The mean amount of cloud showed a deficiency of .67, being 5.85. Wind force was increasing, giving a mean velocity 8.40 miles, though still 1.63 behind its normal; and prevalent direction was from due W. Rain fell only to the depth of 3.37 inches; whereas the 12 years shew an average of 4.80 inches. 2.1 inches of snow, dispersed over 4 days, fell; being exactly one-half of the normal fall. 18 days were completely dry. 2 gales visited us, but neither were violent.

In temperature, December presented nothing extraordinary: its mean 26°21 was a very small fraction over the normal. For the first time that winter the thermometer marked down to 0 on the 30th, and registered —4° on the morning of the 31st. The mean pressure, though much diminished from last month, kept up to 29.791. The mean amount of cloud was nearly as is common, 6.60. Winds still prevailed from W. and increased much; at last passing the normal speed, and resulting in a mean of 10.92 miles per hour. The rain depth, 4.42 inches, was just 1 inch above the 12 years average; but the 11 inches of snow fell short by over one-third, or 5.7 inches. The total precipitation, 5.49 inches, slightly exceeded the normal fall. But one gale was felt in Halifax, but it was long and fierce. It began from N. E. on the evening of the 14th. At 1 a. m. of 15th it blew from N. 45.6 miles per hour. Veered N. W. that day, and above 24 miles all day. On 16th, still from N. W., it blew over 30 miles till noon, when it gradually fell. The first sleighing was on the 18th, and we had 7 days of it in all December.

Art. V.—Nova Scotian Geology — Antigonishe County.

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Director of the Provincial Museum, Halifax, N. S.

(*Read May* 10, 1875.)

Introduction.

In the session of 1865–6 I read a paper on the subject of my present memoir, which was illustrated by a map. (*Transactions.*)

This paper and map showed the results of amateur work in connection with the views of others. Since then—in the summer of 1868, I made a *thorough* survey of a great part of the County in the service of the Canadian Survey. I also reviewed a part of this work in 1871. These examinations, with others connected, made large accessions to our knowledge of Nova Scotian Geology, and led us to see the great imperfections of our amateur work of 1866.

After all this work, difficulties still existed in the way of understanding certain parts of the Geology of Arisaig township—the part of this county which is the most interesting to the geologist and palæontologist. These difficulties have been dissipated by the revelations made during my examination of the I. C. R. section of the Cobequid Mountains. This is my apology for the production of this memoir "On Antigonishe Geology."

Antigonishe County

is named after the county town Antigonishe. It was formerly called the County of Sydney. It is the north-east County of Nova Scotia proper. It is bounded on the west by Pictou County; on the south by the County of Guysboro; on the north by Northumberland Strait; and on the east by St. George's Bay and the Strait of Canso.

Arisaig

is familiar to the Canadian geologist as a "household word." The use of the word in Nova Scotian geology has been somewhat vague and unsatisfactory. I have elsewhere proposed to give it an exact application, and to use it in its widest sense—as indicating

Arisaig Township.

This is the north-west township of the county. It is bounded on the east by Morristown township; on the west it is bounded by the County line and Pictou county.

A great part of Arisaig is still covered by forest, and thus far in a geological sense it is largely obscure. The soil is generally fertile, as might be expected from the prevalence of feldspathic and calcareous rocks. The numerous brooks which intersect it in vari-

ous directions, are pathways to the geologist. They afford water power to the saw-mill, grist-mill and factory, and supplies of water for other uses. The country is well watered.

The brooks are: Malignant Brook, McNeil's Brook, Doctor's Brook, Arisaig Brook, Smith's Brook, McAdam's Brook, McAra's Brook, Knoydart Brook.

The northern boundary of the township—Northumberland Strait—affords abundance of fish to the settler. Its shore is of surpassing interest to the geologist. Its beaches make it an admirable watering place.

The Arisaig mountains rise to the elevation of 1010 and 1000 feet.

McNeil's mountain is considered the second highest mountain in Nova Scotia proper.

Cape Breton has an elevation 1360 feet.—*Admiralty Chart.*

GEOLOGY.

I purpose to illustrate the Geology of Arisaig by a series of Sections, traversing it in different directions:

1 Malignant Brook Section,
2 Shore to McNeil's Mountain,
3 McNeil's Brook,
4 Doctor's Brook,
5 Shore to McDougall's Mountain,
6 Frenchman's Barn to McDonald's Mountain,
7 Mountain Pass (Doctor's Brook),
8 Arisaig Pier to Mountains,
9 Smith's Brook,
10 McAdam's Brook,
11 McAra's Brook,
12 Knoydart Brook,
13 Shore Section from Morristown township to Knoydart Brook.

I propose also to illustrate the Geology of the whole County by continuations of two of these Sections—of Sections 8 and 13:

SECTION 1.—*Malignant Cove to Sugar Loaf (Mountain.)*

At the Malignant Cove we have a patch of Lower Carboniferous conglomerate, penetrated by trap (diorite) in a singular manner. This conglomerate has been hardened by contact with the trap. The conglomerate and trap in contact are exposed to a short distance up the brook, below and above McDonald's grist mill. The conglomerate is then discontinued. The trap continues to a farther distance and is succeeded by slates. Returning to the diorite (trap) and crossing it westerly a short distance we take our course again southward.

The diorite extends to the summit of the Sugar Loaf, a distance of *one mile*. A band of red slates coming from the west seems to terminate abruptly on the back of the mountain.

SECTION 2.— *West of Malignant Cove to McNeil's Mountain.*

From the shore to the bridge over which the road passes, we have diorite exposed in the brook. Under the bridge there is red syenite. This extends up the brook to some distance. Turning to the right, we come to an eminence of diorites, having a thin vein-like band of red slates, six inches wide, which terminates here. Following this slate westward to the mountain road, we find it in broken patches alternating with the diorite. It occurs in similar manner to some distance up the road, then it becomes a continuous band extending toward the west.

Proceeding along the road toward the mountain we cross *diorite (extending?)*. Succeeding this is the band of red slate of which that of the Sugar Loaf is the eastern extension. This also extends westward.

Another part of this band extending to the rear of the Sugar Loaf, becomes associated with *syenite* and intercepted. Crossing the bridge of McNeil's Brook, beyond it we have associated with these slates a *boss* of a peculiar *Porphyry*. The outcrop is about 28 x 28 feet. This porphyry was long familiar to me from the occurrence of boulders on the shore.

Proceeding onward and topographically upwards we have occa-

sional exposures of slates and quartzites to a distance of —— feet. We come to a porphyry similar to the preceding—we have reached McNeil's Mountain. This is a large *boss* of red syenite, having an elevation as has already been observed, of 1010 feet. On the south side of the mountain the ground is swampy, beyond is wilderness. The distance of this mountain from our point of departure is *two miles.*

SECTION 3RD.—*McNeil's Brook.*

At the mouth of the brook on the shore there is exposed a patch of strata, having a low dip. These are fossiliferous, the fossils indicating C. of the upper series.

Along the brook to the south all is obscure until we reach the diorite of the preceding sections. Passing through this, a straight distance of ———— then comes the band of red slates of preceding sections. In these I found patches of calcite, but no fossils.

