ART. XI. — A REVISION OF THE GEOLOGY OF ANTIGONISH COUNTY, IN NOVA SCOTIA.—BY REV. D. HONEYMAN, D. C. L., F. R S. C., F. S. Sc., *Hon. Member of the Geologist's Association, London, &c.*

(Read May 10, 1886.)

THE construction of a line of railway, which passes through this County, has exposed interesting series of rocks which were largely obscure. Geological investigations of cognate series in other parts of the Province have, in turn, cleared up certain doubts in reference to series in the County which are regarded as "Typical." The examination of correlated series elsewhere have contributed somewhat in this direction. The application of the microscope and polariscope to the study of the crystalline rocks, besides revealing the character and constitution of the rocks themselves, seem also to indicate relationship and age, and thereby serve, *in a manner*, to determine the relationship of associated non-crystalline rocks. In some cases, too, comparative palæontology, without lithology, lends its aid in confirmation of certain conclusions. These considerations have induced me to make a revision of the Geology of Antigonish County. In no other County has the geology been so fully investigated. Parts, however, yet remains to be examined. I have wrought in this field as an amateur or Provincial geologist, more or less, during a quarter of a century, and yet corners remain untouched.

TABLE OF FORMATIONS.

1. Pleistocene,—Champlain and Glacial.
2. Carboniferous,—Middle and Lower.
3. Silurian,—

Upper.	"Upper Arisaig," "Typical."
Middle.	Hall.
Lower.	Hudson River.

4. Cambrian ?—"Middle Arisaig."
5. Archæan,—"Lower Arisaig," "Typical."
6. Igneous Rocks.—

Carboniferous.

Pre-Carboniferous.

I shall, by means of sections and offsets, indicate the several formations and their relative positions. At the same time, I will take occasion to make illustrative notes.

Section I., on the line of railway from Pictou County line to Antigonish harbour.—The range of mountains on this line commences at a distance of about two miles N. W. of the town of Antigonish, and extends westwards to Barney's River Settlement in the County of Pictou. At this extremity the railway has exposed an interesting junction of carboniferous conglomerate, and igneous rocks. Equivalents of A and B members (Hudson River, Lower Silurian) of the "Fossiliferous Arisaig Series," and the metamorphic Cambrian rocks of the mountains. In addition to this it has given easy access to the mountains, in parts where they have been cleared of forest, and can be examined to greater advantage than in Antigonish County. This is the case nearly up to the County line. (*Vide* "Notes on a New Geological Progress Map of Pictou County."—Transactions of the Nova Scotian Institute of Natural Science, 1880, Vol. V.)

Before reaching the County line, the railway has entered an interesting band of rocks, corresponding with A. Arisaig, as above, both in lithology and palæontology. The strata are hard metamorphic slates. The fossils are scattered through the rock, and are all in the state of casts, with the exception of the *Linguloe*, which survive, while the others have only left their impressions, external or internal. Other fossils are *Petraia*, *Cornulites* and *Orthoceras*; the *Petraia* are persistent, being found everywhere, and in pretty much the same condition, wherever corresponding strata are found. Occasionally I have found the corals silicified. In two localities only has the coral survived in A, in a state of distortion. I would further remark that these strata succeed the metamorphic Cambrian (?) formation of the mountains, as their relatives do at the western end, without any

intervention. I shall again refer to this fact. Another fact may be stated. A large piece of rock was pointed out to me, by my companion, on the mountain side, immediately behind our fossiliferous strata, as something peculiar. It was a conglomerate corresponding with rocks found at Wentworth, in the Cobequid Mountains, belonging to the series of rocks with which I have elsewhere correlated part of these mountain rocks. Proceeding on line of railway, we pass the last outcrop of the fossiliferous rocks at the old stage-coach stables. At Glen-Bard are seen outcrops of the Cambrian (?) rocks. Emerging from Marshy Hope, at the Big Clearing Station, we observe Lower Carboniferous conglomerates, succeeded by limestones.

