



EXPLANATION OF FIGURES.

1. A specimen of *D. hastata* 4 mm. long, showing the loop viewed from the dorsal side.  $\times 6$ .
2. A specimen of *D. hastata* 10 mm. long, showing the loop looked at from the ventral side.  $\times 4$ .
3. The same specimen as that shown in Fig. 2 seen from the side.
4. A specimen of *D. hastata* 15 mm. long, seen from the ventral side.  $\times 2$ .
5. The specimen shown in Fig. 4 seen from the side.
6. The loop of a specimen of *D. elongata* 6 mm. long, seen from the ventral side.  $\times 4$ .
7. The specimen shown in Fig. 6 seen from the side.

NOTICES OF MEMOIRS.

ON THE NOMENCLATURE OF THE PALÆOZOIC FORMATIONS OF SWEDEN.

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[Translated from the *Geologiska Föreningens i Stockholm Förhandlingar*, 1908, Band xxx, p. 343.]

“DAS Uebergangsgebirge” (Transition rocks), or the oldest but one of the four main groups in Werner’s geological scheme, corresponded, as we know, to what we now call the ‘Palæozoic’. By and by it was divided up into various systems or periods, but long before that time Werner’s scheme had obtained a footing in Sweden, and Swedish geologists, in referring to the Palæozoic formations of the country, used such terms as the Swedish equivalent for ‘Transition rocks’, ‘formatio transitionis’, etc. Such was the

case, for instance, in Hisinger's *Mineralogical Geography* of 1808, in Wahlenberg's book on the Formation of the Floor of Sweden (1818), and in Dalman's *Palæaderna* (1827), while in 1823 S. Nilsson, in dealing with the geology of Scania, speaks of the 'transition district' of Scania. As late as 1821 Angelin makes use of the heading "Crustacea formationis transitionis" on the title-page of his *Palæontologia Suecica*, and even in 1884 Nathorst, dealing with the geology of South Sweden, tried to reintroduce the appellation 'transition system' as a collective name for the Palæozoic strata of Sweden.

Already in 1834 and 1835 Murchison and Sedgwick had proposed the appellations Silurian and Cambrian for the formations which in England come between the Old Red Sandstone and the primary rocks, i.e. for strata which exactly correspond to the Palæozoic formations of Sweden. For reasons that I will enlarge on later there arose, practically at once, dispute as to where the line should be drawn between Cambrian and Silurian, or, in other words, about the comprehensiveness of these systems in their relation to one another. During the controversies that were consequently raised there poured in from various quarters and to various ends new proposals for the nomenclature of the strata in question. A number of these may be specially named here, since they exercised a more or less considerable influence on the nomenclature used in Sweden.

As far as America is concerned, Emmons formulated his 'Taconic System' in 1848; this, so far as it can really be considered in any way uniform, may be said to correspond roughly to the lower series of Sedgwick's Cambrian. Of more radical importance, however, was Barrande's contribution to the question. In 1846 he proposed the conception of 'Primordial Fauna', i.e. a fauna embracing the oldest known organisms and especially characterized by trilobites with long thorax and small (consisting of few segments) pygidium. Upon this followed, in their proper turns, the second and the third (Silurian) faunas. While in England it was considered adequate to divide the sedimentary rocks in question into only two systems, Barrande divided them into three sections, which proposal—especially since, following this primordial fauna, analogues to Sedgwick's Lower Cambrian could be pointed out in countries widely separated—gradually gained ground, so that in 1878 Barrande, at the International Geological Congress in Paris, called attention to the fact that Murchison himself, in the last edition of his *Siluria*, had made use of a similar terminology, in that he divided his Silurian into Primordial, Lower, and Upper Silurian.

It is clear that the Swedish geologists had, of necessity, to take up a position in reference to this question of nomenclature. But the choice, unless made haphazard, was no easy one. For in this case it is not a question of paying exclusive regard to the priority of the various appellations; it is also of importance, among other things, to investigate whether the terms proposed have a carefully fixed range, and in what measure a certain classification can be said to be suitable for giving us a clear and faithful picture of nature.

Even if the appellations that have come into use for the Palæozoic

formations of Sweden vary with different writers, by degrees the three-fold division introduced by Barrande seems to have gained universal approval. It may not be out of place here, as throwing light on the circumstances, to give a few examples of the nomenclature used by various Swedish authors after that time.