From this the brook passes eastward to the last section.

SECTION 4TH.—*Doctor's Brook to McIntosh's Mountain.*

On the shore and a little way up the brook, trap is crossed. From the miller's house to the height above the mill, and on either side of the mill dam, great and even picturesque exposures of singularly mixed and indescribable rocks are seen, which are regarded as metamorphosed sedimentary rocks, of A of the Upper Arisaig series. Succeeding there is a band of slaty rocks of A or Mayhill Sandstone age, having characteristic fossils. These have a width (thickness) of —— feet. After this there are black shales, (laminated), having *graptolites*, and a large concretion. These have a width of 146 feet. To a farther distance of 192 feet there are black shales and slates. These have *lingulæ* and other fossils. This is B of the Upper Arisaig series.

We have still in the section at the side of the road and the brook, 47 feet of slates—lithologically dissimilar. These are also fossiliferous. I regard these as the lower part of B'.

Continuing the section we have an obscure interval of lofty banks, having a hard rock jutting into the brook. This is probably

the passage of the C strata of the last section. Following the course of the brook westward, for a short distance we have shelving strata, having a northerly dip. These are soft and hard, light green and unctuous. They have fossils characteristic of B' of the upper series. We have thus a *syncline*.

Passing over a field on an elevation of these strata, we reach diorite, a continuation of that of the preceding section. This contains about ———

We have now reached the eastern branch of Doctor's Brook, which here takes a southerly course, being direct south from the main brook and along our line of section. Succeeding the diorite are quartzites and slates having a very thin bed of *öolitic iron ore* (hematite). We have come to the red slates of preceding sections. Here they are parted in several places by diorite—before the *trifurcation* already noticed. After these are slates and quartzites—sections of the mountains on the eastern side of the brook.

The section terminates with the diorite of McIntosh's mountain. Beyond this the rocks are obscured.

SECTION 5TH.—*McDonald's Cove to McDougal's Mountain.*

Commencing at the Point on the east side of the cove, there is first the trap dyke of last section, succeeded by a peculiar green and red jaspideous rock. Then follow the fossiliferous slates of A.

After these come the laminated black shales of B. The contour indicates the probable continuance of these and the shales of B up to the rising ground. We pass on to Doctor's Brook. On its north side strata are observed having a northerly dip. The fossils of these indicate C of the upper series. We are then upon the south side of the Syncline. After these come the B shales of the same side of last section. These are exposed in a section of the elevated ground already referred to. This part is on the bend of the brook formed by the east branch. A strip of interval or meadow extends to the south of the ridge and onward to the preceding section. Along this intervale flows the brook, first on the south side; it then crosses and flows on the north side. As it flows on

the north side it skirts sections of B strata—on the south it washes *strata of limestone.*

This limestone is of lower carboniferous age—it is part of an isolated patch. A continuance of the section shows an outcrop of conglomerate of the same age underlying it and *trap* following. This insertion among pre-carboniferous rocks seems peculiar.

Proceeding we have a considerable width of brown porphyry. This terminates a great exposure of diorite which rises boldly on the east. This diorite as well as that of McNeil's Brook and Doctor's Brook sections is ferruginous. Some have represented these as *mountains of iron.* Passing over to an elevation on the right, covered with small wood, we reach the red slate band; crossing this we have a band of diorite. We descend a steep well and crossing "Bruin's Highway," we have an equally steep and much greater ascent of precipitous slate and quartzite. We are on the side of McDougall's Mountain—climbing still farther the summit is reached—1000 feet above the sea level.

The summit rock upon which Bayfield's *cairn* stands is *petrosilex.* The last rock exposed is a *hard jaspideous conglomerate Ash.* Beyond all is obscure.

SECTION 6TH.—*Frenchman's Barn to McDonald's Mountain.*

In the sea north of the Frenchman's Barn (rock), trap is seen rising. This is a continuation of the trap of two last sections. The Frenchman's Barn is a huge oblong mass of Jaspideous rock—being strata A *porcellanized* by the trap. It is pervaded by veins of *quartz* and *baryte.* After the jaspideous strata there come slates. These have a width of —— feet.

Next come shales B. Shales are seen outcropping on the south side of the road and in a depression to the west through which the road passes. On the elevated ground all is obscure until Doctor's Brook is reached. In the brook there is an outcrop of strata B' of the southern side of the *syncline.*

Ascending we have an obscure interval, outcrops of diorite on either side indicate a continuation in our section. Then come red and gray slates—these have a width of —— feet. Succeeding is

the band of diorite as in the last section having a width of —— feet. An abrupt descent brings us into "Bruin's Highway." Here evidences of Bruin's depredations are met with. All rocks are obscure until we ascend to the sides of McDonald's mountain. Occasional outcrops of slates are seen with *diorite*. The elevation at this point is 1000 feet. Passing over the *petrosilex* band, all becomes obscure. On the mountain road leading from Arisaig to Antigonishe there is an outcrop of *granitoid* rock which may be regarded as a continuation of our section.

Section 7th.—*Mountain Pass along Doctor's Brook.*

Passing along the band of red and grey slates from the last line of section westward; these seemed to terminate, great diorite rocks taking their place. These in turn terminated before reaching Doctor's Brook.

Beginning at the bend of the brook we have elevations with slates and diorites. Then comes the obscure interval which takes the place of the diorites as already described. Crossing the brook as it passes into the mountain, we follow the road along its eastern side. The rocks are obscure. Approaching the site of a saw mill diorites appear on the road side. In the section these have a width of —— feet. Climbing the diorite as it rises towards McDonald's mountain, a beautiful piece of rock scenery stands out before us. Titanic masses are piled one upon another in magnificent order. Masses hoary with lichens and moss, and crowned with gnarled trees, their naked roots clasping the rocks and entering the crevices. This diorite extends a considerable distance up the mountain side.

Extending the line of section we have outcrops of the mountain slates extending to a distance of —— feet. Then follows a section of the *petrosilex* band, showing a thickness of —— feet. This band rises boldly on the east toward McDonald's mountain. Doctor's Brook now crosses the road and passes to a short distance in rear of the ridge, turning again southward at no great distance the brook is lost.

SECTION 8TH.—*Arisaig Pier to the Mountains.*

The Arisaig Pier rocks begin the section. The first rock is the Trap of preceding sections. It is here largely exposed in bold reefs. The second rock is hard porcellaneous jasper, beautifully banded with numerous veins of *quartz* and *baryte*. These have a width of —— feet. Following these are sand and sand banks having arenaceous shales, apparently unaltered representatives of the original of the porcellaneous jasper. They are of A and are non-fossiliferous. After these come B shales, the fossiliferous slates of A in sections 5th and 6th being missing. The B shales are fossiliferous and have the apparently characteristic *cone in cone* concretions. We have then a hill having B' strata. Descending the hill we cross the road and following an old road ascend what is locally called *double hill*. As we take the new road we come upon Arisaig brook, and find on either side sections of *double hill*, having abundance of fossils of B'. On the top of the highest (second) part of the hill the outcropping strata produced a *lingula* of unusual size. The succeeding strata exposed on the side of the brook, show a ferruginous bed, about nine inches thick; some parts of this bed have the qualities of iron ore. It is very fossiliferous.

