TES ON THE GEOLOGY AND PALÆONTOLOGY OF THE ROCKLAND QUARRIES AND VICINITY, IN THE COUNTY OF RUSSELL, ONTARIO, CANADA.

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On the 24th of June last, the OTTAWA FIELD NATURALISTS' CLUB held a very successful excursion to the new Rockland quarries. These are situated about two miles to the south-east of the village of Rockland, in the Township of Clarence, in the County of Russell, Ontario, and were opened with a view of obtaining the stone required for the construction of the Soulanges canal. This locality proved to be very interesting to the geologist, from the fact that six distinct Palæozoic formations were met and examined. Mr. Archibald Stewart, government contractor and proprietor of the new Rockland quarries, and Mr. W. C. Edwards, M. P. for Russell, had extended to the Ottawa naturalists a hearty invitation, and made them welcome. Everything went off well and the day was thoroughly enjoyed by all. Refreshments and conveyances were freely supplied by these two gentlemen, and the excursionists duly appreciating their kindness, unanimously thanked them for their hospitality.

GEOLOGICAL FEATURES OF ROCKLAND.

The following are the different geological formations met with at Rockland, between the mills on the Ottawa River front, and the new quarries, some two miles distant, in descending order. These formations succeed each other in regular order, as seen in the table, with only two unconformities, the first below the glacial drift, and the second below the Potsdam formation. They occupy that zone of country lying between the escarpment at the quarries and the Ottawa River. This escarpment is similar in origin and aspect, to the bluffs and escarpments at Ottawa, and formed at one time the southern shore or cliff-margin of the Pre-glacial stream which flowed from the west in almost precisely the same channel as does the Ottawa River at present.

The Calciferous and Chazy formations form the widest belts, whilst the Trenton, Black River and Chazy formations, are the most fossiliferous in the district.

GEOLOGICAL FORMATIONS AT ROCKLAND, CO. RUSSELL, ONTARIO.

System.	Formations.	Thickness in Feet.	Fossil Remains.
I. Post-Tertiary....	1. Fluviatile.....	Various	
	2. Leda clay.....	Rep. to 25 feet.....	None observed.
	3. Glacial clay, etc..	Various	
	HERE AN UNCONFORMITY OCCURS.		
II. Ordovician.....	4. Trenton.....	About 50 ft.....	Abundant.
	5. Black River.....	" 75 ft..	Not rare.
	6. Chazy.....	" 60 ft.....	Abundant.
	7. Calciferous	" 50 ft.....	None observed.
	8. Potsdam.....	" 75 ft.....	ScolithusCanadensis.
	HERE THE SECOND UNCONFORMITY OCCURS.		
III. Archæan.....	9. Laurentian.....	Several thousand ft.	None observed.

THE LAURENTIAN OUTCROP.

The basal beds of the Potsdam formation are seen to lie unconformably over the denuded and rounded, or irregular surface of the Archæan or Laurentian rocks. These consist of rather coarsely crystalline gneisses and mica schists, along with hornblendic rocks, whose petrographical relations and characters deserve special study. They furnished the material which helped in the building up of the subsequent formations, the quartz of the Potsdam sandstones having been derived from the granitoid gneisses of this vicinity.

THE POTSDAM.

The Potsdam formation at Rockland Mills forms a more or less irregular zone of heavy bedded, light greyish blue or white colored sandstones, which at times become glassy in appearance and give the formation a truly quartzite character. Nevertheless, the grains of quartz may be easily detected, and are cemented together for the most part by silica.

Some of the bands carry iron pyrites, and weather rusty-coloured. The clear and white, or light coloured bands appear to be fit for glass making. The outcrop of this formation near the Ottawa River front, at the Rockland Mills, belongs to the lower portion of the Potsdam. The higher beds of the formation in the Ottawa Valley are finer grained, and have the grains of quartz in the sandstone less coherent, and the beds themselves are less massive and reduced in thickness, often presenting the well known tracks of *Protichnites* as at Montebello, Papineauville and above that again,* eight miles below the mouth of the South Indian River.

The Calciferous and Chazy.

These two formations occupy their regular and respective positions, one below the other, both as regards their geological and geographical relations at Rockland. The zone of farming or pasture land, between the escarpment at the quarries and the town, is occupied by these two formations, whilst the soil is made up to a great extent of the debris of the Chazy, which is the softest and most easily denuded and disintegrated formation in the district.

