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LIMESTONE AT GUNNS PLAINS

Introduction

The occurrence of linestone at Gunns Plains has been known for a great many years, a small amount of quarrying and lime-burning has been attempted, and the limestone caves are a noted tourist attraction; but the deposits have never been mapped or reported on by a departmental officer, and, except for one obscure reference, no samples have been taken. Recently a group of people in North Western Tasmania has become interested in the limestone, mainly for its agricultural use and a request was made to the Department for some advice. The purpose of this investigation is therefore twofold: - to map the extent and structure of the limestone beds as a whole and to make a detailed examination of certain areas favourable for quarrying.

Location and Access

Gunns Plains is a prosperous farming centre, located on pleasant river flats, and rising valley slopes on either side of the River Leven. It is connected by good roads to Ulverstone, 13 miles away and to the railway at Preston (on the Nietta Line) only three miles distant.

Topography

The valley floor of the Leven in this district is considerable, averaging 5 miles in length by ½ mile in width. The topography has first been conditioned by the differing rock types, the wide valley here being first due to the erosion of the readily soluble linestone. The Leven enters the Plains by a narrow deep gorge eroded with difficulty into the hard Tremadoc conglomerates and quartzites and after meandering slowly through the flat wide water-meadows again enters a deep gorge cut into resistant Cambrian rocks. On either side of the Plains the hills rise fairly steeply at first and then as the basalt covering of the plateau is reached steepen to very high angle slopes. During the Pleistocene period, glaciation affected the topography to a marked degree and two distinct cirques may be observed at the southern end of the Plains, where the hills rise many hundreds of feet above the river level.

The detailed topography of the limestone areas is typical. Numerous sink holes occur over the whole district, streams disappear underground and re-emerge many chains away, and cavities in the rock faces are numerous. Cliffs up to 200 feet high fringe the river and creek beds.

Geological Map

On the accompanying geological map, are shown the principal rock types outcropping in this district. The limestone, which is the important rock type as far as this report is concerned, belongs to the Gordon River Series of the Ordovician and is underlain apparently conformably by a series of conglomerates and quartzites, the West Coast Range Conglomerate Series of the Ordovician. Lying uncomformably below this latter Series, and outcropping to the north of the Limestone in the Leven Gorge are slates and other members of the Dundas Series of the Cambrian.

In one locality a small remnant of post-limestone quartzite may be observed. No definite age can be assigned to this but perhaps it is equivalent to the Crotty Quartzites at the base of the Silurian.

During the Tertiary Period, when a good deal of the limestone had already been eroded away, an outpouring of lava formed the extensive basalt deposits, the rich soil from which is so important to North Western prosperity.

Under the basalt, on steep hill sides may be seen remnants of Tertiary river gravels, and huge conglomerate boulders, brought down by Pleistocene moraines, litter many limestone areas. These Tertiary and Pleistocene deposits, because of their thin coating and limited extent are not distinguished on the geological map, but recent river alluvial flats are separately coloured.

Structure

The geological structure in the vicinity of Gunns Plains is dominated by a large dipping syncline which almost reached the proportions of a basin. The axis of this syncline strikes at 120° and is located about the position of the valley south of the caves. Except where the bedding is influenced by a few minor flexures and faults, mainly to the north, all dips to the north of this axis are southerly, and to the south, all are northerly. It is noted that the horizontal distance across the limestone beds is much less on the southern side of the axis than on the northern and this may be due to three causes, all of which probably operate here:-

1. The beds to the south are generally more steeply dipping.
2. Minor folds occur to the north, which causes repetition of the beds. These minor folds and flexures appear very small and some are only a few feet across.

3. Faulting has also caused some repetition.

No minor folding or faulting has been observed south of the synclinal axis; but just to the south of this appears a thin bed of quartzite which seems to indicate the top of the limestone. The bottom of the limestone can be found where the West Coast Range Conglomerate beds begin, so that the thickness of the limestone beds in this area can be measured; and it is found to be almost 3000 ft.

To the south and west then the limestone is limited by its dip and here the underlying West Coast Range Conglomerate beds come to the surface. To the east and sometimes to the west the limestone disappears under Tertiary basalt. To the north a large south-dipping fault brings Cambrian Sediments into faulted relationship with the limestone. Smaller faults, echoes of this large one, and parallel to it, occur in the limestone to the north of the area.

This rock is the typical dark blue, high grade limestone of the Gordon River Series which outcrops in the north of the Island at Melrose, Railton, Mole Creek, Flowery Gully, Loongana and other localities. Although in places it appears massive, it is usually well bedded, the beds varying in width from a few inches to several feet. Fracturing, particularly in a vertical plane, is reasonably common but there does not appear to be any shearing in this district and no igneous intrusion appears to have interfered with the original constituents, as no samples showed the presence of calcium silicates. In certain areas whilte calcite veins and bunches are common but this is not the pure calcium carbonate, as an analysis of the white crystals showed 2% of magnesium carbonate.

