

R E P O R T
on
CEMENT MATERIALS AT BERRIEDALE

INTRODUCTION

This report deals with the proposal to utilise the Berriedale limestone in the manufacture of Portland Cement. For this purpose a Company has been formed to establish works in the neighbourhood of Berriedale, and it is expected that, providing the conditions are considered suitable, the erection of the plant will be commenced early in the new year.

In this report no account is given of the proposed method of operation, nor is any reference made to the system to be adopted for the transportation of the materials required to and from the Cement Plant. Consideration of these questions is beyond the scope of the investigation.

No openings have as yet been made in the limestone beds on the property owned by the Company, and, in consequence, all detailed information relating to its quality had to be obtained from quarries in extensions of these deposits on adjoining properties and in neighbouring areas. These limestone beds have for long been quarried at Granton near Bridgewater, at Glenorchy, and, in recent years, at Berriedale. At present the Granton and Berriedale quarries are in active operation, the lime product supplying the Hobart market for this class of material.

LOCATION AND EXTENT

The property controlled by this Company is situated six miles north-west of Hobart and about a mile west of the Derwent River at Berriedale. It comprises 1000 acres, and adjoins land charted in the name of G.A. Waller. The limestone on the adjoining property is quarried by the Hobart Brick Co. who burn it in kilns on the spot and market the product in Hobart.

ACCESS

Situated so close to Berriedale, through which the main road and railway pass from Hobart to Launceston, the property is very easily accessible. In order to reduce the cost of transport it is proposed to construct a branch railway from the main line to the site of the Cement-making Plant from which a tramway will connect with the quarries.

TOPOGRAPHY

In the immediate vicinity of Berriedale the country is gently undulating, but half a mile westward of the town the foothills of Mts. Faulkner and Hull rise steeply to heights of 1000 to 1500 feet above sea-level. It is on the eastern flanks of these hills between the 700 and 1300

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feet contours that the beds of limestone, from which the Cement is to be made, are exposed. The contour is such that the limestone can be removed on an extensive scale by open-cutting or quarrying methods at a very low cost. The facilities for operation are generally favourable in other respects also.

GEOLOGY

The sedimentary rocks that occur in this area belong to the Permo-Carboniferous, a formation that once extended over the greater part of Tasmania and far beyond its present confines. The Lower Marine members of this formation occur almost continuously along the upper valley of the Derwent, notable exposures being at New Norfolk, Granton, Berriedale and Glenorchy. These beds outcrop in other parts at widely separated points such as Maria Island, Dalmayne, Fingal, etc. The continuity of this formation has been broken by Mesozoic diabase which, intruded in the forms of sills, dykes and large transgressive masses, has dislocated and uplifted the beds to various altitudes. Protrusions of this igneous rock occur at irregular intervals in different shapes and sizes throughout the area under examination. However, enormous quantities of limestone unaffected by the intrusion are available for extraction.

In correlating the Berriedale with similar beds in other parts of the Island it is necessary to confirm the palaeontological evidence by the stratigraphic relationship of all the members that together make up the whole formation. Although limestone beds, for instance, may present distinguishable characteristics in common with outcrops in other localities, it is apparent that some of these may represent repetitions of similar conditions of formation in different horizons. As regards the Granton, Berriedale and Glenorchy outcrops of limestone, it is quite certain that they belong to the one horizon in the Permo-Carboniferous.

The beds exposed in these areas may be grouped with advantage into zones according to the nature of the substance of which they are composed and the prevalence of particular organisms in them.

The Upper of Fenestella zone consists of hardened siliceous mud or shale, finely laminated by the abundance of the common species *Fenestella internata*, *Fenestella plebia* and *Protoretopora ampla*. In addition, *Spirifera* are common in these shales, and separating this from the limestone beds are calcareous mudstones in which the *Spirifera* are very abundant.

Limestone Zone - The members comprising this next group are calcareous and thickly bedded. The beds are separated by bands of calcareous shale containing many rounded pebbles of quartz and vary in thickness from three to eight inches. The limestones are fossiliferous, the genera *Pachydomus*, *Eurydesma*, *Spirifera*, *Aviculopecten*, *Productus*, *Connularia*, *Stenopora* and *Fenestella* being especially characteristic. Although the quality of the limestone varies slightly, each particular bed, characterised by the prevalence of particular fossils, retains a fairly uniform composition over large areas. The limestone

beds vary in thickness from twelve to thirty inches, the whole aggregating 250 to 350 feet in thickness. In the upper beds are found occasional bands of chalcedony which was deposited from infiltrating solutions containing silica; and in the lower quartz pebbles are not uncommon.