The fossils seem to indicate the horizon of C Aymestry limestone. Regarding this section as dividing the area of the upper series into two parts. This bed may be considered as a *passage between C of the two divisions*. These strata dip at a high angle.

Proceeding along the old road we have other strata exhibiting both a northerly and a southerly dip. This is the approximate position of the synclinal axis. The southern strata are non-fossiliferous—they are red and gray. From their relative position to the strata succeeding in the line of section, and from considerations to which I shall afterwards turn attention, I am disposed to regard these as part of a higher member of the upper series, *i. e.*, higher than D Upper Ludlow, and consequently equivalent to the Ludlow tilestone of *England*. I would designate this E of Upper Arisaig series. Succeeding this at a distance of —— feet strata are seen outcropping in considerable extent. These have abundance of fossils of D Upper Arisaig. Descending the hill no farther outcrops

are seen until we cross the road. About —— feet south of the road the mountain series is reached. Here are outcrops of slates. Ascending the mountain we find indications of the red slates of preceding sections. From this the red slates pass on westward and seem to terminate in the mountain beyond. No traces of them could be found west of the mountain. Extending the line of section to the southward of this mountain we have slates, very hard grits, (ash)? and *petrosilex*. Spanning a precipice and deep *gulch*, we have again *petrosilex*, and at a distance of about a quarter of a mile we reach great outcrops of granitoid rocks — *Syenites or diorites?* I am not precisely certain.

Section 9th.—*Smith's Brook.*

At the mouth of the Brook the waters fall over strata B' having characteristic fossils. Up to the bridge and beyond it the same strata continue. Farther up there is another fall. The rocks here are of C Upper Arisaig; this is evident from the fossils found in them. In the field above the brook C fossils are abundant; these strata extending westward are well exposed on the road, above it, and in the fields. The rocks are coarse and hard, giving boldness to the outcrops.

Section 10th.—*McAdam's Brook.*

This section begins with strata of the lower part of C of the upper series—Aymestry limestone. These strata are very fossiliferous. It continues through outcrops of the same strata having abundance of fossils a degree higher in the series. It passes through strata having numerous fossils of D Upper Ludlow. At a distance of —— feet there is a small waterfall with strata having a low dip.

Continuing the section we have a broad band of red slates having a high dip. These extend to the top of the brook, terminating in a swamp, where the brook takes its rise. These slates are apparently non-fossiliferous. I have designated them E as already intimated.

Section 11th.—*McAra's Brook.*

This section begins with amygdaloid (trap); the brook flows through it. Passing through this we come to red slates; then continue up the brook, mixed grey and red slates with *trap*; these slates are apparently non-fossiliferous. As they succeed the strata of the shore section which are the equivalent of the lower Ludlow, I regard them as higher, and although they occur on the north side of the series I consider that they correspond with the red slates of the syncline in section 8, and with the red slates of last section (10). Still ascending the brook we have the lower carboniferous grits of the overlying formation.

Passing through the woods to the north to a distance of about ————, we reach an outcrop of red slates with trap. (*in situ?*) These seem to be a continuation of the red slate (band) of McAdam's Brook.

This ends the section.

Return to Arisaig.

To the south of the section there is a valley through which a branch of Knoydart Brook flows in a westerly direction. On the south side of the valley rise the Arisaig mountains.

We descend into the valley and find a pathway along the side of the brook. This valley is a continuation of Bruin's Highway. It occurs to us that the pathway may be a short way homeward, and that at the same time work may be done. Windfalls, brushwood, and a doubtful path make our way both difficult and tedious. We reach a swamp where our guiding brook takes its rise. Consequently our guide is gone. Alone, apprehensive of approaching night, and the unwelcome society of bruin, we proceed.

At length another brook appears flowing in an easterly direction; we suspect that it is Arisaig brook; we are assured, and following its friendly guidance, we ere long emerge from the thicket, reach the familiar road of section (8), and consider that all is right.

Knoydart Brook.

In the Arisaig mountains—on the table land south of the mouth

of McAra's Brook, we find an outcrop of slates in a little brook. This brook proceeds through a hollow which seems to be a short way to Moydart.

We now descend into the bed of the brook and make it our pathway as there is none other to be found. Coming into the line of the mountains of our sections we see lofty exposures of rocks. They are sections of the *petrosilex* band. Descending the brook the lofty mountains rise on either side without showing outcrops of rocks. We find that the path instead of being a comparatively straight and short one is tortuous and long, as the brook makes considerably west of south. We are diverted from our path as *Bruin* is seen to lie in our way; we climb and pass him by on the steep mountain side. After some time we descend and reach a saw mill on the side of the road. To the left the mountain rises, an outcrop of slates is seen and examined. We proceed.

Coming to the side of the advanced mountain we see an outcrop of rock towards its summit. We climb and find the outcropping rocks to be slates, but not red slates. The Lower Carboniferous Formation succeeds, having a *brine spring* on the roadside, a common occurrence in this geological horizon in Nova Scotia.

We are now on the west of the upper Arisaig series. The eastern branch of Knoydart Brook here unites with the branch which we have just traversed. We are again in *Bruin's Highway*, and near the Pictou County line. A range of lower carboniferous mountains and level ground now take the place of the upper Arisaig rocks. These mountains on the north and the continuation of Arisaig mountains on the south bound a beautiful and fertile valley, which is hid from the traveller who passes along the shore road.

Section 12.—*The Coast from Morristown Township to the mouth of Knoydart Brook.*

Beginning at the line of Morristown and Arisaig Townships, *i.e.* about —— miles from the north side of Cape St. George, we find exposed on the shore metamorphic slates of dark colour. These slates escaped observation until 1871. I was equally astonished when I found them, as I had been in 1868, when I discovered those

that succeed them in our section. With our predecessors we had taken for granted that Lower Carboniferous strata skirted the shore, having for their termini the conglomerates of Malignant Cove and Cape St. George. The rocks before us are, as far as observed, non-fossiliferous. They are, however, unquestionably pre-carboniferous—a thin bed (?) of calcite is regarded as of organic origin. Their age is considered to be Upper Arisaig. They may be on the Middle Arisaig horizon. Farther examination is required to decide this point.

We have next the Lower Arisaig series. The first rocks of this series are syenites, dark red, cream-coloured and white; they are finely granular, sparingly hornblendic and susceptible of a fine polish. Green feldspar occurs in these syenites; they are also traversed by veins of calcite, several inches thick, and penetrated by veins of diorite. Succeeding these are strata of petrosilex. These are traversed by quartz veins, having mica. After these come steep cliffs of granitoid diorites which project into the sea. We have then a bed of ophicalcite and ophite. This extends to the road where it outcrops. To a distance of nearly two and a half miles there is a series of diorites, ophites, crystalline limestones and ophicalcites. The diorites are often granitoid; sometimes the hornblende is in large crystals, set in albite. These are the rocks which produced the boulders in the drift and on the shore at Ogden's. Often the diorite is homogeneous and crypto-crystalline. One rock is almost entirely hornblende and coarsely crystalline.