We are now on the north-west corner of the southern Carboniferous area of the County. Advancing we have limestones, or pits, as far as James's River. Following this river into the mountains, about three miles, we come to a fine waterfall, with rocks rising in peaks, on its sides, to a considerable elevation—estimated about 300 feet. The whole is picturesque and beautiful. Further up, at a distance of two miles, we reach the "Old Mountain Road," with its old clearings. This was formerly a highway between Antigonish and Merigomish.

Returning to the railway and proceeding onward, we enter upon a great belt of gypsum, with occasional limestones. This extends, with occasional interruptions, as far east as St. George's Bay, a distance of fifteen miles. It also passes over to the south, appearing at Addington Forks, and beyond at West River. Reaching Braley Brook, we observe the gypsums rising in a lofty wall, with the brook running along its foot.

Following the brook towards the mountain, we find limestone strata, having brown ochre with calchopyrite coated with green carbonate of copper. This has conglomerate underlying it, which has also green copper carbonate. None of these are of any value. Still advancing, we have the gypsum wall on the right, and come to a small brook, which also issues from the mountain. Going up this brook, we come to a quarry having limestone of considerable quantity and solidity. This quarry furnished the chief building stone of St. Ninian's Cathedral, Antigonish. This

also overlies conglomerates. We have already parted with the mountain metamorphic rocks, and come to a break between the two mountain ranges. This break is occupied by rocks of the two carboniferous areas of the County,—conglomerates, grits. A quarry of the latter in the so called "Yankee grant," furnished the other building stone of the cathedral. Still proceeding, we have the gypsums on the right and another brook, Braley Brook, having turned away from our course. On the left side of this brook we have another limestone quarry, with brown ochre. Still further, we pass into conglomerates, and cross Right's River above the factory. Below it is a bluff of conglomerates, with the gypsums outcropping on the side of the river. Crossing the intervale, we come to the railway station at Antigonish. This is also the site of the "Old Salt Works." In my paper "On the Geology of Antigonish County"—*Vide* transactions of the Institute of Natural Science, 1866—I made mention of the salt pond in the Town and salt springs in the County. In my recent paper "On the Geology of Antigonish County," Trans. I. N. S., 1875, is a "History of the Salt Works." Extract: "Mr. Deacon next operated on the intervale below the town, not far from the confluence of Right's River, Braley Brook and West River. Here, after passing through a considerable thickness of clay, impregnated with salt, he came to 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. He 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, that of the other boring becoming too weak for use, and the working capital exhausted, the work was abandoned."

About one mile north of the salt works, we have the mountain called the "Sugar-loaf." The height of this is 760 feet. Its rocks are highly metamorphic slates, argillites. A section of them is seen on the "Old Gulf Road." They are destitute of fossils. The summit rock is syenite. — (*Vide* "Polariscopic Notes." A Paper preceding.) On the side not far from the summit, the argillites outcrop. They are also seen outcropping in a brook at Doctor's Quarry. I have correlated these with rocks in McLellan's Mountain, which I regard as "Lower Silurian metamorphic" (?); overlying these are Lower Carboniferous conglomerates. The upper parts of these have a little green copper carbonate. The ochreous limestones of the quarry overlie them. South of this mountain is another mountain of less elevation— 480 feet. The argillites of this are overlaid by conglomerates and limestones of another quarry. Returning to the line of railway: In its farther progress, it passes over to the south side of Antigonish harbour. Here gypsums are seen outcropping on its course as far as South River. Before reaching Williams Point, it comes to heights which rise 300 feet above the sea level. In these are syenites with fossiliferous limestones in closest connection, forming a breccia. The limestones are wholly unaltered. *Leperditia, conularia, &c.*, are found near the syenite, and crystals of Galenite. Here we have a sea bottom, while on the "Sugar-loaf," and other mountains, we have sea beaches of the Lower Carboniferous period. The former have been raised *more* than 300 feet since they were formed, as the fossiliferous limestones occur on the summit as well as the syenites. It is probable that the latter, and the mountain range itself, have been elevated to the same extent.

