with numerous crowded keels, but in that number possibly several different species may have been confounded. M'COY Brit. Pal. Foss. p. 299, says »that the absence of the transverse scale like sculpturing and the . . . more numerous ridges, easily separate this from the *E. funatus*». It is indeed most bewildering to discern in all this mass of similar and yet, as their opercula prove, specifically different forms and mistakes can scarcely not have been avoided in my arrangements of them.

#### 6. *Oriostoma coronatum* n.

Pl. XVII fig. 11—16, 18—22.

Shell large, globular, turbinate, spire short, whorls five, ventricose, angular through the many projecting keels with perpendicular walls between them. On the body whorl there may be seen as many as seven or even nine keels on the exterior side from the suture to the highest point of the umbilical side and on that side at least five. Smaller keels intervene between them. The large keels are crenated by blunt spines, formed by regularly distantiated, oblique folds, causing the often occurring cone in cone structure. Where these folds are perfect, their edges are considerably thin, a little forward bent or generally having the shape of small crescents. The interstices, which are nearly five times as large as the keels, are almost smooth, transversally striated by microscopically minute lines, directed obliquely, or nearly perpendicular, backwards from the suture to the umbilicus. The aperture is circular, the outer lip thin, the inner lip thickened, almost reflexed. Around the umbilicus there is a deep and broad groove (fig. 14) bounded by two high and prominent keels, of which the interior one is short and forms the nearest enclosure of the narrow, spirally wound umbilicus. H. 40 mm. br. 53 mm.

The operculum is very frequent and has in some instances been found *in situ*. It is button shaped, perfectly circular, more or less elevated. The dimensions are in four specimens from Östergarn as follows:

1)	Diam.	20 mm.	Height	8 mm.
2)	»	20 »	»	10 »
3)	»	15 »	»	6 »
4)	»	21 »	»	6 »

<sup>1)</sup> SOWERBY Miner. Conchol. pl. 450 fig. 1 (the uppermost one) and fig. 2 (but reversed and restored in Lethæa l. c.),

The inside is bordered by an annular callosity (fig. 18) and the enclosed area is glossy, sculptured by numerous, microscopic striæ, concentric in a zone nearest the border, in the centre spirally curved, where also the surface is somewhat excavated. On the outside the numerous coils are rather flat and broad, as shown in fig. 16, on their inferior face ornamented with some fine, concentric striæ below a larger one. Their appearance in a transverse section is given in fig. 22, to be compared with that of *Oriost. globosum* in fig. 25. The lobes of the sectioned coils are broad and short, with low divisions between them and their tops only finely jagged by the parallel lines.

This shell, as well as its operculum, has been found most numerous in the lower limestone beds of Östergarn, also in Ardre, Gothem, in the Rhizophyllum beds near the church of Lau, and in the limestone beds of Lindeklint.

It is distinguished from its congeners through its more richly sculptured keels, nearly smooth interstices, only finely sculptured and by the peculiar operculum.

From the subjacent shale beds, such as they are in the canal of Wisne myr in Fardhem, I have obtained specimens of a shell nearly resembling *O. coronatum*. In some, however, the sculpturing is intermediate between this and *O. funatum*.

From Martebo numerous specimens of an operculum have been obtained, which, however deviating, still, through certain common details of shape, prove to be related to the operculum of *Or. coronatum*. Pl. XVII figs. 32--35. The shell to which it has belonged is for the present not known, though the operculum is far from being rare. In its form it resembles as nearly as possible the modern artillery projectiles, being elongately conical in outline, fig. 32. They commonly have the same height as the diameter or sometimes higher. Some are constricted transversally along the median line. The dimensions of three specimens are:

1)	Diam.	13 mill.	Height	16 mill.
2)	»	13 »	»	11 »
3)	»	11 »	»	10 »

The coils on the outside are directed obliquely outwards or nearly parallel with the diametral axis of the operculum and are considerably shorter and broader than those of *Or. globosum*.

The narrow, ornamental lines which are crowded on these coils, fig. 34, are most numerous and prominent on the inferior side, short and scarce on the upper half of the coils. On the inner side the annular edge is prominent, the centre deeply excavated and the spiral distinct. A similar operculum has also been found in the upper limestone beds of Slite.

Mr ROB. ETHERIDGE jr has described and figured<sup>1)</sup> several opercula of which some are identical with the Gotlandic. Figures 9 and 9<sup>a</sup> really represent one of the conical opercula from Martebo which I once sent to the British Museum. In fig. 12 an operculum is seen, nearly corresponding with that from Westergarn, figured in my plate XVII fig. 24. Fig. 14 probably represents one of the »sculptum» varieties, as ETHERIDGE also believes, though with some hesitation. But it is only the impression of the inner

<sup>1)</sup> Ann. Mag. N. H., 5th Ser. vol. 7, p. 25 pl. II.

side of the operculum on the limestone or shale, which forms the nucleus of the shell. That it is only a cast and not the operculum itself, may be found by comparing the inside, drawn in fig. 9 of ETHERIDGE'S plate, with fig. 14. Quite similar impressions have been found in several specimens in Gotland. The Oriostomata figured by the ETHERIDGE in figs. 10—11, much resemble *O. sculptum*, but the opercula seem to deviate in shape as well as in sculpture from that, which with absolute certainty is known as belonging to that species. The operculum, fig. 13, is possibly identical with one from Hogrän. Mr FRED. SMITHE has also given a notice with figures »On the opercula of the Silurian Gastropoda» in the Proceedings of the Cotteswold Naturalists Field Club for 1877—78 p. 62. The specimens figured are evidently badly preserved and belong to some unknown species, the shell of which resembles *Or. sculptum*, but the sections given of the operculum show (figs. 3—4) that it cannot belong to that species.

BAILY<sup>1)</sup> has given a figure of the operculum of »*Euomphalus funatus* SOWERBY» but it seems to be different from that described above, and rather more loosely coiled, resembling that in fig. 44 pl. XVII of the present memoir.

Lately WHITEAVES<sup>2)</sup> has described two opercula, of which, at least one, pl. III f. 11 & pl. VII f. 7, comes near to that of *Or. coronatum*. The second operculum, pl. III f. 10, again, is nearly related to those of *Cyclomena* described below.

## 7. *Oriostoma acutum* n.

Pl. XVII fig. 37—40.

Shell globose, turbinate, with spire of six ventricose whorls, angular through the projecting, narrow, revolving keels. On the apical surface there are three keels, separated by large interspaces, on the umbilical side they are much crowded, amounting to ten before the first umbilical ridge is attained. Between this and the interior umbilical ridge some five or six smaller ridges lie in a gently excavated, large groove. The innermost ridge closely environs the deep and narrow umbilicus. All these revolving keels are almost smooth, with sharp or rounded edge, only finely notched by minute, transverse striæ. These are in the interstices directed backwards and so fine that only a few, regularly distantiated ones are perceptible without a lens. Between them the surface looks nearly smooth, but is in reality finely striated. The aperture is circular and both lips are thin. H. 37 mill., br. 45 mill.

But for the find of the operculum of this shell *in situ*, it might easily enough have been mistaken for a variety of *O. globosum*, from which it, however, differs through the minute, transverse striæ, the regular angularity of its apical side and the regularity of the umbilical funnel. The operculum is acuminate conical, nearly of the same height as breadth. The inner side is almost flat, the bordering edge is narrow and low, the central whorl is nearly on a level with the other surface and through corrosion any sculpture, if formerly extant, has been destroyed. The coils on the outside are exceedingly narrow and close. They are formed like the sharp, thin, knife like

<sup>1)</sup> Figures of Charact. Brit. Fossils pt. III pl. 21 fig. 9 b.

<sup>2)</sup> Geol. Survey of Canada. Palæoz. Fossils, vol. III pt I, p. 33.

whorls of a screw, giving the outline of the operculum a serrated appearance as shown in the sections 39 & 40. They are directed rectangularly to the longitudinal axis of the operculum or only slightly curved upwards. They are quite smooth without any smaller, ornamental lines. The dimensions of the operculum are in two specimens:

A. Height 11 mill. Br. 12.

B. » 10 » » 14.

In Martebo almost the same type of operculum has been found detached without any shell pertaining to it. Pl. XVII fig. 36. It deviates, however, in having the coils more distantiated.

*Or. acutum* has been found in many fine specimens in a seam of marly limestone at Slite, along with several opercula, of which one *in situ*. It has also been found in a few specimens at Lännaberget of Slite.

With an operculum so deviating from that of the other *Oriostomata*, it may indeed be questioned whether this species does not belong to another generic or subgeneric division, what must be left for future researches to decide.

### 8. *Oriostoma Wisbyense* n.

Pl. XVII f. 26—28, 45—46.

Shell globular, turbinate, small, of six ventricose whorls. There are only few longitudinal keels, two larger on the apical surface, the lowest leaving a smooth belt between itself and the suture. They are sharp, narrow and prominent, a little jagged by irregular notches. Next them follow at equal distance two smaller keels around the median line of the body whorl and then on the umbilical side a large belt intervenes, with only faint indications of a few longitudinal lines. Around the umbilicus two large keels leave between them a nearly smooth zone, only finely transversally striated. The transverse striæ are gently inclined backwards, somewhat thick, swollen, in other parts fine. All specimens, found in two localities, agree in all particulars and are thus constant in their characters. The umbilicus is wide and deep, showing all whorls. H. 18 mm., br. 18 mm. Spec. B. H. 14 mm., br. 17 mm.

The operculum, which has been found *in situ* in one specimen and in several detached specimens, is in the largest specimen of a combined cylindrico-conical shape, being from the base and a while upwards cylindrical, then at the top changing into a conical shape. The inner side is bordered by a rather broad and elevated edge, the enclosed surface smooth, deeply sunk towards the centre, where the whorl is situated. The numerous coils of the outside are more distantiated than in the preceding, with their edges directed upwards. All striæ decorating them have now disappeared, if once present, and in a section the whorls consequently only show as distantiated, blunt teeth. H. 5 mill., br. 12 mill. One specimen, pl. XVII f. 47, possibly belonging to a different species is elevated and regular, acuminately conical, h. 6 mill., br. 7 mill. From the shale of Wisby numerous opercula have been found, closely resembling those now described, pl. XVII f. 43—44, and almost entirely changed into iron pyrites. Their coils are however more thick and less numerous. When seen in a section they are nearly

horizontal, triangular. The contour of the whole operculum is also more cylindrical. The inside is a little more deepened than in the others. The shell to which it has belonged is not yet known. H. 8 mill., br. 8. mill.

Oriost. Wisbyense has been found in the middle limestone stratum of Wisby and at Kälens Qvarn.

### 9. *Oriostoma angulifer* n.

Pl. XX fig. 17—21.

Shell turbinate, globular with moderately elongated spire, of six angular whorls, the lower surface of which forms the spire into an evenly sloping cone, intersected by the narrow and deep suture. There are from three to four fine and acute keels on the body whorl, one near the sutural groove, one a little below the median line of the whorl and one around the umbilicus. Between the two later there are on smaller specimens one more and indications of yet smaller ones. The transverse striation of the surface is microscopically minute and consists of nearly vertical, straight striae. The aperture is polygonal, higher than broad with thin lips. The umbilicus is wide and open. H. 6 mill., br. 8 mill.

Six specimens have been found in a soft, gray limestone from a canal near Herrevik in Östergarn. This little shell comes near to Or. Wisbyense through its few keels and the deep umbilicus and also reminds of *Oriostoma angulatum* with its angular contour, fine ornamentation and deep suture.

### 10. *Oriostoma Roemeri* n.

Pl. XVIII f. 22—29.

- Euomphalus cornu arietis* 1838. ANGELIN Museum Palæont. Svecic. № 10.  
*Euomphalus funatus* 1867. LINDSTRÖM Nomina, 23.  
 1876. FERD. ROEMER Leth. Geogn. Atlas pl. 14 f. 12.

Shell turbinate, globular, with six ventricose whorls. The longitudinal ornamentation predominates entirely and the surface is consequently covered by chord like keels, going close from the suture to the umbilicus, as many as 43 in some specimens. They are all nearly of the same size, only a few narrow are mingled with them. They continue without interruption close to the suture, without there leaving any zone free. The transverse striation is visible as scaly, crescent like indentations on the revolving lines, which sometimes are as if cut up in a great number of thin laminæ. These transverse imbrications vary much as to proximity and shape, being, when close together, only as lamellar crescents, when more wide apart, as longitudinal tubes, cone in cone shaped. There are no ridges around the umbilicus, more elevated than the other ridges. The umbilicus is narrow and partially hidden by the reflexed border of the inner lip. The aperture is circular and both lips are thin. The shell is very thin and it is almost impossible to find a specimen which is not crushed or distorted. On the nucleus fine traces of the interior nacreous coating are seen. H. 30 mill., br. 36

mill. This is the common proportion, but in a few instances the shell is so much elongated, as to be higher, than broad, fig. 25, h. 40 mill., br. 34 mill.

Of the operculum of this species the State Museum in Stockholm possesses three specimens *in situ*, of which two are too fragmentary for description. In one shell there is the impression of the interior side on the nucleus. A cast in plaster of Paris shows that this side nearly resembles that figured on plate XVII fig. 35, the central whorl being larger, the marginal rim flattened and the central concavity not so deep. It is probable that the outer side, which is not preserved in any specimen, also resembles that of *Or. globosum*.

This species is very common and is indeed the most characteristic one in the shale beds around Wisby and also in the overlying limestone. A few specimens have also been found in the shale beds of Gnisvård and Westergårn, proving the contemporaneity of these strata with those of Wisby. There are also single specimens from the upper and lower strata of Hallshuk.

*Or. Roemeri*, which easily might be confounded with some of the varieties of *Or. sculptum*, differs from them through the continuity of the longitudinal ridges close to the suture, while they are somewhat more distantiated in the later and there is a space left free without any revolving lines between the lowest keel and the suture. The umbilicus is narrow in *Or. Roemeri*, wide and open in *O. sculptum* and environed by two higher ridges, while in *Or. Roemeri* all ridges are of the same size.

Besides the opercula, which with absolute certainty can be referred to the preceding four species or are most nearly related to them, there are some others which belong to unknown species of other genera, also unknown, but probably of the same family. They may be described here in connection with the former.

1. Pl. XVII fig. 53—55. Four specimens of this variety have been found in the middle limestone beds of Wisby. They are regularly circular, depressed, nearly flat, thin, attaining their largest thickness around the borders and at thinnest in the centre. Section fig. 54. The coils on the outside are rather irregular or, as it were, occasionally evanescent, thick and coarse around the margins, narrower and more indistinct near the centre. The marginal coils are obscurely ornamented by finer, concentric lines. On the inside, which is shallow and concave there is no elevated annular rim as in the preceding type, the whole surface is sloping without interruption, smooth and glossy, to the centre, where a broad, faintly distinguished whorl is seen. Diam. 13 millim., thickness of margin 2 millim.

2. Pl. XVII fig. 56. A single specimen with the inside affixed to the rock has been obtained from Samsugn in Othem. It is of obovate outline, flat, the numerous coils are coarse and angular. A section, fig. 56, reveals that they are narrow lamellæ, inwards bent, at largest near the margin and diminishing towards the centre. It is thickest along the margin. Longest diameter 18 millim., the shortest one 15 mill., thickness at the margin 2 millim.

3. Two specimens from the upper limestone of Hogrån. The outline is obovate, the outer side, the only one accessible, is entirely flat, without any prominence

near the centre. It is extremely thin, more so than in the preceding two forms. The coils are narrow, numerous and regular. Their sides are ornamented by numerous, thin and narrow lines, nearly parallel with the coils, but sectioning them in slight obliquity. Longest diameter 12 millim., shortest diam. 10 mill. Thickness of margin scarcely 1 millim.

If these three forms of opercula belong to a common generic type, as I think, the following one differs so essentially from them, that it must be regarded as belonging to an other genus, which for the present is quite as unknown as the former.

4. Pl. XVII fig. 57. From the shale beds near Wisby four specimens of the largest operculum known in Gotland, have been obtained. But only the outside is visible, the extremely thin shell firmly adhering with the inside to the soft shale. It is circular, flat, covered by thick laminar, elevated, spirally wound coils, in all twelve. They have broad bases and obtuse tops. They leave between them deep interspaces, nearly as large as themselves and they lean with their tops towards the centre. The largest diameter is 32 mill. and it must consequently have appertained to a very large shell, possibly to *Cyclonema? giganteum*, of which a few specimens are found in the same beds.

The opercula of the *Oriostoma* pattern have sometimes been compared with those extant in several recent genera as *Torinia* and *Omalaxis*. The operculum of *Torinia* is, however, constructed upon a quite different plan, its inside is wholly dissimilar, protruding in the centre in a rod like prolongation, while the operculum of the palæozoic shells is sunken in the centre. Moreover, both *Torinia* and *Omalaxis* have entirely chitinous opercula, whilst the palæozoic ones evidently from the beginning were shelly. I have not found any other opercula resembling the palæozoic ones more than that figured by D'ORBIGNY in his »Paléontologie Française, Terrains Crétacés», pl. 186 bis, f. 13—17 and which, according to him, l. c. p. 228, has belonged to unknown species of *Turbo*. It comes nearer to those of *Cyclonema*, than those of *Oriostoma*. D'ORBIGNY remarks that the coils are »très rapprochés, comme chez les *Trochus* pro-prements dits». And, in fact, the opercula of *Cyclonema*, of which see below, in a high degree resemble the operculum of the Trochoid *Livonia* as to the outside, especially in the ornamentation by fine, oblique lines.

### 11. *Oriostoma helicinum* n.

Pl. III fig. 27—31, Pl. XX fig. 30—33.

Shell globular, heliciform, with short spire ending in a blunt point, whorls four and a half, convex; suture shallow. Ornamentation consisting only of a succession of fine, transverse lines bending backwards on the median line of the last whorl and then again forwards on the umbilical side, very close and with smooth interstices. They are arranged as it were in small groups divided through shallow furrows which give the shell a wavy contour. There are absolutely no traces of any longitudinal lines even in the best preserved specimens and the surface of the whorls is glossy and shining



with a brownish tint. In other specimens again there are very distinct bands of the original colour left, transverse, at regular distances, brown on the white surface of the shell, parallel with the sculptural lines. The aperture is circular and its rim not continuous, interrupted at the interior lower corner. Outer lip thin, the interior one with a somewhat callous border, umbilicus narrow and deep, entirely open and defined along its periphery by a low and narrow ridge, which inwards sinks perpendicularly and meets the sloping funnel of the umbilicus.

Dimensions: height 15 millim., breadth 18 millim. Aperture: high 11 millim., broad 10 millim.

From Samsugn in Othem, the canal near Westöös, Halls huk, in the uppermost stratum and from Wialmsudd.

## 12. *Oriostoma alatum* n.

Pl. XVI fig. 14—19.

Shell disciform, whorls rather transversally dilatated, increasing rapidly in width from the minute apex of three whorls. Whorls in all six. A narrow, laminar, sharp edged keel divides the umbilical and the apical surfaces and thus gives the shell a slight resemblance to *Pleurotomaria alata* and the allied species. But in this species the laminar keel is solid and the transverse striæ continue in the same direction on both sides of it. Parallel with the keel there run some five narrow, thread fine lines, equally distantiated on the apical side and, likewise on the umbilical side, five, though more indistinct. The transverse striæ are distinct, rather coarse and regularly directed backwards. The aperture is transverse, obovate, the outer lip on the middle of its height thickened by the keel, else thin, the interior lip thin, only expanded and thicker, where it joins the whorl. The umbilicus is wide and so open that all whorls are seen inside it. Specim. A, h. 14 mill., br. 23 mill.; B, height 10 mill., br. 24 mill.; sp. C, h. 14 mill., br. 44 mill. One specimen has been obtained from the middle limestone strata near Wisby and three from the higher strata of Kyrkberget in Wisby.

## 13. *Oriostoma angulatum* WAHLENBERG.

Pl. XX fig. 34—41.

<i>Helicites supra-angulatus</i>	1818.	WAHLENBERG Petref. Tell. Sv., 72 <sup>1)</sup> .
<i>Helicites angulatus</i>	1818.	Id. ibid., 73.
	1828.	HIS. Anteckn. IV, 237.
<i>Euomphalus angulatus</i>	1829.	Id. Tableau ed. 1, 10.
	1831.	Id. ib. ed. 2, 9.
	1831.	Id. Anteckn. V, 114.
	1848.	BRONN Nomencl., 478.
<i>Inachus angulatus</i>	1837.	HISINGER Leth., 37, tab. XI f. 12.
	1840.	Id. Förteckn., 55.
	1867.	LINDSTR. Nomina, 23.
<i>Euomph.? supra-angulatus</i>	1837.	HIS. Leth., 37.
	1848.	BRONN Nomencl., 482.
<i>Straparollus angulatus</i>	1850.	D'ORB. Prodr., 30.

<sup>1)</sup> Errore *Helic. supraangulatus* pro *Hel. supraangulatus* apud BRONN Nomenclator p. 572, 1848.

Shell discoidal, planorbiform, spire of eight whorls, depressed or only slightly prominent. Whorls cylindrical, terete with several sharp keels, which are more prominent and distinct in young specimens than in older, where they are more or less obliterated. On the apical side there are two sharp and prominent, narrow keels, leaving a flat band between them, one close to the suture, the other and larger on the outside. Between the interior keel and the next whorl a deep, narrow groove is going and the innermost apical whorls are in many instances sunk as a shallow depression. The middle of the body whorl and also of the others is encircled by a highly acute keel and on the umbilical side there are at least three such, forming between them sharply marked facets, of which the lowest is abruptly turned down. On the umbilical side there are thus at least four different faces. The apical keels disappear during the continued growth of the shell and instead of the seven original keels there are on the body whorl finally only four or five on the umbilical side. The contour of the whorls is, when all keels are present, a regular octagon, fig. 37, as the surface between the keels is nearly straight or only slightly concave. The fine, transverse striae run almost straight down over the keels, only a little bent forwards on the keels. In fullgrown or large specimens the aperture is circular and the umbilicus is wide and open, more so than in most of the other shells. There is some variability, for instance in several specimens from Follingbo, where the whorls on the apical side are so much sunk, that there is a spire on the umbilical side. In some there are no keels at all on the larger whorls, not even near the umbilicus, and the whorls are uniformly tubular. There is also a tendency in the body whorl to disjoint itself from the other whorls, as remarkable in specimens from Fårösund. Br. 66 mill., h. 18 mill.

The figure given by HISINGER of his *Inachus angulatus* is bad and exaggerated. There are four specimens with HISINGER'S hand named thus in his own collection, of quite the same variety as mine. But the type specimen of his figure is not amongst them, it is probably from the Museum of Upsala. That WAHLENBERG'S *Helicites supraangulatus* is identical with this species, is corroborated through his type specimen, which I have been able to see through the kindness of Prof. CLEVE and it quite agrees with the large specimens from the limestone of Wialmsudd.

