

tory of Gothland, where the preceding section terminates; showing how the same sandstone (*i*) which occupies the surface of the plateau at Gröttingbo on the N., is here brought down to the sea level; thus proving a general southerly inclination. The overlying calcareous strata (*j*, *k*, and *k**) are described in the memoir.

Fig. 13. General section from E. to W. across Scania. This is merely given to indicate, as far as possible, the successive outcrops of Lower and Upper Silurian rocks in a low obscure tract much covered with mud, rolled blocks and gravel (*bl*). The Lower Silurian sandstone (*a*) is partially seen, the alum schist (*b*) with its fine trilobites is copiously exposed, but the prevailing Swedish and Russian Orthoceratite limestone with *Cystidea* is no where seen, its place being taken by an occasional thin course of black limestone subordinate to graptolite schists (*d*). The Upper Silurian rocks are recognizable in grey limestones and shales (*f*, &c.) which are surmounted by purple sandstones containing casts of *Cypricardiæ* and other fossils apparently belonging to the uppermost zone of the Ludlow rocks. The porphyry of Ofved Kloster is marked (*p*).

JUNE 17, 1846.

George Aug. M. Dermott, Esq., and Thomas Macdougall Smith, Esq., were elected Fellows of this Society.

The following communications were read:—

1. *Description of a Fossil CHITON from the Silurian Rocks, with remarks on the fossil species of the genus.* By J. W. SALTER, Esq., F.G.S., of the Geological Survey of Great Britain.

THE discovery of a species of Chiton in beds of undoubted Silurian age appears to be a fact sufficiently important to be brought under the notice of the Geological Society, not only from the rarity of the genus in a fossil state, but because it carries back to an earlier date another of the many families we are in the habit of considering as characteristic of later epochs. The shell I have now to describe presents peculiarities distinguishing it both from recent species, and also from those found in the carboniferous rocks. In introducing the subject I propose to glance at the ordinary characters of the family, for so this group must be considered, in order to show the relation of the fossil with the living species.

The Chiton is one of the lowest forms of Gasteropodous Mollusca, and is considered by naturalists as closely allied to the genera *Patella* and *Lottia*, and as forming with them a distinct order of Mollusca under the name of *Cyclobranchia* (Cuvier), distinguished by the arrangement of the branchiæ. The Chitons have a double generative system, terminating (according to Blainville and Rang) on either side of the body. This is a very marked character, and one indicating strongly the low position the group holds in the order to which it belongs. The shell is of course the only part with which we have to do (in treating of fossil species), and its variations are fortunately

accompanied by differences in the structure of the mantle and the thickness or expansion of the entire form.

Lamarck had long ago described a tertiary species, *C. grignonensis*, figured by Deshayes; and Cantraine, in his 'Malacologie Mediterr. et littorale,' added another, *C. subapenninus*, from Italy. As both these belong to the common form of Chiton, no more need be said of them. Count Münster in his 'Beiträge' first described a species from the carboniferous strata of Tournay, under the name of *Chiton priscus*, and from detached valves, which are very numerous there, he reconstructed the shell (fig. 2). Dr. Sandberger added two species from the Devonian rocks of Vilmar, *C. fasciatus* and *C. subgranosus*, and subsequently De Koninck figured two more new ones, *C. gemmatus* and *C. concentricus*, adding a third, *C. cordifer*, which however by his own consent is now admitted to be an Encrinital plate. These eight species were all that were known fossil, until very lately the Baron de Ryckholt described ten additional ones from the carboniferous and Devonian rocks of Tournay and Visè. The notice of these appears in an elaborate paper on the external structure of the shell, in which rules are given for reconstructing the entire shell, when only one or part of one cerame or plate is discovered*.

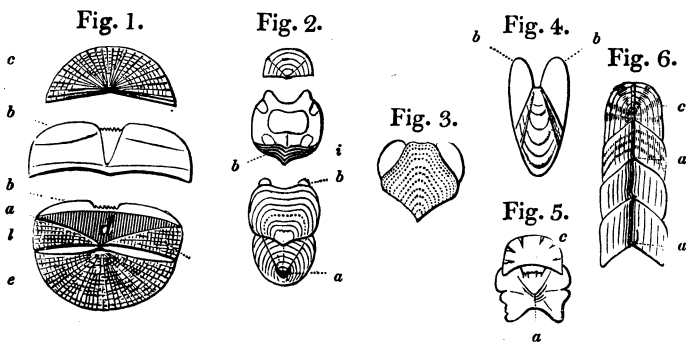


Fig. 1. *Chiton Cumingii*.
2. *Helminthochiton priscus*.
3. *H. eburonicus*.

Fig. 4. *Chitonellus*.
5. *Chiton amiculatus*.
6. *Helminthochiton Griffithii*.