Section II., from North River, Antigonish harbour, to Cape St. George. — Crossing from Williams point to the mouth of North River, we find the gypsums re-appearing on the north side of the harbour. Up the river, on both sides of the Harbour Road, they are very largely developed, and they continue still farther towards the mountains. Beyond this conglomerates occur as far as the mountain rocks. At Town Point, on the harbour, "Mr. Deacon made a six-inch boring, and lined it with

iron tubing. At a certain depth in the soil and clay, he entered gypsum. He came to sandstone without finding any indication of brine, and concluded that further operation in this locality was useless." This was his first boring. Back from this, nearer the mountain, gypsum is seen rising to a height of fifty feet. I would here remark that all these altitudes are taken from the Admiralty Chart of Antigonish harbour. After another interruption, they re-appear, having the same height, advance to the road, where they are cut off by it; disappear again, pits only showing their existence underneath, and re-appear on St. George's Bay. The mountains come forward at the same time and end near the road. The termination of the gypsums is shown as it was 25 years ago in "Acadian Geology." By the constant undermining process going on, the once picturesque prominence has been sadly reduced, and almost destroyed. This is the other corner of the "north side of the southern carboniferous, area of the County. The rocks "consist of conglomerate, breccia, sandstone and limestone, partly covered by a great bed of drift, containing and discharging large boulders on the shore of strikingly characteristic rocks of the Lower Arisaig (Archæan) series of Northumberland Strait." In the limestones there is a cave, where ice can be had at any time. Every variety of gypsum, selenite, fibrous, soft, anhydrous and red, occur in this section. At McIsaac's Brook there is a low lying outcrop of *slates* and *igneous* rocks. This is the extension of the mountain series north of the "Sugar-loaf." Continuing the section, we come to Cribbean's Head. Here is a large exposure of Lower Carboniferous strata containing casts of trees and calamites. This is on the south corner of the northern carboniferous area. Beyond this are Morristown Lakes, obscurity, or rocks without anything of sp cial interest, until we reach Sinclair's Brook. Here are sandstones with *flora*, casts of lepidodendra. Farther on are sandstones, grits and conglomerates. In the sandstones I found scales of *Palæoniscus* and casts of sun-cracks. The conglomerates constitute Cape St. George and its ledges. These rocks belong to the north side of the carboniferous area.

Section III., on Northumberland Strait, from Cape St.

George to Pictou County line.—At the Cape and westward, as far as "Arisaig Township" line, we have conglomerates, with a projecting trap-rock here and there, especially at the *point* of the cape. Beginning at the line, we find exposed on the shore, and up a brook, metamorphic slates of dark colour, with a thin bed of calcite. They seem to be identical with the rocks of the "Sugar-loaf." We shall have occasion to refer to them again. These bring us to what I have, in former Papers, called the "Lower Arisaig" and "Archæan Typical Series." The first rocks of this series are (quartz) 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. Succeeding these are *strata of petrosilex.* These are traversed by *quartzite veins* having mica. After these come steep cliffs of granited diorites, which project into the sea. We have then a bed of ophite and ophicalcite. They extend to the road south of the shore, where it outcrops. To a distance of nearly 2½ miles, there occur diorites, ophites, crystalline limestones and ophicalcites (marbles), hornblende rock, hornblende and albite rock. (*Vide* Polariscopic Notes, No. 1. Paper preceding.) The last is the rock which produced the "boulders in the drift" and on the shore. (*Vide* Section II.) A line connecting this rock with the drift runs S. 20 to 30 E. This is the course of transportation of amygdaloids, &c., from Blomidon. (*Vide* Paper "Glacial Transportation in Nova Scotia and Beyond."—Trans. Institute Natural Science, 1872-73.) Diorites of this series are also traversed by veins of snow-white calcite and quartz. When I discovered these in 1868, I considered them to be of "Laurentian" age. Sir W. E. Logan thought they were of "Quebec" age. Dr, Hunt's opinion coincided with my own. In order to harmonize the two opinions, I have adopted the term "Archæan," which has been applied to the series under consideration in Dana's Manual, last edition, and I thereby designate corresponding rocks. Boulders of these rocks, which first directed my attention to the rocks themselves, succeed. After these are sections of "drift." I regard these as something different

r o m the drift of Section II. While I regard the *latter* as the result of glacial (ice) transportation, I consider water as the agency employed in the production of the *former*. We shall notice this again. At the Cove solid rocks appear. Here we have an isolated patch of Lower Carboniferous conglomerates. Originally this was doubtless connected with the other isolated patch of the same formation which occurs farther west, on the middle and eastern branches of Doctor's Brook. The associated and intervening *igneous* rocks evidently effected a separation. We find similar rocks dividing into parts and branches a band of an older formation, which we shall yet have occasion to notice.