None of the characteristic fossils of the Calciferous formation were found on this occasion, but at the turn of the road on the hillside about 1½ miles south of Rockland the typical shales of the Chazy formation crop out and are fossiliferous. These overlie the fine-grained and compact limestones, on which Mr. Edwards' celebrated stock and breeding stables are built.

These limestones are characterized by the presence of concretions or inclusions of irregular masses of pink calcite varying in size and intensity of colour. There are two or three bands of these limestones, which, both in Nepean and elsewhere, have been utilized or described as "cement-rock." This is the same band of limestone which crops out at the Hull cement quarries, Skead's mill, Ont., also at Hog's Back, and again on a lot the property of Mr. T. M. Clark, of New Edinburgh close to Hemlock Lake.

The following species of fossils have been recognized by the writer in the dark and chocolate coloured and purple, calcareo-argillaceous

*Geology of Canada, 1863, p. 94.

shales of the Chazy and in the accompanying calcareous bands :

Fossils from the Chazy Beds.

1. Orthis imperator, Billings.
2. " borealis, Billings.
3. " platys, Billings.
4. Rhynchonella plena, Hall.
5. Raphistoma staminea, Conread.
6. Modiolopsis parviuscula, Billings.
7. Orthoceras antenor? Billings.

But little time was spent collecting here, which accounts for scarcity of forms.

Black River and Trenton Formations.

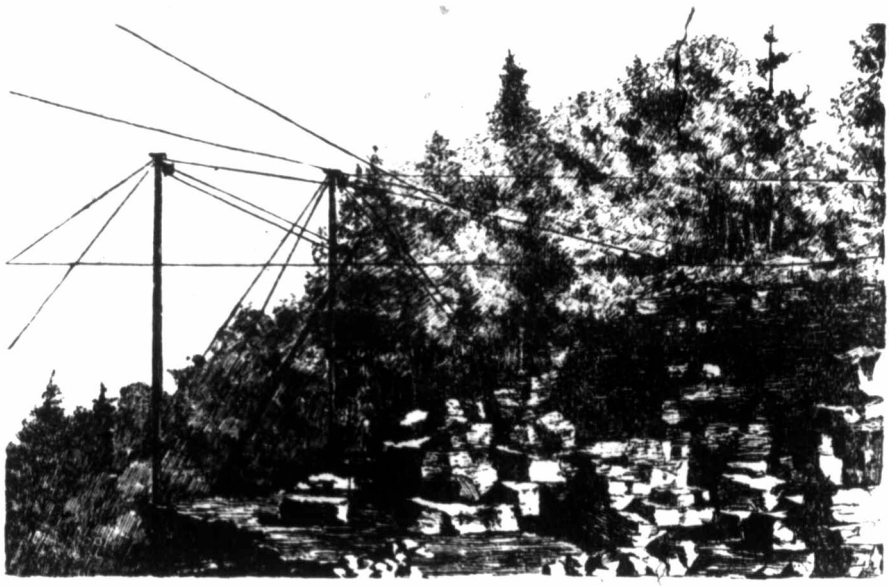
Following the measures in an ascending order the escarpment is met with next. This escarpment, which faces the north and presents its bold front to the Ottawa Valley at the quarries, belongs to the Black River and Trenton formations, or to the Trenton group as it is sometimes called.

The two formations pass imperceptibly from one into the other, only an arbitrary line can be drawn to separate them. The lower part of the escarpment at the quarries belongs to the Black River formation, whilst the upper portion is distinctly Trenton in *facies*. It was in the lower half at the level of the tramway and track, some 15 feet higher than the swamp facing the quarry, that the proprietor, Mr. Archie Stewart found a large coral mass, which he brought to the museum of the Geological Survey for identification. It proved to be the typical coral, *Columnaria Halli*, Nicholson. At a higher elevation, some fifty feet above the Columnaria horizon, masses of *Tetradium fibratum*, Safford, were found, which are considered characteristic Black River forms also, yet these were immediately followed by large colonies of *Prasopora Selwyni*, Nicholson, associated with orthoceratites and brachiopoda, of typical Trenton aspect.

The beds throughout the section proved to be highly fossiliferous, but especially so were those in the highest and thin-bedded portions of the escarpment. The beds were seen to vary in thickness, but

the heavier beds and more compact ones occupied the lower portion of the outcrop.