Quantity

No overall estimate of the quantities present has been attempted as these are far in excess of any present day needs, but on the geological map the limestone areas are coloured blue. This does not mean, of course, that limestone actually outcrops over all this area. In some places it is covered by soil and basalt debris in others by Tertiary gravels and Pleistocene glacial material; all these coverings, are but thin skins and here and there limestone pokes up from under each of these covers. Certain areas, however, are available where the overburden is practically negligible. The recent alluvium, shown on the map in yellow, covers limestone at no great depth but as the limestone could not be obtained from beneath this except by sub-surface workings, it is differentiated on the map.

Quality

The quality of the limestone throughout the area is good and very consistent. In one locality beds were channel sampled over two faces. One face, in five foot samples showed, over 75 feet, an average $CaCO_3$ content of 87.8 and the other, over 130 feet, showed, in 6 foot samples, an average $CaCO_3$ content of 87.1. Altogether in the district 46 samples were taken and the results of these showed an average calcium carbonate content of 87%. Most of the samples taken showed the percentage of $CaCO_3$ in either the eighties or nineties. The magnesium carbonate content of the samples varies considerably and in some samples is surprisingly high. In the majority, the percentage is under 3, but many have 4 or 5% and the highest contains 12%. The acid insoluble portion of the samples is quite constant, varying (except in one sample) from 3 to 12%. Of this acid insoluble portion the majority consists of SiO_2 (82%); AlO_3 (12%) being the only other constituent of any appreciable amount. In some of the samples small specks of pyrite could be detected but an estimation of the sulphur content showed that one sample contained 0.2%, a few 0.1%, but the majority less than 0.1%.

Accessibility and Ease of Quarrying.

As the district is a rich agricultural one, it is closely settled and consequently roads are numerous so that no outcrop is very far from a road of some sort. Moreover, the greatest density of roads is on the plains about river level and the limestone outcrops on the hill slopes on either side so that there could always be a road below the base of a possible quarry. In certain localities the limestone outcrops boldly in cliff faces or on very steep slopes with little or no overburden thus forming natural quarry sites.

All these points, however, will be discussed in greater detail when dealing with individual selected sites.

INDIVIDUAL SITES

1. Winduss' Property

This site (or rather sites, for there are two possible quarry sites) appears to be far the most favourable in the district and for this reason a more thorough survey and sampling of the area was undertaken than at other sites.

This area has many advantages from a quarrying point of view. There are two natural faces of almost vertical rock with little or no overburden and of the order of 100 feet in height at the faces, with the hill sloping more gently behind these for another hundred feet. These faces are looking north-easterly and as the dip of the beds is to the south there is a component of dip inwards from them. This deposit is close to a good road and to electric power. A permanent stream runs through the area and there are good stretches of flat ground for building purposes. The quantities of limestone that could be quarried, with no overburden but a little soil, are enormous. The rock faces themselves are some two hundred feet each in length; the number one face is 75 feet high, rising a further hundred feet to the crest of the hill, some 250 feet in; the Big Face is over a hundred feet in height and the hill behind it rises another 150 feet to the hill top, 250 feet in. Millions of tons of limestone could thus be obtained from this area with no overburden but a little soil.

The grade of stone in this property is comparable with that generally in the District and except for one 5 foot bed is of good even quality averaging about 88% $CaCO_3$.

These two faces were carefully channel sampled; that is a section was taken right across the beds and divided into widths of 3' to 10' which generally corresponded with the individual beds. It is of course possible for these beds to vary laterally in grade but over this small area the grade of the samples should indicate the average grade of the beds. The attached sections show the position of the various samples, which may be shown diagrammatically as follows: -

No.1 Face.

Sample	9	(20')	
	8	(4')	
	7	(5')	)
	6	(4')	)
	5	(5')	)
	4	(5')	) Main Rock Face
	3	(5')	)
	2	(6')	)
	1	(6')	)
	10	(5')	
	11	(5')	
	12	(5')	
	13	(8')	
	14	(5')	
	-	(25')	No outcrop
	15	(3')	

Big Face.

Sample	18	(5')	
	17	(5')	
	16	(5')	
	19	(8')	)
	20	(5')	)
	21	(6')	)
	22	(6')	) Main Rock Face
	23	(6')	)
	24	(6')	)
	25	(7')	)
	26	(7')	)
	27	(5')	)
	28	(6')	)
	29	(6')	)
	30	(5')	)
	31	(7')	)
	36	(3')	)
	35	(8')	)
	34	(10')	)
	32	(7')	
	33	(7')	

Sample 37 was a general sample taken over several beds at the outcrop nearer the road and contained on lease 305P/M, 24 acres held by H.L.Munro.