By the igneous rocks the conglomerates have been much hardened and permeated. We therefore infer that the one is of more recent formation than the other. The igneous rocks also appear in a brook a little to the west. Drift then occurs until we reach McNeil's Brook. Here the first strata of the Fossiliferous Silurian series occur. Their second occurrence in the section is at the cove west of Doctor's Brook. From Arisaig Pier to McAra's Brook they then occupy the section. The other rocks in the section, from McNeil's Brook to Arisaig Pier, are a band of metamorphic rocks of Lower Silurian age associated with a great dyke of igneous rocks which extends into the sea, making the shore rocky and dangerous.

At McAra's Brook and beyond are Lower Carboniferous conglomerates, grits and sandstones, with trappean ledges and seemingly intercalary beds, which have been much worn by the sea, frosts and ice. One great projecting mass of amygdaloid to the east of the brook, which was a bold and picturesque feature of the section twenty years ago, now has scarcely a vestige left. The seemingly intercalary beds of trap standing out from the excavated sandstones are very striking. Near the county line, after an alternation of grits, sandstones and slates, there is a considerable bed of Lower Carboniferous limestones resting on slates, marls and a thin bed of limestone having *oolitic* structure, and characteristic Lower Carboniferous fossils. Still further there are sandstones in which I found, in 1868, two thin beds of

lignite, with copper and iron sulphide. This was operated for copper. After these are sandstones with concretions. We have reached the end of our coast section.

Arisaig Fossiliferous Series.

Owing to the difficulties connected with correlation, I have subdivided this series alphabetically, at the same time giving their supposed British or American equivalents. (*Vide* "Geology of Arisaig, Nova Scotia," Quarterly Journal of Geological Society, 1864, and Papers in the Transactions of the Nova Scotian Institute of Natural Science.)

A, Mayhill sandstone, Eng.; B, and B', Clinton, Am.; C, and C', Aymestry limestone, Eng.; Niagara limestone, Am.; D, Upper Ludlow, Eng.; E, Ludlow tilestone, Eng.

The fossiliferous strata have the greatest width to south of Arisaig Pier, where the west branch of Doctor's Brook enters the "Arisaig Mountains." The width is about a mile.

In Geology of Antigonish County, Trans. I. N. S., 1875, I have shewn the relation of the fossiliferous series to the two non-fossiliferous of the Arisaig Mountains, thus, by a collation of *four* sections at right angles (south) of the coast section, I will give the results, beginning with McNeil's and McDougall's Mountains. The elevation of one is 1010 feet; of the other 1000.—Bayfield.

Mountain Formations.				
	Archæan.	1	Syenitic.	McNeil's Mountain.
	Cambrian. (?)	2	Felsite.	McDougall's "
	.....	3	Jaspideous conglomerate	
	.....	4	Felsitic.	Summit Rock.
	.....	5	*Slates.*	.....
	Lower Silurian	6	Argillites, red and grey.	
	Igneous.	7	*Diorites* and Porphyrite.	

Doctor's Brook Formations.

CARBONIFEROUS.

Igneous. Trap. Middle & East Branches of
Conglomerate. Doctor's Brook.
Limestone. .....

SILURIAN.

"Fossiliferous," Lower { A & B | wanting ..... / do. .....
Middle B' v .....
Upper C' .....
..... *Synclinal axis*.....

LOWER SILURIAN. B .....
..... A .....
L. SILURIAN, *Metamorphic.* a .....
CARBONIFEROUS, *Igneous.* Trap. .....

REMARKS ON THE ABOVE.

1. Archæan of McNeil's Mountain does not appear to the west of the Mountain. It stretches out northerly towards the shore section so as to approach the Archæan of the section. A singular syenitic porphyrite which occurs in the mountain is also seen in sections about ¾ of a mile to the north; occupying the space that 2, 3, 4, 5 Cambrian ? of McDougall's Mountain would occupy is extended eastward. The latter (Cambrian ?) extends westward beyond the county line.