The following view of the quarry reproduced from a pen and ink sketch by Miss A. M. Living, of our club, gives a good general idea of the upper portion of the quarry, with some of the large blocks of quarried limestone to be taken down to their destination, the Soulanges Canal.



Along the western extremity of the quarry, large blocks of quarried and dressed limestone had been piled up and were examined, showing the character of the limestone, thickness of the beds and mode of occurrence. It was evident that a quarry similar to those of central Ontario, from which the material was obtained for the construction of the Trent Valley Canal, had been opened at Rockland, and that the rock was of superior quality. Some of the upper beds of the quarry were apparently more easily shattered, but the hard compact and heavy bedded strata of the lower two-thirds will no doubt afford excellent blocks for the canal.

Through the kindness and courtesy of Mr. Stewart, the writer has been furnished with information on the character of the limestones of the new Rockland quarries. The result of examinations and tests

made of the rock are herewith given, and refer to the chemical composition, to the crushing strength of the stone, and to the microscopical characters of the same, besides a note on the absorption of moisture by the same limestone.

1 and 2.—*Chemical composition and ratio of absorption*, determined by Dr. B. J. Harrington, of McGill College, Montreal.

CERTIFICATE OF DR. B. J. HARRINGTON.

"The specific gravity of the stone was found to be 2.704, and the weight of a cubic foot deduced from these figures 168.5 lbs.,(1 cubic foot of water being taken at 62.321 lbs). The analysis shows the stone to consist almost entirely of calcium carbonate, with a little insoluble matter and small quantities of the carbonates of magnesium and of iron The exact figures are as follows :

Insoluble (including a little organic matter)	2.75
Calcium carbonate	94.70
Magnesium "	2.37
Ferrous	0.18
	100.00 "

As to the ratio of absorption of water by the limestone from Rockland, the following is an extract from a letter by Dr. Harrington dated 28th April, 1893 :

"The absorption of your specimen of limestone was almost *nil*. The exact figures were 0.03 of a part of water absorbed by 100 parts by weight of the stone. That is an absorption ratio of $\frac{1}{3333}$."

(Signed.) B. J. HARRINGTON.

McGill College, 31st March, 1893.

3. *Macroscopic and Microscopic Examination of the Rockland limestone, by Prof. A. P. Coleman, of the School of Practical Science, Toronto.*

The following is the text of a report by Dr. Coleman, of Toronto, entitled : "Examination of Building Stone for Mr. Archibald Stewart, Ottawa. The specimen sent for examination is a cube of dark grey bituminous limestone from a quarry at Rockland, Ontario. Microscopically the stone is compact in texture with included crystals of

calcite and a few fossils, chiefly fragments of brachiopods. A thin section examined with the microscope shows a compact ground mass of calcite with enclosed crystals of the same mineral, some obscure fossil forms (bryozoa, brachipod shells or crinoids), and some brown lines of bituminous matter.

Judged as a building material the specimen has all the characteristics of a durable stone. The dark grey color will probably bleach to a lighter grey on exposure to the weather."

(Signed.) A. P. COLEMAN, PH. D.,
Prof. Metall. and Assaying.

School of Practical Science, Toronto, March 27th, 1893.

4. *Crushing strength per square inch determined by Prof. H. T. Bovey, M. A., LL.D., of the Physical Laboratories, McGill College.*

The following is an extract from a letter by Prof. Henry T. Bovey on two specimens of limestone from the Rockland quarries:—

Specimen A. Dimensions 2″ x 2.02″ x 2.01″.

Tested on bed.

Total crushing strength	92,000 lbs.
Crushing strength per square inch	22,772 "

Specimen B. Dimensions 2.01″ x 2.025″ x 2.01″.

Tested on edge.

Total crushing strength	60,000 lbs.
Crushing strength per square inch	14,741 "

Weight of stone as per sample A = 168.11 pounds per cubic foot.

(Signed.) HENRY T. BOVEY.

McGill College, Montreal, March 22nd, 1893.

It will thus appear from the combined results of the tests made both at the Toronto and Montreal laboratories, that the stone from the Rockland quarries is of a superior quality. When compared with the results obtained from similar severe tests of limestones of Canada and the United States—those of the Rockland limestone stand high. For the record of such tests, the reports published by the State Surveys of New York, Pennsylvania and Minnesota—besides many other valuable contributions contain the most extensive and comprehensive remarks.

Fossil Remains.