While Lindström in his *Elements of Geology* (2nd ed., 1859)—a work based on Lyell's *Elements and Principles of Geology* and other works—divides the Palæozoic formations of Sweden into Upper Silurian (= Gothland and Klinta-formation) and Lower Silurian, in which latter was also included the lowest sandstone of the Vestrogothian rocks, later on he made use of the terminology Cambrian, Lower and Upper Silurian, as for instance in his *List of the Fossil Faunas of Sweden*, i (1888).

Angelin, in his geological map of Scania with letterpress, of which two sheets were already printed in 1862, though they only appeared posthumously in 1877, gives the strata in question the common appellation "Silurian, or Older Transition Formations", remarking at the same time that the name 'Silurian System' is not used by anyone in its original sense, and also that, if we pay attention to priority, it would be more correct to use the terms Taconian, Cambrian (or Cumbrian), and Silurian for Barrande's "faune primordiale, faune seconde, and faune troisieme".

In Torell's contributions to the petrology and palæontology of the Sparagmite formation he used the name Cambrian or Taconic System for Angelin's regions I-III, the next overlying strata being the Lower Silurian System; and Linnarsson, who in his earlier works (1868-9) simply comprises all the strata in question as Silurian, in all subsequent works calls Angelin's regions I-III Cambrian, IV-VII Lower Silurian, and VIII Upper Silurian.

That Nathorst, who, when he began to occupy himself with the formations we are speaking of, called those strata which include the primordial fauna 'Cambrian', and afterwards tried to introduce the term 'transition system' for the three groups of the 'Cambrian-Silurian' (Cambrian, Lower and Upper Silurian), has already been referred to above. In this place we need merely add, that the proposal in question evidently owed its origin to a desire to accentuate the necessity of introducing a collective name.

In 1880 Tullberg speaks of the Cambrian and Lower Silurian strata at Kiviks-Esperöd and Röstånga, whereas in 1882, in his work on the graptolites of Scania, he divides the Silurian formations into Primordial Silurian, Lower Silurian, and Upper Silurian, thus entirely avoiding the use of the term Cambrian.

Latterly, however, the Swedish geologists have as good as unanimously accepted the division of the Swedish Palæozoic formations into the three groups or systems Cambrian, Lower Silurian, and Upper Silurian; thus, for instance, Törnqvist (1889) in *Some Remarks on the Cambrian and Silurian Corology of Western Europe*, Holm (1901) in *Kinnekulle*, and Wiman (1899) in *Eine untersilurische Litoralfacies bei Locknesjön in Jemtland*.

Nevertheless, the name 'Silurian' has at the same time often been employed as a collective name for *all* the formations in question,

viz. by Wiman (1893) in *Über die Silurformation in Jemtland* and by Högbom (1906) in *Norrland*. The appellation Cambro-Silurian or Cambrian-Silurian formations seems, however, to be at least as common (as a collective appellation) as the name Silurian. In this case, then, the terminology has not even yet become properly established.

As far back as 1879 it was proposed by Lapworth ("On the Tripartite Classification of the Lower Palæozoic Rocks": *GEOL. MAG.*, Dec. II, Vol. VI) to change the name Lower and Upper Silurian into Ordovician (Ordovian) and Silurian, a proposal that gradually gained ground, and has of late years obtained some footing in Sweden. In 1901 Törnqvist (*Researches into the Graptolites of the Lower Zones of the Scanian and Vestrogothian Phyllo-Tetragraptus Beds*, i) used the divisions Cambrian, Ordovician, and Silurian. In 1906 he lays stress on the fact that he has definitely abandoned the older nomenclature Cambrian, Lower and Upper Silurian (*Some Remarks on the Ordovician System in Skåne*). As these works of Törnqvist's were written in English, and thus were specially addressed to the English public, he possibly attracted less attention to his new terminology from Swedish readers; that, at least, holds good as far as we are concerned. It was also with much hesitation that the writer of these lines, in a paper on the *Dicellograptus* schists of Scania (1907), and so to speak tentatively, exchanged the term Lower Silurian for Ordovician: in our opinion the suitability of the exchange from more than one point of view was not decisive. The new appellation was especially inconvenient in that it did not lend itself to the formation of compound words. Our first impression was that this difficulty might be removed by using the term Ordovian, sometimes used by Lapworth instead of Ordovician. This would have permitted such Swedish compounds as "ordovsystem, ordovfossil", etc. But, as this could evidently only be adopted if the termination *-ician* did not include any part of the stem of the word, we asked the advice of Nils Flensburg, the Professor of Comparative Philology at the University of Lund, from whom we received the following elucidation: The name Ordovices, which is met with in Tacitus (*Agricola*, ch. xviii, and *Annales*, book xii, ch. xxxiii), is made up of the stem *ordo* (or, in Old Cymric, *ord*), meaning 'hammer', and the verbal root *vik*, meaning 'to fight'. Ordovices consequently means 'hammer-fighters', and as the *vik* in it represents an independent link the form *ordov* is of course unallowable. Therefore we must write Ordovician, in which case we could also make use of such compounds as "ordoviklager, ordovikfossil", etc. So much for the purely linguistic point of view.