With two exceptions, all the Devonian and carboniferous species (figs. 2, 3) much resemble each other, and their relations to living forms seem only to be with such as *C. incisus* and *C. alatus* of the Philippines, in which the plates are lengthened, and their contour square instead of transversely oblong. The ordinary form of Chiton is seen in fig. 1, *C. Cumingii*, a species from Valparaiso, and may be recognised in the common *C. cinereus* of our own shores; the plates are transverse, and the sides are marked by a diagonal line, fig. 1 *a*, the ornaments behind which are of a different character to those in front of it. The two areas (*d* and *e*) are called respectively the dorsal and lateral areas. The under surface is marked for the attachment of muscles, and is imbedded in the surface chiefly by an ex-

* Bulletin de l'Acad. Royale de Bruxelles, tom. xii. 2nde partie, 1845, p. 36.

pansion of the forward edge, divided into two rounded lobes (*b, b*) and separated by a toothed central portion. These sharp edges or sustentacula (termed by De Ryckholt *apophyses*) are important to notice, and are very large and remarkable in some of the fossils before us (fig. 3) and in *Chitonellus* (fig. 4). The extent to which the mantle covers the upper surface varies in different groups of the genus: in fig. 1 it extends but just over the edge, in many common species much further, and so as to leave only a rhomboidal surface free, the covered part being smooth, and always at a lower level than the free portion. In *C. incisus*, which has a great general resemblance to fig. 1, it does not extend very far over, but has a great expansion beyond the shell; in *C. amiculatus*, fig. 5, the shell is wholly concealed by it; in *C. porosus* and *C. monticularis* a narrow ridge alone is free, and the mantle is so thin, that the rugosities of the shell are seen beneath it.

There is one more peculiarity in the formation of the shell that is worth notice, viz. the inflected portion beneath the apex of each plate (fig. 2 *i i*), which diminishes in size according as the plates are more closely pressed against each other. Now the difference between the cephalic plate (fig. 1 *c*) and those on the back, consists in the former wanting the distinction of lateral and dorsal areas, for this reason, that the dorsal area is the space covered by each preceding plate from its earliest size, and the anal plate (*e*) differs from the dorsal ones only in having the area behind the apex turned out instead of inflected, being then ornamented in the same way as the lateral area of the other plates, which are in fact portions of a similar surface.

In the elongated form of Chiton, of which *C. incisus* may be taken as a type, we have the plates as long as or longer than they are wide, the apex of each plate a little produced behind, and that of the anal plate (fig. 2 *a*) carried back considerably, not, as in fig. 1, brought up close to the penultimate plate. The mantle too is widely expanded, smooth, and covering only the anterior corners of each plate. The sustentacula (*b, b*) are of moderate size and widely separated in this group. That the smooth plates of our palæozoic fossils were not covered by the mantle, I have reasons for believing certain, and therefore we have a tolerable approximation to a rare modern form. But in such species as *C. gemmatus*, De Kon., and *C. eburonicus* (fig. 3) we have a departure from this type so considerable, that I am inclined to believe it a distinct subgenus, connecting those last mentioned with *Chitonellus*, Lam. (fig. 4), in which the plates are inserted at a distance from each other, their form being that of an elongated rhomb, and the sustentacula occupying the larger part of the plate. The fossils of this section however (fig. 3), though decidedly approaching *Chitonellus*, the lateral area being undistinguishable from the dorsal, have the sustentacula widely separated and the surface granulated equally all over. In *C. tornaticola* and *C. Scaldianus*, De Ryckh. (minute carboniferous species), the form is much more nearly that of ordinary Chitons, and the lateral area is marked by a faint row of granules.

The Silurian fossil however (fig. 6) differs essentially from those

above mentioned in having the plates deeply emarginate behind, and as it were bent backwards, a character very rare in living species, and never occurring to this extent. The shell described, of which only the four front plates are preserved, was not so much elongated as in the group containing *C. incisus* (fig. 2), the plates being wider than long, carinated, but not with a separate ridge along the back, and evidently of a very thin texture, as may be seen by the broken edges on the cast. In the former respect it resembles *C. amiculatus* (fig. 5), but there is an essential difference between the smooth external shell (as I believe it to be) of the fossil and the internal one of that species; for, as if to show in what light we are to regard the inflected portion, in *C. amiculatus* it is turned outwards in all the plate (fig. 5, *i i*), just as in other species occurs in the anal plate, and the apex therefore (5 *a*) is within the margin.

In our fossil the apex (6 *a*) is *on* the posterior edge, and there is no expansion behind it, not even the broad double lobe that occurs in *C. porosus* before mentioned.

