

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. 1. NOTES ON THE GEOLOGY OF NOVA SCOTIA AND CAPE BRETON. BY REV. D. HONEYMAN, D. C. L., F. G. S. &c., *Director of the Provincial Museum.*

(*Read Nov. 11, 1872*)

I PURPOSE to direct attention to the results of a detailed examination of the metamorphic rocks of the interesting localities to which my attention was directed last summer. The first in order was in Cape Breton at George's River, in the vicinity of the Sydney portion of the great Cape Breton Coal Field. George's River is a small inlet of the Bras d'Or near the Little Passage, having a brook flowing into it. When I arrived at the head of the inlet, I observed an outcrop of red syenite at the bottom of the mountain, and near it the remains of an old excavation. The latter consisted chiefly of weathered serpentine. I then examined more particularly the heap of material taken from a shaft recently sunk at a short distance west of the old excavation. Here the prevailing rocks were a beautiful white calcite and dark green serpentine. I was at once assured that I had before me a counterpart of the metamorphic, syenite, serpentine, and calcite, of Arisaig, Nova Scotia.

The other products of the shaft were small pieces of red jasper, parts of a vein of iron pyrites of three or four inches thickness, and a ponderous mineral of dark color chiefly, also iron pyrites. Of another excavation farther to the west the product was a white marble coarsely crystalline. Still farther on, for the distance of probably two miles the sides of the mountains showed extensive out-

crops of marble. After this reconnaissance I commenced a regular examination with the assistance of Messrs. Bell and McQuarrie, starting about a mile to the east of the parts already mentioned. On the shore of the Bras d'Or we found the beginning of the red syenite of our former outcrop. Passing along westward we met a series of outcrops of red syenite, and at last reached the summit of a syenitic (George's) Mountain, having an elevation of 890 feet, according to the measurement of Capt. Bayfield. Descending the mountain we reached our first noticed outcrop of syenite. There we found the syenite and serpentine already referred to in all but immediate contact. Passing the excavations we mounted to the summit, and found blueish-colored marble, rising in lofty and precipitous walls. Proceeding onward we found the marbles parted by bands of jaspideous rock; then followed beautiful serpentinous marbles and others. Our course was thus chiefly on the southern side of the mountain range. Wishing to ascertain whether the marbles and syenite were arranged as bands, we examined the opposite or northern side of the range, a distance of 6 miles, and observed continuous outcrops of red syenite, the limit of our examination being the second highest mountain of the range, having an elevation of 700 feet. (Bayfield.) Re-examining the mountain outcrops we found jutting out boldly between red syenite outcrops, diorite, similar to that at Arisaig. I had here another evidence of identity with the series of Arisaig. Subsequently we passed through the mountain range in rear of the marble, and after passing over outcrops of red syenite, probably a distance of a quarter of a mile, we reached the rear of the marble massive walls of beautiful ophiocalcite — serpentinous limestone. On the banks of George's River we find outcropping, thick beds of limestone having a lower carboniferous aspect.

In order to shew the relation of these to the metamorphic rocks already described, we have the aid of an excellent section of rocks on the shore of the Bras d'Or, having the syenite already noticed for its geological centre.

Beginning at the mouth of George's River, north side, we first exposed strata of limestone having a low dip. These are evidently lower carboniferous; they have abundance of small fossils chiefly

crinoidal joints. These limestones when struck emit a strong odor of petroleum. To some distance the section is obscure, and then we find holes indicating the existence of underlying limestone. Then comes the syenite centre. Next to this, is a considerable thickness of greenstone; succeeding is a considerable thickness of lower carboniferous shales, much disturbed and contorted by the greenstone: in these are imbedded limestones. A projecting point shews limestone and shales, apparently forming the termination of a synclinal axis. There is also a thick bed of *brachiopodous* limestone, familiar in Nova Scotian and Cape Bretonian lower carboniferous Geology. They form a point on what we may call the mainland and the south end of Long Island. (See map of Nova Scotia.) These limestones are destitute of the petroleum odor.

Following the members of this section in their courses westward we have the crinoidal limestone evidently forming the substrata of the elevated bank on the north side of George's River. The limestones which I have already noticed as outcropping on the same bank are a continuation of that indicated by the holes of the section. This also has the strong petroleum odor. They directly overlie the syenites, serpentines, and marbles, the first of which are a continuation of the central syenite of the section. The greenstone extends westward for nearly a mile, forming with the carboniferous strata an elevation which partially obscures George's Mountain on the northern side. The carboniferous strata of Long Island are co-extensive with the island, which is four miles in length. They dip into the channel at a very high angle, enabling the steamer to skirt the Island so as to make the minute details of structure in the strata distinctly visible to the passenger.