SALTER<sup>1)</sup> says that »*Inachus angulatus* HISINGER, is probably an extreme form of the group (of *Trochonema*) with a greatly depressed spire». This statement can hardly be accepted and the fossil in question is here retained within *Oriostoma*. It may through future researches be decided whether it should not rather be placed with the *Euomphali*, from which it, however, differs in the want of any notch in the last whorls and the concomitant ridges. The transverse striae are, moreover, bent *forwards* on the keels, not backwards.

This is a very abundant and well preserved shell in some localities: Lansa and Lutterhorn of Fårö, Wialmsudd and Sändviken at Fårösund, Länna near Slite, Samsugn in Othem, Qvarnbacken of Slite, Kylley, Enholmen, Barabacke, Follingbo, Kälens Qvarn, Wisby in the uppermost limestone, Klinteberg, Stora Carlsö near Altaret. It thus occurs exclusively in the uppermost, crystalline limestone.

<sup>1)</sup> Geol. Survey of Canada, Canad. Org. Remains, Decade I, 27.

14. *Oriostoma lineatum* n.

Pl. XX fig. 42—44.

Shell discoid or nearly so, with short spire of five ventricose whorls. The suture is deep and the surface is uniformly lineated by thread fine, elevated, narrow, longitudinal ridges continuing without interruption from near the suture to the upper margin of the umbilicus. They are a little larger and more distantiated on the rounded, middle line of the shell. The interstices between them are nearly smooth and the transverse lines which cross them are straight and minute, only in the umbilical opening they are more prominent. The aperture is circular with thin lips and the inner one closely moulded to the preceding whorls, the umbilicus is wider than in any of the other species, with all whorls visible. H. 16 mill., br. 44 mill.

In the Palæontological State Museum of Stockholm twelve specimens are preserved, all from the limestone of Klinteberg, and four from the uppermost limestone of Fröjel. From the limestone beds nearest above the oolite in Wamlingbo I have obtained a fragmentary *Oriostoma*, which somewhat resembles the preceding. The transverse striæ are wavy and coarse, and there seems to be a deep groove along the suture on the apical side. It forms probably a new species.

15. *Oriostoma nitidissimum* n.

Pl. XXI fig. 4—10.

Shell small, disciform, apex on a level with the outer whorls; five whorls in all, evenly rounded without any keels or longitudinal striation at all. They are transversally and most finely striated by straight lines, running to the open umbilicus. The suture is shallow. The aperture circular and the lips thin. H. 3 mill., br. 8 mill.

It is very common in the red limestone of the hills of Sandarfve and Linde and a few specimens also from the gray limestone. A shell occurring in the limestone of Stor Wede in Follingbo is probably only a variety of this. It is more ventricose in the body whorl, the umbilicus is more narrow, and the perpendicular striation is not so dense as in the other form.

16. *Oriostoma dispar* n.

Pl. XXI fig. 11—14.

Shell planorbiform, low on the apical side as well as on the umbilical one and excavated on both sides. Whorls five and a half, rounded on the apical side, flattened on the umbilical one and there provided with a prominent keel in the margin. The transverse striæ are distantiated on the umbilical side, finer on the apical side, and directed at first backwards near the suture, then straight down, past the keel and on the umbilical side forwards. The aperture is nearly circular, a little angular through the outgoing keels. H. 2 mill., br. 7 mill. A single specimen has been found in the limestone of Follingbo.

Gen. **CYCLONEMA** HALL.

*Cyclonema* 1852. HALL Pal. N. York vol. II, 89.

*Shell turbinate, whorls ventricose, finely striated or carinated by longitudinal ridges, which are more developed than the transverse ones, which often are wanting. The shell has been nacreous, as can be seen by the traces left by the interior stratum on the nucleus. The operculum is broadly conical, with some ten large coils outside, impressed by a shallow groove along their superior border and streaked by oblique, transversal lines.*

This genus comprises Litorina like shells, which differ from Oriostoma chiefly through their operculum and through the regularly predominating, longitudinal ornamentation. In consequence of their characteristic operculum, which so much resembles that of the Turbinidæ, they cannot any longer be regarded as Litorinæ as STOLICZKA has proposed.

In the strata of Gotland twelve species have been found and in the Lower Silurian of Dalecarlia and of Öland there have been detected some well preserved specimens of this genus.

1. **Cyclonema delicatulum** n.

Pl. XV figs. 27—44.

This shell, being one of the most common and characteristic of the Silurian formation of Gotland, is, as may be seen by the many figures and by the dimensions below, one of the most variable, with forms ranging between elongate Murchisonia like shells to depressed globular ones like Natica. But the many transitional forms and above all the characteristic ornamentation unite them. They are, moreover, found in the same stratum and often on the same locality. The most common variety is figured on plate XV fig. 28. It has four or five whorls, ventricose, with deep suture. The body whorl is almost as long as all the others taken together. The ornamentation of the surface is a most delicate net work of fine, sharply elevated spiral lines and equal sized transverse lines, which intercross them and at the meeting point form a small blunt tubercle. The surface of each quadrangle, enclosed by these lines, is with the aid of a magnifying lens seen to be minutely and transversally lineated. The figures 42—44 on pl. XV, show how the form of these quadrangles varies in different species according to the distance and position of the crossing lines, being elongate or equal sided or transverse. Besides the now mentioned, prevalent type of the shell, there are more elongated ones, of 6 or 7 whorls, the body whorl being equal to a third of the whole length. The most extreme of the elongated ones is figured. In figures 40—41 the outlines of its antipodes are given, almost globular with enormously large body whorl and short spire. The specimen figured on pl. XV fig. 45 is probably only a corroded specimen of this form from the shale of Wisby.

The aperture is rounded, the exterior lip sharp and thin, entire, the inner one thin, reflexed. There is no umbilicus. The common variety has in length 12 mill.,

br. 10 mill. One of the extreme varieties is in length 14 mill., br. nearly 14 mill., height of aperture 10 mill. Another, the opposite extremity is 26 mill. in height and it has probably, when the apex was entire, attained 30 mill. in height, br. of body whorl 14 mill. height of aperture 11 mill.

This is one of the most abundant Silurian Gastropoda from the neighbourhood of Wisby in the middle limestone (b) and also, though not so common, from the shale. From the sandstone of Bursvik a small specimen has been obtained, which highly resembles the Wisby specimens as to their ornamentation, but it is not certain that it belongs here.

*Cycl. delicatum* may, possibly be the shell designated by ANGELIN in his Museum Palæontol. Suecicum as *M* 49 *Littorina?* *striata*, but I have not succeeded to find a complete series of that collection, containing this species with the others.

## 2. *Cyclonema? apicatum* n.

Pl. XVIII fig. 36.

Shell elongate, conical, whorls five, the body whorl more than double the size of the others. They are moderately convex and the suture only slightly impressed. On the body whorl there is a blunt angle, where the umbilical surface begins. It is there the semblance as of a slit band, like that in the *Pleurotomariæ* of the division *Multicarinati*, but not sufficiently clear enough to decide if the shell really is a *Pleurotomaria*. The surface is finely cancellated and the transverse striæ are below the angle bent backwards. The band like sculpture is visible only on the body whorl. The aperture is elongate, ovate, the lips are thin and sharp, and there is no trace at all of any umbilicus.

The peculiar elongate, succinoid shape sufficiently distinguishes this shell from similar. H. 7 mill., br. 5 mill.

This shell has been found in two specimens in the red limestone of Sandarfve hill.

## 3. *Cyclonema cancellatum* n.

Pl. XVIII fig. 25—27.

Shell moderately large, turbinate, with seven ventricose whorls, of which the body whorl is nearly twice as large as the spire. The surface is evenly rounded without any prominent keels and it is regularly cross bared by thread fine, longitudinal lines and not quite so prominent, transversal ones, covering the whole surface with minute quadrangles. Some of the longitudinal lines are at irregular distances rather more prominent. The transverse lines have uniformly the same size and take in several specimens a gentle curve backwards, run else straight and near the umbilicus directed forwards. The aperture is obovate, the lips thin, the outer one in some specimens with a shallow, gently curved notch which also is clearly indicated by the above mentioned course of the transverse striæ. There is no umbilicus. H. 36 mill., br. 42 mill.

Several specimens found in the limestone of the hills at Sandarfve and Linde.

Besides its size and shape this species is distinguished from the nearly allied *C. delicatulum* through its ornamentation, which is different as to its direction and size.

#### 4. *Cyclonema distans* n.

Pl. XVIII fig. 37.

Shell small, turriculate, of five whorls, of which the body whorl is nearly as high as the spire. There are eighteen sharp, distinct, distantiated keels and the transverse lines which intersect them are also distantiated but narrow. They are directed slightly backwards, but converge on the umbilical side. H. 8 mill., br. 6 mill.

Only a single specimen has been found in the limestone of the hill of Sandarfve.

#### 5. *Cyclonema striatum* His.

Pl. XVII fig. 48, pl. XVIII fig. 39—42.

- Turbo striatus* 1837. HISINGER Anteckn. VI, 109, pl. VIII f. 2.  
 1837. ID. Lethæa, 38, tab. XII fig. 5.  
 1840. ID. Förteckn., 55.  
 1867. LINDSTR. Nomina, 23.  
*Turbo Leda* 1850. D'ORB. Prodr. I, 30.  
*Turbo striatus* 1877. KRAUSE Zeitschr. d. deutsch. Geol. Gesellsch., 23, can only with doubt be referred to this genus.

Shell turbinate, with six ventricose whorls, suture deep and immersed; there are only spiral, closely set lines, which vary in their distance from each other, but generally leave an interstice smaller than themselves. Around the umbilicus they are more distant and more prominent. The last whorl is free near the aperture, which is quite circular without any reflexed lips, which are sharp all around. The original specimen of HISINGER is figured here anew; it is fragmentary and the revolving lines are more distant than in other specimens. In his collection there are two specimens thus denominated, the smaller one is only a cast without shell from the shale of Högklint. The larger specimen, the figured one, is from Klinteberg and the Palæontological Museum also has specimens from that locality as well as from Östergarn, Samsugn in Othem and the shale beds of Wisby. H. 16 mm., br. 14 mm., diam. of the aperture 6 mm. *Turbo corallii* Sow., and *Trochonema pauper* HALL 20:th Rep. p. 343, pl. 15 f. 5, 6 (= *Cyclonema pauper* HALL 20:th Rep., Docum. Ed. p. 395 pl. 15 f. 5, 6) come near to this shell. The largest specimens somewhat resemble smaller specimens of *Or. globosum* or *sculptum*. The narrowness or total want of any umbilicus, the elevated spire of rounded whorls, the circular, nearly free aperture, however, distinguish them sufficiently.

From the limestone of Samsugn a specimen has been obtained with an operculum in reversed position in its aperture. It has no doubt belonged to the shell,

being of exactly the same size as the aperture. It is of quite the same shape as that delineated on plate XVII fig. 48. It is depressedly conical, of about twelve coils and perfectly circular outline. The coils are large, convex, with the superior border bent out in a thin, laminar edge, the suture between them is shallow. The transverse, oblique striae are distinct. The inside is deeply concave and in well preserved specimens almost all the coils are seen, the outermost forming the elevated bordering rim. Dimensions: diameter 6 millim., height 3 mill., thickness of margin 1 millim.

In the crystalline limestone near Westerby in Ardre there occur numerous nuclei, which through some fragments of the shell with its sculpture make it evident that they have been nearly allied with *Cycl. striatum*. There seems to have been some variability in the size and distance of the longitudinal, threadlike striae. The whorls are six, tubular. Along with these shells, the only ones found there, lie a great number of detached opercula of a type, quite corresponding to that of *Cycl. striatum*, though modified in details. Its size also tallies with that of the shell. It is figured on plate XXI fig. 66. It is of perfectly circular outline, moderately and obtusely conical. Coils on the outside about twelve, large and broad, proportionately more so than in *Cycl. striatum*. A little below the upper rim a shallow groove runs. The thin edges of the coils are cloven by a narrow slit running along them. The interspace between the adjoining coils is very shallow. The outer sides are ornamented by densely crowded, exceedingly fine and minute, oblique and transversal streaks, reminding of the somewhat larger ones on the outside of the operculum of many of the recent *Trochidæ* and *Turritellidæ*. On the inside the centre is environed by a thick, callous whorl which encircles the innermost concavity. Around the whorl the surface is smooth and there is no annular rim. This great dissimilarity of the interior surface indicates a different specific type, which, however, can, for the present, not be succinctly enough described as the shell is so imperfectly preserved. Dimensions of the shell: H. 23 mill., br. 18 mill. H. of operculum 5 mill., diameter 11 mill.

In connection with the forms of opercula, now described, two more may here be mentioned, because they evidently belong to the same generic type.

1. Pl. XVII, fig. 50—52. From the lower strata of Östergarn found in a few specimens. These resemble, as to their exterior, those from Ardre with their large, eight or nine coils which also have a shallow groove running along their superior border. The minute, transverse striae are not conspicuous and the top of the coils is more lacerated by longitudinal slits. The inner side is also more excavated, fig. 50, and the central whorl not so prominent. An annular rim is formed by the inside of the outermost coil. H. 3 mill., diam. 8, thickness of the margin 1 mill.

2. Pl. XVII, fig. 49. This is acuminate conical, higher than broad, the base is crushed, but it has probably had a circular outline. The coils are broad, band like, ascending like steps, about fifteen. There are indistinct, oblique, transverse lines, nearly parallel with the edges of the coils. A single specimen has been found in the uppermost limestone of Lännaberg in Slite. Diameter 10 mill., height 17 mill. It has to all appearance been still longer.

6. *Cyclonema zonatum* n.

Pl. XVIII fig. 43—44.

Shell small, turbinate, with obtusely elevated spire of six whorls. These are evenly rounded, the body whorl of the same size as the spire. The keels are longitudinal, rounded, with interstices of equal size. The keel which is situated a little below the median line of the body whorl is larger than the others and more distantiated from the nearest and there thus originates a zone or a belt around the whorl. Microscopically minute, transverse lines are crowded on the keels, deviating only slightly from a vertical direction. Near the suture the longitudinal lines also are larger and they leave a smooth zone between them and the suture. The aperture is obovate and the umbilicus is narrow. H. 15 mm., br. 14 mill.

Four specimens derived from the red limestone of the hill of Sandarfve. There is also from the same locality a very large specimen (h. 18 mm., br. 18 mm.) which perhaps belongs to this species. The longitudinal keels, however, are, below the middle of the whorl, not so distinct, nor is the zone so definite. A shorter variety with larger striæ has been obtained from the shale beds north of Skäret in Fröjel.

7. *Cyclonema adstrictum* n.

Pl. XV fig. 49.

Shell turbinate, of three whorls. The body whorl more than double the size of all the others. It is nearly of elliptical outline, suddenly constricted in a more narrow neck just above the suture; the next whorl is conically rounded without any constriction. The surface is smooth and only through the magnifying lens a fine longitudinal striation is revealed, as of engraved lines, crossed by irregular short, arched lines. The aperture is obovate with thin lips. There is no umbilicus. H. 15 mm., br. 16 mm.

Some specimens have been found in the red limestone of the hill of Sandarfve. This is possibly identical with *Naticopsis concinna* MAC COY Sil. Foss. Ireland p. 13, pl. I f. 10.

8. *Cyclonema carinatum* SOWERBY.

Pl. XVIII fig. 28—30.

- |                          |       |   |
|--------------------------|-------|---|
| <i>Turbo carinatus</i>   | 1837. | Sow. Sil. Syst., tab. 5 f. 28.              |
|                          | 1843. | MORRIS Catal. Brit. Foss. 165.              |
|                          | 1848. | BRONN Nomencl., 1358.                       |
| <i>Turbo octavia</i>     | 1850. | D'ORB. Prodr. I, 30.                        |
|                          | 1854. | MORRIS Brit. Foss., 283.                    |
| <i>Litorina octavia</i>  | 1855. | MAC COY Palæoz. Foss., 305.                 |
| <i>Cyclonema octavia</i> | 1859. | SALTER ap. Siluria ed. 3, 548, pl. 24 f. 4. |
|                          | 1873. | ID. Cat. Cambr. Foss., 156, 172, 185.       |



Shell turbinate, acuminate, with six ventricose whorls, the five inferior whorls with two sharp keels each. On the body whorl there are a variable number of 8 or 10 keels of which the lowest two are largest and most prominent, the most inferior leaving a larger zone between itself and the suture than the space to the next keel. There is also a low keel near the suture. The surface between the keels is finely and transversally striated by dense, obliquely backwards slanting streaks. The aperture is almost ovate, higher than broad and the umbilical opening is narrow, being in some specimens covered by the inner lip, which is reflexed towards the columella. H. 30 millim., br. 25 mill., height of aperture 15 mill.

It has been found at Djupvik in Eksta, Samsugn in Othem, north of Skäret in Fröjel and at Follingbo, Slite and Petesvik in Habblingbo.

#### 8 a. *Cyclonema carinatum* Sow. var. *glabrum* n.

Shell small, turbinate, acuminate, five ventricose whorls with three or four longitudinal, distantiated keels on the apical side of the body whorl. They are entirely wanting on the umbilical side which is almost smooth, only ornamented with the same sort of faint, transverse striæ as on the apical side. Around the umbilical cavity a short, sharp ridge starts from the upper edge of the aperture, which is obovate, acuminate below. The umbilicus is narrow. H. 8., br. 6 mill. It has been found together with the typical specimens in the shale of Djupvik in Eksta.

#### 8 b. *Cyclonema carinatum* Sow. var. *multicarinatum* n.

Pl. XVIII f. 31—32.

This differs chiefly from the main species through the numerous and small longitudinal keels, the nearly circular aperture and the large and open umbilicus. The keels are as many as 14 on the body whorl and from five to seven on the whorls next in size. On the body whorl the keels are more distantiated a little above the suture. As many forms connect it with *Cyclon. carinatum*, forma typica, there is no cause to represent it as a species of its own. H. 19 mill., br. 17 mill. Several specimens have been obtained from the shale of Djupvik in Eksta.

#### 9. *Cyclonema nodulosum* n.

Pl. XVIII fig. 33—35.

Shell variable with long or short spire, with deeply impressed suture, whorls six, nearly disjointed, as seen by section fig. 35, with 8—10 distantiated keels. It differs from *Cycl. carinatum* in the peculiarity that the transverse oblique striæ at regular distances are more elevated than the others, and where they cross the keels, they form a small tubercle or nodule through which the surface acquires a retiform aspect. All specimens have a wide umbilicus and the axis is hollow. The aperture is circular with thin lips and almost free from connection with the next whorl. H. 20 mill., br. 16 mill. It has hitherto been found only in the shale of Djupvik in Eksta and Fröjel.

10. *Cyclonema? tenuissimum* n.

Pl. XVIII fig. 38.

Shell globose with six whorls, the body whorl several times as large as the spire. The ornamentation consists of narrow spiral lines, very fine and closely set, especially on the umbilical side. The suture is partly filled up by the overlying whorls. The aperture is transversally ovate and the lips thin. The umbilicus is deep and funnel shaped. H. 10 mill., br. 11 mill.

There is only one specimen as yet found from the limestone of Follingbo.

11. *Cyclonema? giganteum* n.

There exist only some fragments of the nucleus, by which it can be concluded that this shell was turbinate with much ventricose whorls, of which three are extant in the same specimen. There are also impressions of fourteen moderately elevated longitudinal keels, the interstices between which are finely and transversally striated. This fossil which in its size so much surpasses the other *Cyclonemata*, as well as almost all other Silurian shells, can only hesitatingly be referred to this genus with which it else coincides as to the ornamentation of the surface. H. 86 mill., breadth of body whorl 95 mill. It has been found in the shale beds near Wisby and in Lummelund.

12. *Cyclonema perversum* n.

Pl. XXI fig. 55—56.

Shell sinistral, to judge by the only existing fragment of three ventricose whorls, elongated or turreted, ornamented by numerous thread like, somewhat irregular and unequal, longitudinal striæ. These are crossed, especially near the aperture by coarser, elevated lines of growth and for the rest by narrow, impressed lines. The suture is moderately deep, the aperture is elongate and angular, acuminate in its upper and inferior corners and on the middle of the inner lip. The lips are thin and straight. The umbilicus is visible as a narrow slit. Size of the fragment: height 16 millim., br. 12 mill.

The single specimen has been found in the upper gray limestone beds of the hill of Linde.

GEN. *TROCHONEMA* SALTER.1859 SALTER *Canad. Organ. Remains* Dec. 1, 27.

*Shell turbinate, elongated, keeled, with wide and open umbilicus, surrounded by an elevated keel.*

I have adopted this genus for a widely spread shell, which cannot aptly be united with any of the previously known. SALTER thinks that *Inachus angulatus* HISINGER (*Oriostoma angulatum*) probably is an extreme form of this group, but I cannot

find that there is any foundation for this supposition. *Trochonema* differs from *Oriostoma* through its elongate spire and from *Cyclonema* in the sculpture and the wide and open umbilicus.

### 1. *Trochonema turritum* n.

Pl. XXI fig. 15—19.

Shell elongated, turbinate, of seven whorls, angulated through the prominent keels of which there are six on the body whorl, besides the sharply eminent one around the umbilicus. The three lowest keels are sharper than those on the umbilical side. The transverse lines of growth are thin, lamellar, with sharp edges, more or less distantiated, the interstices varying in breadth from nearly two mill. to close contiguity of the lamellæ. On the keels they are bent in a little tubular fold. The interstices are finely and minutely striated by lines parallel with the enclosing lamellæ. On the umbilical ridge the transverse lamellæ are crowded and the striæ converge in the interior of the umbilicus. The aperture is obovate, the longitudinal axis being the longest. Its outer lip is angular through the shallow notches, which cause the longitudinal keels. The inner lip is straight and not reflexed. H. 37 mill., br. 29.

A great number of specimens has been found at Samsugn in Othem and also a few in Martebo, in the limestone of Kyrkberget, Wisby, and on Galgberget near Wisby. There is a more slender variety from Klinteberg, small, with the lamellæ more numerous and crowded and the umbilicus narrow, reduced to a slit.

### 2. *Trochonema muricatum* n.

Pl. XVIII fig. 52—53.

Shell turriculate, acuminate, upper whorls rapidly increasing in size. Whorls six, angular, body whorl with four large keels, the uppermost around the umbilicus. They are lacerated with broad, acuminate points at regular distances all round. Each of them is, as it were, a complex of the folded edges of several transverse lamellæ, which have a nearly straight direction. The aperture is elongate, angular through all the keels in the outer lip. The inner lip is curved and thin. The umbilicus is wide and open. H. 14 mill., br. 12 mill. A single specimen has been found in the middle limestone strata of Hoburg.

In the list of the distribution of the species I had placed this shell in the genus *Eunema* SALTER, but I now find, on closer consideration, that it cannot be kept there, but rather corresponds with *Trochonema*.

### Gen. **CRASPEDOSTOMA** gen. nov.<sup>1)</sup>

*Shell globular, naticoid, commonly with transverse lamellar ribs. Aperture circular, enclosed within an enormously enlarged and thickened border, formed by successive, thin strata, in the superior, inner corner elongated in an acute spur and a smaller, corresponding one in the inferior corner. The inner lip is bifurcated. The umbilicus is deep and narrow.*

<sup>1)</sup> Κρασπέδον, collar, σιῶμα, mouth, aperture.

