

of which, if I am correctly informed, receives a Provincial grant for its support.

With such examples before us, we may surely venture to hope, that Nova Scotia never backward in promoting whatever has a beneficial tendency, will not refuse to extend a helping hand to this Institute, whose publication of its transactions every year is diffusing, at home and abroad, much valuable information respecting the resources and capabilities of this fine Province, but whose endeavours to become of more extended practical utility, are paralysed by the want of the pecuniary means, requisite to enable it to carry out effectually the objects it has in view.

ART. VII. NOTES ON THE ECONOMIC MINERALOGY OF NOVA SCOTIA: PART III.; LIMESTONE AND MARBLE. BY PROF. HOW, D. C. L., *University of King's College, Windsor.*

(Read Feb. 6, 1866.)

LIMESTONES.—These are found in practically inexhaustible quantities in the Province, where there is estimated to be a thickness of thirteen thousand feet of the various strata comprising the carboniferous system, among which limestones are frequent, especially in the lower carboniferous beds, which in fact consist largely of them and measure six thousand feet in thickness. This system is developed almost exclusively to the north and north-east of the capital, in which part of the Province upwards of eighty beds of limestone are indicated in Dawson's geological map; the rest of Nova Scotia, including the whole western portion and the southern shore, has but two small patches of carboniferous rocks. The limestones have sometimes been thrown by metamorphic action into the crystalline state, and frequently converted under these circumstances into marble, so that many varieties of this material are met with. Geological details respecting this deposit are given in Dawson's *Acadian Geology*.

The economic value of the limestones will probably always be found in the making of lime for washes, mortar and cement, and for manuring, and in their use as fluxes in iron smelting, since the great abundance of excellent freestone will almost preclude their use as a building material except in rubble work and making foundations. As

regards the use in manuring, a considerable portion of the agricultural districts in the Province lies in the formation affording limestones, and except for special and occasional purposes lime will not be required in their cultivation—but it must find profitable application by the farmers in the rest of the Province where lime rocks are altogether absent or but scantily developed. In recent years stone bridges have been constructed for railways, and wooden buildings have been replaced in the capital by those of brick and stone; before this change there could have been little demand for lime, which must have been used chiefly for building foundations and chimneys, because the walls and ceilings would be almost everywhere of the plaster made from the gypsum, which is found as the very frequent associate of the limestone.

On comparing the census returns of 1851 and 1861, we find, of course, that with the progress of the country there is increased use of lime. In the former year there were burned in the Province 28,603 casks; taking four bushels to the cask, which is St. John measure, the amount will be

Lime burned in Nova Scotia in 1851, 114,412 bushels.

By the late census we find there was of

Lime burned in Nova Scotia in 1861, 136,848 bushels.

And no doubt, for the reason just given, the next census will show as great an increase as the latter numbers do over the former.

As regards the amount of lime employed, Mr. Lang thinks that for the last five years not less than eight to ten thousand barrels of lime have been used per annum in the city of Halifax, and that there will be wanted from seven to eight thousand pounds worth of lime during the ensuing summer.

The details of the census returns are interesting: they show that five counties only burned no lime and that the rest of the eighteen gave very different quantities:

CENSUS RETURNS FOR 1861.

<i>Counties.</i>	<i>Bushels of Lime Burned.</i>
Colchester,.....	4,860
King's.....	10,635
Cumberland,.....	35,990
Annapolis,.....	17,474
Pictou,.....	
Hants,.....	

<i>Counties.</i>	<i>Bushels of lime burned.</i>
Sydney,	3,232
Inverness,	6,486
Halifax,*	26,050
Lunenburg,	3,100
Yarmouth,	3,500
Digby,	
Guysborough, ¹	320
Victoria,	4,730
Queen's,	
Shelburne,	
Richmond,	406
Cape Breton,	20,092
	<hr/>
Total,	136,848
	<hr/>

