The Anorthosite Rocks of Canada.

By FRANK D. ADAMS, *Geological Survey of Canada.*

This series of rocks has also been called the Upper Laurentian or Norian series. The name anorthosite is perhaps preferable, as it refers to their distinguishing characteristic as compared with the orthoclase rocks of the Lower Laurentian, viz. the predominance in them of plagioclase or anorthose feldspar. These rocks form detached areas in the great Laurentian districts, and bear a strong resemblance in part to the gabros and gabrodiorites of Scandinavia, and in part to the labradorite rock of the same country. It is, however, by no means certain that the rocks of the two countries are of the same age. At least nine of these areas are now known to exist in Canada, and there is also one in the State of New York. In addition to plagioclase, which generally predominates largely, these rocks contain rhombic and monoclinic pyroxenes (including augite, diallage, hypersthene, and probably enstatite), olivine, magnesia mica, spinel (including both pleonaste and picotite), garnet, iron ores, pyrite, and apatite. Orthoclase is seldom or never found, except in veins cutting the anorthosite. The hornblende, mica, and pyroxenes are intimately associated and often intergrown, all of them sometimes being found in the same thin section. Garnet occurs sparingly, and generally near the contact of the anorthosite with the gneiss. When the olivine comes against plagioclase it is always bounded by a double concentric zone, the outer zone consisting of hornblende, and the inner, or that next to the olivine, consisting of a pyroxene. While the iron ores associated with the Lower Laurentian gneisses are generally free from titanium, those associated with the anorthosite rocks are always highly titaniferous; a fact which makes the study of these rocks a matter of considerable economic interest. The anorthosite varies a good deal in composition, some areas, for instance, being rich in olivine, while others are destitute of that mineral, and different portions of even the same area often showing wide differences in this respect. The rock also shows a good deal of variation in structure. It is rarely quite massive, frequently well foliated, but usually consists of a rather coarsely crystalline ground mass through which are scattered irregular strings and masses composed of iron ore, bisilicates, and mica, as well as larger porphyritic crystals of plagioclase. Even when it is tolerably constant in composition there is generally a great variation in size of grain, coarse and fine alternating in rude bands or rounded masses. In the case of some of the areas there can be but little doubt that the anorthosite is eruptive, in others, however, it seems to be intertratified with the Laurentian gneiss, and in one of them to merge imperceptibly into it. The original relations of the rocks are, of course, much obscured by the effects of subsequent heat and pressure. The evidence at present, however, seems to indicate that these anorthosites are the result of some kind of extravasation, which in those early times corresponded to what in modern times we call volcanic eruption.

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The Culm Measures of Devonshire. *By* W. A. E. Ussher, *F.G.S.*

The late Professor Phillips contributed the most considerable and important part of the literature of this subject in 'The Palæozoic Fossils of Somerset, Devon, and Cornwall,' a work from which several quotations are given; Mr. T. M. Hall and other writers are cited as to the occurrence of anthracite in the neighbourhood of Bideford, &c.

After having observed the Culm Measures on the borders of the Triassic area for some years, the author was enabled to study them in detail during the years 1876 and 1877, his researches being confined to the area east of a line between Hartland Point and Okehampton. In this area he discovered that the Culm Measures were broadly divisible into three groups, which, however, owing to the passage of one group into another, to local intercalations, and to the innumerable flexures and disturbances by which the main synclinal structure is obscured, cannot be separated by hard and fast lines—at least, on the one-inch scale.

The following is the general classification given:—

Culm Measures.	Upper.	Eggesford type	Hard, rather thick, even bedded grey grits, and dark grey shales and slaty beds.
	Middle.	Morchard type	Thick-bedded, grey, greenish, and reddish sandy grits, associated with marly splitting shales in places; irregular grits, slates, and shales.
	Lower.		Dark grey shales with grit-beds, generally thin and even, slaty and splintery shales (St. David's Exeter, type), even-bedded cherty shales and grits (Coddon Hill type), limestones and dark grey shales.

Some leading characters in each group are then pointed out. The Lower Culm Measures are assigned a breadth of from two to three miles on their northern outcrop, and of about fifteen miles in the southern area on each side of Dartmoor. The impersistent character of the limestones of this series, and the frequent absence of their most marked characters from the beds on the Coddon Hill horizon, is also mentioned. The apparent passage of the Culm Measures into Devonian in the north is contrasted with the seeming unconformity between these strata in the south.

The Middle Culm Measures attain a breadth of about four miles in their northern, and from four to five in their southern outcrop. Some structural peculiarities in this series, and a part of the coast section between Portledge Mouth and Westward Ho, are briefly described.

The Upper Culm Measures are said to form a band of from six to seven miles in width. The even character of the bedding and the interstratifications of dark grey shales render the contortions of this series on the coast between Portledge Mouth and Clovelly very apparent.

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Editors Can Recast of Science,
Gentlemen
It may be of interest
to reprint the following. A figure was
prepared for the Geol Mags, and as
not needed till my return to Montreal,
I can secure a copy. Yours
Wm Dawson

From the London Geological
Magazine
Dec. 1892

.—On *Palæosaccus Dawsoni*, Hinde, a New Genus and Species of Hexactinellid Sponge from the Quebec Group (Ordovician) at Little Métis, Quebec, Canada.

By George J. Hinde, Ph.D., F.G.S.