We have these lower carboniferous strata thus lying directly on the metamorphic rocks, but uncomformably. The carboniferous strata are a part of the Sydney carboniferous formation, consequently the metamorphic series which I have described are the pre-carboniferous rocks of this well known coal field.

Closely connected with the limestones of George's River are the limestones and gypsum that skirt the shores of Boulardarie Island, lying opposite. These limestones have also the petroleum odor.

I found in them abundance of the *Entomostraca*, *Leperditia*, and *Beyrichia*.

The examination of the metamorphic rocks of George's River, led to a re-examination of those related at Arisaig: of this I now give the results. This locality is unlike the other in this, that it is well known. It has been the subject of papers which are to be found in the Journal of the Geological Society and Silliman's Journal, and it has been referred to in one of my papers read before this Institute in 1870.

This publicity is to be regarded as premature, for although it is four years since I made the discovery of this series of rock, it was only last summer that I had the opportunity of making such an examination of them as I regarded necessary for arriving at satisfactory conclusions respecting their proper character, so that I am not astonished that the conclusions formerly deduced are not altogether so satisfactory as I could have wished.

I have already given general descriptions derived from a cursory examination made under very unfavourable circumstances. I now give a very minute description resulting from a thorough examination made with an intelligent assistant, and under the most favourable conditions. The whole series is here beautifully exposed in a fine shore section, so that on this consideration in addition to priority and completeness, it is to be regarded as typical. Like the George's River series, it has an easterly and westerly trend, so that it is in a manner parallel to it.

For the purpose of further comparison I shall commence at the north end of the Arisaig series, as I did with that of Cape Breton.

On the shore about miles from the north side of Cape George, we have first syenites of three distinct colors, white, cream colored, and red, with interbedded metamorphic quartzites of dark color. These syenites are fine grained and have very little hornblende, just enough to give them a syenitic character, and all contain crystals of green feldspar. This is the only place where I have seen these in the province. Its venation is also peculiar as far as my experience shows. Besides being of quartz they are pervaded by numerous veins of calcite; some of these are from four to six inches thick.

The metamorphic slates which intervene are also intersected by veins having a granitic composition, *i. e.* quartz with abundance of mica aggregations. These, in this character have some resemblance to the slates in the vicinity of Halifax, to which I have lately been directing attention. Proceeding with the section, we have diorites which project boldly into the sea; these pass into serpentine having considerable beds of serpentinous limestone, which extend into the diorite to the distance of about half a mile. This is the bed of the supposed *Eozoön*, and the supposed evidence of Laurentian age. Then we have diorite with quartz veins having abundance of talc foliated, and in prismatic crystals. Next comes diorite, perphyritic, with large crystals of amphibole. Then diorite with numerous veins of quartz and saccharine limestone. This is a character which it has in common with the syenite of the section. After this is diorite with blue crystalline limestone in lenticular beds and veins. Then hornblendic rock. Lastly, diorites with crystalline limestones, serpentine and serpentinous limestones.

This series is beautifully connected in its parts by blending, and by a sort of system of venation, the results of a common metamorphism, but still I regard it as composed of two divisions which probably belong to two different geological periods.

I regard the syenite, as belonging to the azoic period; and the diorites, argillites, ophites, and varieties of crystalline limestone, serpentinous and bluish as belonging to the Lower Silurian period.

I consider that there is here a sort of parallelism with rocks which I have lately examined in Halifax and environs. I shall have occasion to refer to this point in a future communication.

I would now show the relation which this Lower Arisaig series bears to the Upper Arisaig series, and to an associated formation. On the north-west side of the series there is necessarily obscurity, as the rocks pass into Northumberland Straits. On the south-east side the overlying rocks are lower carboniferous, consisting of conglomerate, grits, sandstones, and limestones. Toward Cape George they are succeeded by a considerable band of metamorphic argillites, which much resemble those of the Antigonish Sugar Leaf range. These as I have shown elsewhere, are in all probability Middle Silurian; they are well exposed along the shore,

and in a fine cross section in a brook at a distance of about a mile from Cape George. There the band dips north. There are no fossils in these rocks, but there is a small bed of crystalline limestone (white marble,) which was doubtless a small fossiliferous bed, and was rendered crystalline by the same action which rendered the slates metamorphic. They are overlaid by a brecciated conglomerate hardened, and having quartz veins. The last is of lower carboniferous age. I was not aware of the existence of this band of argillites, until last season. This is bounded on the S. E. by a continuation of the lower carboniferous strata overlying the *lower series*. On the south-west there is trap and lower carboniferous conglomerate intersected and hardened by trap, with obscurity intervening between this and the upper Arisaig series (Middle and Upper Silurian.)