It is perhaps remarkable that, notwithstanding the vast profusion of limestone in the Province, a good deal of limestone is imported from the West Indies, and much lime from New Brunswick. There is no doubt that the native rocks yield with careful burning excellent lime, and the cost of it is probably less than that from the foreign rocks. At Windsor lime will sell at the kiln at three and sixpence the barrel, and the price would be lower if there were more demand; as it is I am told the New Brunswick lime costs more money: for some reason however, the latter often obtains the preference, as was the case in building the new library at King's College, Windsor, in the neighbourhood of rocks affording excellent lime, as will appear by an analysis in a subsequent page. This is not, however, an invariable rule, and the Nova Scotian stone has been used and found to give excellent lime: in the construction of the railway bridges on the line between Halifax and Windsor, lime from the neighbourhood of the latter place was employed and gave great satisfaction to the engineer, who pronounced it to be a very "strong" lime. A limestone found at Indian Point, Chester, of a deep blue colour, yields a lime which becomes as hard and lasting as a cement: the rock is much valued in Halifax for building up the arches of kilns, a situation in which poor limestone crumbles away while this remains quite hard. The lime prepared from this rock was preferred to that from New Brunswick in building the Wellington Barracks, in Halifax.

*The greater part of the lime burnt in the city, Mr. Lang thinks, is from foreign limestone.

Mr. Peters, the builder of the barracks, is my authority for this character of the Chester rock and he tells me that the lime from it is the only one yet found to his knowledge fit to use in making concrete. A black limestone is found at St. Peter's, Cape Breton, which is said to afford most excellent lime.

HYDRAULIC LIMESTONES.—These are limestones which contain a certain proportion of clay and sometimes magnesia and have in consequence the valuable property of setting under water after being burned to the proper degree.* These important minerals should receive careful attention ; they are reported to exist in several parts of the Province. Mr. G. Lang informed me last year that Shubenacadie affords a limestone the lime from which was used twelve years ago in building a chimney for a steam-engine and that the work under water cannot now be separated. He says now that this lime takes the first place in the family of limestones on this continent as affording a lime for mason work and for all exterior work. The lime from it slacks with unusually little water and takes as much sand again as any other used in the country, and makes a mortar which is better than any cement except the Portland, made in England, resisting the severe frosts and sudden thaws much better than that made with lime from St. John or West Indian limestone. He has burned about 300 tons and now has his kiln ready to burn about 2,000 tons. Hydraulic limestones are also reported from Windsor, and from St. Peter's, Cape Breton.

Cement-stones are limestones containing foreign ingredients, which when burned and ground can be made into cement. Mr. Handley, of Halifax, showed me a cement he had used in putting together fire-bricks, which he had made from a stone found near St. Peter's, Cape Breton, by careful burning, grinding and mixing with sand in certain proportions : he assured me it was a very strong cement. Such stones are very valuable : during the construction of railways and other public works in Canada one manufacturer made on the average 80,000 bushels of cement annually. The limestones of Walton and Teny Cape, in Hants Co., often contain magnesia, but in what quantity is not known, nor have they been examined as to their hydraulicity. A good deal of work on this subject awaits a

*An excellent account of these is given in Weale's Series on "Limes and Cements." See also Chem. News, xii p. 287, and xiii p. 86, and Geology of Canada, 1863, p. 805.

geological survey. Limestones fit for making lime for manure are those which are nearly pure carbonate of lime. I have heard it objected to the use of Windsor lime as a manure that it contains magnesia in large quantity; this is certainly not the case with that obtained from the rock on the property of O. King, Esq., for when I made an analysis of a specimen of that found on the bank of the Avon behind his house, it gave me :

Carbonate of Lime,	97.64
Carbonate of Magnesia,	1.10
Oxide of Iron,	.07
Clay, sand and silica,	0,68
Phosphoric Acid,	traces
	99.49

results which show that there is but little magnesia in it, even for an ordinary lime; for the sake of comparison I may state that in Professor Anderson's "*Elements of Agricultural Chemistry*," the analyses of two common limestones are given as examples of the composition of these rocks, and 1.61 and 7.45 are the respective percentages of carbonate of magnesia.