Detailed results of this sampling are as follows:-

Sample	Width	Insoluble	AL_2O_3 & Fe_2O_3	CaO	$CaCO_3$	MgO	$MgCO_3$	S.
1	6'	9.7	1.2	47.2	84.2	2.2	4.5	0.2
2	6'	7.8	0.6	49.1	87.6	1.5	3.1	under 0.1
3	5'	3.3	0.3	52.8	94.2	0.8	1.6	"
4	5'	8.1	0.7	49.6	88.5	0.9	1.8	"
5	5'	3.9	0.5	52.6	93.9	0.8	1.6	"
6	4'	7.2	0.6	50.4	89.9	1.0	2.1	"
7	5'	5.4	0.4	51.8	92.4	0.7	1.4	"
8	4'	4.4	0.5	52.2	93.1	0.9	2.0	"
9	20'	11.7	0.8	47.3	84.4	1.3	2.8	"
10	5'	19.4	1.4	39.1	69.8	4.1	8.7	"
11	5'	4.9	0.6	51.9	92.6	0.9	1.8	"
12	5'	8.5	0.8	47.6	85.0	2.4	4.9	0.1
13	8'	12.4	1.2	45.6	81.4	1.9	3.9	"
14	5'	7.7	0.6	49.7	88.7	1.0	2.2	under 0.1
15	3'	5.4	0.4	51.5	91.9	0.9	1.9	"
16	5'	8.3	0.8	49.7	88.7	0.7	1.4	"
17	5'	4.4	0.6	52.1	93.0	0.6	1.2	"
18	5'	4.7	0.6	51.9	92.6	0.6	1.2	"
19	8'	12.8	1.1	47.1	84.1	0.7	1.5	"
20	5'	8.9	0.9	49.3	88.0	0.6	1.2	"
21.	6'	10.8	0.9	48.5	86.8	0.6	1.2	"
22	6'	4.6	0.7	52.1	93.0	0.6	1.3	"
23	6'	7.2	0.7	50.[illegible]	90.0	0.7	1.4	"
24	6'	10.2	1.0	48.5	86.6	0.9	1.8	"
25	7'	11.8	1.0	47.7	85.1	0.8	1.7	"
26	8'	6.0	0.7	50.9	90.9	0.9	1.8	"
27	5'	7.3	0.8	49.7	88.7	1.2	2.6	"
28	6'	4.2	0.8	50.1	89.4	2.5	5.3	"
29	6'	5.4	0.8	49.6	88.5	2.0	4.2	"

Sample	Width	Insoluble	Al_2O_3 & Fe_2O_3	CaO	$CaCO_3$	MgO	$MgCO_3$	S.
30	5'	8.3	0.6	47.9	85.5	2.1	4.4	0.1
31	7'	8.1	0.8	47.3	84.4	2.7	5.6	"
32	7'	14.0	1.1	43.5	77.6	2.8	5.9	"
33	7'	7.2	0.7	49.3	88.0	1.6	3.3	"
34	10'	12.0	0.9	46.2	82.5	1.7	3.6	"
35	8'	8.6	0.7	48.4	96.4	2.2	4.5	"
36	3'	9.8	0.8	44.8	80.0	4.4	9.2	"
37		6.5	0.8	49.3	88.0	2.4	5.0	"

8.

It can be seen that the $MgCO_3$ content varies considerably but if a low magnesium content were desired at any time, it is interesting to note that samples 16 to 26, that is the upper 66 feet of the Big Face, contain less than 2% $MgCO_3$.

In each tenth sample, the acid insoluble portion was separately analysed and an overall average showed 83% of it consisted of SiO_2 and 10% Al_2O_3. Details of samples are as follows:-

Sample	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO
1	83.2	9.0	0.7	0.7	0.6	1.3
10	83.1	10.0	0.7	0.6	0.5	1.5
20	85.5	8.6	0.6	0.5	0.5	1.3
30	80.0	12.7	0.6	0.7	0.5	1.0

11. Limestone Bend

In the southern portion of the area and just after the Leven emerges from its upper gorge is a large bend in the river containing flat meadows. To the north of these flats and on the opposite side of the river are limestone cliffs, some 200 feet in height and fringing the river for hundreds of feet along the strike of the beds. Unfortunately the base of these cliffs is the river itself which would make quarrying from their face very difficult. However, the eastern end of the ridge ends in river flats and although there is not a sheer face in this direction a quarry site could be easily opened and very little overburden would result. As can be seen on the plan, the hillside rises at about 30_o and the top of the hill, nearly 200 feet above the flat, is in a distance of 400 feet. The reserves in this area are almost limitless and the quality is high, the average $CaCO_3$ content being 90%. Two samples were taken one (44) from flat level to 80 feet and the second (45) from 90 feet to the top. These showed: -