The lower member of the series in question is extensively distributed in Nova Scotia and Cape Breton. The syenites enter largely into the constitution of their mountain ranges, forming their highest elevations. They are overlaid either by middle silurian—fossiliferous or non-fossiliferous—or lower carboniferous. In several localities in Nova Scotia and Cape Breton, I have reason to believe that both members of the series exist, more or less complete. One of these is found in the Cobequids—the greater number exist in Cape Breton. *George's River* has been illustrated. I hope next season to be able to illustrate other localities equally satisfactory.

I would, however, in the meantime make a particular observation upon one of these localities. In the serpentinous strata of Whycomagh, a vein of iron has been discovered, which is reported to be of economic importance. There can be no doubt that the containing rock belongs to the Lower Arisaig series. R. G. Fraser, Esq., has kindly furnished me with specimens of the rocks, which are unmistakably of the second number of the series. There are serpentinous schist and marble.

I would now direct your attention to the opinions of other geologists, on the subject before us, especially in reference to the rocks of *George's River*. Richard Brown, F. G. S., in his late admirable work, "On the Coal Fields and Coal Trade of the

Island of Cape Breton," London, 1871, thus writes page 4, "the limestones of this formation, (carboniferous) are well adapted for agricultural and building purposes, and in some places, in the vicinity of igneous rocks, furnish white, gray and variegated marble of good quality in great abundance." The "igneous rocks" are the syenites and diorites described; and the "white, gray and variegated marble," are our white, blue and serpentinous marbles.

In the geological map of Cape Breton, opposite the title page of Mr. Brown's work, and intended to illustrate it, I find the geology of George's River indicated by a broad band of carmine color, (igneous) and then a band of light purple metamorphic and Silurian, extending to George's River. This covers all the region of my survey from Long Island to George's River, and inserts a metamorphic and Silurian band between his igneous rocks and carboniferous, which would interfere with the conversion of any limestone of the latter by the igneous rocks into marble.

Dr. Dawson, in his Acadian Geology, specifies this district and its marble, under "Carboniferous System, Cape Breton County," page 419. He says, "An altered limestone which extends from the neighborhood of Long Island on the Little Bras d'Or, toward the East Arm, affords a gray and white marble."

This is substantially the same view in reference to the age and origin of the George's River marble, as given by Mr. Brown.

In answer to this view, I only adduce one incontrovertible fact, which proves that the contact of syenite with lower carboniferous limestone, does not produce marble. On the south side of Antigonish Harbor, there is a mountain consisting of syenite and lower carboniferous limestone, having syenite in direct contact with fossiliferous limestone throughout. On the summit the syenite and limestone form a breccia. The limestone and its fossils, which consist of *connularia* and *entomastraca*, are *entirely unaltered*. *Vide* specimens in the Provincial Museum and in the Museum of the Dominion Survey, Gabriel Street, Montreal.

In the Map of the Cape Breton Coal Field, Acadian Geology, page 413, I find that the geology of the whole George's River district under examination, is indicated by five parallel lines, and

the capital letter F, which are explained as metamorphic Silurian. There is here also some discrepancy. I would observe that I have no objection to the indication as far as the serpentine and marble are concerned, provided it is explained metamorphic *Lower Silurian*.

On comparing these rocks with the metamorphic rocks of the Paleogeological series of Eastern Canada, as described in the *Geology of Canada, 1863, of the Canadian Survey, pages 597–618.*

<i>Canada.</i>	<i>Nova Scotia.</i>	<i>Cape Breton.</i>
Beds of Jasper		George's River.
Argillites	Arisaig	George's River.
Agalmatolite		George's River.
Diorite	Arisaig	George's River.
Imbedded Hornblende } Crystals, large	Arisaig	
Talc	Arisaig	George's River.
Serpentine	Arisaig	{ George's River. Whycocomah.
Calcareous Oph ^{16L} odite	Arisaig	George's River.
Limestone	Arisaig	George's River.
Iron Ores		Whycocomah.