This is a well characterized genus with its peculiarly framed lips and lamellar ornaments of the shell. I have placed this genus with the Turbinidæ in consequence of the congruence of its shell with several of the Liotidæ of which group there are some representatives not only recent and tertiary, but also in secondary strata. What STOLICZKA says<sup>1)</sup> of Liotia is wholly applicable to the Gotlandic fossils in question. He says: »The Liotidæ are usually of small size, sub-orbicular, with short spire, transversally and spirally ribbed, often umbilicated, with the aperture circular, having more or less thickened and continuous margins». In the figure of Liotia Gervillei, given by S. P. WOODWARD<sup>2)</sup>, there is seen an acuminate spur projecting from the lower or median edge of the inner lip quite as in ours. Strange enough no similar shells seem to have been hitherto found in the Devonian and the Carboniferous Formations, as I cannot find any mention made of such in the works of GOLDFUSS, SANDBERGER and DE KONINCK.

D'ORBIGNY<sup>3)</sup> has described and figured a »Delphinula reflexilabrum», which comes very near to our genus through its »bouche ronde, avec un bord fortement épaissi, et réfléchi en un large péristome tranchant». It is derived from the Middle Lias of France.

In the Upper Silurian of Gotland I have found six species and in the Lower Silurian hitherto not a single one has been discovered.

### 1. *Craspedostoma spinulosum* n.

Pl. III fig. 32—34.

Shell globular, naticoid, last whorl several times as large as all the others. Whorls four, of which three form the short spire. Suture shallow. The surface is richly ornamented by transverse ribs, situated at regular distances and there provided with blunt spines. These spines, being regularly distantiated, form rows which also continue on the reflexed outside of the lip and give its extreme edge a serrated outline. The aperture is ovate, inferiorly somewhat more narrow. The outer lip with a broad border forming an expansion at right angle to the outside of the last whorl, projecting above it to the length of two millimetres. It is evident that there has been a spur or processus on the interior, upper edge, and probably also beneath the inferior corner of the aperture but both have been broken. It is imbricated by the wavy lines of former lips, resting in their place, while the aperture has been more constricted. The inner lip is straight, bifid, thin and smooth, but does not cover the narrow and deep umbilicus. H. 14 millim., br. 15 millim., length of aperture outside the lip 13 millim., inside 7 millim.

From the limestone of Hoburg, between the oolite and crinoidal limestone strata, where I found one specimen.

<sup>1)</sup> Palæont. Indica, Gasteropoda of the Cretac. Rocks, 351.

<sup>2)</sup> Manual of Shells, pl. 10 f. 14.

<sup>3)</sup> Paléont. Franç. Terr. jurassiques, 317, pl. 323 f. 14—16.

## 2. *Craspedostoma elegantulum* n.

Pl. II fig. 58, pl. XXI fig. 20—29.

Shell globose, naticoid, whorls five, body whorl enormously developed, the others forming a small, obtuse spire. The thin, transverse ribs are densely packed, running obliquely, directed backwards toward the umbilicus. Their edges are minutely frilled in a succession of diminutive wave lines and bent backwards, as to resemble hooks in longitudinal sections. In older specimens, at least from some localities, the ribs are distantiated, with smooth interstices near the aperture. Thread fine, longitudinal lines cross them, especially distinct on the smaller whorls. They are usually more distantiated than the transverse ones, though there also is variability and the longitudinal striæ are more close and numerous, pl. II fig. 58. The aperture is obovate, rounded above, pointed below, the outer lip is large and bent obliquely outwards, thin, and its interior corner, where it meets the inner lip, is prolonged in a triangular, acuminate tooth which stretches far backwards and nearly reclines on the body whorl. The inner lip is narrow, straight, near the umbilicus divided in two diverging branches through a triangular slit between them. Of these the shorter one ends on the inner wall of the umbilicus, while the longer borders the umbilicus on the outside. The umbilicus is narrow and deep. H. 20 mill., br. 25 mill.

Several specimens have been found in the upper limestone strata of Slite, Samsugn, Stor Wede in Follingbo, Nya Slitegårds in Dalhem and Klinteberg.

## 3. *Craspedostoma elegantulum* var. *brevispira* n.

Pl. XXI fig. 30—34.

This variety is small, globular, with five whorls, spire short as not to be visible when the shell is seen from the side. The aperture is large and widened. The superior spur is relatively shorter than in the former, more narrow and pointed. The ornamentation of the surface is finer and more reticulate, the edges of the transverse ribs only a little outstanding and obtuse. The umbilicus is wide and the two branches of the interior lip widely diverging. H. 5 mill., br. 7 mill.

A few specimens have been found in the limestone of the hill of Sandarfve.

## 4. *Craspedostoma flistriatum* n.

Pl. XXI fig. 35—38.

Shell globular, helicoid, body whorl considerably enlarged, the spire prominent, though obtuse, whorls four. The surface is smooth, nearly glossy, without any peculiar ribs, of which there only are a few distantiated traces. The ornamentation con-

sists of minute and closely set transverse, nearly straight striæ, crossed by more irregular, wavy, impressed, longitudinal lines. The aperture is obovate, almost as in *Cr. elegantulum*, but situated deep beneath the outgoing frame, which above is prolonged in the characteristic spurlike process and below in an obtuse lappet. The interior lip is bifid in the same manner as the others. On the outside of the body whorl near the aperture there is a transverse, shallow groove dividing the enlarged apertural frame from the deeply hidden aperture proper. This frame is here as in *Craspedostoma elegantulum* very thin and sharp edged. H. 10 mill., br. 13 mill.

Two specimens have been obtained from Klinteberg and one from Samsugn.

#### 5. *Craspedostoma involutum* n.

Pl. XXI fig. 39—42.

Shell small, globose, helicoid, whorls five, spire short but prominent, the transverse ribs numerous, close, with frilled edges where they meet the longitudinal striæ, which resemble those of the other species. The aperture is obovate, acuminate below, the broad frame is broken away. The inner lip is bifid as in the others, its outer branch straight and somewhat thickened, but its inner branch does not continue straight down as in the others, it is convoluted around the central axis of the conical hollow which it forms and thus hiding the umbilicus: h. 9 millim., br. 11 millim.

Four specimens have been found in the highest limestone stratum of Wisby on Kyrkberget.

#### 6. *Craspedostoma glabrum* n.

Pl. XXI fig. 43—54.

Shell globular, small, naticoid, thin, whorls five, with short, though prominent spire and the body whorl many times surpassing the others in size. Surface apparently smooth with only a few, much distantiated, transverse sigmoid ribs, which are faintly prominent with an obtuse edge. Between them the surface is most distinctly longitudinally striated by somewhat wavy and graduated lines and transversally to them and parallel with the ribs there are microscopically minute lines. The aperture is circular or obovate, environed by exceedingly broad, reflexed lips, forming a large frame around it, of such enormous size that in relation to it the shell looks as an appendix. This frame is prolonged in a large, acuminate spur near the umbilicus, which it nearly completely covers and its lowest corner near the spire is also elongated in a triangular spur. The surface of the frame is finely lineated by the parallel, superimposed strata of growth of successive lips, giving it an imbricated appearance. The umbilicus is narrow. Only the largest specimens are provided with an inner branch of the inner lip. H. 13 mill., br. 13 mill., breadth of aperture 11 mill.

Most abundant in the red and gray limestone of the hill of Sandarfve.

## Fam. XI PHORIDÆ GRAY.

Gen. **AUTODETUS** nov. gen.<sup>1)</sup>

1884 *Anticalyptæa* QUENSTEDT Handbuch der Petrefaktenkunde, 3e Aufl., 673.

Shell broadly conical, sinistral, affixed with the truncated apex to other marine bodies, whorls externally not visible, no suture, aperture narrow, transverse, with a blunt, toothlike projection near the centre of the flat, umbilical surface. There is no umbilicus, the axis is solid. The shell is interiorly subdivided in bladderlike compartments along the exterior wall.

This curious little shell has by its first describers been referred to several recent genera as *Calyptæa*, *Capulus* and *Trochita*, with none of which it, however, on closer inspection can be regarded as related. This is chiefly found through the aspect of the volutions in the interior, the characteristic sculpture of the umbilical surface and its peculiar way of fixing itself with the apex to the hard structures of other animals. In outward appearance it has certainly a great similarity to species of the recent genus *Galerus* and also in some degree in the form of the aperture, which in some species of *Galerus* have a tooth like prolongation. There seems, however, to be more reason to regard it as a precursor of the recent *Phoridæ*. The shape of the aperture as well as the ornamentation of the umbilical surface justify this comparison. But instead of fixing other objects to its shell, as its recent relatives, it fixed itself to larger objects.

This is, perhaps with exception of *Clisospira*, the oldest known representative of this curious family, as there is before none older known than *Xenophora* or *Pseudophorus antiquus* MEEK<sup>2)</sup> and *Phorus Bouchardi* EUG. DESLONGSCHAMPS<sup>3)</sup> both from the Devonian formation. Then none is found before the Jurassic time. Perhaps also *Trochita antiqua*? MEEK<sup>4)</sup> belongs to this family. But, as surmised above, it may be questioned whether such Silurian shells as *Trochus cavus*, *Tr. profundus* etc. do not rather belong to the *Phoridæ* and to the genus *Onustus*.

**Autodetus calyptratus** SCHRENK.

Pl. I fig. 17—24, pl. XXI fig. 57—60.

<i>Capulus calyptratus</i>	1854.	SCHRENK Uebersicht des Schichtensystems Liv- und Esthlands, 83.
	1858.	FR. SCHMIDT Geol. Esthlands, 206, but not <i>Patella mitreola</i> EICHW. Bull. Moscou 1854, I, 94.
<i>Calyptæa calyptrata</i>	1860.	EICHWALD Leth. rossica I,II, 1104, pl. 51 f. 13.
	1867.	QUENSTEDT Handbuch der Petrefaktenkunde 2e Aufl., 526, f. 117.
<i>Trochita calyptrata</i>	1867.	LINDSTRÖM Nomina fossil. Gotl., 23.
<i>Anticalyptæa calyptrata</i>	1884.	QUENSTEDT Handb. d. Petref. 3:e Aufl., 673.

Shell irregularly conical, sinistral, with the truncated and affixed apex forming a flat surface. A few large specimens from Lau and Hoburg seem to have freed themselves at an early stage of growth and have a bluntly pointed apex, without

<sup>1)</sup> *Ἀυτόδετος*, who has bound himself.

<sup>2)</sup> Geol. Survey of Ohio, vol. I, 221.

<sup>3)</sup> Bull. Soc. Lin. de Normandie VI, 151.

<sup>4)</sup> Proceed. Ac. Nat. Sc. Philad. vol. 23, 82.

any scar of the attachment. The whorls are in most specimens not apperceptible on the outside, but through sections it has been made out that there with certainty are six. They are almost smooth, not separated by any regular suture and are finely and transversally striated by exceedingly narrow lines. These, which run in an oblique direction, are crossed by more conspicuous, though minute lines and parallel with these or with the umbilical border there are irregular ridges or constrictions or even edges of the lines of growth. The affixed apex has often been strengthened by radiciform offshoots, which give the shell a strange, nearly corallian aspect, and this is also the case when two *Autodeti* have grown close together and, as it were, clasp each other with their roots. In the youngest specimens the ornamentation, pl. XXI f. 58, is better preserved and we see that the oblique, transverse lines are by far larger than the delicate, longitudinal ones. The umbilical surface is much more distinctly circumscribed in this shell than in any other, excepting, perhaps, such forms of *Trochi* as *T. cavus* and *T. profundus*. Its borders are very thin and seldom entire, but broken and fragmentary. Inside the surface is moderately concave, elevated in the centre around the axis in a faint convexity. Around this or as far as the thin margins reach, a wreath of small bladders, of much unequal size in different specimens, as seen by figs. 18 and 22 pl. I, is stretching. These and the whole central surface are covered by minute, wartlike prickles, amongst which curved striæ radiate from the axis to the periphery. There is no umbilicus and the axis is solid. The aperture is a narrow, transverse slit with the upper lip laminar and ending in a blunt, broad, triangular spine, which is bent a little upwards near the centre of the umbilical side. The inner lip is thick and is distinctly separated from the surface. Around the inferior side of the aperture the shell has, as in the recent *Phoridæ*, a covering of a thin, glossy stratum of porcellaneous shell matter.

A longitudinal section, pl. I fig. 23, through the axis reveals five or six whorls of elliptical shape and nearly similar to those seen in other regular shells and not at all analogous to the spiral laminae in *Calyptræa* and *Trochita*. But there is a characteristic feature in it, worthy of attention, and consisting in an accumulation of small bladder like cells along the inferior corner near the wall of the whorls. These bladders, in some cases amounting to as many as six above each other, are thus comprised in an angle between the roof of a lower whorl and the floor of the next. They form the circle along the inside of the umbilical border, described above, and may there be seen in their original shape when uncovered. In pl. I fig. 19, rows of these bladders are seen in a corroded specimen, indicating the wanting lines of the suture. These bladders are then evidently formed on the top of the whorls along the thin rim of the umbilical surface and are again covered during the growth of the shell by the new whorls. By pl. I fig. 18 it can be found that they originate, as could be expected, near the outer corner of the upper apertural lip and thus had been formed along with the aperture. As to the nature and homologies of these bladders, I can for the present only compare them with the interior partitions through transverse laminae in several shells as in *Triton corrugatus* LAM.<sup>1)</sup>. But there is the essential dif-

<sup>1)</sup> WOODWARD Manual of Shells, ed. 1, 100.



ference that in this and similar (species of *Conus* etc.) the partitions are *inside* the whorls and only near the apex, whilst in *Autodetus* they are decidedly *outside* the whorls and everywhere along the suture.

The apical whorls are often filled with shelly matter and solid. H. of a specimen 6 mill., br. 8 mill. Another specimen from Lau, h. 5 mill., br. 9 mill.

The smallest or youngest specimens might easily be mistaken for young annelid tubes. A few have been delineated on plate XXI figs. 57—60. Specimen, fig. 59—60, is the youngest, nearly 2 millim. in diameter, broadly affixed, of nearly three whorls, without the thin, umbilical border and with the centre of the axis prominent as a point. Next we have, figs. 57—58, larger specimens, nearly 3 millim., where the thin border just is beginning to appear. In this, as well as in the yet smaller, previous shell, the ring of bladders is already present on the bottom of the aperture.

This characteristic shell is distributed nearly over the whole island and has been met with in all strata, in the lowest shale beds, as well as in the uppermost limestone. It is, however, more abundant in the southern localities. It has been found in the shale beds of Halls huk, of Djupvik in Eksta and in the contemporaneous sandstone of Bursvik. The State Museum has further obtained it from the limestone beds at Medebys in Hall, Likkershamn, Slite, Wisby, Östergarn, Grötlingbo, Lau, from the oolite of Bursvik and the middle and uppermost limestone of the hill of Sandarfve and Hoburg. It has also been found in the isle of Oesel in corresponding strata, where SCHRENK first discovered it.

## Fam. XII. LITORINIDÆ GRAY.

### Gen. HOLOPEA HALL p. p.

?1845 *Cyclora* HALL p. p. Sillim. Journ. vol. 48, 294.

1847 *Holopea* ID. p. p. Pal. N. York vol. I, 169.

1866 *Litiopsis* EDW. FORBES according to SALTER in Mem. Geol. Survey, III, 346.

*Shell globose, naticoid, with short spire, smooth whorls with faint, transverse striæ, outer lip thin, inner lip reflexed, peristome interrupted, umbilicus deficient or narrow.*

According to the first definition given by HALL these shells were difficult to distinguish from *Cyclonema*, as he states that the surface is cancellated. But in his later descriptions in Palæont. of N. York vol. III p. 294, species have been described which are similar to the Gotlandic ones, enumerated below and also correspond with those referred to *Holopea* by SALTER in Mem. Geol. Survey vol. III p. 347, where also species with high spire are included, which probably rather had to be numbered with another genus.

#### 1. *Holopea nux* n.

Pl. XV fig. 62.

Shell moderately large, ventricose, nearly globose, with short spire and body whorl many times the size of the spire. Whorls five, obscurely and transversally stri-

ated. H. 17, br. 17. Fragment of a larger specimen 20 mill. broad. In the limestone of Sandarfve kulle, Linde klint and from Samsugn.

## 2. *Holopea transversa* n.

Pl. XV fig. 59—60.

Shell minute, globose, with acuminate, though short spire, whorls five, ventricose, smooth or glossy, body whorl transverse, aperture obovate, outer lip thin and sharp, inner lip thick, reflexed and hiding the umbilicus. H. 7, br. 7,5 mill. Only a single specimen found in Follingbo.

## 3. *Holopea perforata* n.

Pl. XVIII fig. 45.

Shell minute, globose, transverse, spire short and acute, whorls five, ventricose, their surface smooth, only transversally wrinkled by a few, depressed lines of growth, directed backwards or nearly vertical. Aperture obovate, or almost circular, both lips thin, the inner one not reflexed. Umbilicus open, relatively wide. H. 12 mill., br. 13 mill. Two specimens from Kyrkberget in Wisby.

This species and the preceding one seem to form part of those shells which compose the genus *Cyclora* of HALL, but which well may be united with the *Holopeæ*.

## 4. *Holopea nitidissima* n.

Pl. XV fig. 50—51.

Shell minute, elongate, with five ventricose whorls, surface glossy, with faint transverse striae. Suture slightly impressed. Aperture obovate, acuminate below, outer lip thin, continuing on the body whorl without meeting the much shorter inner lip, which is reflexed and hides the umbilicus. H. 8 mill., br. 6 mill. From Follingbo and Kyrkberget in Wisby.

## 5. *Holopea applanata* n.

Pl. XV fig. 46—47.

Shell elongate with five whorls of nearly conical outline, transversally and minutely striated, somewhat concave above the suture, which lies in a groove on the inferior border of the whorls. Aperture obovate, outer lip thin, continuing on the body whorl, without meeting the inner lip, which is thick and reflexed, hiding the mbilicus. H. 10 mill., br. 7 mill. In all seven specimens from Kyrkberget in Wisby.

## Fam. XIII. SCALARIDÆ BRÖDERIP.

Gen. **CALLONEMA** HALL.

1865 *Isonema* MEEK and WORTHEN p. p. Proceed. Ac. Nat. Sc. Philad., 251.

1879 *Callonema* HALL. Palæont. N. York vol. V,II, 50.

*Shell elongate or short and globular, ornamented by transverse, distantiated lamellar ribs, aperture circular, peristoma continuous.*

This genus was established by HALL to include some Devonian and Silurian species which had to that time been numbered with *Isonema*, though they rather did not correspond to the definition given to that genus by its authors MEEK and WORTHEN. I follow the subsequent authors who have placed the genus *Callonema* amongst the *Scalaridæ*. In Sweden it had already appeared in the Lower Silurian times, as there are fine species of it in the *Leptæna* Limestone of Dalecarlia.

1. **Callonema obesum** n.

Pl. XV fig. 27.

Shell thick, trochiform, of the same length and breadth, with transverse whorls, broader than high, regularly increasing in size. Whorls five, ornamented with oblique, chordlike, lamellar ribs, directed in a gentle curve, going from the suture backwards. The surface acquires through them a fluted appearance, as these chords are more close together than in the next species, finer and more regular. The aperture and the umbilical side are destroyed in the only specimen extant. H. 8 mill., br. 8 mill. This specimen belongs to the Museum of the University of Copenhagen, and has been found by ANGELIN probably in the limestone of Wisby.

2. **Callonema scalariforme** n.

Pl. XV f. 24—26.

Shell elongate, turriculated and slender, of six moderately ventricose whorls. Surface ornamented by obliquely transverse, thread like lamellæ, and between them with parallel lines of growth. The aperture is ovate and the lips thin. The lamellæ project beneath each other as scales, the younger beneath the older and they may properly be regarded as the edges of successive apertures. H. 15 mill., br. 10 mill. Another specimen h. 10 mill., br. 5 mill., height of aperture 4 mill.

Some specimens from the middle limestone of Wisby.

Gen. **HOLOPELLA** MAC COY.

Syn. 1852. *Holopella* MAC COY Brit. Pal. Foss., 303.

1881. *Aclisina* DE KONINCK p. p. Faune Carbonif. II, 3, p. 86.

*Shell elongate, slender, smooth or finely striated, peristome continuous.*

This genus should, according to MAC COY be characterized through its remarkably convex whorls, which are ornamented by »slightly arched striae» or even cancelled by transverse and spiral striae. DE KONINCK's *Aclisina* then seems in no particular to differ from *Holopella*. The specimens are generally small. It has probably occurred in the Lower Silurian of Sweden; at least *Loxonema dalecarlicum* LINDSTRÖM<sup>1)</sup> may rather be classed with *Holopella* and it is derived from the Leptæna Limestone of Dalecarlia. In the Upper Silurian of Sweden there are three species, described below. The genus has continued during the Devonian, the Carboniferous and probably also during the Triassic times.

### 1. *Holopella teres* n.

Pl. XV fig. 61.

Shell elongate, thick, with seven whorls, which are smooth and transverse, twice as wide as high, with glossy surface. Aperture circular, outer lip thin, the inner lip thick, large and reflexed not only over the umbilicus, but also at the lower edge of the aperture. H. 6 mill., br. 3 mill. Found in Slite.

### 2. *Holopella regularis* n.

Pl. XV fig. 12—13.

Shell moderately large, elongate, turruculate, with five ventricose whorls, separated by a deep suture. The surface is smooth, glossy, covered by extremely fine, slightly sigmoidally wound lines, the aperture ovate, below acuminate, with sharp and thin lips. Umbilicus deficient. H. 21 mill., br. 10 mill. The aperture 8 mill. high, 6 mill. broad. The specimen figured belongs to Adjunct M. KLINTBERG, who found it in the shale beds of Wisby. It has also been found in the shale of Petesvik in Habblingbo.

### 3. *Holopella minuta* n.

Pl. XV f. 63.

Shell one of the tiniest found, being so uncommonly narrow in relation to the length, regularly elongated and slender of eight globose whorls, one and a half time as wide as high, regularly striated with fine, curved lines, having their greatest bend along the median line of the shell. H. 7 mill., br. 2 mill. Occurs frequently in the red limestone of Sandarfve kulle.

## Fam. XIII. PYRAMIDELLIDÆ GRAY.

### Gen. *MACROCHILINA* BAYLE.

1841 *Macrocheilus* PHILLIPS Palæoz. Foss. Cornw., 103.

1842 *Plectostylus* CONRAD Proceed. Ac. N. Sc. Philad. 275.

<sup>1)</sup> ANGELIN & LINDSTRÖM, Fragmenta Silurica p. 14, pl. XV, f. 19.

- 1860 *Soleniscus* MEEK and WORTHEN p. p. Proc. Ac. N. Sc. Philad., 467.  
 1879 *Duncania* BAYLE Journ. de Conchyliologie, vol. 19, 35.  
 1880 *Macrochilina* Id. ibid. vol. 20, 241.