Veins of *snow-white calcite* and quartz traverse the diorites in the same manner as the syenites. In one thick vein of quartz in the diorite there is *talc* in *prismatic crystals* as well as *amorphous*. The ophite often passes gradually into the hornblendic rocks (diorites), as if *pseudomorphous*. A hand specimen in the museum has the ophite blending with the diorite. I regard this series as divisible into two members as I have already indicated. 1st—syenites, diorites, and hornblendic rock; 2nd—ophites, ophicalcites, granular limestone (marble), and petrosilex. I consider that the syenites and diorites and hornblendic rock, were of earlier formation than the ophites, calcite, crystalline limestone

and petrosilex, and that conjointly they had been subjected to metamorphic action, by which the calcite veins had been formed in the syenite and diorite marbles formed; and the whole series blended and metamorphosed.

Passing Boulder Point we enter Malignant Cove, with its sections of drift, and come to the carboniferous conglomerate with intruded diorite.

This is the beginning of section 1st.

Proceeding along the shore we pass sand banks and then come to a little brook having diorite at its mouth. This is the beginning of section 2nd. We have then sections of banks, of clay, sand and gravel, until we reach the mouth of McNeil's Brook. Here the upper Arisaig series commences with a small outcrop of C strata, having fossils. These have a northerly dip. This is the beginning of section 3rd. Then follows an obscure interval, and an outcrop of rock appears of doubtful character. After these there are outcrops of jaspideous rocks of A, or the lowest member of the strata on the northern side of the *syncline* of sections 4th, 5th, 6th, and 8th, so that in the obscure interval passed there is concealed a *synclinal axis*. These jaspideous rocks include 12 feet of soft rocks, (Dysyntribite) *hydrous, silicates of alumina*. Parts of these rocks are easily polished and are very beautiful. The rocks were at first regarded as a variety of *saponite*. These rocks have been metamorphosed by the succeeding trap dyke.

Of this dyke we have now a magnificent continuing exposure extending about ——— along the shore. This *trap* is compact, porphyritic, amygdaloidal and tuffaceous. At Doctor's Brook it is the first rock of Doctor's Brook section, No. 4. The termination of this exposure is the first rock of McDonald's Cove, section No. 5.

The rocks of our section here are 1st, a jaspideous rock; 2nd, slates and sandstones of A. Mayhill sandstone, having abundance of *fossils*; 3rd black laminated shales of B Lower Clinton, having abundance of *cone-in-cone* and other concretions. The latter are fossiliferous. A few years ago these shales were trenched with the expectation of finding a vein of ore, of which specimens were found on the shore. On the west side of the cove we have again slates

of A, having lenticular beds of fossils. These have a thickness of —— feet. Succeeding these on the shore is trap, compact and tuffaceous. Then trap and altered strata of A are seen. The trap then disappears.

We have then a recurrence of the *Hydrous silicates of Alumina*, having brilliant yellow colours. Polished specimens of these are very beautiful. There are also jasper, like serpentine, associated with the Frenchman's Barn and trap of section No. 6. Beyond this is the greatest amount of *hydrous silicate of alumina rocks.* After their discovery, these were regarded by some as of probable economic importance, and were consequently quarried to some extent without realizing expectation. In these are veins having the characters of true agalmatolite (Figure stone). After an obscure interval we have again, trap, with an elevation to the south, consisting of red porcellaneous rocks. After this comes clay, which seems to overlie *hydrous silicate of alumina* rocks, and to have been formed from them, and then the trap and jaspidious rocks of Arisaig Pier—section No. 8. The rocks of A, whether metamorphosed and non-fossiliferous, or partially metamorphosed and fossiliferous, do not extend beyond this. The latter is not known to the west of the Frenchman's Barn, and it is only fossiliferous, from Doctor's Brook outcrops on the road 200 feet east of Doctor's Brook, and at the shore at McDonald's Cove, so that this, the lowest member of the Upper Arisaig series, is *very limited.* It does not occur elsewhere in the township of Arisaig. Its next occurrence being at *Marshy Hope* and *Lochaber Lake.*

Continuing the section, we have in the Cove the black laminated shales of B, Lower Clinton, having *cone-in-cone* concretions and abundance of fossils. These terminate at the mill sluice of Arisaig Brook, where strata of B' Upper Clinton commence. These are lithologically unlike the strata of B. They are greenish, while the others are black. They also shew *distinct* stratification, by the alternation of slates and shales. These are exposed in low sections along the shore, being overlaid by great accumulations of drift. They are also seen on the beach at low water. They dip with varying angles, and in different directions. One of the highest

sections is at the mouth of Smith's Brook, being the first rocks of the section No. 9. Here by a *fault* they are thrown forward upon the shore; another set of strata coming in between them and the lofty bank of drift on the south.

Large boulders of amygdaloid are seen on the shore at this point. These seem to indicate the existence of a continuation of the trap dyke, covered by the sea.

The character of the strata now reached differs very much from the preceding.

On palæontological considerations, I have separated them from the others. This conclusion has been confirmed by the analogy of the Upper Arisaig series of Springville, East River of Pictou. Peculiar organisms, found nowhere else, are common in the same position to both. [*Collections in the Provincial Museum, and in the Museum of the Geological Survey of Canada, Gabriel Street, Montreal.*]

Being palæontologically and lithologically different, I regard the strata in the section as the beginning of C, Aymestry limestone. These strata are black, coarse, hard slates and shales. The one is so hard that it is scarcely possible to extract fossils from them—the others are so yielding that it is almost equally impossible to preserve the fossils taken out of them.

These rocks extend along the shore in ledges as far as McAdam's Brook. They have a southerly dip. Succeeding them in the section are shaly strata, also of dark colour, having numerous and large concretions, regularly rounded. Beautiful fossils abound in them, but they cannot be extracted, as the concretions are very hard, besides they have a cross fracture.

After these come the ledges of Moydart Point. These consist of compact argillaceous strata with shales. They are very fossiliferous; the fossils being highly characteristic of C.

Extending along the shore to some distance south west of this point, and strongly resisting the elements by their hardness, they form bold ledges, precipices and deep recesses. They pass into D, Upper Ludlow. These strata present the same general aspect as the preceding. Only the highest strata become beautifully

variegated with alternating red strata, presenting a bold precipice with a beautiful series of layers, having a dip 45°.

Following these and seeming to butt against them is a wall of dark red strata. The colour of these is uniform. They have a southerly dip. The great change of direction shown by these is doubtless the effect of the action of a mass of amygdaloid. This is the first appearance of igneous rock since we left Arisaig Pier.

The observer now can see the effect, although the cause is not so strikingly apparent as it was when I became acquainted with the spot about 20 years ago. This piece of rock scenery then was truly magnificent. The huge rounded mass of amygdaloid extending across the shore toward the sea so as to project into it at full tide, while at the same time it overlapped and reposed on the wall of silurian strata on the shore, covering what was then regarded as the point of junction between the devonian and lower carboniferous formations. When in 1868 I re-visited this scene of a multitude of interesting associations, of much hammering, and many interesting disclosures of new forms of ancient silurian life. I must confess to a feeling of sadness at the changes wrought on the scene by the almost total disappearance of the great black rock with its friendly shelter from the hot rays of the midsummer sun. The junction of the then *supposed Devonian* and *Lower Carboniferous*, and subsequently of the *Upper Silurian*, and *supposed Lower Carboniferous*, is now completely exposed by the removal of the mass of trap (amygdaloid), by the action of the tides and storms.