To the Eastward the rocks of } At Arisaig, syenites and diorites
upper Silurian and Devonian age, } are overlaid by middle and upper
are found reposing on those of the } Silurian.
Quebec Group.

These coincidences are too numerous to be accidental, and when we consider that the rocks compared are at Gaspé and Arisaig on opposite shores of the Gulf of St. Lawrence, with Prince Edward Island only intervening, identity can scarcely be questionable.

The evidence of fossils is a desideratum for the complete solution of the problem of the age of these metamorphic rocks of Arisaig. At one time it was supposed by some that this evidence was also available. The discovery of the supposed *Eozoon Canadense* was considered as conclusive proof of the Laurentian age of the Arisaig serpentines. It was afterwards found that the tubulation of the Arisaig fossil was different from that of the *Eozoon Canadense*, and it was considered by Dr. Dawson that the rock in question might consequently be of later age. I must confess that I never attached much importance to the discovery of the supposed fossil, and consequently I always regarded its existence as proof of any

age, rather questionable. Sir Wm. Logan at first entertained the opinion that the lower Arisaig Series, especially its serpentines, were probably of the age to which I now consider them to belong, but subsequently he changed his opinions.

There can be no question, however, that marine life was abundant at the period when the rocks of the lower Arisaig series were formed. The extent of the marbles, especially in Cape Breton, proves this. These marbles were doubtless originally fossiliferous limestones which were subsequently rendered crystalline by metamorphic action. I have already referred to a case of this kind in the metamorphic middle Silurian, near Cape George. The great development of these marbles shows that life then was at least equal in prevalence to that of the lower carboniferous period, and greater than that of the middle and upper Silurian. The latter under the most favorable circumstances, *e. g.* McAra's Brook, show limestones only in lenticular beds, a few inches in thickness, while the carboniferous has limestones of considerable extent and thickness.

I have shown that these marbles cannot be metamorphosed lower carboniferous limestones. It is, therefore, a just inference that they belong to another period which is known to have abounded in life, to the lower Silurian which includes the limestones of the Calciferous, Chazy and Trenton.

I consider that the syenites, diorites, porphyries and hornblende rock, are indigenous, *i. e.* resulting from the metamorphism of sedimentary rocks, belonging to an age preceding the Silurian—Azoic,—that they were subaërial during the Lower Silurian period,—that by the tear and wear of these, the argillites and quartzite were formed,—while at the same time the marine fauna of the period, were actively or passively forming limestone, that all were unitedly exposed to metamorphic or hydrothermal action, under pressure,—that the argillites were metamorphosed, the serpentines formed, and the limestones crystallized,—that the syenites and diorites were then fissured and pervaded with veins of calcite and quartz,—that they were conjointly elevated after the upper silurian and prior to the lower carboniferous period, that they formed islands in the lower carboniferous seas, upon which

limestones, sandstone, shales and conglomerate, were deposited. The crystalline rocks which have been examined, are thus brought into relation with the auriferous rocks of Nova Scotia. The syenites, (diorites and hornblende rocks?) are correlated with the granites; the argillites, serpentines and marbles with the argillites, quartzites, schists, and ironstones. Cape Breton is thus considered to have a greater extent of metamorphic lower Silurian rock than geologists have heretofore been disposed to concede to it, and of a character which may in no small measure compensate for the probable limitation of auriferous deposits.

ART. II. ON THE EAGLES OF NOVA SCOTIA. BY J. BERNARD
GILPIN, B. A., M. D., M. R. C. S.

(Read November 11, 1872.)

HAVING, in pursuing the subject of scutellation on the tarsi of rapacious birds, been led to examine many eagles lately in this Province, I have thought a short description of the known eagles inhabiting it would be acceptable to the Institute. Although we have a greater variety of Brown Eagles of various shades, or, as they are termed, Gray Eagles, than of any other colour, yet all that have come under my notice may be referred to two species and their young: the eagle of the old world, or the Golden Eagle, and the White-headed or American species. Although many of the brown ones resembled, and even excelled in size the Washington Eagle of Audubon, yet their bills and feet so exactly corresponded to the White or Bald Eagle, that I had to refer them to the young of that species.

Aquila chrysaetos, (Linn., Richardson, Sclayter.)

Aquila canadensis, (Linn., Baird.)

Aquila fulva, (Temminck.)

Aquila antiquorum, (Cuvier.)

Ring Eagle and Ring-tailed Eagle of Wilson and various European authors, being the young.