Sample	Width	Insoluble	Al_2O_3 & Fe_2O_3	CaO	$CaCO_3$	MgO	$MgCO_3$	S.
44	80'	5.0	0.6	51.8	92.5	0.9	1.9	und 0.
45	90'	7.4	0.7	48.9	87.3	2.2	4.6	"

The River Leven flows right past this site and there are ample river flats. However, it is the remotest spot from access roads in the area and a road 50 chains in length would have to be constructed from the present end of the metal.

111. About the centre of the district, close to the road leading to John's property and just south of the caves, is a hill from which limestone could be obtained from two possible quarry sites.

9.

A. The first is situated opposite John's house where Caves Creek runs underground. The hill rises from a small flat at a 20° angle to a height of 90 feet and then flattens. The limestone in this area is full of cavities and is likely to include a lot of rubbish, such as surface soil. A sample taken from all the beds showed: -

Insoluble	11.6
Al_2O_3 & Fe_2O_3	0.9
CaO	44.6
$CaCO_3$	79.6
MgO	3.7
$MgCO_3$	7.7
S	0.16

The hill slope is almost a dip slope and the beds are dipping outward at 10°.

B. The second possible site occurs on the Caves Reserve at the first bend in John's Road where a small quarry has previously been opened, to utilise the limestone as road metal. The hill into which this quarry has been opened, is a spur running from the main hill and rises to ninety feet above the flat. The dimensions of the hill are 200 by150 feet. A sample (41) taken over all the beds showed.

Insoluble	10.3
Al_2O_3 & Fe_2O_3	1.1
CaO	42.8
$CaCO_3$	76.4
MgO	5.8
$MgCO_3$	12.1
S.	0.1

The beds dip in the direction of greatest hill slope.

These two sites although centrally situated close to formed roads have several disadvantages; the quality is not as good as at other localities, the quarries would face south and in one case the limestone would contain a certain amount of rubbish while in the other the quantities available would not exceed one hundred thousand tons.

1V. Where the metal road ends to the south of the area but to the north of the River are extensive outcrops along the face of a small hill which rises from the flat at an angle of 30° to a height of 80 feet and then flattens. The beds average 3 feet in thickness and dip into the hill at 15°. A small stream flows from the hill near this point. The quality of the limestone is good and except for its southern aspect it would appear a good quarry site for limited production. A sample (40) taken over all the beds showed: -

Insoluble	4.7
Al_2O_3 & Fe_2O_3	0.6
CaO	50.7
$CaCO_3$	90.5
MgO	2.0
$MgCO_3$	4.2
S.	0.1

V. Other Sites

In several other localities, quarrying could be satisfactorily carried out but the sites mentioned appear the most favourable. Twin hills of limestone rise behind Lasts' Dairy on the western side of the Leven and a composite sam.e (43) was taken across beds 30 feet in width on one hill and 60 feet on the other. This showed limestone of good quality viz.

Insoluble	5.3
Al_2O_3 & Fe_2O_3	0.6
CaO	51.2
$CaCO_3$	91.4
MgO	1.3
$MgCO_3$	2.7
S.	0.1

Another area that might be considered because of its high level position is on C.Clarke's property and could be approached from the Preston plateau and not from the lower Gunns Plains. Bold cliffs, 50 feet high fringe the gully of a small creek which disappears underground. The dip of the beds is into the hill from the gully. A sample taken over the 50 feet showed : -

Insoluble	11.6
Fe_2O_3 & Al_2O_3	1.0
CaO	47.5
$CaCO_3$	84.8
MgO	1.1
$MgCO_3$	2.3
S	0.1

On the first big bend on the road from Gunns Plains to Preston are bold outcrops of limestone on a steep hill slope. Two samples were taken across the beds which dip into the hill at 20°. One (38) included beds from road level to 50 feet and the other (39) from 50 to [illegible]0 feet.

	38	39
Insoluble	6.4	8.0
Fe_2O_3 & Al_2O_3	0.8	0.8
CaO	47.8	47.0
$CaCO_3$	85.3	83.9
MgO	3.5	3.7
$MgCO_3$	7.3	7.7
S	0.1	0.1

Conclusions

Enormous quantities of high grade limestone outcrop on steep hill slopes fringing alluvial flats at several localities in the Gunns Plains area and although quarries could be successfully operated at many of these sites it is considered that either of the two cliff faces on Winduss' property is the most promising site.

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