In general the beds are horizontally disposed, but a slight inclination is noticeable varying in degree and direction in different localities.

QUANTITY OF LIMESTONE AVAILABLE

No attempt has been made to estimate the tonnage of limestone on this property. It is sufficient to state that the deposits extend nearly 20 chains into the hill before being intercepted by diabase and that they are fully 200 feet thick and extend along the front of the property without interruption.

From the foregoing it will be seen that no apprehension need be felt regarding supplies.

It having been established that there is a large quantity of limestone and shale available, the next consideration is the nature of the materials of which they are composed.

THE DETERMINATION OF THE UTILITY OF BERRIEDALE

LIMESTONE FOR THE MANUFACTURE OF PORTLAND CEMENT

In order to determine whether the limestone and shale deposits of Berriedale contain the requisite proportions of the essential constituents (carbonate of lime, silica and alumina) of cement a number of samples were taken of the several layers of limestone and shale for testing. These samples were obtained from the quarries now being worked by the Hobart Brick Co. on the property adjoining that of the Tasmanian Cement Co.

The results of the analyses show that the limestone contains less than one per cent of magnesium carbonate and a small percentage only of free silica.

The average composition, taking into consideration the varying thicknesses of the layers, is as follows:-

Silica	Ferric Oxide + Alumina	Calcium Carbonate
22.37%	4.16%	72.92%

This shows that the ratio of silica to Ferric Oxide and alumina is 5.37 to 1.

The average composition of the shale, taking into consideration the varying thicknesses of the bands, is as follows:-

Silica	Ferric Oxide + Alumina	Calcium Carbonate
54.08%	14.19%	27.47%

The ratio of silica to ferric oxide and alumina is 3.81 to 1.

The average composition of the deposit as a whole, that is, the layers of limestone and the bands of shale separating them, is as follows:

Silica	Ferric Oxide + Alumina	Calcium Carbonate
28.51%	6.10%	64.15%

In this case the ratio of silica to ferric oxide and alumina is 4.67 to 1.

The shale bands contain a small proportion of silica in the form of quartz pebbles. If these pebbles are not separated by screening it will be necessary to reduce them with the other components to a very fine state of division. Free silica in a coarse condition remains inert in the kiln.

It will be perceived that the deposit in bulk does not possess the desired proportions of the essential materials for the manufacture of Portland cement.

By selective mining it would be possible to obtain materials more suitable for this purpose, but operated in this way a large proportion of the limestone would be valueless.

Whichever method is decided upon in operating these deposits it will be necessary to obtain supplies of high grade limestone in order to adjust the composition as desired.

It is obvious that a larger quantity of high grade limestone will be required if the system of selective mining is not adopted. In any case the proportion of pure limestone to effect this result will not be considerable.

Supplies of such material are obtainable at Ida Bay.

COMPARISON WITH THE DEPOSITS IN OTHER LOCALITIES

In order to ascertain whether the quality of the limestone varies appreciably from point to point a number of samples were obtained from the Nassau quarries owned and operated by Mr. Rathbone of Granton. Analyses of the samples show that the difference in the average grade of the cement materials of the Berriedale and Granton quarries is inconsiderable. This is apparent from a perusal of the subjoined table. These quarries are five miles apart and show little variation in the composition of the limestone. Therefore, it may be safely assumed that the extension of the same beds occurring on the property owned by the Tasmanian Cement Co. is of similar quality.

In the Granton quarries the proportion of calcium carbonate varies from 60 to 86 per cent in the limestone layers. If the silica occurring on the margin of the layers is included in the bulk sample the proportion of calcium carbonate is found to be only 66 per cent in average content. On the top of each limestone layer there is a 2 to 3 inch scale of siliceous limestone which, however, is easily removed by a blow of the hammer. The scale splits off along a bedding plane. By this means the richer interior limestone is kept free from contamination of undesirable materials.