It is all very well that we should, by introducing the aforesaid denomination, attain to a greater uniformity with the terminology that seems to be naturalizing itself more and more abroad, especially in England and North America. But it would be better, instead of submitting our terminology to this kind of patchwork, once for all to subject this terminology in its entirety to a revision, especially as the moment for this can be said to be at hand. It is not our intention to introduce any innovations; it is merely a question of making a choice

from the older terminology, at once consistent with what is *fair* and *suited to the circumstances* in general.

In the first place we must set down that in proportion as the geological researches into our Palæozoic formations have advanced the old conviction that the latter in our country form a connected whole, the various parts of which are not divided by sharp limits, has become a certainty. However, for faunistic reasons it seems advisable to divide the formations in question into *three* groups, in the main corresponding to Barrande's three Silurian faunas. It is no less for the formations considered as a whole than for the various groups that we must establish appellations.

Before entering upon this we must touch, however briefly, upon a very debated question of priority, viz. the name Silurian or Cambrian. In our opinion it is the more bootless to enter into details, as no one is likely to assert that either Murchison or Sedgwick were really fully cognizant of what it was that they stamped with the respective names. That any dispute about the line between the different systems could arise at all is due, of course, to the fact that the authors themselves did not recognize with certainty coeval formations where these in any degree showed varying development. That Murchison's Caradoc was the same as Sedgwick's Bala, was a point on which both were equally in the dark, even if Sedgwick, as it soon appeared, saw that this was the case, at least as far as certain strata were concerned. That Murchison's stratigraphical mistakes, which considerably increased the chaos, did not bring him great distinction, goes without saying, but on the whole we must not forget that palæontological science at that time, when, for instance, the graptolites and their stratigraphical significance were still practically unknown, was insufficient to determine with certainty the stratigraphical succession when the strata were not in a relatively undisturbed position. That both Murchison and Sedgwick added so much to our knowledge of these older Palæozoic strata, that the names given by them must by no means be condemned by reason of the flaws which were inherent in them, and which, we may say, were bound to exist in them, is beyond all doubt. But the manner in which these names should be used, or, in other words, the establishment of the range of their meaning, must concern a period which will have made a real limitation of the idea possible.

To return to the question of what appellations we are to select, our first business is to see what names can be used as a *collective appellation* for these formations. Among the likeliest of these we may mention especially Transition System, Cambro-Silurian, and Silurian. Of these, for reasons we need not repeat here, Transition System is very unsuitable. The same is true of Cambro-Silurian, especially as Sedgwick himself proposed this name in 1843 for all strata from the Bala, inclusive, to the base of the Wenlock, a proposal which, however, he afterwards (1854) withdrew. On the other hand, the name Silurian seems to be quite suitable, not only because the range of the word corresponds with Murchison's latest claims, but because it has often been used, as we pointed out above, as a collective name. *But if it is to be used as such it must, of course, not be admitted as a group name.* Since, for obvious reasons, we retain the names

Cambrian and Ordovician<sup>1</sup> for the two lower groups, it remains for us to choose another name for what is otherwise called Upper Silurian or Silurian.

In 1900 de Lapparent, in his *Traité de Géologie*, proposed for this group the name 'Gothlandien'. And we think there is every reason to accept this proposal. The sedimentary rocks which are here in question are completely represented<sup>2</sup> in Gothland, and no other strata occur among the rocks there. As Cambrian and Ordovician have been named from tribes, we should, perhaps, in case we had to choose the name, take one that would recall to us the Gutar, the Gothland settlers—for instance, Gutnium or Gutnian; but such an emendation of de Lapparent's appellation would be looked upon as exaggerated purism. Already in Angelin's General Map of Scania, there is a mention of a "Fifth or Gothland Group" as being about synonymous with what has latterly been called Upper Silurian. Even if we wish to see in this a pronouncement in favour of the nomenclature here recommended we must point out that as an adjective to the proposed name Gotlandian we ought to adopt a new term, 'Gotlandisk' (Gothlandic), since the Sw. 'gotländsk' (or the representative prefix form, 'Gotland's-') should be reserved for cases where there is some reference to the Island of Gothland or its belongings.

Even provided the name Gotlandian should not readily gain the approbation of strangers—we know how long it was before Lapworth's Ordovician made its way—it can safely be used in our country without danger of being either *not understood or misunderstood*.