Mr. Weston, of the Canadian survey, informed me last summer that he had found fossils which were not carboniferous, in the soft unstratified (apparently) rocks which succeed the silurian wall of our section, so that the said point of junction is no longer to be regarded as that of the silurian and carboniferous, but as the probable junction of two *pre-carboniferous formations*, or D and E of the Upper Arisaig series, *vide* sections :—

McAra's Brook, No. 11.
McAdam's Brook, " 10.
Arisaig Pier, " 8.

Passing these soft strata we reach a ledge of trap, then a sinus of the soft strata, and then another ledge of trap. A third exposure of trap includes the mouth of McAra's Brook, section 11. Continuing the section we have unmistakable lower carboniferous conglomerate. This brings the junction of the pre-carboniferous and lower carboniferous to McAra's Brook—the *junction* being concoaled by the trap of the McAra's Brook section.

The continuation of the lower carboniferous conglomerate becomes interbedded with trap at intervals, which may be regarded by some as contemporaneous, by others as intrusive. I regard them as the latter, and consequently of a time subsequent to the formation of the conglomerate.

This alternation of hard igneous, and comparatively soft rocks on a shore exposed to violent storms and wasting ice sheets, has resutled in the formation of jutting ledges, precipices and caverns, with trappean roofs.

Running the section a short distance beyond the county line, we have alternations of grits, sandstones and slates. A considerable bed of Lower Carboniferous limestone, resting on slates, marls, and a thin bed of öolitic limestone, with characteristic Lower Carboniferous fossils.

Still farther we have sandstones with two thin beds of *lignite* having grey sulphuret of copper. After these sandstones continue—some of these have *arenaceous* concretions.

We have now reached the end of our coast section.

Knoydart Brook, Pictou Co.

The sections described shew that we have in the Township of Arisaig, three series of Pre-carboniferous Rocks:

1. A crystalline series.
2. A mixed crystalline and uncrystalline series.
3. An uncrystalline series.

I have characterized the 1st as the Lower; the 3rd as the Upper, and I would now characterize the 2nd as the Middle series.

The granitoid members of the *lower series*, e. g. syenite and diorites, pass on so as to beard the middle series on the south.

The middle series is distinct in sections 5, 6, 7. In 5 and 6 it is bounded by members of the upper series. In section 8 it is bounded by the upper and lower series.

Collating the various sections, we find the *middle series* as consisting of—

1. Jaspideous conglomerate (ash).
2. Petrosilex.
3. Quartzite.
4. Argillites—red and grey, mixed and separate.
5. Diorites.
6. Porphyry.
7. Syenite. (?)

In section 2 the series has a width of nearly two miles. From the shore to the red syenite of McNeil's Mountain. In sections 5, 6 and 8, the series has a width of about one mile.

SECTION 5th.—*McDougall's Mountain to the shore* may be regarded as the representative section of this series, as it is characteristic, and as it also exhibits clearly the relation which the middle series bears to the lower and upper.

Assuming that syenites or diorites of the lower series lie in the obscure district to the south of McDougall's Mountain, as we are warranted to do by the existence of these in similar positions in sections 1, 2, 4 and 8. The sections are as follows:

1. Syenite or diorite. Lower.

2. Jaspideous conglomerate (ash),	Middle series.
3. Petrosilex,	
4. Slates—grey,	
5. Diorite (homogeneous),	
6. Slate—hard, red,	
7. Diorite and porphyry,	
Diorite (Trap,	Carboniferous.
Conglomerate,	
Limestone,	

A, B } wanting,
B′
C
B
A
Diorite (Trap),
} Upper series.

The resemblance between this section, until the Upper Arisaig series is reached, and a great part of the Wentworth section of the I. C. R. (*Transactions* 1873-4) is sufficiently obvious.

The sequence of the section shews that this series is *between* the other two series, and that it is below the upper—Middle Silurian—and that it is therefore Lower Silurian.

The upper series is wholly *uncrystalline*, being unmixed.

Lithologically this seems to indicate that the whole Wentworth section of the I. C. R. between the syenite and the carboniferous, with an exception to be afterward noticed is *Middle Arisaig*—as it is mixed crystalline and uncrystalline.

Palæontology *may* lead to a different conclusion in reference to the *last part* of the Wentworth section of the pre-carboniferous rocks. (*Vide* Paper on the I. C. R.)

It is only in this section that the carboniferous comes between the middle and upper series—in sections 4, 6, and 8, it is absent. Section 5 vies with the Wentworth section in having a representation of the *Oldest Sea Beach*. In Nova Scotia it surpasses it by having it at the loftiest elevation. The conglomerate of the section is about 980 feet above the present sea level, being only 30 feet lower than the syenitic top of McNeil's Mountain, of Section 2nd, 1010 feet, which as far as known, is the second highest in Nova Scotia Proper. If the conglomerate is *volcanic ash*, this may be a *sea bottom*.

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* This band of Petrosilex seems to have supplied the aborigines of Prince Edward Island with choice material for stone implements. (*Vide* specimens of hatchets in the Provincial Museum.) P. E. I. is on the opposite side of Northumberland Strait; the eastern part of it being 20 miles distant from Arisaig. The geological formations of the Island being Carboniferous, Permian (?) and Triassic, could not meet their wants, and consequently they had to come to Arisaig.

The members of the *upper series* are arranged in a synclinal form, having a northern and a southern side. These are irregularly distributed over the area. Regarding the area as divided into eastern and western by section No. 7, the Arisaig Pier section.

The lower member A is confined to the eastern division, beginning between 3 and 4 and ending with the dividing line. The second B is principally in the eastern division. It begins with section 4 and ends in the western division, between the dividing line and Smith's Brook, section No. 8. It is wholly on the northern side of the synclinal. The third member B' occurs on both sides of the synclinal, in the eastern division. In the western division it occurs on the northern side, beyond Smith's Brook section.

The fourth member C occurs in the eastern division on the southern side of the synclinal, beginning with section 3, McNeil's Brook. It occurs next in section 5. It then occurs on the northern side of the dividing line and extends beyond McAdam's Brook section and beyond Moydart point to the vicinity of McAra's Brook. The fifth member D occurs to the east of the dividing line on the southern side. It occurs in the western division and north side in McAdam's Brook section, and its principal part is in the shore section, between Moydart point and McAra's Brook section. The last member E appears on the south side of the dividing line, the north side of McAdam's Brook section, and in the whole of McAra's Brook section, north and south sides of synclinal.

These facts are important as shewing the irregularity of occurrence and conditions of formations even in a very limited area.

Correlation.

(I).—The *Lower Arisaig series* has its corresponding rocks in the I. C. R. section of the Cobequids.

On the Colchester side the syenites and diorites of the centre are succeeded by petrosiliceous rocks, jaspers, gneisses, diorites (crypto-crystalline) and calcite, to which may be added the marbles of Five Islands. This series has its counterpart on the Cumberland side. Syenites, diorites, porphyries of the centre succeeded by the diorites, porphyries and jaspers of Smith's Brook and section.