*Shell elongate, bulimoid, terete, aperture ovate, columellar lip considerably thickened toward its base and twisted, often so much that an acute, revolving plait is formed.*

I have ventured to place three species of Gotland Silurian shells within this genus, mostly on account of their general habitus. But this position seems also justified through the conformation of the inner lip, which, though not showing such a distinct plait as in some of the Carboniferous species, is evidently tortuous as in many of them and the Devonian ones.

The oldest authors placed these fossils with *Buccinum* as HOENIGHAUS or *Buccinites* SCHLOTHEIM, and of the subsequent names *Soleniscus* ought to have the priority, as *Macrocheilus* as well as *Plectostylus* were already preoccupied. But as this genus according to the revision of WHITE<sup>1)</sup> contains chiefly species, which, with their gutter-like prolongation of the superior corner of the aperture, indicate relations with the large division of the *Siphonostoma*, it can only partly be admitted as synonymic. *Duncania*, given by BAYLE, had already twice been employed for corals, fossil and recent, and its author consequently changed it into that now prevalent.

### 1. *Macrochilina cancellata* n.

Pl. XVIII fig. 46—47.

Shell elongate, bulimoid, terete, with seven much convex whorls, the body whorl being nearly of the same length as the spire. The suture is rather impressed in consequence of the globosity of the whorls. The surface is most finely ornamented by minute striæ, which intersect each other longitudinally and transversally, forming small regular quadrangles. The aperture is elongated and ovate, the outer lip is thin, the inner lip thick and slightly twisted in its central part. There is no umbilicus. Height 30 mill., br. 19 mill. Eight specimens have been obtained from the hill of Linde and two from Sandarfve.

### 2. *Macrochilina bulimina* n.

Pl. XV fig. 14—16, pl. XVIII fig. 48—49.

Shell elongate, bulimoid, whorls seven, moderately ventricose, body whorl in length equal with the spire. Suture slightly impressed. Surface covered only with rather irregular, transverse striæ, finer and coarser intermingled. The aperture is elongate, the outer lip sharp and thin, the interior one thickened towards the base, slightly twisted and hiding the umbilicus. H. 17 millim., br. 10 millim. Another specimen, h. 25 mill., br. 13 mill.

<sup>1)</sup> Proceed. Un. St. National Museum, vol. VI, 184.

Several specimens have been found in the limestone of the hills of Sandarfve and Linde.

This species comes very near to the Lower Silurian *Holopea exserta* FORBES, Mem. Geol. Survey vol. III, p. 347, but is rather not so much ventricose.

### 3. *Macrochilina fenestrata* n.

Pl. XV fig. 17—18.

Shell elongate, slender, conical, with five whorls in the only, fragmentary specimen. These whorls have a nearly conical outline and are very little convex, the suture is shallow. The surface is almost smooth, reticulated by transverse and longitudinal, impressed lines of extreme minuteness, forming regular, fenestrate quadrangles, relatively more quadrate and larger than in *M. cancellata*. The aperture is elongate, acuminate and narrow below, widened and rounded above. The outer lip is thin, the inner one is thick and somewhat tortuous. H. 12 millim., br. 5 millim.

A single specimen has been found in the limestone of Samsugn in Othem.

### Fam. XIV. SUBULITIDÆ n.

*Shell elongate, fusiform, aperture oblong, narrow, slightly, but most distinctly canalculated in the superior corner near the columella and thus a short siphon is formed. Whorls generally straight, conical, smooth and unadorned and the suture very shallow.*

In this family I enclose such palæozoic shells as *Subulites* and *Euchrysalis*. *Bulimorpha* WHITFIELD and *Fusispira* HALL probably also belong here. What characterizes them all, besides the elongate and smooth shells and the narrow aperture with incomplete peristome, is the important feature of a distinct apertural canal, situated exactly as in all *Siphonostomata* and quite as much developed as in several of them, where it has attained its smallest dimensions. This will be found on comparing such genera as *Pisania*, *Metula*, *Mangelia* and especially *Daphnella* with *Subulites*, as will be done more in full further on.

We see, consequently, in this family the most ancient representatives of the great section of the *Siphonostomous* shells. Hitherto the oldest known species of that group have been found in the Triassic strata of St. Cassian in Austria. Shells bearing affinity to *Fusus* and *Fasciolaria*, if not strictly belonging to these genera, but at all events to the section of the *Siphonostomata*, have been described by LAUBE<sup>1)</sup>. The limits of the range of the *Siphonostomata* in time must then be removed as far back as to the youngest beds of the Lower Silurian, where there are species of *Subulites* found in the *Leptæna* limestone of Sweden. In Esthonia species of *Subulites* have also been discovered in the contemporaneous strata.

<sup>1)</sup> Fauna der Schichten von St. Cassian, III Gastrop. Denkschriften der Akad. der Wissensch. zu Wien, Bd 28, 2e Abtheil., 31.

The systematic place of the species of this family is by far not as easily cleared up as their nature of siphonostomous shells and I think, that this question must for the present be left undecided.

### Gen. SUBULITES CONRAD.

- 1842 *Subulites* CONRAD Nat. Hist. of N. York, Geol. vol. II, 392, fig. 3.  
 1843 *Polyphemopsis* PORTLOCK, Rept. Geol. of Londonderry, 415.

*Shell slender, elongate and fusiform. Whorls straightly conical or only slightly convex, suture shallow, and on both sides a nearly rectilinear outline is formed. Shell thin, fragile and unadorned, last whorl elongated. Aperture elongate or more than double the length against the breadth. It is narrow, the outer lip thin and its lowest corner prolonged into a small acuminate hook, which is most characteristic. The inner lip is involute, thus forming a central canal around the axis, and it ends above abruptly in a transverse line, from which the apertural edge continues in a rounded arch. They have a tendency to grow obliquely along a curved axis.*

On plate XVIII a sketch of the aperture of the recent, siphonostomous *Daphnella linnæiformis* L. has been given, fig. 64, to compare with that of *Subulites ventricosus*, figs. 58 & 59, and of *Subul. curvus* fig. 61. The great accordance, especially between fig. 64 and fig. 59, is striking. In all there is almost the same form of the aperture, on the columellar side the same narrow coating of a thin porcellanous stratum, and, above all, uppermost the peculiar and characteristic notch which indicates where the siphon is protruded in the recent shells and probably also had been protruded in the extinct ones. As far as this evidence goes, there is every reason to conclude that *Subulites*, as well as the related genera, also have been siphonostomous. The transverse sections of *Subulites* and *Euchrysalis*, figs. 62 & 68, show the inflected columellar lip in the same manner as a similar section of *Daphnella*, fig. 63, while the section of a holostomous, recent *Turritella*, fig. 69, is quite different.

The oldest specimens of this genus already occur in the Leptæna Limestone of Dalecarlia. In the »Fragmenta Silurica»<sup>1)</sup> I have with some hesitation described a species as *Subulites elongatus* PORTLOCK, but I now think that it is identical with *Helicites utricularis* WAHLENBERG<sup>2)</sup> and that it thence is to be named *Sub. utricularis*. This genus seems to be restricted exclusively to the Silurian formation.

#### 1. *Subulites ventricosus* HALL.

Pl. XV fig. 19—21, tab. XVIII fig. 58—59.

- Subulites ventricosa* 1852. HALL Pal. N. York, II, 347, pl. 83 f. 7.  
 1865. ID. 20th Rept. N. Y. St. Cab., 346, pl. 15 f. 1.

<sup>1)</sup> Pag. 13, pl. XV f. 21—23.

<sup>2)</sup> Petref. Suec. p. 72.

- Subulites brevis* 1865. WINCHELL and MARCEY, Fossils of the Niagara Limestone of Chicago in Mem. Boston N. H. Soc., vol. I, 100, pl. II f. 19.  
 1868. MEEK and WORTHEN Geol. Survey of Illinois, III, 362, pl. 5 f. 6.  
*Subulites ventricosus* 1868. HALL 20th Rept. N. Y. St. Cab. Revis. Ed., 398 pl. 15 f. 1.

Shell, short, thick, with five whorls, body whorl in length equal to the other four whorls, with which it forms a small angle. Seen from the side the axis is slightly curved. The aperture is narrow, elongate, inferiorly acuminate, above rounded; lower lip continued downwards in an acuminate point. The outer lip thin and sharp, somewhat inflexed, inner lip involuted, bent in a gentle curve and covered with a thin coat of porcellanous shell matter. The siphonal notch is small, but distinct and directed obliquely towards the outer lip. H. 38 mm., breadth 20 mm., h. of aperture 19 mm., breadth 10 mm. There is commonly only the nucleus left and the few vestiges of the shell and its ornamentation show a smooth surface. Through the exterior resemblance with American specimens, which I owe to the kindness of Messrs S. A. MILLER and WORTHEN, I have thought it most convenient to refer the Swedish specimens to the same species as the American ones.

It occurs in the soft shale at Hallshuk north and south of Wisby, Gnismvård. Walve ref, Westergarn, also from Fårö and the canal in Rute. Prof. CLEVE found specimens in Häftingsklint.

## 2. *Subulites ventricosus*, var. *curvus* n.

Pl. XVIII, fig. 60—61.

Shell slender, bent in a crescent shaped curve, the body whorl forming with the apical ones a larger angle than in the preceding. Whorls six, elongated, slightly convex, smooth, the suture shallow. The aperture is narrow and nearly elliptical, acuminate below and widened above, where the siphon is situated. The inferior corner of the outer lip is widened in a downwards directed thorn. H. 33 millim., br. 15 millim. This variety which I consider as an evolutionary form or mutation of the preceding, has been found only in the upper limestone beds near Wisby at Kälens Qvarn and Kyrkberget and in the limestone of Samsugu.

It differs from *Sub. ventricosus* chiefly in the more slender shape which is so much curved.

## 3. *Subulites attenuatus* n.

Pl. XV fig. 22, 23, 48, pl. XVIII fig. 62.

Shell elongate, slender, fusiform, with seven whorls, body whorl nearly twice as long as broad, axis of the shell straight, not curved. Surface of the extremely thin shell smooth, without the least traces of ornamentation preserved on the patches still left. Aperture elongate, narrow, nearly four times as long as broad. Lips thin, lower corner of outer lip prolonged in a little acuminate thorn. Aperture on columellar



side gently curved, lip much involute. H. 60 millim., br. 19 mill., length of body whorl 35 mill., width of same 6 mill., length of aperture 29 mill., width of same 8 millim.

Abundant at Lansa and other places in Färö, at Wialmsudd in Bunge, in the canal from Stormyr in Rute, in Martebo, in the shale beds of Wisby, Westergarn and Gnisvärd.

The specimen delineated on plate XV fig. 48 deviates thus far, that it is more slender and the whorls relatively much longer than wide, but as there is only one specimen as yet found, I cannot ascertain if it is a distinct variety or species.

### Gen. **EUCHRYSALIS** LAUBE.

*Euchrysalis* 1868. LAUBE Denkschriften der Akad. der Wissensch. in Wien 2e Abtheil., 69.

*Shell elongate, widest at the middle of its length, whorls short and numerous, smooth and glossy, suture shallow, the aperture long, narrow, outer lip sharp and thin, the inner lip involute as in Daphnella, ending upwards in a very shallow notch.*

After having compared specimens of *Euchrysalis fusiformis* MÜNSTER from St. Cassian with specimens from Gotland described below, I cannot but think that they all belong to the same genus. The Silurian species deviates, however, from the Triassic ones in having a fine sculpture on the glossy surface. The characteristic form of the aperture and the general shape of the shell itself is quite identical. No species seem hitherto to have been found in the Devonian and Carboniferous formations.

### **Euchrysalis lineolata** n.

Pl. XVIII fig. 65—68.

Shell conical, tapering, slender, acuminated and straightly grown, with nine whorls, regularly increasing in size, the body whorl being only twice as large as the next preceding. The whorls are only slightly convex or tumid around their middle and the suture is not much impressed. The surface is sculptured by perpendicular, equidistant, minute ridges, which have their inner side thrice as large as the exterior one. For the rest the surface is smooth. The aperture is, as far as visible, elongated and pointed below, widened above. The columellar lip is involute and the siphonal notch, above, only just perceptible. H. 13 millim., br. 4 mill. Another specimen: h. 18 mill., br. 4 mill.

A dozen specimens have been found in the beds of the red and gray limestone of the hills Sandarfve and Linde.

Additional genus, the systematic place of which is at present uncertain.

Gen. **ONYCHOCHILUS** n.<sup>1)</sup>

*Shell ovate, sinistral, aperture narrow as a slit, oblique, outer lip with thick border, the inner lip involute, elongate and curved like a claw, probably with a rudimentary siphonal notch. The umbilical region is excavated and deepened into a funnel, wide above and narrow downwards.*

This genus must remain provisional until more specimens have been collected, apt to further elucidate its structure and systematic place.

1. **Onychochilus physa** n.

Pl. XV fig. 55—58.

Shell tumid, ovate, sinistral, whorls four, the last being of more than double the size of all the others taken together. The surface is transversally striated, parallel with the outer lip, the striæ fine, like ribs, running nearly straight from the suture to the umbilicus. The aperture is obliquely elliptical, the outer lip thick, turned out in a narrow elevated rim, the inner one involute and the whole side narrow. The umbilical region is partly destroyed and partly covered as not to be discernible. H. 4 millim., br. 3 millim. Another specimen is 8 millim. in height.

Two specimens, found in the uppermost limestone of Slite by Prof. P. T. CLEVE, are preserved in the Museum of the University of Upsala.

2. **Onychochilus reticulatum** n.

Pl. XXI fig. 61—65.

Shell small, trochoid, obese, whorls four, tumid, body whorl more than twice surpassing the other whorls. Their sides are straight or even, only slightly convex and the suture is shallow. The ornamentation consists of fine, longitudinal striæ crossed by thicker, transverse, elevated ridges, nearly double as large and running obliquely from the suture backwards to the umbilicus. There are small, indistinct tubercles at their meeting. The aperture is oblique and narrow, a little more widened at its superior edge. Both lips are thin and the inner one shows the peculiar, clawlike curvature. The umbilicus is a funnel, wide upwards and narrowing downwards. Sectioned longitudinally the whorls show an elongated kidney like shape, being somewhat impressed on the inner side, turned against the umbilical funnel. H. 4 millim., br. 3 millim. Three specimens have been obtained from the red limestone of the hill of Sandarfve.

<sup>1)</sup> ὄνυξ, claw, χεῖλος lip.

3. *Onychochilus? cochleatum* n.

Pl. XVIII fig. 54—57.

Shell small, narrow, sinistral, elongately turriculate. The fragmentary specimens have only five whorls left. These whorls are short, depressed, nearly disciform, with an acute ridge around their median line and another ridge on the umbilical side. Transverse lines, regularly distantiated, cross these ridges in a highly acute angle. To judge by the fragments the columellar side of the aperture has been narrow and curved and the umbilicus open and wide. H. 6 mill., br. 4 mill.

From the limestone beds of Slite and Sandarfve.

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## APPENDIX A.

## Table showing the succession of the Palæozoic strata of Sweden.

## I. Cambrian.

1. *Oldest sandstone beds of Westrogothia* etc. Eophyton and Fucoïd sandstones at Lugnås.
2. *Paradoxides-schists*.
  - a) *Zone of Paradoxides Kjerulji*. Hyolithus. A »Metoptoma» found by SCHMALSENSEE according to LNSN.
  - b) *Parad. Oelandicus*.
  - c) *Parad. Tessini*. »Metoptoma» Barrandei LNSN.
  - d) *Parad. Davidis*.
  - e) *Parad. Forchhammeri*.
  - f) *Agnostus lævigatus*.
3. *Olenus-schists*.
4. *Dictyonema-schists*.

## II. Lower Silurian.

1. *Ceratopyge-limestone*.
2. *Lower Graptolite-schists*.
3. *Orthoceratite-limestone*.
  - a) *Lower red limestone*. Pleurotomaria.
  - b) *Lower gray limestone*. Bellerophon. Euomphalus
  - c) *Upper red limestone*. Metoptoma.
  - d) *Upper gray limestone*. Conularia.
4. *Middle Graptolite-schists*.
5. *Chasmops-limestone*. Conularia. Tremanotus.
6. *Trinucleus-schists*. Phanerotinus (?).
7. *Brachiopod-schists*. Platyceras.
8. *Upper Graptolite-schists* (Retiolites shale of Borensult etc.) Conularia. »Patella» antiquissima. Murchisonia.
9. *Leptaena-limestone* of Dalecarlia. Platyceras. Cyclonema. Callonema. Holopella. Subulites.

## III. Upper Silurian.

1. *Llandovery-beds* near Wisby in Gotland, also at Stygfors and Nitsjö etc. in Dalecarlia.
2. *Wenlock shale* and sandstone of Gotland. Signed *a*, see page 7.
3. *Limestone beds* of Gotland, Scania and Jemtland, shale and sandstone beds of Scania. The Gotland beds are signed *b* and *c* on pages 7 & 9 and following.

## APPENDIX B.

## Index to the generic names applied to the Gastropoda of the Palæozoic Period.

- Aclis* LOVÉN 1846, Ind. Moll. 16, used by WHITE 1881, App. to Rep. U. S. Geol. Survey vol. III, XXXV, for a Carbonif. shell.
- Aclisina* DE KONINCK 1881, Faune du Calcaire Carbonif. de la Belgique II, III, 86. Like a *Holopella*.
- Acroculia* see the next.
- Acrocyllia* PHILLIPS 1841, Palæozoic. Foss. of Cornwall, 93. As the name is derived from *ἀκρον* apex and *κύλιον* I roll, it must be written as here. Identical with *Platyceras*, which is prior.
- Acrocyllia* HERMANNSEN 1846, Ind. Gen. Malac. primordia, 15. See *Acrocyllia*.
- Actita* FISCHER VON WALDHEIM 1823, Mém. de la Soc. imp. d. Naturalistes de Moscou vol. VI, 234. Deriv. *ἀκτίτης*, living near the shore. Intended not only for the recent genera *Capulus* and *Pileopsis*, but, as seen in Bull. de Moscou 1844, 832, FISCHER also included Carboniferous *Platycerata* in it.
- Agnesia* DE KON. 1883, Faune Carb. Belg. II, III, 99. A sinistral *Pleurotomaria*.
- Ampullacera* QUOY & GAIMARD 1832, Voy. Astrol. Zool. II, 196. Used by DE KONINCK 1843 in Anim. Foss. Carbonif. Belg. 486. One of the *Pleurotomaridæ* = *Scalites* according to DE KON. 1881.
- Ampullaria* LAMK 1799, Prodr. 76, employed by SOWERBY 1828, Min. Conch. VI, 40, for shells of the Belgian Carbon. Form. probably *Euomphali*.
- Anatomus* MONTFORT 1810, Conch. Syst. II, 278. = *Pleurotomaria* p. p.
- Anomphalus* MEEK & WORTHEN 1866, Proceed. Acad. N. Sc. Philadelphia, 268. Seems to be one of the *Umbonidæ*.
- Anthracochiton* ROCHEBRUNE 1882, Ann. Sc. Géol., XIV, 26. Carbonif.
- Anticalyptæra* QUENSTEDT 1884, Handbuch der Petrefaktenkunde, 3e Aufl., 673. — *Autodetus*.
- Autodetus* LINDSTRÖM 1884, Silurian Gastropoda of Gotland, 185. One of the *Phoridæ*.
- Baylea* DE KON. 1883, Faune II, IV, 68, Fam. *Pleurotomaridæ*?
- Bellerophon* MONTF. 1808, Conch. System. I, 51.
- Bellerophus* BLAINVILLE 1825, Malac. 477. «Mala emendatio» of the preceding, says HERMANNSEN.
- Beloplaxus* OEHLERT 1881, Mem. Soc. Géol. de France, 3 Ser. vol. II, 17. A Devonian Chitonid; type *Chiton sagittalis* SANDBERGER.
- Bifrontia* DESHAYES 1833, Descript. Coq. Foss. des environs de Paris II, 221. Contains chiefly Tertiary species, but DESHAYES also ranged *Euomph. catillus* in this genus.
- Brilonella* KAYSER 1873, Zeitschrift Deutsch. Geol. Gesellsch., 672. A Devonian shell of the *Pleurotomaridæ*.
- Bucanella* MEEK 1870, Proceed. Amer. Philos. Soc., vol. 11, 426.

- Bucania* HALL 1847, Pal. N. York I, 32.  
A Bellerophon with cancellated ornamentation.
- Buccinites* SCHLOTHEIM 1820, Petrefactenkunde, 127. Contains, besides others, Devonian Macrochilinæ.
- Buccinum* L. 1758, S. N. ed. X, 734. HOENIGHAUS and others used it for species of Macrochilina.
- Bulimella* HALL 1858, Transact. Albany Instit. vol. IV, 29. = Macrochilina? The name is preoccupied by PFEIFFER in 1852.
- Bulimorpha* WHITFIELD 1882, Bullet. J<sup>o</sup> 3, American Museum Nat. Hist., 74.
- Callonema* HALL 1879, Pal. N. York vol. V, pt. II, 50. The species of this genus were formerly regarded as belonging to Isonema.
- Calyptraea* LAM. 1799, Prodr., 78. Autodetus was first considered to belong to this genus by EICHWALD Leth. ross. I, pt. 2, 1104.
- Capreolus* R. ETHERIDGE Sr 1878, Qu. Journ. Geol. Soc. vol. 34, 603, *lapsu pro* Capulus.
- Capulus* MONTFORT 1810, Conch. System. II, 54 has been applied by various authors to most species of Platyceras.
- Carinaropsis* HALL 1847, Pal. N. York, I, 183. Species of Bellerophon and Lepetopsis.
- Catantostoma* SANDBERGER 1842, LEONH. & BRONN Jahrb. 392. Fam. Pleurotomaridæ.
- Centrifugus* HISINGER 1835 in a letter to BRONN according to Lethæa Geogn. vol. 1 ed. 1, 96. = Inachus HIS.
- Cerithium* ADANSON 1757, Seneg. 153. Used by VERNEUIL and others for Silurian shells of different genera.
- Chelodes* DAVIDSON & KING 1874, Qu. Journ. Geol. Soc., 167, a subgenus of Chiton.
- Chemnitzia* D'ORB. 1839 in WEBB and BERTHELOT Iles Canar. . . HERMANNSEN. Ind. I, 222 identifies LOXONEMA PHILLIPS and Phasianella p. p. GOLDF. with this genus.
- Chiton* L. 1758, S. N. X, 667. BARRANDE Syst. Sil. Boh. III, 175 has a species of Chiton, which belongs to Chelodes.
- Chonechiton* CARPENTER 1882 according to DALL Proceed. Un. States Nat. Museum, 1882, 280. Carbonif. Belgium.
- Cirridius* DE KON. 1882, Faune, II, III, 101 = CIRRUS DE KON. 1843 not SOW.
- Cirrus* SOWERBY 1816, Min. Conch. II, 93 = EUOMPHALUS according to SOWERBY himself l. c. p. 219.
- Clisospira* BILLINGS 1865, Pal. Foss. I, 186. A Lower Silurian species probably allied to Autodetus or the Phoridæ.
- Codonochilus* (not Codonocheilus) WHITEAVES 1884, Geol. Surv. of Canada, Palæoz. Foss. vol. III pt. I, 17. Upper Silurian Canada.
- Coelocentrus* ZITTEL 1882, Handbuch d. Pal. 1 Bd., 206 = CIRRUS DE KON. EUOMPH. Goldfussi D'ARCH. & VERN is the type.
- Conchopeltis* WALCOTT 1876, 28th Rept. State Cab. N. Y., 93. A Patelloid or a Pteropod?
- Conchula* STEININGER 1853, Geognost. Beschreibung der Eifel, 46. Differs from Scoliostoma through the shape of the aperture, which is parallel with the axis of the shell. Devonian.
- Craspedostoma* LINDSTR. 1884, Silur. Gastropoda of Gotland, 181.
- Cryptænia* E. DESLONGCHAMPS 1865, Bull. Soc. Linnéenne de Normandie, 424. A Pleurotomaria found in the Carboniferous strata and also in Lias.
- Cyclonema* HALL 1852, Pal. N. Y. vol. II, 89.
- Cyclora* HALL 1845, Sillim. Journal, vol. 48, 294.