In 1887 and 1888, Sir J. W. Dawson discovered in dark carbonaceous shales of the Quebec group, exposed at Little Métis, on the north shore of the Lower St. Lawrence, some thin bands of rock largely filled with the remains of siliceous sponges, and similar fossils were found to be sparsely scattered in adjacent beds through a vertical thickness of forty feet. This discovery of an abundant sponge fauna at so low an horizon, in rocks previously considered to be unfossiliferous, proved to be of considerable importance in showing the character of these organisms which flourished at this early epoch, and though the condition of the specimens was far from perfect, Sir J. W. Dawson was enabled from the materials obtained to describe eleven new species, which were placed in the genera *Protospongia*, *Cyathospongia*, *Acanthodictya*, *Hyalostelia*, *Lasiothrix*, and *Halichondrites* (Trans. Royal Soc. Canada, vol. vii. section iv. 1889, pp. 31-55, pl. iii.). With the exception of the species referred to the three last-named genera, of which the relationships are at present doubtful, these sponges belong to the group Lyssakine Hexactinellids, of which the earliest traces are found in the Cambrian strata of this country and elsewhere.

Since 1888, Sir J. W. Dawson has improved the opportunity afforded by passing the summer vacation in Little Métis in energetically working at fresh excavations in the beach and cliff sections at that place, with the result of obtaining many fresh specimens, which confirm the characters of the forms already described. This last summer his search was further rewarded by finding a specimen of a new and very distinct form, which he has done me the honour to entrust to me for description. As is the case with all the other sponges preserved in these black shales, this specimen is now in a flattened or compressed condition on the surface of the rock, and has the general appearance of a piece of coarse open network. Unfortunately the entire specimen could not be secured, and the portion on the slab, shown in the accompanying photograph, which has been reduced to about $\frac{3}{7}$ the diameter of the original, probably represents less than one-half of the whole form. The original siliceous structure of the skeleton has now been replaced by pyrites, so that the form and dimensions of the spicules are but imperfectly shown. The same mineral change has affected all the other sponges in these beds, and, in fact, it is of very general occurrence wherever siliceous sponges are embedded in similar black carbonaceous shales. The specimen evidently belongs to a new genus, which is proposed below.

Palæosaccus,[1] gen. nov.

[1] παλαιος, ancient: σακκος, coarse cloth, sack, strainer.

Cylindrical or sack-like sponges, with thin walls of rhombic meshes. The strands of the mesh-work consist of fascicles of slender rods, cruciform, and, perhaps, five-rayed spicules; the interspaces are either open or covered with a thin layer of irregularly disposed rods and cruciform spicules. No anchoring spicules have been found in immediate connection with the sponge, but there are in the same beds elongated anchoring spicules with ornamented spiral ridges which may perhaps belong to it.

From *Cyathophycus*, Walcott (=*Cyathospongia*, Dawson, non Hall), which appears to be nearest allied, this genus is distinguished by the rhombic character and large size of the mesh-work; the generally similar structure both of the longitudinal and transverse strands of the mesh, and the greater development of rod-like spicules. The same features likewise diferentiate it from *Plectoderma*, Hinde, and *Phormosella*, Hinde.

Palæosaccus Dawsoni, sp. nov. (Pl. III.)

Sponge of large size, apparently cylindrical in its complete form; the part preserved consists of a flattened portion of the wall-surface more than a foot in diameter; both the upper and the basal portions of the sponge are wanting. The rhombic meshes of the wall vary from 14 to 20 mm. in width, the average width is nearly 17 mm. The strands of the mesh mostly consist of very slender rod-like threads apparently simple, which are loosely arranged, generally

Phormotella, Hinde.

PALÆOSACCUS DAWSONI, sp. nov. (Pl. III.)

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Some uncertainty also arises respecting the anchoring appendages of the sponge, since the basal portion is wanting, and no anchoring spicules are found in immediate contact with the specimen, but on the surface of the same rock-bed in which it occurs, there are some peculiarly ornamented spiral rods which may belong to this species. Sir J. W. Dawson has given a diagrammatic representation of one of these spicules (*op. cit.* p. 49, fig. 20) which appears as if it consisted of several very minute filaments spirally twisted together, like the strands of a rope. Each filament has a row of projecting tubercles which in the rod are definitely arranged in quincunx, so that the general ornamentation is very striking. At the distal end the rods are slightly curved, and the raised lines are straight instead of spiral. As with the other spicules, these anchoring forms are now of pyrites, and it is not easy to decide whether they result from the amalgamation of slender strands or whether the spiral tuberculated ridges are merely the surface ornaments of a single rod-like spicule. Be this as it may, we cannot as yet state positively that these peculiar anchoring spicules really belong to the present species.

So far as can be at present determined this sponge appears to have consisted simply of a delicate thin sack or cylinder of spicular strands forming a rhombic mesh, with possibly a thin outer spicular layer. There is no evidence that the sack inclosed an inner spicular tissue, and probably this thin wall represents its entire skeleton. A similar condition seems to have been present in *Protospongia*, *Cyathophycus* and probably also in *Dictyophyton* and the genera allied to it, but in none of these do we find the structure on such a large scale as in the present form.

I have much pleasure in associating the name of this remarkable sponge with its discoverer, Sir J. W. Dawson, F.R.S.

Distribution.—Shales of the Quebec Group, probably near the base of the Lévis Division, at Little Métis, Lower St. Lawrence, Province Quebec.