As many limestones of the Province, like that of which the analysis has just been given, are chiefly made up of the shells of *mollusca* it will not be out of place here to give an unpublished analysis* of a recent shell made many years ago; the cleaned shell of the Periwinkle (*Litorina litorea*), gave

Carbonate of Lime,	97.175
Sulphate of Lime,	.479
Organic Matter,	2.010
Phosphoric Acid,	0.001
Silica and Sand	0.164
	99.829

whence it appears that there is not a great difference between the composition of the recent shell and the rock which, many hundreds of thousands of years ago probably, was to a great extent made of the remains of the shells of allied animals.

*Published with others since this paper was read, in Silliman's Journal of Science, May, 1866.

The presence of phosphoric acid in a manure is valuable in most cases, and there are limestones in which this acid exists in considerable proportion, as Dr. Dawson mentions in speaking of those found at the Joggins: I have examined one of these, of a black colour, which I obtained from a bed on the beach and can fully confirm his statements; I found in it a notable amount of phosphoric acid; he justly says that such would be worth about three times the price of ordinary limestones, and that the richest of the beds found would possibly be sufficiently appreciated on trial to allow them to be profitably worked.

(I may mention here that a deposit consisting in small part of carbonate of lime, but made up mostly of clay and sand found near Mill Village, Parrsboro', was examined by me some time ago at the request of Rev. W. King, and found to be so rich in phosphoric acid that it ought to prove a good manure).

LIMESTONE AS A FLUX.—At the only iron works now carried on in the Province, viz: the Acadia Iron Works, Londonderry, limestone from the neighbourhood is employed. When the Nictaux works were in operation limestone was imported from New Brunswick to a port on the Bay of Fundy and thence conveyed by land carriage some eleven miles to the furnace. The importance of having a supply of this rock near the works is seen by observing the amount employed. In 1861 the quantity of iron made at Londonderry was 1,200 tons, and Mr. Jones, the manager, stated (see these Notes, Part I), that 200 bushels of limestone were required to smelt one ton of ore, so at that time there was a consumption of 240,000 bushels of limestone, a quantity more than two-thirds greater than that of all the lime burned in the same year throughout the Province,

MARBLES.—These have been long known to exist in various localities but none of them have been worked, an attempt having been made at one place only to make use of a deposit. A fair representation of the varieties best known was made at the International Exhibition of 1862*, when there were shown thirteen specimens from eleven localities.

Parrsboro' yields a purplish coloured marble with green spots of serpentine. *Onslow* mountains furnish a chocolate and a red variety, Cheverie a reddish brown with red bands. Pictou Co., affords

*Want of time prevented as good a representation at the Dublin Exhibition.

several kinds: one of a greenish hue, and among the rest one which is very remarkable. It is of a grey colour and when polished shows concentric waved bands covering the entire surface in beautiful markings. The specimen exhibited had perhaps a square foot of surface and was due to the liberality of Messrs. Wesley & Sanford, who also polished some of the other marbles shown. So far as I know this marble is unique and if it should be found in large slabs of the same character as that which was shewn and excited so much admiration there can be no doubt it would be very profitable. Even in small slabs it would be probably prized for inlaying. Cape Breton has large deposits, there are known a white marble with blackish veins, a black with white veins, and a white and deep green variety, which is very handsome. All the specimens at present met with are from the surface. The deposit of marble which is best known is that at Five Islands, in the Basin of Mines, where it forms large beds in the metamorphic rocks; the marble is of excellent grain and of a fine white colour, surpassing in beauty, when polished, according to Messrs. Wesley and Sanford, the Italian Marble. It is this which has been to some extent tried as to its value. About 1852 a gentleman was sent from England with two quarrymen to get out a block. He remained for some months and finally shipped a block of considerable size at an expense, it is said, of about £1,000. The explorer is reported to have stated that the marble was superior to any he had seen from Carrara, but on the arrival of the block in England it was pronounced unserviceable from being shattered. This condition of the specimen is considered to have been due, at all events in part, to the block having been got out by blasting, so that this trial may not have determined the real value of the deposit, and I have also heard from a resident in the neighbourhood at the time of quarrying, that more might have been done at the same expense. Even if larger and better conducted operations do not show that large masses can be got out, at least it is probable that smaller blocks suitable for busts and statuettes may be obtained.