- Cyrtolites* CONRAD 1838, Ann. Rep. N. Y. State Cab., 118.
- Cyrtonella* HALL 1879, Pal. N. Y. vol. V, pt. II, 123.
- Delphinula* LAMK 1804, Ann. du Muséum IV, 108. GOLDFUSS and HISINGER have referred several of the Oriostomata to this genus. True *Delphinula* begin to appear in the strata of St. Cassian.
- Dentalium* L. 1758, S. N. ed. X, 785. The oldest species known are Devonian.
- Ditaxopus* RAFINESQUE 1839, Bull. Soc. Géol. X, 378. Perhaps a *Bellerophon*.
- Duncania* BAYLE 1879, Journ. de Conchyliologie vol. 19, 35, later changed into *Macrochilina*.
- Eccyliomphalus* (not *Ecculiomphalus*) PORTLOCK 1843, Rep., 411. Most species nothing but evolute *Euomphali*. According to the derivation the name is to be written as above.
- Elenchus* HUMPHREY 1797, Mus. Calonnaianum . . ., according to MAC COY Carb. Foss. Ireland, 42, a species in the Old Red Sandstone of Ireland, but may probably belong to another genus.
- Ellipsolithes* SOWERBY 1813, Min. Conch., vol. I 81, non MONTFORT, whose genus embraced only *Polythalamia*. SOWERBY has himself later in Min. Conch. vol. 5 p. 107 corrected his species and indicated two as *Cephalopoda* and one, *Eu. ovatus*, as a *Bellerophon*.
- Entalis* GRAY 1840, Syn. Brit. Mus. . . . See WAAGEN. Pal. Ind. XII p. 180.
- Eotrochus* WHITFIELD 1882, Bullet. Amer. Mus. N. Hist. № 3 p. 77.
- Euchrysalis* LAUBE 1868, Denkschriften Akad. Wissensch. zu Wien, 2:e Abtheil. 69. Silurian and Trias.
- Eulima* RISSO 1826, Hist. IV p. 123, *Loxonema* and *Polyphemopsis* are synonymous according to HERMANNSEN.
- Eunema* SALTER 1873, Catal. Mus. Cambridge, 156.
- Euomphalopterus* FERD. ROEMER 1876, Leth. Geogn. Atlas. Taf. 14. f. 9. — Type, *E. (Pleurotomaria) alata*, Silurian.
- Euomphalus* SOW. 1814, Min. Conch. vol. 1, 97.
- Euphemus* MAC COY, 1844 Carbonif. Foss. of Ireland, 25. Although M'COY himself later, in Brit. Palæoz. Foss., 308, declared that this genus was identical with *Bellerophon*, the slit band having by oversight been described as deficient, WAAGEN and DE KONINCK have again tried to revive it. But on comparing the species described by both these authors as belonging to *Euphemus*, it is easily found that the *Euphemus* of WAAGEN cannot be reconciled with that of DE KONINCK. While the latter author as *Euphemi* describes *E. Urii* and other *Bellerophons*, WAAGEN makes us acquainted with several forms so strange, that it may be doubted whether they are *Gastropoda* at all or not rather *Cephalopoda* of some new genus.
- Exogyroceras* MEEK and WORTHIEN 1868, Geol. Survey of Illinois, vol. III, 509.
- Fissurella* BRUG. 1789, Encycl. method. vol. I p. XIV, palæozoic according to GOLDFUSS and MAC COY, but JHERING, Moll. p. 78, says that they are met with first in Trias.
- Flemingia* DE KON. 1882, Faune II, III, 94.
- Fusispira* HALL 1870, 24th Rep. St. Museum N. York p. 229.
- Glyptobasis* DE KON. 1883, Faune, II, III, 92. Similar to a *Trochus*.
- Glyptochiton* DE KON. 1883, Faune II, III, 211.
- Gosseletia* DE KON. 1883, Faune II, III, 28. The name is already in 1881 preoc-

- cupied for a Lamellibranchiate by CH. BARROIS in Ann. Soc. Géol. du Nord VIII p. 176. Pleurotomaria.
- Gryphochiton* GRAY, 1847, Proc. Zool. Soc. p. 70. Devon. and Carbon.
- Gyrotrema* BARRANDE 1868, apud BIGSBY. Thes. Silur. p. 167 = Tremanotus. HALL.
- Helcion* MONTFORT 1810, Conch. Syst. II p. 63, applied by some to palæozoic Patellids.
- Helicites* SCHLOTHEIM 1813, Jahrb. VII p. 35. Contains species of different genera, as Euomphalus, Pleurotomaria, Oriostoma.
- Helicotoma* SALTER 1859. Dec. I, Geol. Survey of Canada, 10 = Euomphalus and Pleurotomaria.
- Helminthochiton* SALTER 1846, Proc. Geol. Soc. Lond, 49, 51, 52, f. 6.
- Hercynella* KAYSER 1878, Fauna der ältesten Devonabl. d. Harz, 101. = Piliidium BARR. Mss not FORBES.
- Holopea* HALL 1847, Pal. N. Y. vol. I, 169.
- Holopella* MAC COY 1852, Brit. Pal. Foss., 303.
- Hormotoma* SALTER 1859, Canad. Organ. Remains Dec. I, 18. = Murchisonia.
- Igoceras* HALL 1859, Pal. N. Y. vol. III, 330. = Platyceras.
- Inachus* HISINGER 1838, Lethæa, 37. Name preoccupied for a Crustacean. Consisted of three species of which one, *I. sulcatus*, is a Pleurotomaria, *I. angulatus*, is a Oriostoma and *I. costatus* a Cephalopodous shell, probably a Trochoceras.
- Isonema* MEEK and WORTHEN 1865, Proc. Acad. Nat. Sc. Philad., 251.
- Lepetopsis* WHITFIELD 1882, Bullet. Amer. Museum of Natural. Hist. № 3, 67.
- Litiopsis* EDW. FORBES accord. to SALTER 1866 in Mem. Geol. Survey III, 346 = *Holopea*.
- Litorina* FÉR. 1821, Tabl. System., XXXIV. Several of the palæozoic species, which have been called Cyclonema, were regarded as Litorinæ by PICTET.
- Loricites* CARPENTER accord. to DALL, Proceed. U. S. Nat. Mus. 1882, 281, A Carboniferous Chitonid from Belgium.
- Loxonema* PHIL. 1841, Palæoz. Foss. of Cornwall, 98.
- Luciella* DE KON. 1883, Faune Carbonif. Belgique II, IV, 107. A Pleurotomaria.
- Maclurea* EMMONS 1843, Geol. N. Y. II, 312.
- Maclurita* BLAINVILLE 1825, Malac., 424.
- Maclurites* LE SUEUR 1818, Journ. Ac. N. S. vol. I, 312.
- Macrochilus* (not *Macrocheilus*) PHIL. 1841, Palæoz. Foss., 103.
- Macrochilina* BAYLE 1880, Journ. de Conchyliologie 3 Ser. vol. XX, 241. = *Macrochilus* & *Duncania*.
- Margarita* LEACH 1819, Journ. de Phys. 464, WAAGEN Salt Range Fossils, 111.
- Metoptoma* PHILL. 1836, Geol. Yorkshire pt. 2, 223.
- Michelia* F. A. ROEMER 1854, Palæontographica Bd. 3, 73. Near *Loxonema*.
- Microceras* HALL 1845, Sillim. Journ. vol. 48, 294.
- Microdoma* MEEK and WORTHEN 1866, Philadelphia Proceed. 269.
- Mitchellia* DE KON. 1876, Foss. du Nouv. Galles du Sud I, 128.
- Mogulia* WAAGEN 1880, Salt Range Foss. Palæont. Indica vol. XIII, 131.
- Mourlonia* DE KON. 1883, Faune Carbonif. de Belg., 245. = A Pleurotomaria.
- Murchisonia* D'ARCHIAC & VERNEUIL 1841. Bull. Soc. Géol. XII, 154.
- Narica* RÉCLUZ 1841, according to D'ORB. Moll. Cub. II, 39, used by DE KONINCK 1844, Anim. Terr. Carbonif., 475.



- Nassacites* KRÜGER 1823, Gesch. der Urwelt Th. 2, 417. = *Machrochilina*?
- Natica* ADANSON 1757, Sénégal., 172. D'ORBIGNY and PICTET consider that this genus is represented in the Silurian formation, probably = *Platyceras*.
- Naticella* SWAINSON 1840, Malac., 345. There are species referred to this genus described from the Silurian and Carboniferous formations, but probably belonging to other genera.
- Naticodon* DE RYCKHOLT 1852, Mélanges paléontologiques, 75, in Mém. Cour. Acad. R. d. Sci. de Belgique 1re pt., 75. Carboniferous.
- Naticopsis* MAC COY 1844 Synops. Carbonif. Spec. of Ireland, 33.
- Natiria* DE KON. 1881, Faune Calc. Carbonif. Belg. II, III, 5.
- Nerita* L. 1758 S. N. ed. X, 776, *N. haliotis* Sow. Sil. Syst. = *Platyceras*.
- Neritomopsis* WAAGEN 1880, Pal. Ind. XII, 106.
- Niso* RISSO 1826, Hist. IV, 218. Employed by DE KONINCK in Fossiles Pal. de Nouv. Galles du Sud 1876, 127, for a Devonian species.
- Odontomaria* FERD. ROEMER 1876, Leth. Geogn. 1 Theil. Taf. 29, f. 10, Devonian.
- Omphalotrochus* MEEK 1864, Rept. Geol. Surv. California. Palæont. vol. 1, 16. Related to *Oriostoma*, not a *Pleurotomarian* as DE KONINCK thinks.
- Onychochilus* LINDSTRÖM 1884, Silurian Gastropoda of Gotland, 196.
- Ophileta* VANUXEM 1842, Geol. N. Y. vol. III, 36.
- Oriostoma* MUNIER-CHALMAS 1876, Journal de Conchyl. vol. XVI, 103. Comprises several palæozoic forms which have been regarded as *Euomphali*, without being provided with the characteristic slit in the aperture.
- Orthonema* MEEK & WORTHEN 1861, Proc. Acad. N. Sc. Philad., 146, Carboniferous.
- Orthonychia* HALL 1843, Rept. 4th Distr. N. Y. Geol. Surv., 172. A division of *Platyceras*.
- Orthostoma* CONRAD 1838, Ann. Rep. N. Y., 119. Perhaps a disjointed *Euomphalus*, perhaps a Cephalopod.
- Palæacmæa* HALL 1873, 23d Rept. N. Y. St. Cab., 242.
- Palæotrochus* HALL 1879, Pal. N. Y. vol. V, pt. II, 133.
- Patella* L. 1758, S. N. ed. X, 780.
- Patellostium* WAAGEN 1880, Pal. Ind. XII, 131. One of the Bellerophons.
- Phanerotinus* Sow. 1844, Min. Conch. vol. VII, 29. A very interesting form with disjointed whorls, plano-spiral and a large cristate lamina along the dorsal side. Is it related to the alate *Pleurotomaria*?
- Phasianella* LAMK 1804, Ann. du Muséum, IV, 295. According to WAAGEN Pal. Indica XII, 109, Carboniferous.
- Phorus* MONTFORT 1810, Conch. Syst. II, 158. According to EUDES-DESLONGCHAMPS, Bullet. Soc. Linnéenne de Normandie VI, 146 there is a Devonian species.
- Phragmolithes* CONRAD 1838, Rept. N. Y. Geol. Surv., 119. = *Cyrtolites*.
- Phragmostoma* HALL 1861, 14th Rept. N. Y. State Cab., 94.
- Phymatifer* DE KONINCK 1881, Faune II, III, 149. Related to *Porcellia*.
- Pileopsis* LAMK 1812, »Extrait d'un Cours» etc. according to HERRMANNSEN Index II, 268. Anim. sans Vertebr. 1822, vol. 6, 2 p. 16. The fossil species of LAMARCK are tertiary, the majority is recent.
- Pilidion* BARRANDE 1865, according to BIGSBY. Thes. Silur. 161, 168.
- Pithodea* DE KONINCK 1881, Faune II, III, 88.

- Pitonellus* MONTFORT 1810, Conchyl. System. II, 170.
- Platyceras* CONRAD 1840, Ann. Rept. Geol. Surv. N. Y., 205.
- Platystoma* (not *Platyostoma*) CONR. 1842, Acad. Nat. Sci. Philad. Journ. 1839—42, 275.
- Platy(o)stomella* R. ETHERIDGE jr 1880, Proc. R. Phys. Soc. Edinb., 163, Carbonif.
- Platyschisma* MAC COY 1844, Carbonif. Foss. of Ireland, 38.
- Plectostylus* CONRAD 1842, Journ. Ac. N. Sc. Phil. 1839—42, 275. The name in 1837 preoccupied by BECK for a Helicid shell.
- Pleuronotus* HALL 1879, Pal. N. Y. vol. V, pt. II, 138. = *Euomph.* *Decewi*.
- Pleurotomaria* DE FRANCE 1821 in FÉRUSAC, Tabl. Syst., XXXIV.
- Pleurotomarium* BLAINVILLE 1825, Malac., 429, »male» HERMANNSEN.
- Polyphemopsis* PORTLOCK 1843, Rept. Geol. Londonderry, 415, probably = *Subulites*.
- Polytremaria* D'ORB. 1850. Prodr. I, 122. Carbonif.
- Polytropis* DE KONINCK 1881, Faune II, III, 107. = *Oriostoma*.
- Porcellia* L'ÉVEILLÉ 1835, Mém. Soc. Géol. de France II, 39.
- Portlockia* DE KON. 1881, Faune II, III, 81.
- Priscochiton* BILLINGS 1865, Palæoz. Foss. Canada I, 394. Lower Silurian.
- Probolæum* CARPENTER according to DALL 1882, Proc. N. S. Nat. Mus. 281, a Devonian Chitonid.
- Protalochiton* ROCHEBRUNE 1882, Ann. Soc. Géol. XIV, 30, Carbon.
- Pseudophorus* MEEK 1873, Geol. of Ohio I, 222.
- Pterochiton* CARPENTER according to DALL 1882, Proc. U. S. Nat. Mus. 281, Belgium, Ireland, Carbonif.
- Ptychomphalus* AGASSIZ 1837 in Gröss-Britaniens Mineral Conchologie von James Sowerby. Deutsche Bearbeitung von Ag., 23 and 222,
- Pycnomphalus* LINDSTR. 1884, Silurian Gastropoda of Gotland, 153.
- Rhabdopleura* DE KON. 1881, Faune II, III, 75.
- Rhaphistoma* HALL 1847, Pal. N. Y. I, 28.
- Rhineoderma* DE KON. 1883, Faune II, IV, 103.
- Rhombochiton* DE KON. 1883, Faune II, IV, 206.
- Rotella* LAM. 1822, Hist. VII, 6. According to DE KONINCK a fossil species occurs in the Carbonif. form. of Belgium.
- Rotellina* DE KON. 1883, Faune II, IV, 92.
- Sagmaplæus* OEHLERT 1881, Mém. Soc. Géol. de France 3me Ser. Tome II, 15 a Chitonid.
- Salpingostoma* FERD. ROEMER 1876, Leth. Geogn. Taf. 5, f. 12.
- Scavogyra* WHITFIELD 1877, Palæontology of Wisconsin, 253.
- Scalites* CONRAD 1842, EMMONS Geol. Rep., 312.
- Scissurella* D'ORB. 1823, Mém. Soc. H. N. Par. I, 340.
- Schizostoma* BRONN 1835, Lethæa, Ed. 1 vol. I, 95.
- Scoliostoma* M. BRAUN 1838, N. Jahrbuch, 291.
- Serpularia* A. F. ROEMER 1843, Geol. Harzgebirge, 31. = *Pleurotomaria*.
- Siphonaria* SOW. 1824, Gen. of Shells, pl. 143. Used by BARRANDE according to BIGSBY, Thes. Sil., 168 for a Bohemian Patelloid.
- Solarium* LAMK 1801, Syst. anim. s. vert. 86. DE KONINCK used 1843 this name for *Euomphalus* or *Pleuronotus*.
- Soleniscus* MEEK & WORTHEN 1860, Proc. Ac. N. Sc. Philad., 467, Carbonif.
- Spirorbis*, STEININGER 1831, Bemerkungen über die Verstein. in der Eifel. STEININGERS *Sp. maximus* belongs to the Devonian *Euomphalus*.

- Stachella* WAAGEN 1880, Pal. Ind. XII, 132.
- Stomatella* LAMK 1809, Phil. zool., I, 321.  
Used by BARRANDE accord. to BIGSBY  
Thes. Sil., 168.
- Stomatia* LAMK 1801, Syst. anim. s. vert.,  
96. PICTET and JHERING think that  
there are Silurian species.
- Straparollina* BILLINGS 1865, Palæoz. Foss.  
of Canada, 223.
- Straparolus* MONTFORT 1810, Conch. syst.  
II, 174. Derived from *στρούβός*, tor-  
sus, and Rollus, a barbarous word for  
the French »Rouleau».
- Strobeus* DE KON. 1881, Faune II, III, 25.  
= Elenchus MAC COY not HUMPHREY.
- Strophites* DAWSON 1880, Amer. Journ. Sc.  
& Arts 3d Ser. vol. 20, 412. A De-  
vonian Landshell?
- Strophostylus* HALL 1859, 12th Rept. N. Y.  
St. Cab., 20. Probably a Platyceras.
- Subulites* CONRAD 1842, N. Hist. of N. Y.,  
vol. II, 392.
- Sulcochiton* RYCKHOLT 1862, Journ. Conch.  
X, 259.
- Terebra* ADANSON 1757, Seneg., 49, used  
by SOWERBY for *Loxonema sinuosa*.  
Sil. Syst.
- Trachydomia* MEEK and WORTHEN 1866,  
Geol. Survey Illin. vol. 2, 364. Carbonif.
- Tremanotus* HALL 1868, 20th Rept. N. Y.  
State Cab. 399.
- Trochilites* SCHLOTHEIM 1820, Petrefakten-  
kunde, 156.
- Trochita* SCHUM. 1817, Essai, 184, MAC COY  
Carbonif. Foss. Irel., considers a fossil  
to belong here. There are also other  
palæozoic species by mistake referred  
to this genus.
- Trochonema* SALTER 1859, Canad. Organ.  
Remains I, 27.
- Trochotremaria* RYCKHOLT, Carbonif. of Bel-  
gium according to ZITTEL Palæont. Bd  
1, 2, 181.
- Trochus* L. 1758, S. N. Ed. X, 756.
- Tropidocyclus* DE KONINCK 1882, Mém. Soc.  
Geol. de Belg. t. IX, 12.
- Tropidiscus* MEEK 1866, Proc. Chic. Acad.  
Sc. vol. I, 9. = *Cyrtolites*.
- Tropidodiscus* WAAGEN 1880 Palæont. Indica,  
XIII, 131, name of the former emen-  
dated by WAAGEN.
- Tryblidium* LINDSTRÖM 1880, in Fragmenta  
Silurica, 15.
- Tubina* BARR. 1860, in OWEN Palæonto-  
logy, 71.
- Turbina* DE KONINCK 1881, Faune II, III, 67.
- Turbiniopsis* DE KON. 1881, Ibid. 89.
- Turbinites* SCHLOTH. 1820, Petref.-kunde  
163, WAHLENBERG applied it to several  
species of *Oriostoma*.
- Turbo* L. 1758, S. N. X, 761, PICTET and  
D'ORBIGNY gave this name to several  
of the *Oriostomata* and *Cyclonemata*.
- Turbonellina* DE KON. 1881, Faune II, III, 77.
- Turbonitella* DE KON. 1881, Faune II, III, 72.
- Turritella* LAMK 1801, Syst. anim. s. vert.  
89. Used for *Murchisonia* and other  
spirally wound shells by several au-  
thors.
- Tychonia* DE KON. 1881, Faune II, III, 7.
- Umbonium* LINK 1807, Beschreib. Rostocker  
Samml. III. 136, Devon.
- Vasulites* HERRMANNSEN 1849. Index II, 677,  
cites it as used by MONTFORT in »Suites  
à BUFFONN-SONINI IV, 298.
- Waagenella* DE KONINCK 1883, Faune II, iv.  
Explic. des planches n:o 38, for
- Waagenia* DE KONINCK 1882, Ann. Soc. Geol.  
de Belgique t. IX, 14, which name had  
already been preoccupied.
- Warthia* WAAGEN 1880, Pal. Indica XIII, 131.
- Worthenia* DE KON. 1883, Faune III, iv, 64.
- Xenophora* FISCHER VON WALDHEIM 1806,  
»Museum Demidowianum, 213». MEEK  
and WORTHEN ranked a Carbonif. spe-  
cies in this genus.



PLATE I.

The originals to the figures belong to the Swedish State Museum of Natural History in Stockholm, unless otherwise stated.

## PLATE I.

- Fig. 1—3. *Conularia cancellata* SANDB. pag. 42. Fig. 1 spines on the lowest row with broken points, whence the circular openings, f. 2 part of two transverse ridges highly magnified, f. 3 longitudinal section. The long spines are those on the ridges, the short ones are sections of the ridges where no spines are found.
- » 4—8. *Conularia bilineata* n. p. 45. F. 4 lateral view, f. 5 section near the upper margin, f. 6 surface near the apex magnified, f. 7 the same higher up between the two median septa, f. 8 ornamentation in lower part of the shell.
- » 9—12. *Conularia monile* n., p. 44. F. 11 transverse lines magnified and sectioned longitudinally, f. 12 transverse section of transverse lines.
- » 13—16. *Conularia lavis* n., p. 45. Fig. 15 transverse section of specimen fig. 13., fig. 16 surface of fig. 14 enlarged.
- » 17—24. *Autodetus calyptratus* SCHRENK, p. 185. Fig. 17 shell in its natural position and grown on a Favosites, figs 17 a — 22 other specimens and details of apex and umbilicus, fig. 24 part of the longitudinal section magnified to show the cellular structure outside the whorls.
- » 25—31. *Tryblidium reticulatum* n., p. 55. Fig. 27—28 apex of a young specimen, f. 29 interior stratum with traces of colour bands, f. 30 muscular scars of the inside, f. 31 longitudinal section of the shell.
- » 32. *Patella (Olana) cochlear* L. Recent. Inside to show the muscular scars.
- » 33—37. *Tryblidium unguis* n., p. 56. Fig. 36 inside of apex with oval pit like a scar, f. 37 inside of shell with muscular scars.
- » 38—39. *Nacella deaurata* GMELIN, recent from Foua, to compare the exterior shape with the preceding.