6. Lower Silurian extends eastward and is parted into two by the associate igneous diorites. One part passes to the north of the 1 Syenitic, terminating, apparently, on the back of the Malignant Cove and Brook, Sugar Loaf (mountain) constituting, with the igneous diorites, the rocks of the mountain. The other part comes to the front in a prominence not far from the road to McNeil's Mountain. After being much shattered, it terminates like a *red vein*. With diorites the same red argillites extend westward, suffering displacement or being faulted and consequently thrown out of line and seems to terminate in a mountain south of Arisaig Pier, unless certain red slates that occur to the south of McAra's Brook on the side of a branch of Bailey's Brook be the termination. This may be the *western* termination

of this much disturbed band, while an outcrop at Malignant Brook to the south of the "Igneous" rocks of the coast section may be its *eastern* termination. Veins of iron ore occur in this series.

Carboniferous series. I have already referred to this isolated series when describing the other isolated conglomerates at Malignant Cove, in the Section III.

We have two fossiliferous silurian series, both of which are very defective. Next the Mountain we have B' and C', A. B., are wanting as well as C. D. and E. Next the shore (N) we have A. B; B.' C. C.' D. E., are wanting. Farther up Doctor's Brook on the rising ground south of Arisaig Pier, we have D. and E., (?) with C possibly underlying as well as B.'

The arrangement of the two series is synclinal.

A. occurs at Doctor's Brook and in Section III. Cove to the Westward. In the latter it is very complete and characteristic, lithologically and palæontologically. The lowest part next sea is argillaceous, the next is arenaceous, the third is argill-arenaceous, and respectively—have fauna, characteristic, 1st—*orthis* and *athyris*; 2nd—*trilobites, cyclonema crebristriata, strophomena corrugata, petraia*; 3rd—*lingula, petraia.*

B. at Doctor's Brook is characteristic in its *Graptolites.* At the Cove in its *lingula* at the Cove at Arisaig Pier, in its *trilobites, corals,* &c.

B' C. C' D., require no *revision.* I would refer to "Geology of Arisaig," Quart. Jour. Geol. &c., 1864. E. at its junction with D. in section is characteristic in its *fauna,* there as well as in McAra's Brook and McAdam's Brook, its litholology is distinctive. The only part of this Typical Series that calls for special *Revision* is A. and B., with associate rocks *(a.)* When my collections were examined by Mr. Salter and Sir R. I. Murchison in 1862, I had not discovered the bed of graptolites in the lower part of B. at Doctor's Brook, consequently these were not taken into consideration when A was correlated with the "May Hill Sandstone." I have no doubt that Sir R. I. Murchison would have considered the *Diprionidean graptolites* as of Lower Silurian age and have regarded B as of that age and consequently A as

at least Lower Silurian. In my Paper "On the Geology of Antigonish County," Trans. I. N. S., 1866, we thus read, "Hall's noble work on the 'Canadian Graptolites,' has led me to consider that there is yet something to be done in the correct determination of the equivalency of the 'Arisaig Group,' as the graptolites of B appear to have the *facies* of the graptolites of the 'Hudson River Group,' so that A. B., may be the Arisaig equivalent of this group." Instead, therefore, of beginning with the Upper Silurian age, it may begin with part of the Lower Silurian. During the course of my investigations, I have found it impossible satisfactorily to correlate series of rocks which are evidently identical in their palæontology with A and B, on the supposition that these are of any other than Lower Silurian age. My examination of the Utica formation of Ottawa convinced me that they are equivalent to this. In the beautiful collection of the graptolites from the Isle of Orleans, presented to me by Dr. Hill, of Ottawa, as well as in the fine collection of graptolites from Moffat, Scotland, presented by John Dairon, Esq., Glasgow, I recognize the *facies* of the Doctor's Brook graptolites. I am therefore forced to conclude that B is of Lower Silurian age. The palæontology of A is also of the Utica formation.*

Underlying A is a highly metamorphic and non-fossiliferous band of rocks (a) in contact with trap. These extend (with breaks) from Arisaig Pier to the neighbourhood of McNeil's Brook. They occupy the same relative positions as band No. 6, already described, and have in like manner been much affected by the igneous rocks with which they are associated.