A material may be mentioned here which may prove, under certain circumstances, a useful substitute for marble, viz: the hard plaster or anhydrite, which is found abundantly, and could probably be obtained in blocks of any useful dimensions. It occurs at Falmouth and St. Croix of a white colour, at Windsor of a bluish tint

and also a mottled white ; at Parrsboro' a purple rock is met with and no doubt it presents other varieties elsewhere. Its greatly superior hardness at once distinguishes it from the ordinary plaster. It is used in this neighborhood (Windsor), in building the foundations of houses. At the International Exhibition two specimens of the Windsor hard plaster were shown cut and polished : one gave a finely clouded surface and the other was rather uniformly spotted ; both were grey, and one showed in some lights a slightly bluish tint : the edges of both at the meeting of the polished surfaces were remarkably sharp and perfect. Since sulphate of lime (the chemical name of plaster) is not insoluble in water, polished surfaces of hard plaster would lose their lustre in the open air, and the material can only be used when cut and polished in in-door work ; under these circumstances it may prove more durable than marble, which is said to be so subject to change from variations of temperature that the mantle of a chimney piece immediately over the fire is invariably in a crumbling condition long before the sides or those parts which are not so exposed to heat. This statement is given in Hunt's Handbook to the International Exhibition (Vol. I, p. 325), and we find there also (p. 332) in a very interesting passage, that some alabaster, a variety of *soft* plaster, is more durable than Purbeck marble. The author says "notwithstanding alabaster is decidedly so soft a substance that it may be easily cut with a pocket-knife, or abraded with the nail, it is nevertheless an extremely durable material, if not openly exposed to the weather. In most of the large churches in the south of England, especially in Westminster Abbey, there are instances of monuments constructed with Purbeck marble, and ornamented with alabaster tracery, niches, canopies, and little figures, which are almost without exception perfectly free from decay ; angles sharp, surface smooth, colour scarcely altered ; while the Purbeck, a harder material, upon which the alabaster is fixed, has scarcely any of the original surface left : although these two substances are close together, equally exposed to the same atmospheric influences of damp and dry, summer and winter, from the fifteenth or sixteenth century, to the present time, yet one is apparently unaltered, while the other is certainly perishing, disintegrating, and gradually mouldering away."

Having been led to the subject of alabaster, I may state that the

compact gypsum of Antigonish has quite the character of alabaster. I have only seen small pieces but probably larger ones are to be got. The quality of this as a material for carving was shown at the Dublin Exhibition, it proved excellent. A small piece was carved to represent a bunch of grapes and some leaves by Mr. C. Harding, of Windsor, whose skill and taste in another department of fine art, viz : pen and ink drawing, have contributed materially to the adornment of the Nova Scotian Courts in both the late Exhibitions. It came under my own notice that both the carving and the material, attracted the attention of a wood-carver and called forth the expression of his favourable opinion.

In the Provincial Building now being erected, an opportunity offers for testing the value of native materials in internal decoration, and perhaps the public voice will be heard in favor of embracing it as the matter is surely one of Provincial interest.

ART. VIII. REMARKS ON THE PITCH LAKE OF TRINIDAD. BY
REV JOHN MORTON, LAHAVE.

[*Read March 8, 1866.*]

THE Pitch Lake of Trinidad lies on the western side of the island and about a mile from the Gulf of Paria. It is nearly circular, and about three-fourths of a mile across. There is no point from which a view of the whole lake may be obtained, as it is broken in upon by islands and obtruding points. These lie principally about 400 yards from the western side of the lake ; and from these the view easterly is very striking, and relieves the disappointment which is generally felt upon the first view of the lake. The expression *lake* is apt at first to mislead. The pitch is not in a fluid state, except in a very small spot, and may be safely walked upon over all the rest of the lake. Indeed teams might be driven over a great part of it, although any heavy weight left on it would gradually sink. The pitch, which from the heat of the sun and probably also from subterranean fire, is hot all over the lake, becomes hotter as you approach a point near the centre, where it is simmering and boiling over very gently. You can safely advance to the very edge