PLATE II.



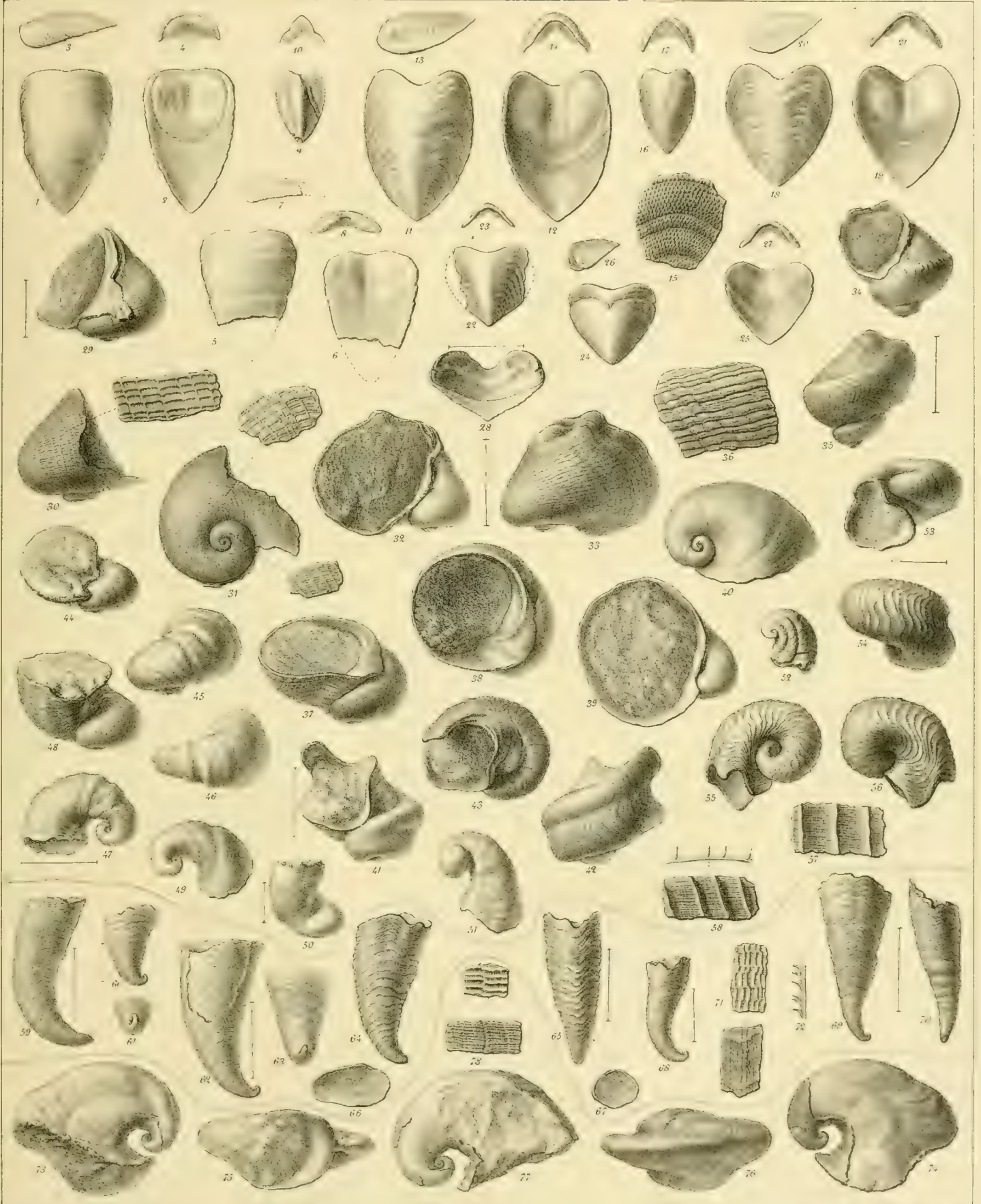




PLATE III.

## PLATE III.

- Fig. 1—5. *Tryblidium reticulatum* n. p. 55. Fig. 1 & 2 microscopical vertical and horizontal sections of the shell, showing its strata perforated by tubes of unknown, parasitic organism, f. 3 another vertical section, f. 4 vertical section with apparently tubular structure, formed by small depressions or pits on the surface of the shelly strata, f. 5 surface of shell from the margin of the aperture, magnified; the elevated, white dots being the filled up tubes of the parasitic organism.
- » 6—9. *Platyceras cornutum* His. p. 63. Fig. 6 from Klinteberg, with aperture evidently moulded after the surface of some other organism on which it had been fixed, f. 7—9 from Wisby.
- » 10—18. *Platyceras prototypum* PHILL. p. 67. Fig. 10—10 a from Klinteberg, f. 11—12 from the shale of Wisby, identical in ornamentation with specimens of *Platystoma niagarensis*, f. 13—14 from the hill of Sandarfve, f. 15 ornamentation of the same and profile of a transverse ridge, f. 16 a pair of its apertural lamellæ, f. 17 vertical section of seventeen lamellæ, as they were left *in situ* imbedded in soft limestone, slightly magnified, f. 18 one of the lamellæ highly magnified to show its intimate structure.
- » 19—26. *Platyceras cornutum* His. p. 63. Fig. 19—22 vertical sections of the shell, f. 23 interior surface of the shell seen under the microscope; f. 24 part of the same still more magnified, f. 25—26 horizontal sections of the shell.
- » 27—31. *Oriostoma helicinum* n. p. 170, from the canal near Westöös in Hall.
- » 32—34. *Craspedostoma spinulosum* n. p. 182, from Hoburg, f. 34 nat. size.
- » 35—38. *Bellerophon sphaera* n. p. 74, from the shale of Wisby.
- » 39—40. *Tremanotus longitudinalis* n. p. 86, from Lutterhorn in Fårö, with apertural expansions left *in situ*.

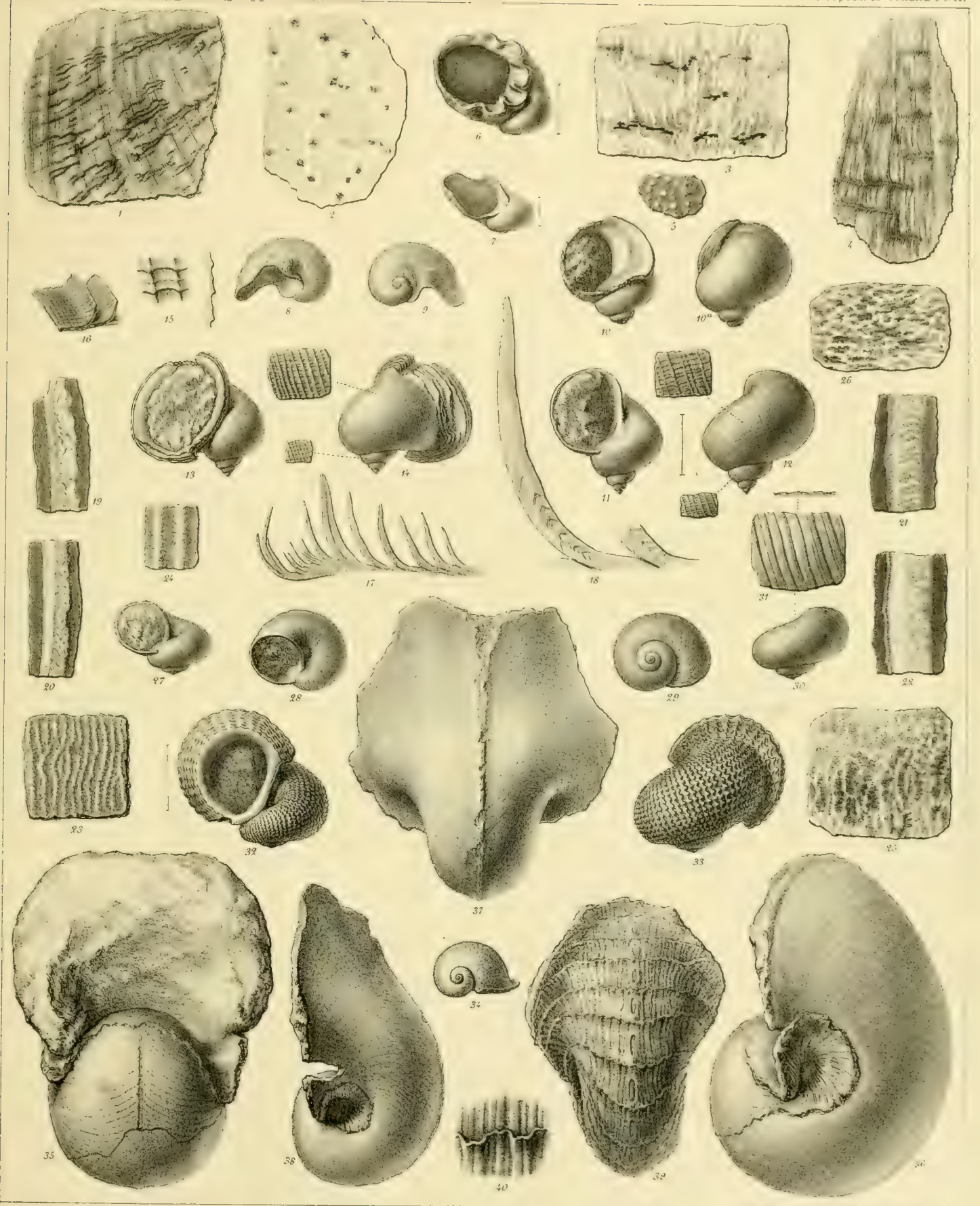






PLATE IV.

PLATE IV.

- Fig. 1— 7. *Tremanotus longitudinalis* n. p. 86, all specimens from Wisby, f. 5 dorsal keel with apertures, from a cast, f. 6 magnified details of the same, showing septa like, curved lines, going transversally, marking where apertural lamellæ have been situated.
- » 8—12. *Tremanotus compressus* n. p. 87, from Östergarn.
- » 13—15. *Bellerophon trilobatus* Sow., p. 80, from Petesvik, Habblingbo.
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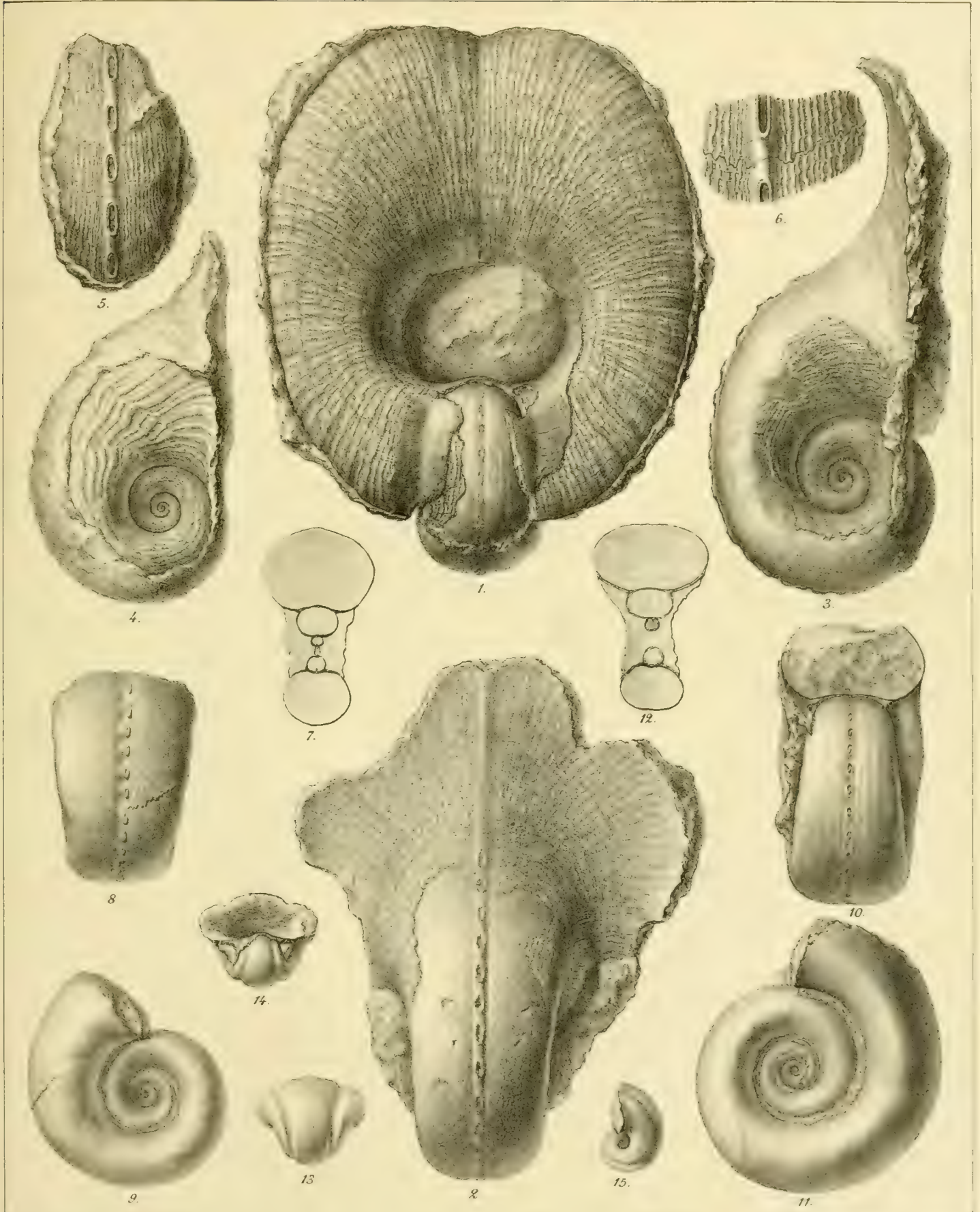




PLATE V.

PLATE V.

- Fig. 1—16. *Bellerophon sphæra* n., p. 74. Fig. 3 cast of »dorsal» part with the elevated slit band and section of the same, f. 4 the same from the side, f. 7, surface of a variety with lateral view and section, f. 8 slit band enlarged, f. 10 section of the innermost whorls, with the hooklike lamellæ of the surface, f. 12 section of a large specimen with exceedingly thick walls around the umbilicus, f. 13—16 details of surface sculpture around the umbilicus.
- » 17—24. *Bellerophon squamosus* n., p. 78. Fig. 17—19 specimen in nat. size, f. 20 smaller specimen in natural size and its slit band in f. 21, f. 23 section of the shell with the thin lamellar processes from the lines of growth, f. 24 curves formed by the extreme edges of these lines of growth, sectioned horizontally.
- » 25—34. *Bellerophon globulus* n., p. 75. Fig. 34 enlarged view of the umbilicus.
-

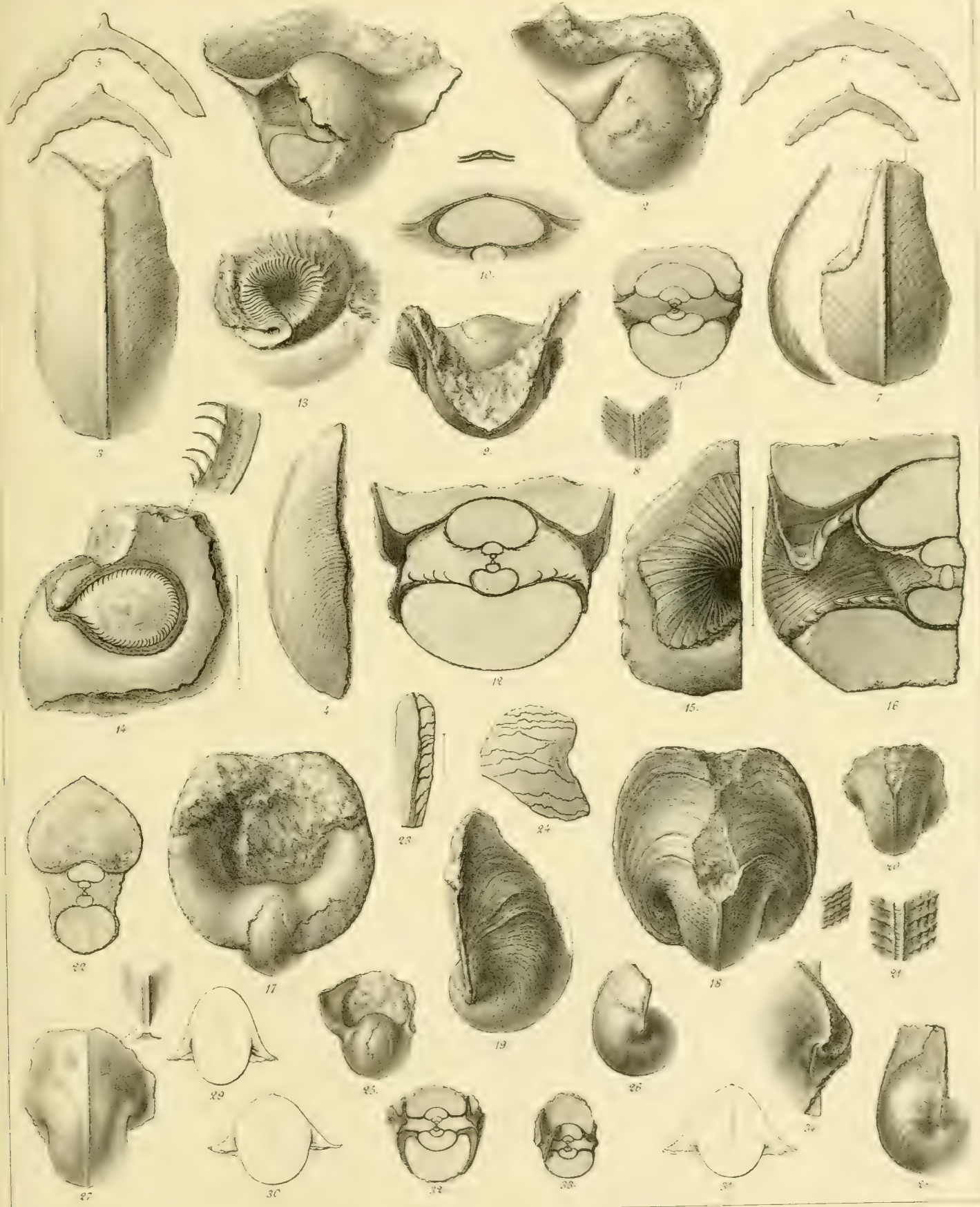






PLATE VI.

## PLATE VI.

- Fig. 1—10. *Bellerophon fastigiatus* n., p. 76. Fig. 10 side of the largest whorl.  
 » 11—12. » undetermined species, p. 77, sections showing the great obliquity of the shell.  
 » 13—14. » *fasciatus* n. p. 75.  
 » 15—18. » *elegantulus* n. p. 79.  
 » 19—21. » *Eiseni* n. p. 78.  
 » 22—25. » *tænia* n. p. 76. Specimens from Östergarn, original to f. 22 belongs to the  
 Museum of the School of Wisby.  
 » 26—28. *Bellerophon latevittatus* n., p. 79.  
 » 29—30. » *pilula* n. p. 80.  
 » 31—38. *Cyrtolites lamellifer* n. p. 82, f. 37 details of ornamentation and lateral view of the outstanding  
 lamellæ, f. 38 the slit band near the aperture, much magnified.  
 » 39—51. *Cyrtolites pharetra* n. p. 83. Fig. 39 specimen with traces of colour bands, magnified, f. 43  
 lower lip of the aperture, f. 50 groove beneath the inferior apertural lip, in which the apex  
 of the shell is lodged.  
 » 52—53. *Cyrtolites arrosus* n., p. 83.  
 » 54—55. » *obliquus* n., p. 84.
-





PLATE VII.

## PLATE VII.

- Fig. 1—3. *Conularia aspersa* n. p. 46.  
 " 4—5. *Bellerophon tænia* n. p. 76. The original specimen belongs to the Mineralogical Museum of the University of Copenhagen, from Östergarn.  
 " 6—8. *Bellerophon latevittatus* n. p. 79. Nuclei from the shale of Wisby, with a peculiar, transverse, necklike constriction.  
 " 9. *Bellerophon sphaera* n., p. 74. Microscopic, vertical section of the shell.  
 " 10—15. *Cyrtolites euryomphalus* n. p. 84.  
 " 16—17. " *orbiculus* n., p. 85.  
 " 18—21. " *discus* n. p. 84, the original specimen belongs to the Museum of the Geological Survey of Sweden.  
 " 22. *Platyceras cyathinum* n. p. 69.  
 " 23—25. *Pleurotomaria scutulata* n. p. 95.  
 " 26—27. " *gradata* n. p. 96.  
 " 28—30. " *scutulata* n. p. 95. Fig. 28—29 from Samsugn, f. 30 from Follingbo.  
 " 31—36. " *claustrata* n. p. 97. The original specimen of f. 34 belongs to the Mineralogical Museum of Copenhagen.  
 " 37—38. *Pleurotomaria glandiformis* n. p. 98.  
 " 39—42. " *biformis* n. p. 98. Fig. 42 magnified details of slit band.  
 " 43—49. " *Lloydi* Sow. p. 101, f. 43—44 from Djupvik, Eksta, f. 45—46 from Petesvik in Habblingbo, 47—49 from Wisby.







PLATE VIII.

PLATE VIII.

- Fig. 1. *Pleurotomaria Lloydii* Sow., p. 101.  
 » 2—7.       »       *robusta*, n. p. 103. Specimen from Eksta.  
 » 8—9.       »       "       var. *lavissima* n. p. 104.  
 » 10—14.     »       *elliptica* His., p. 104, f. 10—11 from Wisby, 12—13 from Östergarn. Fig. 14 slit  
                   band magnified and section of it, from Lerkaka in Öland.  
 » 15—25. *Pleurotomaria bicincta* HALL, p. 106. Fig. 15—16 specimen from Westergarn, f. 17 from  
                   Borkholm in Esthonia, belonging to the Mineral Cabinet of the University of Upsala, f. 18—19  
                   large specimen in natural size from the limestone of Slite, belonging to the Marklinian  
                   Collection of Upsala, f. 20 specimen natur. size from Ardre, f. 21—22 details of slit  
                   band, specimens from Follingbo, f. 23 slit band of specimen from Fårö, f. 24—25 from  
                   Gotheinshammar.
-





PLATE IX.