The difference in the lithological character of the two may be accidental. Here we have sandy shale porcellainized and converted into jaspideous rocks, as at Arisaig Pier, Frenchman's Barn (rock) and near McNeil's Brook. These rocks of quartz hardness are associated with others which have a serpentine aspect, and a hardness corresponding. The latter have attracted some

*Professsor Hall, who has examined my collections in the Museum, confirms these views. He considers them to be of Hudson River age. He also considers my Wentworth, I. C. R., series. Cobequid Mts., as of the same age.—Sept. 7. Trans., 1873. p. 354, and Annual Report of Geol. and Nat. History Survey of Canada, 1885. Ells, page 53, Note and Map.

attention on account of their beauty, and supposed adaptability to ornamental purposes. Drs. Hunt and How, and Mr. Louis, Assoc. Royal School of Mines, have examined them, and agreed that they are *hydrous silicates of alumina*, and allied to *agalmatolite*, or Chinese Figure Stone. Constituents of this rock are segregated in veins in the same way as quartz in the jaspideous rock of Arisaig Pier. This band precedes A and B of Hudson River age. How much, we cannot say. The same may be affirmed of Band No. 6. The associated igneous rocks are an extension of those that are found at Malignant Cove, hardening and permeating the conglomerates Section III. They have sometimes been characterized as *augitic*, and at other times as *hornblendic*. Microscopic sections of these are described in a preceding paper.

Section IV., from Northumberland Strait to Guysboro' County line along Meridian Long. 60°.—We begin in the metamorphic Lower Silurian (?) of Section III, one mile west of Livingstone's Cove, and the same distance east of the "Archæan Series." Crossing *a mile* and *two-tenths* we reach the carboniferous of Section II, *i. e.*, the north side of the Basin. The rocks upon which we have entered extend eastward to St. George's Bay. Proceeding westward they skirt and overlie the Archæan series and come up against the Arisaig Mountains. Some of them rise to the side of the Sugar Loaf (mountain). Proceeding seven miles farther we reach the so-called "Morristown Coal Mines." My attention was first directed to this interesting locality in the summer of 1859. A specimen of black shiney bituminous shale, which the discoverer supposed to be *Albertite*, was brought to me in Antigonish for examination. Its highly bituminous character excited interest. I visited the locality and saw a large outcrop of this shale associated with a chocolate-coloured shale, which was equally bituminous. In the latter I found abundance of scales of *Palæoniscus* and various forms of *Lepidodendra*, &c., *vide* Dawson's Fossil Plants of Canada, Geological Survey of Canada. On a subsequent visit I found a section of a cast of a *Sigillaria*. This is from six to ten inches thick and ten inches inches in diameter.

Considerable work has been done in the search for coal under the direction of John Campbell, Esq., of Dartmouth, N. S., who has reported the discovery of coal beds having an aggregate thickness of 28 to 30 feet. Work has been discontinued for many years. Not far from this locality there is a bed of limestone. Advancing further, four miles, we reach the conglomerates of the south side of the basin, at the back of the Antigonish Sugar Loaf. We have noticed the eastern extension of these at McIsaac's Point and Cribbeau's Head, in Section II. The western boundary of the basin are the Arisaig Mountains, as already noticed, and the Antigonish Mountains of Section I. At the back of the former and the beginning of the latter, as the road from Arisaig Pier and Brook descends into Pleasant Valley, Lower Carboniferous limestones are seen outcropping. Fine exposures of conglomerates and coarse grits are seen in Right's River. Black shales outcrop in the "Big Marsh," on the "Old Gulf Road." Sandstones outcrop in all directions, and in Malignant Brook before we reach the cove, and Section III. To the west of this brook hills are seen in the rear of McNeil's Mountain. These are formed of conglomerates belonging to the west side of the basin.