These are the undoubted equivalent of the series in question.

The *Middle Arisaig* series has no representative on the *Colchester side*. It is well represented, as has already been observed in the conglomerates, jaspers, slates, shales, diorites and porphyries of the *Cumberland side* of the I. C. R.

(II).—I have elsewhere shown the relationship of George's Mountain (C. B.) rocks to the lower Arisaig series. (Transactions 1872-3.)

In 1860 I found red syenites at the mouth of Louisbourg Harbour, C. B., and along the shores toward Gabarus. The entrance of the magnificent ocean harbour of this once celebrated fortification of Louis XIV, is a break in this syenitic wall.

This syenite was observed as crossed in several parts by dark green homogeneous diorite. These had not been previously indicated in the Geological map.

Mr. Bowser, Halifax, who has been engaged by the Department of Marine and Fisheries in repairing the light-houses of Scatarie Island, which lies to the north of Louisbourg, has presented to the Museum a very interesting collection of rock specimens from the island, which shew that it is composed of rocks of the Middle Arisaig series. The rocks of West Point, as shown by the specimens, are jaspideous conglomerates and diorites. One conglomerate is brown, with crystals of feldspar, like a porphyry. The others are green, with pebbles of brown and red jasper. The diorite is homogeneous and coarsely crystalline. If the syenites of Louisbourg and the carboniferous strata of the Cape Breton County were to be extended eastward, so as to run parallel, the rocks of Scatarie would lie between them. A conglomerate boulder from the beach derived from the rocks on the shore of Scatarie is of peculiar interest. Being polished, it shows an imbedded pebble of many striped jasper, which might be regarded as derived from the striped jasper band associated with the ophicalcites, marbles, &c. of George's Mountain, C. B. (Paper in Transactions 1872-3.) This is admitted by all who have compared the boulder with the specimen of the jasper rock in the Museum. The Scatarie conglomerates very much resemble those of the I. C. R. in the Cobequids. These and other considerations seem to justify the opinion—obliterated by erasure :

1.—That the Lower Arisaig series is distinct from the Middle series.
2.—That by volcanic agency the lower series was elevated above the sea, *prior* to the formation of the middle series. (?)
3.—That while the *latter* is regarded as Lower Silurian the *former* may be regarded as Cambrian (?) or Laurentian, *until* palæontology has decided the question.

In my paper on the I. C. R. section, (Transactions 1873-4), I correlated the Wentworth section with a section of the Wales' Silurian rocks, according to Professor Ramsay's authority. The difference between the Wales and I. C. R. section, now seems to be that the latter seems to have a greater range *downward*.

MORRISTOWN TOWNSHIP.—(*Continuation of Section* 12.)

Traversing the shore of Northumberland Strait, eastward of the Arisaig Township. Before reaching the north side of Cape George we pass out of the metamorphic (?) middle, and upper silurian slates into lower carboniferous conglomerate. This conglomerate varied by a projecting trap-rock (diorite), here and there, especially at the point of the Cape, constitutes the section to the south-east side of the Cape in St. George's Bay. These form the north-east part of the north side of the northern carboniferous area of the County.

The remaining part of this side westward extending to the Arisaig mountain (Sugar Loaf), is separated from the strait by the metamorphic slates and the Lower Arisaig series of the section already described. In the part that overlies the Lower Arisaig series there occurs lower carboniferous limestone. Continuing the section on St. George's Bay we have coarse sandstones, with shrinkage cracks, and sandstones with scales of *palæoniscu*. At Graham's Brook we found flora in the sandstone, casts of lepidodendron, &c.

Between this and the north side of the Morristown lakes there is no outcrop of interest—the ground being flat. From the Cape to Morristown lakes the carboniferous series *ascends*; after that there comes another series which descends. The Morristown lakes' strata include a coal field—*Dawson's Acadian Geology, Ed.* 1867. This coal field has a history.—

As far as I can recollect, in the summer of 1859, one of the McDonalds' of the North Grant, Antigonishe, brought to me a specimen of highly bituminous shale, from an exposure found while searching in the woods for ship timber. At this time I was residing in Antigonishe. I accordingly visited the locality and saw a large outcrop of black shiny bituminous shale, associated with a dark brown shale equally bituminous. In these I found abundance of scales of *palæoniscus* and various forms of *lepidodendra*. (*Dawson's Fossil Plants of Canada. Geological Survey of Canada.*) The discovery of the Fraser Oil Coal in the Pictou Coal Field, and its uses, encouraged the expectation that this shale might be available for the manufacturing of Coal Oil, or that something highly bituminous, or coal itself might be associated with it. This expectation induced the discoverer to undertake the work of exploration, associated with John Campbell, Esq., of Dartmouth, who is well known as an indefatigable and successful explorer of the gold and coal fields of Nova Scotia. This work continues up to the present time, and is to be continued during the coming season. Mr. Campbell reports as having discovered as follows :

5. Coal—4 feet or more. Beds, thickness not ascertained.
4. Coal—4 to 6 feet. Beds, thickness unknown.
3. Coal—3 feet 6 inches. Beds, unknown. 280.
2. Coal—5 feet 9 inches.
1. Coal—6 feet.
   Shale--3 feet.
   Coal—2 feet.

Coal—28 to 30 feet.

Continuing the section we have to the south of Morristown Lakes, Cribbean's Head, a large exposure of Lower Carboniferous strata, containing casts of trees and calamites. Near McIsaac's Point, we have reached the lowest strata of the south side of the carboniferous basin. At McIsaac's Point we have an outcrop of metamorphic slates and diorite (igneous.)

This is the eastern terminus of a formation which extends into the township of Dorchester in the form of an isosceles triangle, its base commencing at a distance of 1½ miles from Antigonishe (Town),

and extending to the north a further distance of 4½ miles. About two miles to the west of this base we have what may be *strictly* regarded as a continuation of the same formation. The intervale is occupied by lower carboniferous conglomerate and grits, which doubtless overlap and obscure the underlying connection. This continuation beginning on the north in the Arisaig mountains, extends southward to a distance of about two miles north-west of Antigonishe, bounding Pleasant Valley and the *north carboniferous area* of Antigonishe on the west.

I observed this continuation to extend to the west of Antigonishe at least a distance of 6 miles in the mountains. The Falls of James' River being formed by a magnificent and on either side towering exposure of these metamorphic olive coloured slates.

About a mile south-west of the *outcrop of the section*, the range of mountains commences and continues to Antigonishe, their culmination being the Sugar Loaf, 760 feet above the sea level. The summit of the Sugar Loaf is an igneous rock—diorite. About 2½ miles north of the Sugar Loaf is another igneous centre. Appearing first on the fields and brooks at Donald McDonald's (Brook), it extends westward, outcropping and joining a lofty bluff on the east of Right's River. Here the rock is *amygdaloidal*. It is uncertain whether the diorite of the *outcrop* is the extension of the first or second, or of both. I have heretofore regarded it as the continuation of the second. I regard this eruption as contemporaneous with that of the diorite of McLellan's Mountain and Sutherland's River as post Upper Silurian and pre-carboniferous—*Devonian*, and the metamorphic slates as metamorphosed Middle and Upper Silurian, according to the analogy of East River, Pictou, McLellan's Mountain, &c.—(*Transactions* 1870-71.)