## PLATE IX.

- Fig. 1—3. *Pleurotomaria dolium* n., p. 102.  
 » 4—6.        »     *laqueata* n., p. 102, f. 4 the original specimen belongs to the Museum of the  
                   School of Wisby, f. 5—6 from Klinteberg.  
 » 7—10. *Pleurotomaria tubulosa* n., p. 103 from Kräklingbo.  
 » 11—13.        »     *valida* n. p. 110.  
 » 14—17.        »     *Othemensis* n. p. 111, f. 17 the umbilicus seen from above.  
 » 18—19.        »     *comata* n. p. 111 from Eksta.  
 » 20—29.        »     *aequilatera* WAHLENBERG p. 111, f. 20—22 the original specimen of WAHLENBERG  
                   from the Mineralogical Cabinet of the University of Upsala, somewhat restored as to the  
                   aperture and sections of the slit band, f. 23—24 from Kyrkberget in Wisby, f. 25—26 from  
                   the shale of Wisby, f. 27 ventricose variety from Samsugn in Othem, belonging to the Min.  
                   Cab. University of Upsala, f. 28 from Samsugn in Othem, f. 29 section of two whorls to  
                   show the shape and place of the slit band.  
 » 30—38. *Pleurotomaria labrosa* HALL, p. 113, fig. 30—36 from Westergarn, f. 37—38 from Klints  
                   in Boge. Fig. 36 section along the median axis of the slit band.
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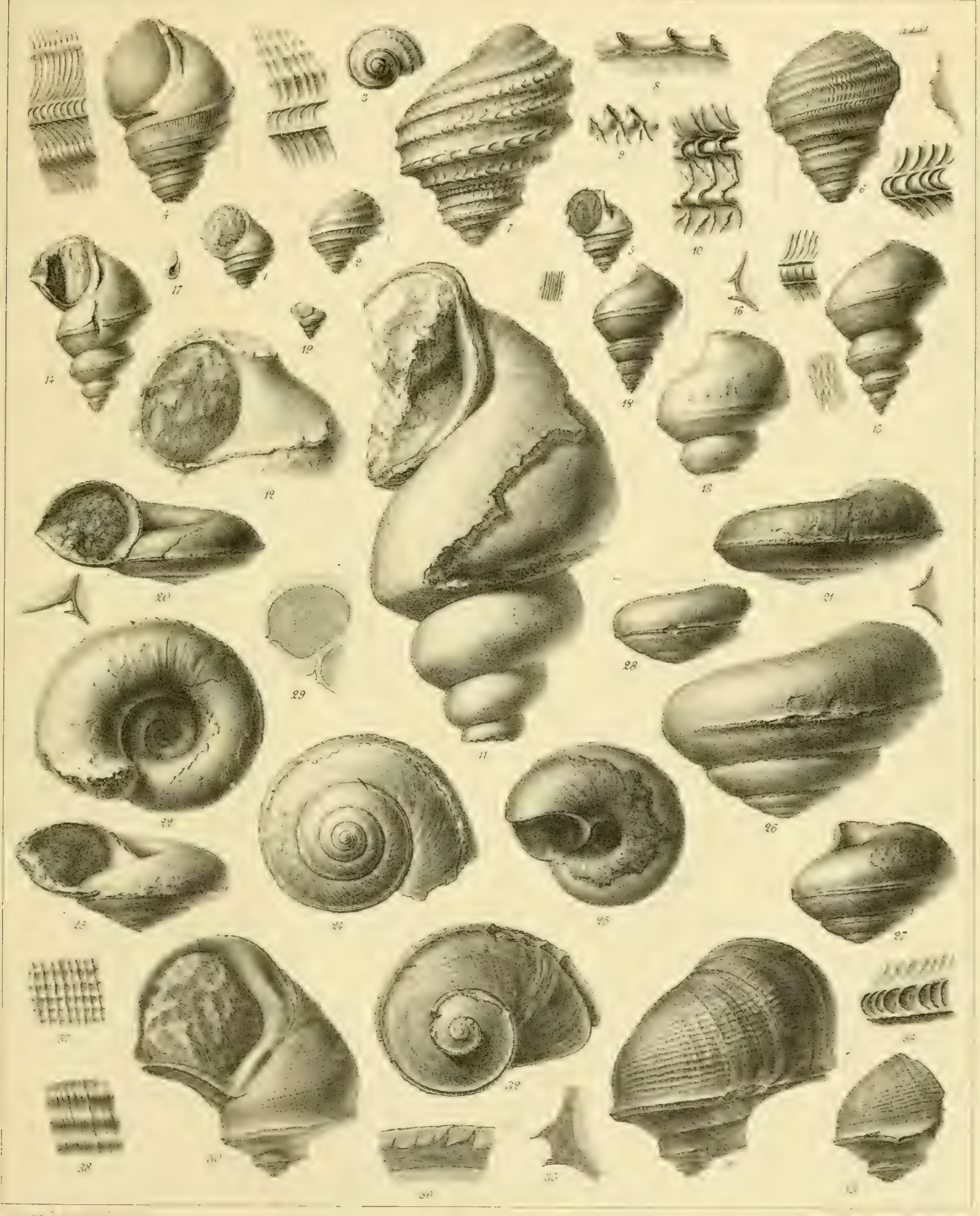






PLATE X.

## PLATE X.

- Fig. 1. *Pleurotomaria latezonata* n., p. 99.  
 » 2—17.       »       *limata* n., p. 114, f. 2—5 from Klinteberg, f. 6—9 from the middle limestone strata of Wisby, f. 10—11 variety from the canal near Westöös in Hall, f. 12 specimen from Wisby seen from the umbilical side with a largely developed slit band, f. 13 details of ornamentation of the slit band and the surface around the umbilicus, f. 14 transverse section of the slit band, imbedded in fine grained rock, f. 15—16 slit band of two different specimens, magnified, f. 17, part of a slit band cloven in two parts along its median line to show how the crescentic lamellæ continue outward to the thin bordering lines.  
 » 18—32. *Pleurotomaria alata* His., p. 116. All the originals to the figures from Wisby. Fig. 23, near the aperture the crescentic lamellæ between the bordering laminæ are conspicuous as black lines below the surface and they are partially restored by dotted lines where they have been broken away, f. 24 inferior surface showing the wavy edge of the slit band, f. 25 ornamentation of umbilical surface, f. 27 details to elucidate the structure of the slit band, f. 28 ornamentation of apical surface from a specimen with a ridge, f. 30 transversally sectioned slit band, magnified, f. 31 extreme edge of a slit band, f. 32 variety from Wisby with downwards and inwards curved slit band.  
 » 33—37. *Pleurotomaria alata*, var. *subcarinata* n., p. 118, f. 33 specimen from Lingsarfve in Näs, enclosed in an oolitic nodule, figs 34—37 from Djupvik in Eksta.  
 » 38—40. *Pleurotomaria alata*, var. *opposita* n., p. 119, from Habblingbo, f. 39 apical side of body whorl and part of next whorl, f. 40 ornamentation of umbilical side and slit band.





PLATE XI.

## PLATE XI.

- Fig. 1—7. *Pleurotomaria prætecta* n., p. 119. Fig. 5 the slit band cloven, the lower stratum shows the oblique, crescentic lamellæ of the slit band. Fig. 7 part of the surface around the slit band and its both parallel ridges.
- » 8—13. *Pleurotomaria togata* n., p. 119. Fig. 12 part of apical surface from the suture to the rim of the slit band, f. 13 longitudinal section along the whorls.
- » 14. *Pleurotomaria frenata* n., p. 120.
- » 15—23. " *undulans* n., p. 120. Fig. 21 with details of the structure of the slit band. Fig. 22 slit band sectioned along the outer rim, f. 23 slit band sectioned transversally.
- » 24—26. *Pleurotomaria Marklini* n., p. 121.
- » 27—29. " *cirrhosa* n., p. 121 longitudinal section, f. 29 part of apical surface with the thin, wavy slit band sorded to the body whorl, f. 28 section of the same.
- » 30—33. *Pleurotomaria exquisita* n., p. 125, f. 33 section of two whorls showing how the superior one is overlaying the inferior.
- » 34—37. *Pleurotomaria helicina* n., p. 124.

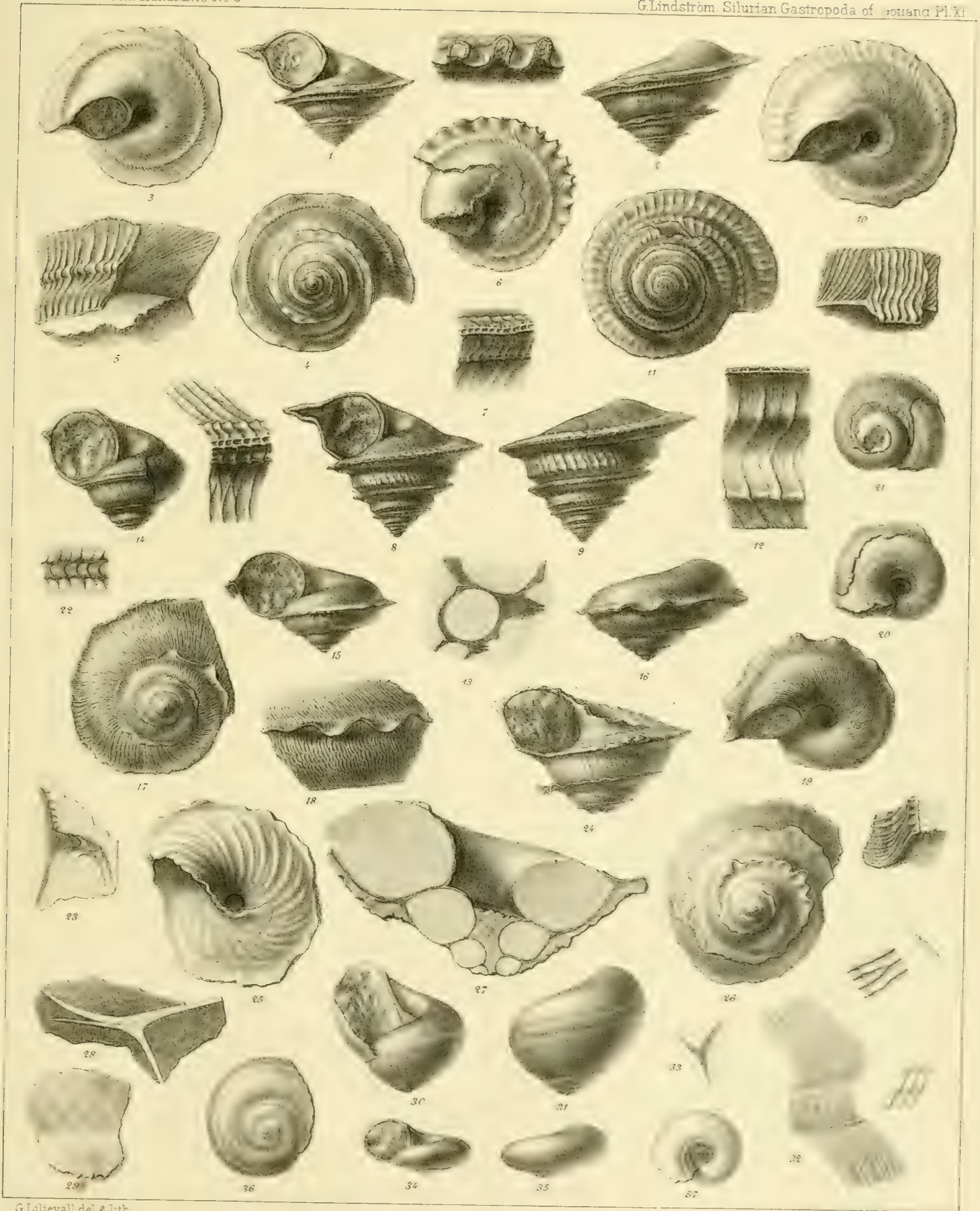






PLATE XII.

## PLATE XII.

- Fig. 1—3. *Pleurotomaria cirrhosa* n., p. 121, specimen from Östergarn, with details of surface.  
 » 4. *Murchisonia cava* n., p. 128, from Martebo and details of the slit band.  
 » 5—6.        »       *moniliformis* n., p. 128, from the sandstone of Bursvik.  
 » 7.            »       *obtusangula* n., p. 128.  
 » 8.            »       *subplicata* n., p. 129.  
 » 9—10.       »       *cingulata* Hrs. p. 127, f. 9 the type specimen of HISINGER, which he delineated  
                   in »Lethæa Suecica» on pl. XI fig. 6 a. In natural size.  
 » 11—12. *Murchisonia obtusangula* n., p. 128.  
 » 13—14.       »       *crispa* n., p. 131.  
 » 15—19.       »       *compressa* n., p. 129. Fig. 15, nucleus with traces of sculpture, fig. 17 one  
                   of the largest nuclei with an obtuse end above the filled up apex, fig. 18 longitudinal  
                   section along the median axis, fig. 19 transverse section of the apex, showing the dark  
                   apical whorls, filled with organic deposit, and the lighter nucleus of the younger whorls.  
 » 20—24. *Murchisonia attenuata* HISINGER p. 130.
-





PLATE XIII.

## PLATE XIII.

- Fig. 1. *Murchisonia cancellata* n., p. 133.  
 » 2—3.        » *cochleata* n., p. 134.  
 » 4—5.        » *tortuosa* n., p. 132.  
 » 6.            » *munda* n., p. 132.  
 » 7—12.       » *imbricata* n., p. 133. Fig. 7 slender, finely striated variety; fig. 8 the thicker and more coarsely striated, f. 9—12 details of aperture, umbilical region and slit band.  
 » 13—14. *Murchisonia tortuosa* n., p. 132.  
 » 15—16. *Pleurotomaria qualteriata* SCHLOTH., p. 108. Fig. 15 from the shale of Wisby. Fig. 16 ornamentation and slit band in specimen from Lerkaka, Öland.  
 » 17—18. *Pleurotomaria obvallata* WAHLENB., p. 108. Fig. 17 section of the shell, f. 18, details of the slit band; lowest figure, slit band on the apical side; middle figure, section of the edge, uppermost figure, slit band from the umbilical side. From specimens belonging to the Museum of the Geol. Survey of Sweden from the upper gray Orthoceratite Limestone at Wångsgärdet in Dalecarlia.  
 » 19—31. *Euomphalus Gotlandicus* n., p. 139. Fig. 19—25 specimens from the shale of Wisby. Fig. 26—29 evolute specimens from Kyrkberget in Wisby, the nucleus lying beside the shell, the apex of which is filled with organic deposit; fig. 30—31 from Westergarn.  
 » 32—35. *Euomphalus triquetrus* n., p. 140.  
 » 36—38.        » *Angelini* n., p. 138. Lower Silurian from the inferior gray Orthoceratite Limestone at Utby, Lindgården in Dalecarlia, fig. 38 sculpture on the lateral surface.  
 » 39—44. *Pleurotomaria replicata* n., p. 116. Fig. 39 from the aperture, apical side downwards, f. 40 from the umbilical side, f. 42 slit band magnified, interiorly the oblique crescentic lamellæ are seen, f. 43 transverse section of slit band, f. 44 slit band along its exterior edge.







PLATE XIV.

## PLATE XIV.

- Fig. 1—11. *Trochus Gotlandicus* n., p. 146, fig. 1—2 from Kyrkberget, Wisby, 3 from the limestone (b.) of Wisby, 4—7 from the canal near Westöös in Hall, f. 8, var. without ridge from Kyrkberget in Wisby, f. 9 microscopical section of the shell, f. 10—11 from the limestone of Wisby.
- „ 12—13. *Trochus fulminatus* n., p. 147.
- „ 14—17. „ *mollis* n., p. 147, f. 14—16 from Klinteberg, f. 17 from Samsugn.
- „ 18—21. „ *Dalli* n., p. 150.
- „ 22—31. „ *incisus* n., p. 151. Fig. 22—23 from Kyrkberget in Wisby; f. 24—25 from Samsugn in Othem; f. 26—30 from Stor Wede in Föllingbo; f. 31 from Kyrkberget in Wisby.
- „ 32—34. *Trochus Kolmodini* n., p. 150.
- „ 35—43. „ *Wisbyensis* n., p. 150. All species from the limestone of Wisby, excepting f. 43 from the canal near Westöös in Hall.
- „ 44. *Trochus lamellosus* n., p. 151.
- „ 45. „ *Wisbyensis* n., p. 150.
- „ 46—53. „ *Lundgreni* n., p. 149, fig. 46—50 from Samsugn in Othem, f. 51 from Lutterhorn in Färö, f. 52 transverse section of the keel showing different lines of growth hidden inside it, f. 53 the keel from without.
- „ 54—58. *Trochus astraliiformis* n., p. 153, from Klinteberg, specimens figures 56—57, belonging to the Marklinian Collection in Upsala.
- „ 59—69. *Trochus Stuxbergi* n., p. 147. Fig. 59—61 from Klinteberg, f. 62—69 from Samsugn in Othem.

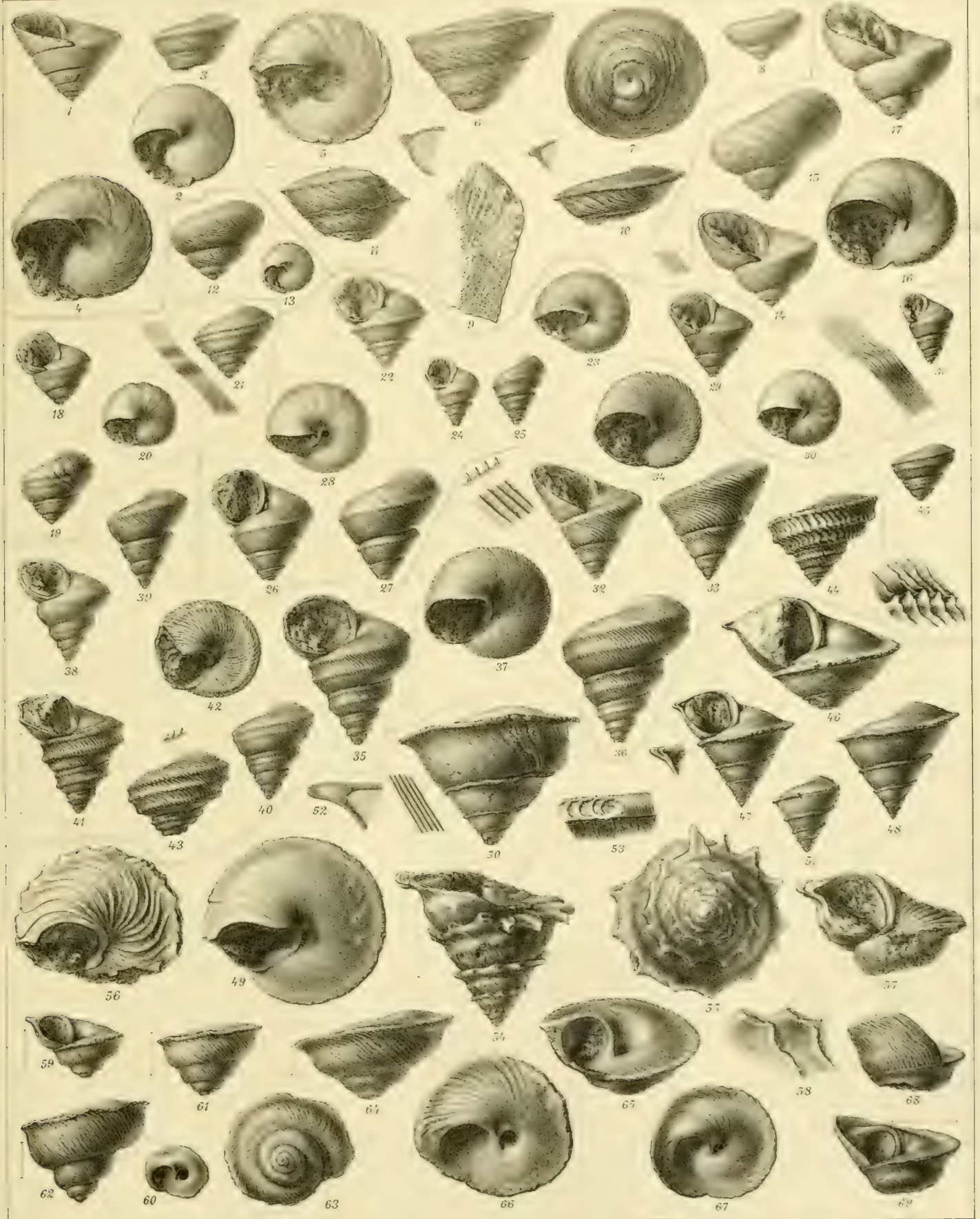
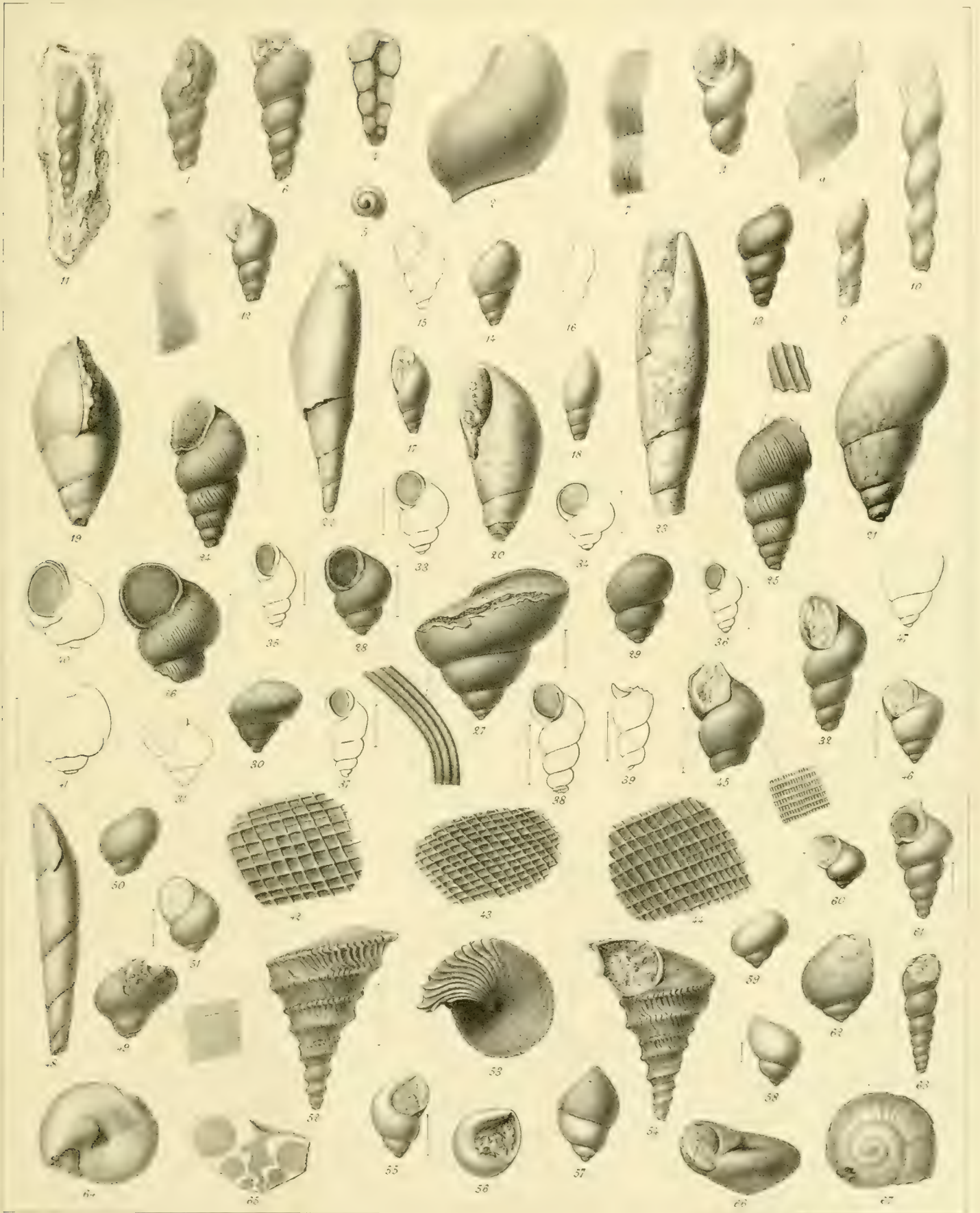




PLATE XV.