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FUEL SUPPLY

One of the principal considerations in a Portland cement plant is the fuel supply. In importance it almost ranks with the supply of limestone and shale.

The fuel in this instance will be used for burning the cement mixture only. Power will be obtained from the State Hydro-electric installation.

Most of the native coals are suitable for burning in modern rotary kilns provided they are pulverised so that 95 per cent will pass 100 mesh and 80 per cent 200 mesh screen.

The coal used will be governed largely by the cost of delivering it to the works.

RETARDER

Calcium sulphate, which is used as a retarder to prevent the quick setting of Portland cement, does not occur in Tasmania in commercial quantities. The quantity required can be obtained from South Australia. If the output of cement be 30,000 tons per annum, approximately 600 tons of gypsum will be necessary.

A.M.Reid

GOVERNMENT GEOLOGIST

GOVERNMENT ASSAYER.

GEOLOGICAL SURVEY
LAUNCESTON
24th October, 1922

TABLE OF ANALYSES

Locality	No. of Sample	Nature of Material	Thickness in inches	Silica Per Cent	Ferric Oxide Per Cent	Alumina Per Cent
Berriedale	1	Limestone	15	19.36	0.57	3.59
"	2	"	22	28.36	2.93	2.27
"	3	"	15	19.60	1.43	2.17
"	4	"	24	18.68	1.43	2.53
"	5	"	16	25.20	1.21	2.39
"	6	Shale Band	6	57.72	3.15	12.21
"	7	"	8	54.00	3.14	13.70
"	8	Outcrop Limestone	--	29.72	1.72	5.00
"	9	Shale Band	8	51.44	10.01	0.67
Granton	1	Limestone	--	31.40	1.79	4.45
"	2	"	--	10.32	0.93	2.27
"	3	"	--	25.48	1.29	3.39
"	4	Shale Band	6	46.20	2.86	12.10
"	5	Limestone	--	26.64	1.86	2.54
"	6	"	--	23.56	2.14	3.74
"	7	Shale Band	--	60.92	2.36	14.32
"	9	Limestone	--	30.04	1.86	4.50
"	10	"	--	12.88	0.70	1.78
	Selected					
"	10A	"	--	17.60	1.60	2.40
"	11	"	--	29.72	1.56	2.64
"	12	"	--	27.28	1.64	2.28
"	12A	Shale Band	--	71.40	3.70	15.98

Granton Quarry

Average grade of limestone including siliceous band on margin of layers (Sample No. 10 is not included).

Silica
26.82

Ferric Oxide + Alumina
5.78

TABLE OF ANALYSES

Locality	No. of Sample	Calcium Carbonate Per Cent	Magnesia Per Cent	Ignition Loss Per Cent	Ratio		Name of Owner
					SiO ₂	Fe ₂ O ₃ + Al ₂ O ₃	
Berriedale	1	76.39	0.72		4.6		Hobart Brick Co.
"	2	65.87	0.72		5.4		" " "
"	3	76.39	0.72		5.4		" " "
"	4	77.37	0.72		4.7		" " "
"	5	69.44	0.87		7.0		" " "
"	6	21.60	0.94	3.10	3.7		" " "
"	7	24.80	0.57	3.51	3.2		" " "
"	8	62.76	0.79		4.4		Tasmanian Cement Co
"	9	34.54	0.65	2.68	4.8		Hobart Brick Co.
Granton	1	59.89	1.09	1.00	5.0		Mr. Rathbone
"	2	86.40	0.72		3.2		" "
"	3	68.90	1.09		5.4		" "
"	4	33.73	1.45	2.96	3.1		" "
"	5	68.93	0.36		6.0		" "
"	6	70.70	0.24		4.0		" "
"	7	16.60	1.09	3.6	3.7		" "
"	9	63.60	0.50		4.7		" "
"	10 Selected	84.34	0.20		5.2		Siliceous band on margin of limestone layer excluded
"	10A	78.49	0.60		4.4		
"	11	62.26	1.01	0.79	7.0		
"	12	65.26	1.23	0.75	6.9		
"	12A	2.65	1.23	4.24	3.6		Supposed to contain high percentage of alumina

Calcium Carbonate

65.92

Ratio of silica to ferric oxide and alumina

4.6 to 1.