As it was remarked, before, the rocks of the quarry were very fossiliferous. On the occasion of the excursion of the O. F. N. C. quite a number of interesting forms were collected and the following succession of zones was noticed in the rocks forming the escarpment of the quarry in descending order.

(1) Zone of *Leptæna sericea*, Sowerby.
(2) Zone of *Streptelasma corniculum*, Hall.
(3) Zone of *Prasopora Selwyni*, Nicholson.
(4) Zone of *Endoceras proteiforme*, Hall.
(5) Zone of *Tetradium fibratum*, Safford.
(6) Zone of *Columnaria Halli*, Nicholson.

No less than sixteen species of fossils were collected at the quarries as follows :—

1. Crinoidal fragments.
2. Tetradium fibratum, Safford.
3. Columnaria Halli, Nicholson.
4. Streptelasma corniculum, Hall.
5. Prasopora Selwyni, Nicholson.
6. ?Homotrypa similis, Foord.
7. Stictopora acuta, Hall.
8. Serpulites dissolutus, Billings.
9. Rafinesquina alternata, Conrad.
10. Orthis testudinaria, Dalman.
11. " tricenaria, Conrad.
12. Ctenodonta sp. indt. cf. C. abrupta, B.
13. Orthoceras sp.
14. Asaphus platycephalus, Stokes.
15. Endoceras proteiforme, Hall.
16. Calymene senaria, Conrad.

Most of these were collected by the writer, determined by himself; they represent a part of the fauna entombed in the rocks which occupy the face of the quarry. The horizon here is precisely the same as that at Wright's new quarries, Hull, near the C. P. R. station of that town.

Just previous to leaving the field, Dr. R. W. Ells, ex-president of our club, visited Rockland and the quarries adjoining. When at Clarence Creek, one and a half miles below Rockland, Ont., he made quite an extensive collection of fossils which the writer has examined only cursorily and the following forms are included in it :—

Fossils Collected by Dr. R. W. Ells at Clarence Creek, near Rockland, Ont., Sept., 1893.

1. Crinoidal fragments.
2. Stictopora acuta, Hall.
3. Prasopora Selwyni, Nicholson.
4. ? Monotrypella sp.
5. Discina or Trematis sp.
6. Crania sp. cf. C. sp.
7. Lingula quadrata, Eichwald.
8. Leptæna sericea, Sowerby.
9. Rafinesquina alternata, Conrad.
10. Streptorhynchus filitextum, Hall.
11. Orthis testudinaria, Dalman.
12. " pectinella, Conrad.
13. " sp. (? N. sp.)
14. " vel Anazyga sp.
15. Platystrophia biforata, v. lynx, Eich.
16. Bellerophon sulcatinus, Emmons.
17. Rhynchonella increbescens, Hall.
18. Calymene senaria, Conrad.
19. Cheirurus pleurexanthemus, Green.
20. Dalmanites callicephalus, Green.
21. Illænus sp (cf. I. Milleri or Trentonensis.)
22. Asaphus platycephalus, Stokes.
23. " megistos, Locke.
24. Trinucleus concentricus, Eaton.

Of these Nos. 5, 6, 7, 16, and 24 are of more than ordinary interest, especially the last form Trinucleus concentricus, Eaton, a small trilobite which is very common in the Trenton of Montreal and Montmorency,

but which has not, as far as I am aware, been recorded from the Ottawa district as yet.

From the foregoing remarks it is hoped that such general characters of the rock formations of Rockland can be gathered as will be of service to those interested in the quarry as well as others. The beds of the Lower Trenton—and those of the Black River formation almost everywhere in Eastern Canada—have been used as building material, whether for piers, bridges or canals, and proved highly satisfactory.

The Trent Valley Canal locks, as above stated, the piers for the Victoria Tubular bridge, the locks and improvements on the Lièvre River, and the locks on the Rideau Canal at Ottawa, have all been constructed with stone from the Trenton and Black River formations.

In the case of the Rideau Canal at Ottawa, the limestones constituting the upper half of the Trenton formation here are too nodular and concretionary for canal purposes, and if only blocks from the lower half had been used it would have saved the department thousands of dollars that were subsequently spent in repairs.

In conclusion, the writer begs to thank Mr. Archibald Stewart for this opportunity of examining the geological features at the quarry under such favorable auspices, also for the information as to tests and reports of results made by the gentleman above quoted.