Notwithstanding the thin texture and deep emargination of the plates, I have no doubt this is one of the *Chitonidae*. It is not quite anomalous, the *C. alatus*, Sow., a member evidently of the *incisus* group, having an approach to the emarginate form. This latter is a tolerably thin shell, though the lateral areas are marked by being slightly ornamented, and by a diagonal fold; nevertheless it more closely resembles our species than any other, and has a smooth thin expanded mantle.

Mr. Gray has (I believe in MSS. only) separated the species with tufted thin spines or with hairs by the name of *Acanthochates*, but I am not aware that the elongate group has been recognised, and I venture to propose for this genus or subgenus, and rather for the fossils than the recent shells, the name *Helminthochiton*, from its vermiform character.

The twenty-three fossil species will then stand as follows* :—

Genus HELMINTHOCHITON.

Elongate; plates as long as wide, subquadrate, thin; apex of the anal plate remote from its front edge; sustentacula widely separated; shell but very little covered by the mantle [mantle expanded, smooth, thin]. Tropical?

1st Section, allied to *C. alatus*, Sow.

H. Griffithii, Salter (in Griff. Sil. Fossils of Ireland, pl. 5. fig. 5).

* Not having access to Sandberger's paper, I cannot refer his species *C. fasciatus* and *C. subgranosus* to their proper sections.

I had overlooked Mr. W. King's interesting discovery of a Chiton in the magnesian limestone. His description of the anal plate in the 'Annals of Natural History' (afterwards republished with a figure in Charlesworth's Geological Journal) would induce one to believe his shell to be a species of *Helminthochiton*, and the figure given with it of the somewhat keeled dorsal plates, emarginate behind, would probably refer it to my first section. The Irish fossil however has no sinus in the cephalic plate, and we do not possess the anal one for comparison.

2nd Section, allied to *C. incisus*.

<i>H. nervicanus</i> , <i>De Ryckh.</i>	<i>H. viseticola</i> , <i>De Ryckh.</i>
<i>H. turnacianus</i> , <i>De Ryckh.</i>	<i>H. priscus</i> , <i>Münster.</i>
<i>H. mempiscus</i> , <i>De Ryckh.</i>	

3rd Section, resembling *Chitonellus*.

<i>H. gemmatus</i> , <i>De Kon.</i>	? <i>Sluseanus</i> , <i>De Kon.</i>
<i>H. legiacus</i> , <i>De Ryckh.</i>	? <i>mosensis</i> , <i>De Kon.</i>
<i>H. eburonicus</i> , <i>De Ryckh.</i>	? <i>concentricus</i> , <i>De Kon.</i>

Perhaps palæozoic forms of *Chiton* proper.

<i>C. tornacicola</i> , <i>De Ryckh.</i>	<i>C. scaldianus</i> , <i>De Ryckh.</i>
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Chiton proper.

<i>C. grignonensis</i> , <i>Lam.</i>	<i>C. tenuisculptus</i> , <i>S. Wood.</i>
<i>C. subapenninus</i> , <i>Cantraine.</i>	<i>C. arcuarius</i> , <i>S. Wood.</i>
<i>C. fascicularis</i> , <i>Sow.</i>	<i>C. angulosus</i> , <i>S. Wood.</i>
<i>C. strigillatus</i> , <i>S. Wood.</i>	

I have one remark to offer concerning the formation in which this interesting fossil occurs. Mr. Griffiths found it a year or two back in the slaty mudstone overlying the fossiliferous conglomerates of Cong, co. Galway. It is associated with remarkable fossils, and in company too with a new *Pleurorhynchus* (*P. pristis*, Salt.), a genus yet undescribed from the Silurian rocks, unless Hisinger's *Cardium pygmaeum* from the marine rejectamenta of Gothland be considered a Silurian fossil. I have of course nothing to do here with the remarkable conglomerates overlaid by this slate; I may however state (as Mr. Griffiths has already published the fact), that it contains fossils hitherto considered as characteristic of both Upper and Lower Silurian rocks associated in one bed of sandstone. Future researches will show whether the present is an instance of the continuance of Lower Silurian species to a later period, owing to favourable conditions, or a proof of the English tilestone fossils having been introduced from Ireland, where they had been developed at an earlier period. My own opinion is in favour of the former hypothesis.

2. *Notice of the occurrence of the ELEPHAS PRIMIGENIUS at Gozo near MALTA.* By JAMES SMITH, Esq., of Jordan-hill, F.G.S.

THE fragment which accompanied the specimen was given to Mr. Smith by Mr. St. John of Valetta, who stated that he found it, encrusted with stalagmite and adherent to the rock, in the island of Gozo. According to Dr. Falconer, it consists of two plates of a young grinder of the true *Elephas primigenius*.

The occurrence of so large an animal in a locality of such limited extent seems to point to a period when it was connected with a continent.