Crossing the mountains of the section, at a distance of half a mile, we find an axial series of igneous rocks. We have already met these at St. George's Bay, Section II. They also outcrop to the west in a bluff on Right's River. The central rock of the "Sugar Loaf" is Archæan *(vide* "Polariscopic Notes"). The rocks of these mountains, with the exception of the igneous rocks, are of Lower Silurian age (?). With the igneous rocks, they are analogous to McLellan's Mountain, Pictou County. Two miles farther we come to their south side, and to the north side of the southern Carboniferous area. A little farther we reach Section I, Line of Railway. Proceeding further (18 miles) we pass through this area with its conglomerate sandstones, gypsums and saltsprings, limestones, ochreous and non-fossiliferous. To the west there are great beds of gypsum. On a small tributary of the Ohio River there is an interesting limestone replete with Lower Carboniferous Brachiopoda. It is one of the two

limestones in Nova Scotia's Carboniferous having trilobites, *Phillipsiaan* of interesting Palæozoic race, that abounded at Arisaig in Silurian time. To the west of these is the Archæan formation of the Ohio Mountains, which are common to the counties of Antigonish and Pictou. To the east are the limestones, sandstones, &c., of Upper South River and St. Andrew's, and at Pomquet small *seams of coal* and sandstones, with copper sulphide.

Our section terminates in a Silurian region of more than common interest, having lakes in abundance. The chief of these are Lochaber Lake, Polson's Lake and South River Lake. This is a water shed. The first sends its water to the Atlantic; the two last to Antigonish harbour.

There are two series of rocks about those lakes: 1st—a fossiliferous; 2nd—a metalliferous. The *first* is on the west side of Lochaber Lake. It begins near the head of the lake and extends nearly a mile. The lower part is on the side of the mountain, the upper is on the side of the lake and enters it. The *second* forms an island in the lake, and passes over to the west side. It forms the high lands on the east side, and extends into the County of Guysboro' southward. It extends eastward beyond South River Lake, including Polson's Lake. It bounds and underlies the Carboniferous of the Section from above Lochaber Lake to Upper South River and beyond. The "fossiliferous series" consists of equivalents of A, C', and D, "Arisaig Series." It is defective by the absence of equivalents of B, B', C and E. This was the locality where I first found A. Subsequently it was found at Doctor's Brook, Arisaig. A beautiful internal cast of the characteristic coral *Petraia, (forrestari* Salter.) McCoy led to the discovery. The rocks are dark brown in colour, and almost of flinty hardness. All the fossils in it that I have collected are casts, with the exception of *Athyris.* In some cases the calcareous part of *Petraia* has been replaced by quartz. Fossils are by no means numerous, but those that do occur are characteristic. There is not the variety in lithology that we find at Arisaig, neither are the fossils regular in their general mode of occurrence. *Orthis, athyris* and *Petraia* intermingle. The

peculiar *cornulite* was by Salter characterized as "trumpet-shaped." The chief rock of the mountain, which rises to a considerable height, is crystalline diorite and intrusiœ? There is nothing intervening between this and A. The D member of the series is seen outcropping on the road and side of the lake. Between this and the outcrops of A are cultivated fields. That C underlies, I know from the rocks of cairns which have produced two large *orthoceratites*, the trilobite *homalomatus* of C horizon, as it appears at Arisaig and elsewhere. D. *strata* have produced the characteristic fossils—Brachiopoda, *Chonetes Nova Scotia*, Hall. *Crania, Acadiensis*, Hall. Trilobite, *Dalmania Logani*, Hall. Here, then, we have A of Hudson River *Lower Silurian*, and C of Aynestry Limestone, or Niagara Limestone, age, and D of Upper Ludlow or Lower Helderberg age—*Upper Silurian.*