This, then, is the nomenclature we propose: *Silurian*, with the three series, *Cambrian*, *Ordovician*, *Gothlandian*. This nomenclature fully takes into consideration the excellent methods in disentangling the formations in question that we owe to Murchison, Sedgwick, Barrande, and Lapworth. And it can scarcely be considered presumptuous if the Silurian geologists of Sweden, in generally adopting de Lapparent's appellation, Gotlandian, recognize in some measure what we hold to be a noticeable contribution made by them and their predecessors to the Silurian division.<sup>2</sup>

If anyone should possess world-embracing views it is the geologist; but, as a matter of fact, even his point of view is not a little influenced by his nearest surroundings—his own country and the prevalent opinions in it. A word or two supplementary to what has been said above seems to me, therefore, to be appropriate on this occasion, since I am now especially addressing English readers.

<sup>1</sup> As it is quite superfluous to repeat here the reasons stated by Lapworth (see op. cit.), in our opinion most satisfactorily, for his proposed name, Ordovician, we will only point out that this name, apart from the fact that its meaning offers a way out of a difficulty in nomenclature acceptable to the various English schools, is also made necessary, so to speak, for us, since on the one hand we wish to retain the name Cambrian, but on the other hand wish to use the name Silurian exclusively as a collective appellation.

<sup>2</sup> However, J. Kiaer, in his *Das Obersilur im Kristianiagebiet*, which has just appeared, expresses the opinion that the lowest strata in Gothland correspond to the *uppermost* part of Llandovery; the lower part of the latter is therefore inaccessible in Gothland. Moreover, he questions whether there is anything there to correspond to the most recent Ludlow strata.

As far as I have been able to discover, the majority of the English geologists at the present time wish the term Ordovician to be generally adopted. And so do I. We are also of one mind that, if the term Lower Silurian is to be rejected, the term Upper Silurian must also be given up. But when the proposal is made to substitute for the latter the term 'Silurian' simply, then I think a false move has been taken, which may lead to confusion not only abroad but also in England. Even if Murchison's term, Silurian, was originally applied to only the upper part of the formations in question, it must not be forgotten that it was created earlier than the term Cambrian, and that also Llandeilo was included in it. Murchison's term, Silurian, has consequently never coincided with what would now be called by that name. And lastly, as we know, he let the name embrace all the strata from the base of the Cambrian up to the base of the Devonian. In this comprehensiveness the name Silurian, especially through Barrande's influence, has also come to be used throughout the world.

To use the name Silurian in the significance that English geologists have of late attempted is, as I have shown above, not justified, as well as very misleading. To discard it entirely is quite unfeasible; not only would it be an act of great injustice towards the renowned author of the Silurian System, but it would be an injustice that would assuredly bring its own punishment.

Since, then, the term Silurian *must* be used, it seems to me that nothing else is possible but to take it in the sense Murchison ultimately gave it, which, through Barrande's influence, has won favour everywhere. If the name Ordovician is introduced, the name Silurian, as far as I can see, must be used as a collective name, and the so-called Upper Silurian receive a fresh name. And as such, de Lapparent's 'Gothlandien' (Gotlandium) would certainly be suitable.

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## R E V I E W S .

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I.—ROCK SALT: ITS ORIGIN, GEOLOGICAL OCCURRENCES, AND ECONOMIC IMPORTANCE IN THE STATE OF LOUISIANA; TOGETHER WITH BRIEF NOTES AND REFERENCES TO ALL KNOWN SALT DEPOSITS AND INDUSTRIES OF THE WORLD. By G. D. HARRIS, assisted by C. J. MAURY and L. REINECKE. Bulletin No. 7 of the Geological Survey of Louisiana, 1908. pp. 259, with 21 text-figures and 48 plates of maps, sections, and views.

**T**HE 'salines' of North Louisiana were known to the Indians before the advent of the white man, and they used to resort to those places to obtain their salt. The position of the 'salines' is indicated by the 'licks', where vegetation is prevented from growing, over patches several yards square, by the licking of the ground by cattle.<sup>1</sup> Their presence is further indicated by brine-springs which issue along the beds of streams, and by the sinking of wells. Brine

<sup>1</sup> The "Big Bone Lick", Kentucky, and others of a similar kind were well known to the early geologists by the discovery of abundance of remains of the *Mastodon* and other extinct mammals who came down to lick the salt in prehistoric times. Many arrow-heads of stone have been found, showing that the Indians also frequented these salines, probably to shoot big game which came there for salt as well as themselves.