Continuing the *line of section* on St. George's Bay, we have on the south side of the pre-carboniferous rocks described the lower strata of the north side of the *southern carboniferous area* of the County. These consist of conglomerate, breccia, sandstone and limestone, partly covered by a great bed of drift, containing and discharging large boulders on the shore of strongly characteristic rocks of the Lower Arisaig series of the Northumberland Strait

part of the section. Boulders from the bed, lying on the shore had long attracted attention and excited enquiry in reference to their origin. Proceeding, limestone occurs having bold sections, and then we have projecting into the sea lofty cliffs of hard and soft gypsum and beds of clays, with fibrous gypsum, and red in great variety.

The intimate connection manifest between the carbonate and sulphate of lime when the two occur in contact, seems to me at variance with some theories that have been advanced relating to the origin of gypsum. We have now come to the mouth of Antigonishe harbour. Monk's Head beyond the harbour at a distance of ——— miles from Ogden's, shows a continuation of the gypsum deposits. Here there is a section of gypsum, which seems to be the southern limit of these deposits. These limestones with gypsum, are also of great longitudinal extent.

At Ogden's Point they are seen leaving the shore. Their course indicated by a series of elevations of 50 feet on Bayfield Plan of the harbour, run parallel with the mountains described, and show occasionally conglomerate underlying, until we reach North River—the line between Morristown and Dorchester Township. On this river the gypsum is prominent and well exposed. It rises in hills and is also exposed in the river and road sections. It reaches to the mouth of the river and is exposed on the opposite side of the harbour in bold sections. It is not again seen on the north side of the harbour, as it has passed over to the south, appearing on that side of the harbour, extending southward on South River, and crossing the road from Antigonishe to the Strait of Canso. On the south side of the harbour it is associated with syenite and fossiliferous limestone. Sometimes the syenite apparently stands alone—at other times it is in direct contact with the fossiliferous limestone—one instance is notably so. We have an elevation which rises 300 feet above the sea level. I have elsewhere referred to this case as subversive of the theory advanced by some geologists —maintaining that the marbles of Cape Breton are *lower carboniferous limestones*, metamorphosed by the action of syenite. (Transactions 1872–3.) Here the limestone in the closest possible

contact with syenite, *so as to form a breccia*, is wholly unaltered, *Entomostraca* even being unaffected.

The reason why is obvious. These syenites existed long before the carboniferous limestones were formed. They were evidently also existing in the bottom of the sea of the carboniferous period. The organic agencies forming the limestone lived and died on and around them. Their remains even until the present period have been totally unaffected by metamorphosing agencies such as those which were at work at Arisaig Pier and elsewhere.

The gypsum re-appears projecting from the bank of Right's River, between Trotter's factory, on the north, and on the bank of West River, south of Antigonishe, on the south. Passing from Right's River, and skirting the overlapping lower carboniferous conglomerates already noticed, that connect the northern and southern carboniferous areas, it meets Brailey Brook, and proceeds along its south side, forming a lofty wall, whose foot is laved by the water of the Brook. This gypsum has the limestones of Purcell's quarry, McIntosh's and Grant's occurring at intervals between the Antigonishe and Malignant Cove road, and the place where Brailey's Brook proceeds from the mountain. These limestones run nearly parallel with the gypsum at a distance of 300 to 500 feet on the north, underlying the gypsum and overlying the conglomerate, which are formed against the metamorphic middle or upper silurian slates of the mountains already described. The limestones contain deposits of brown ochre *calehopyrite*, and occasionally malachite, (ores of copper) in very small quantities. They are used extensively for building purposes. The Antigonishe Cathedral is in large part built of the limestone from McIntosh's quarry. The gypsum proceeds beyond Brailey Brook, westward to the vicinity of James' River, and passes to the south appearing at about a distance of two miles, in a considerable outcrop at Addington Forks.

The limestones proceed westward, after being left by the gypsum at James' River, terminating in this direction with associated conglomerates on the road side at the beginning of the *Big Clearing* 8 miles from Antigonishe.

Southward the lower carboniferous limestones extend on the east side of the Ohio River (a branch of West River), that flows on the east of the Ohio Mountains. One of these limestones is of palæontological interest as containing trilobites (Phillipsia). They reappear at the Lochaber road, having a deposit of beautiful cinnamon coloured ochre. The last of these limestones, as far as we know, is in St. Andrew's Township, where we shall meet them again.

Saline.

The names Saltsprings, Saltpond and Saltworks, are suggestive. These all lie in the gypseous area described. Saltsprings is the name of a settlement on West River. The Saltpond is on the intervale below the Episcopal Church of Antigonishe. The Saltworks are on the intervale below the Town.

History of the Saltworks.

Shortly after I directed the attention of the Institute to the existence of the Saltpond, &c., in 1866, Josiah Deacon, Esq. visited me in Antigonishe, in his search after a proper locality for Saltworks. Encouraged by the indications of salt around Antigonishe, he commenced operations with a magnificent set of boring apparatus, imported from England. Supposing that Town Point, near the mouth of the harbour, would be a point where the supposed flow of the saline waters which supplied the Springs and Pond would be *tapped*, and the salt most conveniently exported, he made a six inch boring, and lined it with iron tubing. At a certain depth in the soil and clay, he entered gypsum—passing through a considerable thickness of gypsum. He came to sandstone without finding any indication of brine, and concluded that farther operation in this locality was useless.

This boring showed that the gypsum bed outcropping on the north or the skirts of the mountain, and the outcrop on the south side of the harbour, were in all probability the edges of a continuous bed of gypsum, and that it was sometimes deposited on the lower carboniferous sandstones without the intervention of the limestone seen elsewhere. It also shewed that the harbour was in an excavated bed of gypsum.

Mr. Deacon next operated on the intervale below the Town, not far from the confluence of Right's River, Brailey Brook and West River. Here salt water and salt occurred on the surface—making the place a favorite resort of the cattle.

Here, after passing through a considerable thickness of clay, impregnated with salt, he came upon gypsum. In this the boring was so dry that it was difficult to work. Suddenly the bore hole was found to be filled to some distance from the top. Mr. Deacon was in transports when he found that the fluid was *brine*. Notwithstanding vigorous pumping, the brine kept up to the mark, with a great discharge of sulphuretted hydrogen. Being now very sanguine in his expectations, he had a steam engine erected for pumping, and furnaces, tanks and evaporating pans of large dimensions constructed for the production of salt. After the manufacture of a considerable quantity of salt, the strength of the brine became very much reduced. Mr. Deacon accordingly commenced another boring at a point near to the evaporating building; after boring through clays, impregnated with salt to a depth of 650 feet, without finding any indications of brine—the brine of the other boring becoming too weak for use, and the working capital exhausted, the work was abandoned.

It is much to be regretted that a greater extent of the saliforous area was not explored by the boring apparatus, especially in the region of the Saltpond. On the south side of this carboniferous area lies Cape Porcupine, on the Strait of Canso. Conglomerates and other lower strata, with limestone advance from this to meet those that I have been describing. Combined they crowd toward the Bay. Higher strata at Pomquet have small coal seams. Near the Forks of Pomquet the sandstones contain deposits of the grey sulphuret of copper, of the usual (?) economic value of such deposits in the Lower Carboniferous Sandstones of Nova Scotia.