We now examine the "Metalliferous Series." I quote the description of this from my Paper—"Geology of Antigonish County." Trans. 1866, page 110: "A very broad band of reddish brown and grey argillaceous slates, which form an island in the lake, extend to Polson's Lake and beyond it. In their strike they extend to the west of Lochaber Lake in the one direction and through South River Lake and the river itself in the other direction; at right angles to the strike they pass into Guysboro' County. On the western side of Lochaber there are magnificent exposures of the brownish red strata in the course of a small brook that runs into the lake. To the south of the brook there is a thick bed of limestones, altered and contorted, which contains blue *fluorite.* This seems to be a carboniferous limestone. Between Lochaber Lake and Polson's Lake the slates contain veins of quartz of considerable thickness, which contain plates of specular iron ore, and at one of the streams that flow into South River, *grey and brownish red slate* is associated with *quartzite,* which contains veins of quartz having colourless crystals (rock crystal) of considerable size and beauty. I also found garnets and crystals of *pyrite* of the beautiful form.—Fig. 4, Dana's Manual, 1878. But these were not found *in situ.* The slates at Polson's Lake are of darker colour than the others."

In these are veins of *calchopyrite,* which are considered to be of economic importance, "Polson's Lake copper mines." There is also a vein of *micaceous oxide of iron,* out of which I had masses at the London Exhibition of 1862. I would observe that these *strata* have been complicated by trap dykes. The position occupied by this series, placed between Fossiliferous D Upper Silurian of Lochaber Lake and the Lower Carboniferous of South River led me to regard it as of Devonian age (in 1866), and to correlate the red strata with E of the Section III., and McAdam's and McAra's Brook. At that time I was not aware of the great band of red and grey strata, No. 6, of the Arisaig mountains, with its disturbing "igneous rocks," with which I now believe it to correspond. I thus place the "Metalliferous Series" *under, Lower Silurian* A of the "Fossiliferous Series," and assign it to an age *prior* to the Hudson River. I am somewhat disposed, on consideration of its lithological and metalliferous character in connection with its "igneous" association, to correlate it with metalliferous rocks of Nictaux and Moose River, in the County of Annapolis.

Pleistocene.

"Drift accumulations abound throughout the county. The transportation of the boulders at Ogden's, Section III, from the Lower Arisaig (Archæan) series of Section III is in the direction S. 30 E. There can be no doubt that this transportation has been effected by glacial action, although no glaciation has been observed in the county. Large masses have been transported from Frenchman's Barn (rock) and Arisaig Pier of the same section to elevated portions of the south."—("Geology of Antigonish County," *Trans., 1875.*)

In my Paper "On Glacial Transportation in Nova Scotia and Beyond," *(Trans., I. N. S., 1883,)* I have referred to this transportation, and especially to the "Archæan" from Section III to Section II, and its course. It corresponds in character with that from the Cobequid Mountains, and in direction with the glaciation which points to Blomidon or Partridge Island as the source of the amygdaloids that are to be found in Halifax and vicinity.

I have also referred to this as a proof that the great glacial movement originated beyond Nova Scotia, and that the coast of Section II was one of its *termini.*

My study of glacial accumulations during the past decade has led me to recognize distinctions in the drift accumulations of this county which I failed to recognize in 1875.

When describing Section III above, I indicated a distinction between the drift of the shore at Malignant Cove and the glacial drift. I connect with this other accumulations to which I referred at the time referred to (1875): "The great drift deposits, which occur in every direction, obscuring the adjacent rocks and rendering the work of exploration often difficult and perplexing. The more prominent are the accumulations on the *hills* that occur in the break that separates the 'Archæan' from the McNeil's Mountain Archæan. About *one* mile from the shore there are gravelly and sandy mounds; gradually they increase in size and numbers until, at a farther distance of *two* miles, the last of the series forms the elevated site of St. Mary's Chapel, which is seen at a distance of *several* miles. In and around the town of Antigonish are similar elevations. My attention was specially directed to these about 20 years ago by the sinking of a well on the side of one on which the 'Old Court House' then stood. After passing through several feet of gravel a bed of clay was struck, which was particularly dry. It was first dark and then light in colour, containing fossil wood, in the centre of which was phosphate of iron of a beautiful blue colour, which might be used as a paint. This is noticed in 'How's Mineralogy of Nova Scotia.' In a section of clays on the side of a small brook, not far from the railway station, I found the same fossil without the phosphate of iron. The fossil was abundant."

These are supposed to be aqueous deposits of Pleistocene age. (Champlain.) Illustrated by a Geological Map of the County.—Scale, *one mile one inch.*—MUSEUM COLLECTIONS.