## PLATE XV.

- Fig. 1 — 5. *Loxonema sinuosum* Sow. p. 142, from Djupvik, Eksta.  
 » 6.            »   *intumescens* n., p. 143.  
 » 7.            »   *sinuosum* Sow.  
 » 8 —10.       »   *strangulatum* n., p. 144, f. 8—9 from Klinteberg, f. 10 from Östergarn.  
 » 11.           »   *fasciatum* n., p. 144.  
 » 12—13. *Holopella regularis* n., p. 190. The original belongs to Adjunct M. KLINTBERG in Wisby.  
 » 14—16. *Macrochilina bulimina* n., p. 191.  
 » 17—18.       »   *fenestrata* n., p. 192.  
 » 19—21. *Subulites ventricosus* HALL p. 193.  
 » 22—23.       »   *attenuatus* n., p. 194.  
 » 24—26. *Callonema scalariforme* n., p. 189. The original to fig. 26 is preserved in the Museum of the School of Wisby.  
 » 27.       *Callonema obesum* n., p. 189. The original belongs to the Mineralogical Museum of the University of Copenhagen.  
 » 28—44. *Cyclonema delicatulum* n., p. 174. The original to fig. 30—31 belongs to Hr H. HEDSTRÖM in Wisby.  
 » 45.       Probably a corroded specimen of the former.  
 » 46—47. *Holopea applanata* n., p. 188.  
 » 48.       *Subulites attenuatus* n., var. p. 194.  
 » 49.       *Cyclonema adstrictum* n., p. 178.  
 » 50—51. *Holopea nitidissima* n., p. 188.  
 » 52—54. *Trochus? lamellosus* var. p. 151. The original from the Mineralogical Cabinet of the University of Upsala.  
 » 55—58. *Onychochilus physa* n., p. 196. The originals from the Min. Cab. of the Univ. of Upsala.  
 » 59—60. *Holopea transversa* n., p. 188.  
 » 61.       *Holopella teres* n., p. 190.  
 » 62.       *Holopea mux* n., p. 187.  
 » 63.       *Holopella minuta* n., p. 190.  
 » 64—67. *Pycnomphalus obesus* n., p. 153.



G. Liljevall del. f. 24-26, 28-44 C. Hedehn del. f. 1-23, 27, 45-67





PLATE XVI.

## PLATE XVI.

- Fig. 1—6. *Pycnophalus acutus* n., p. 154. From Wialmsudd.  
" 7. " *trochiformis* n., p. 154. The original belongs to the Museum of the School of Wisby.  
" 8—10. *Trochus undulans* n., p. 148. Fig. 8 from Samsugn. Fig. 9—10 from Slite.  
" 11—13. " *profundus* n., p. 148. This species is probably rather to be considered as an Onustus.  
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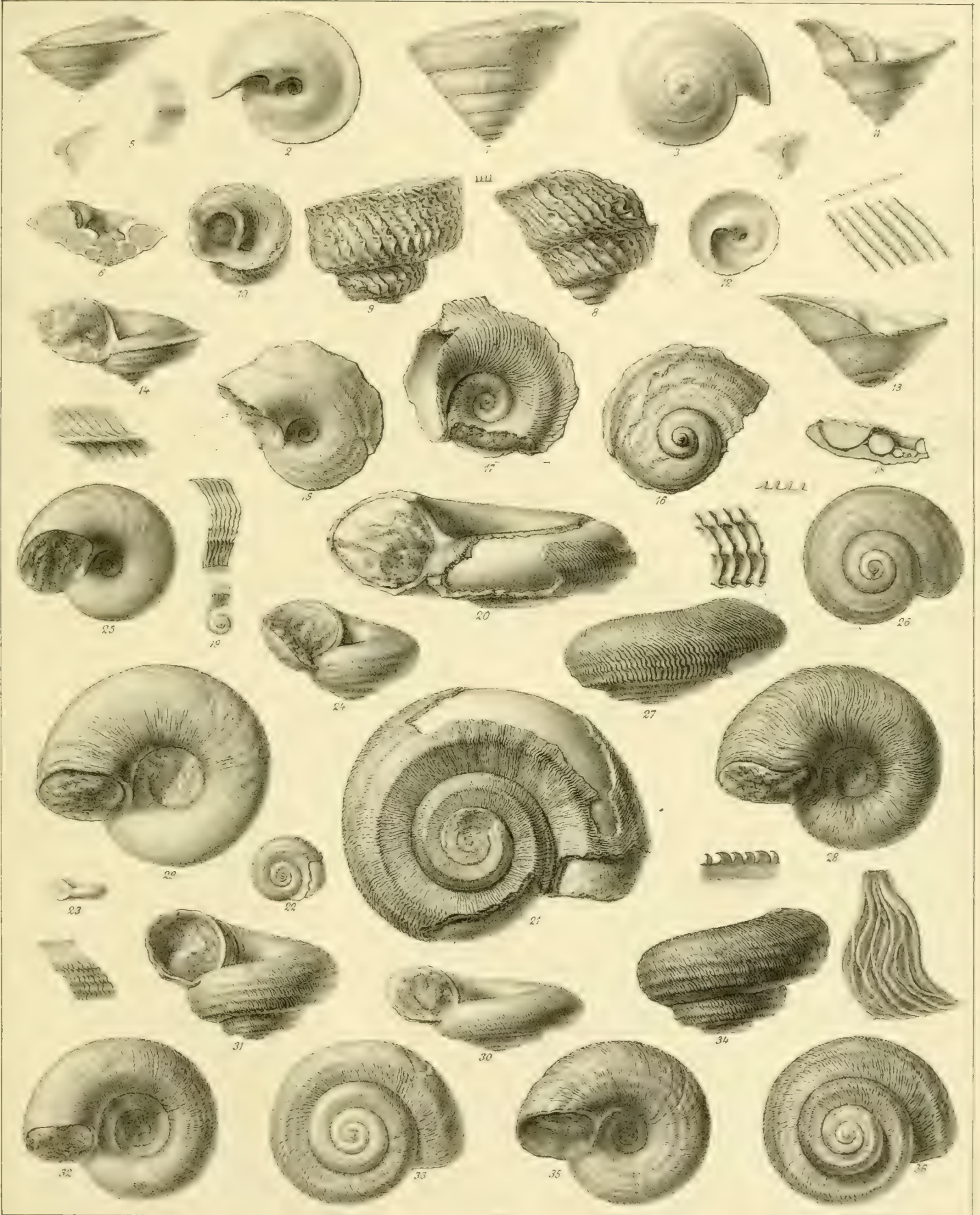
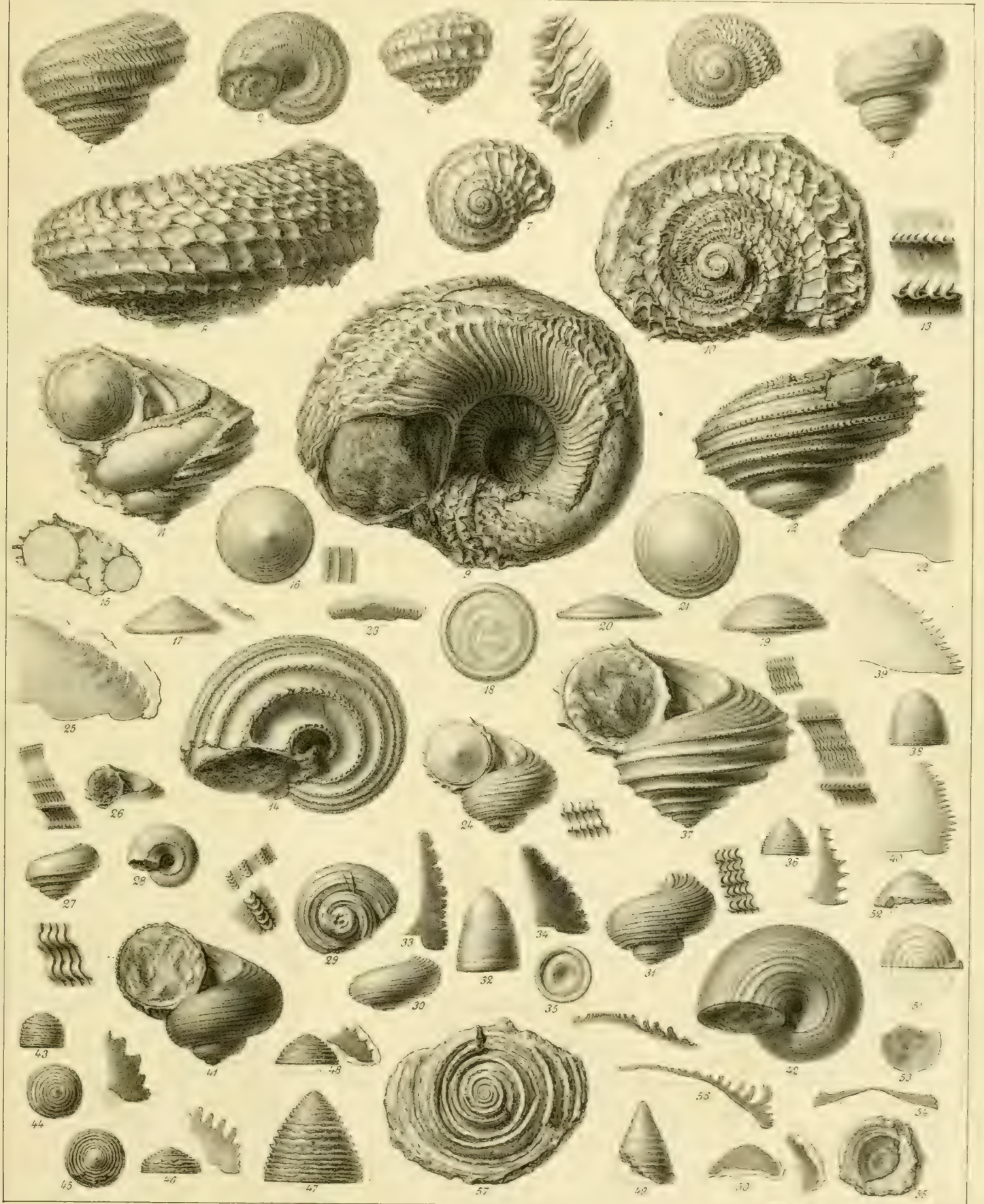




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G. Liljevall, del. & lith.

Central-tryckeriet Stockholm.





PLATE XVIII.

## PLATE XVIII.

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C. Hedehn del.



PLATE XIX.

## PLATE XIX.

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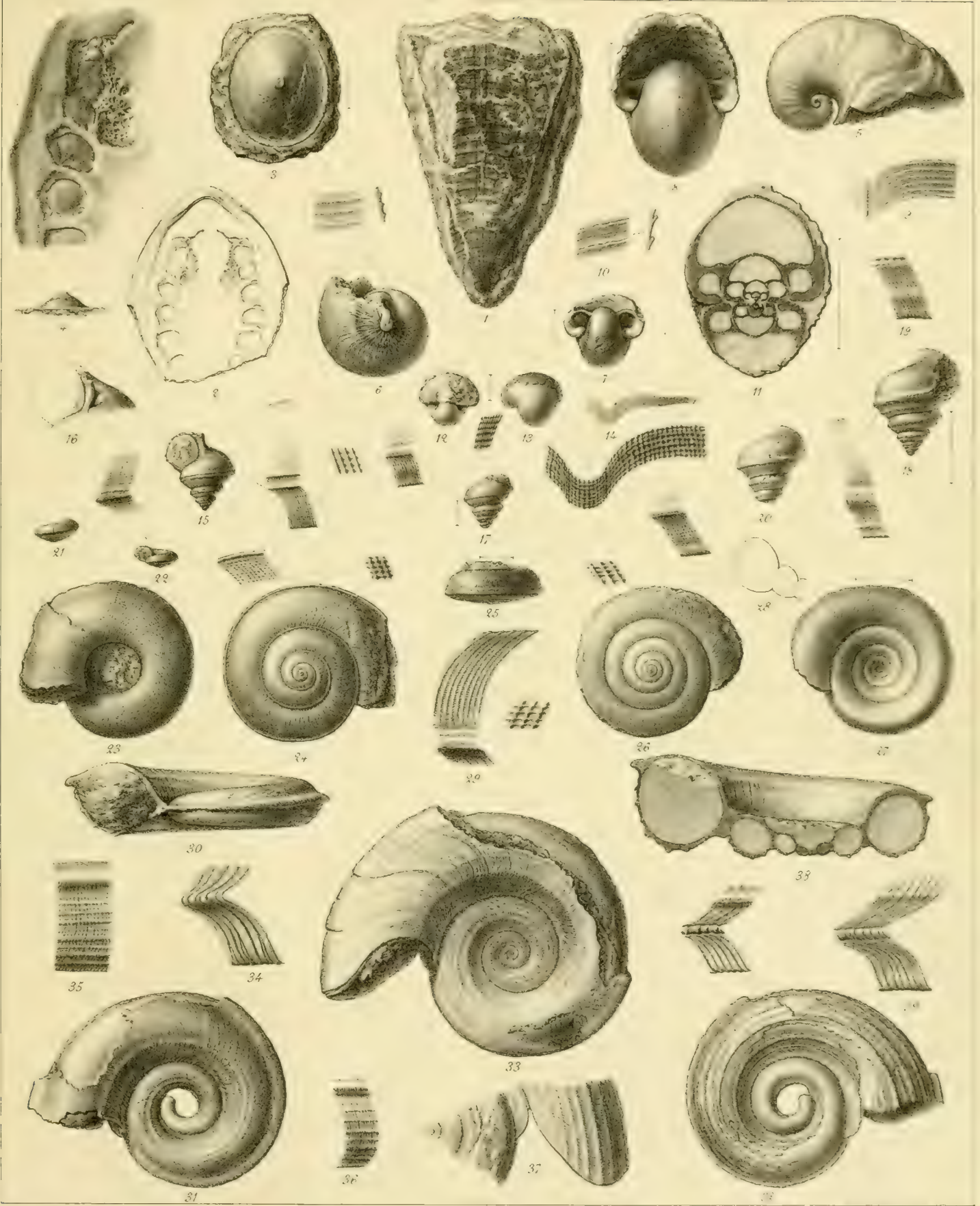






PLATE XX.

## PLATE XX.

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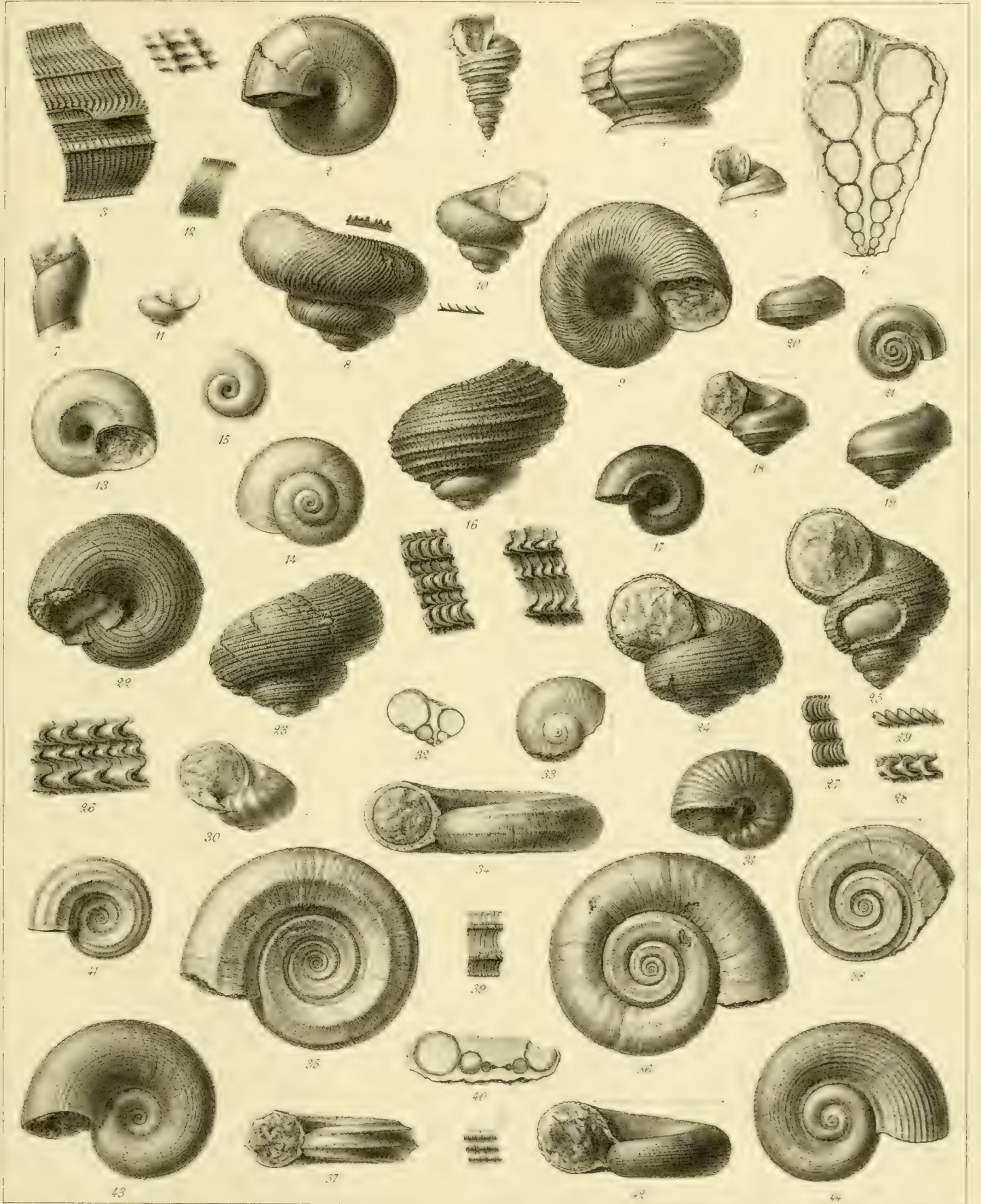




PLATE XXI.

## PLATE XXI.

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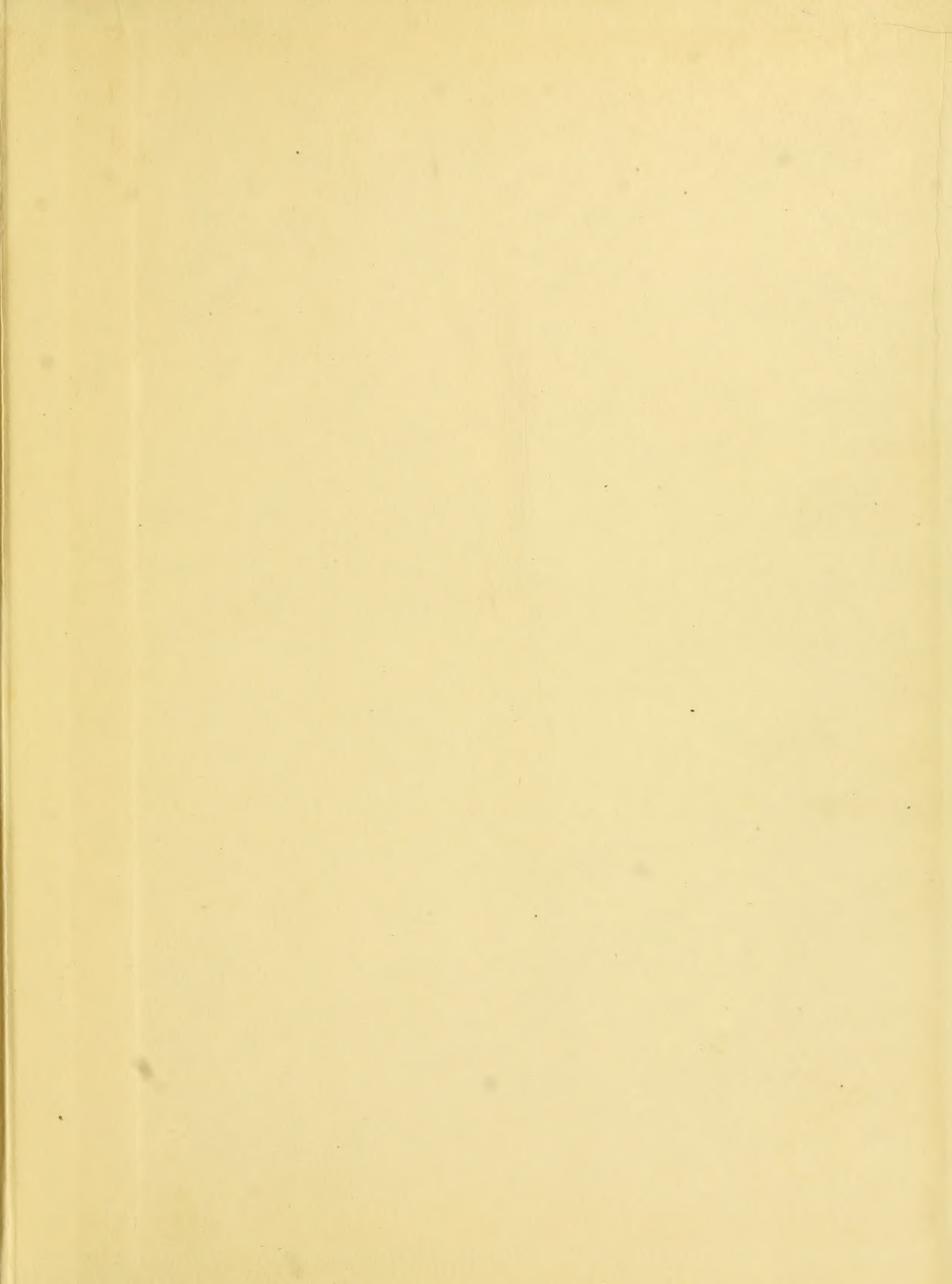
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