I would here observe that the geology of this County, and the physical feature, or hills, lakes, rivers, uplands and intervales, which largely originate from its geology, constitute Antigonishe the finest agricultural county in the Province. Its only drawback is its proximity to the Gulf of St. Lawrence, with its *Glacies* (*Ice.*)

Section 8.—*Continued.*

This section from Arisaig Pier to the Mountains extending south-west to the point where the Marshy Hope Road intersects the county line between Antigonishe and Pictou Counties, passes through a table-land which is covered by forest. On the north side of the road at the county line there is a band of strata A of the Upper Arisaig series with characteristic fossils. This outcrops on the side of the road at the place indicated, and also on the road at the coach stables, east. The section has an obscure passage—from this south to the Ohio Mountains above Addington Forks. It then traverses the red syenites which form the western boundary of a considerable part of the southern carboniferous area of Antigonishe. This syenite extends westward into the County of Pictou, and southward into the County of Guysboro. At a distance of about eight miles from Addington Forks—the section now running eastward to Lochaber Lake, at right angles to its former course, crosses the Ohio River, and passes to the Mountain west of Lochaber Lake, with its granitoid diorite. Overlying this is a band of strata A, Upper Arisaig, or (Middle Silurian), having abundance of characteristic fossils.

It is worthy of notice that this was the position where I first discovered this member of the series in 1858. The fossils here are generally casts, some of them are *silicified*. Perfect specimens are occasionally found. Overlying this are strata of C and D, Upper Arisaig (Upper Silurian), having also abundance of fossils. On the side of the lake were found *in situ*, Chonetesi N. Scotica, Crania acadiensis, Dalmania Logani and Clidophori, characteristic of the upper part of D. Lochaber Lake in the line of section lies beautifully between two parallel ranges of hills, its length is 4 miles. The opening which is at the south end conveys its waters to St. Mary's River, which empties into the Atlantic Ocean.

The lake is about half a mile wide. Near the opposite side is an islet, which is formed by tilted shales of red and grey colours. This band of slates is of considerable length and breadth. They form the elevated ridge on the east side of the lake. They are non-fossiliferous. I am disposed to regard these as corresponding with

the red and grey band of the Middle Arisaig series, and to regard them and the rocks of the rest of our line of section which extends to South River Lake, and Upper South River, consisting of slates, diorites and quartzites, with cavities lined with large and pellucid crystals of vitreous quartz, as having more resemblance to the middle Arisaig series than to the metamorphic upper. The absence of fossils and the isolation of these rocks, may, however, render their relations and age doubtful.

In the part of these around Polson's Lake, there is evidence of the existence of iron and copper. Excavations have shown the existence of veins of hematite. Masses of micaceous oxide of iron are scattered around, and also oxide of iron with pyrite and calchopyrite. The last have, at various times for a quarter of a century excited interest, as indications of copper ore of economic value. Two great searches had been made over twenty years ago. While I resided in Antigonishe two others were made, and two or three since that time. Considerable excitement was manifest in the summer before last, when D. Donald Fraser of Springville in his excavations, came upon a mass which seemed to be the desired lode.

This excitement subsided when it was found that after all it was only a mass; it is likely however that the search will be resumed.

Polson's Lake is on the border of Guysboro County. It and the South River Lake on our line of section, empty into South River which flows through a long and fertile country and then enters into Antigonishe Harbour, so that the waters of the district flow towards the Atlantic on the south and the Gulf of St. Lawrence on the north.

Terminating our line of section—we have after the quartzite with quartz crystals, *Lower Carboniferous*, unconformable, with sandstone and limestone of *St. Andrew's*, we noticed the latter in connection with the previous section.

The Upper Palæozoic part of the coast section as I have described it seems to throw some light upon the character of the Lower Palæozoic or Eozoic (?).

1.—The Lower Carboniferous formation of Antigonishe Harbour shews limestone in contact with syenite, the connection of the

syenite and the limestone being intimate, the latter being unaffected by contact with the former.

2.—The Lower Arisaig series also shows limestone in intimate connection with granitoid diorites. This limestone is crystalline (marble). In some cases it is interbedded (?) with, and penetrated by, green dysyntribite (?) (a serpentine-like rock), leading us to speak of ophite and ophicalcites. There is also a blending of the ophite with the diorites. The associated syenites have, also, in close connection, dark petrosilex, with *veins of quartz containing mica*. The syenites and diorites are also penetrated by *veins of calcite*. The diorites have quartz veins with talc. In the same series there are homogeneous diorites very frequently occurring and seeming to penetrate the syenites, and diorites, and calcites. These seem to be interbedded rocks of igneous origin.

3.—The Section also shews the lower part of the Upper Arisaig series, in contact with diorites of lower carboniferous age, the result of the contact being the conversion of sandstones into porcellaneous jasper—striped and uniform—other strata being converted into yellow, brown, and mottled *dysyntribite* rocks.

4.—I consider that if the cause of metamorphism in the last case, and its action had been brought into association with the syenite and lower carboniferous limestone, specified with an addition of silicious and argillaceous sediment, and accidental elements of syenite and diorite—and also if the cause had been augmented and the action intensified—we should have a reproduction of the characteristics of the Lower Arisaig series, as in the section, and also as in St. George's River, C. B., where we have striped jasper in the place of petrosilex, and (ophite) with calcite, &c.

Volcanic.

This county indicates volcanic action:

1. In the Lower Arisaig series, *Cambrian?*
2. In the Middle Arisaig series, *Lower Silurian.*
3. In the Upper Arisaig series (Metamorphic), volcanoes of *Devonian age*, as in Pictou County.
4. In the *Lower Carboniferous.*

TRANSPORTATION.

Post pliocene.

Drift accumulations abound throughout the county. The transportation of the boulders at Ogden's (*vide shore section continued*) from the Lower Arisaig series of the shore section, is in the direction S. 30° E. No glaciation has been observed in the county.

The drift material is to be regarded as to a large extent the product of the action of subaerial agencies, that were at work as now denuding the various formations in the tertiary period, additions being made, and the transportation being effected by special agencies at work during the post tertiary (post pliocene) period, e. g. *ice agency*. Large masses have been transported from Frenchman's Barn (rock) and Arisaig pier of the same section, to elevated positions on the south.

Recent.

The ice in the Gulf of St. Lawrence often takes up rock masses and distributes them along the shore. Numerous examples can be pointed out, illustrating this statement, where carboniferous and other rocks have been taken from their original position some miles distant, and landed on the shore among Arisaig rocks.

A notable instance of ice transportation occured a winter or two ago, when a large addition to Arisaig pier (wooden) with its ballast, was lifted up and landed in the middle of the cove some distance to the south of the pier. This mode of transportation has doubtless been in operation all along the northern shore of Nova Scotia, since the post pliocene period, and it has yet to be proved that the same process was not in operation prior to that period. This may be one reason why rock masses may often be found in the drift out of the regular course of post pliocene transportation.

(*To be continued.*)