

Section I — Economic and General Geology
 TR13-11-19
 I. LIMESTONE AT SALTWATER LAGOON:
 FRIENDLY BEACHES, COLES BAY
 PENINSULA

by D. J. Jennings

OCCURRENCE AND ACCESS

Limestone occurs in the Cascades Group of the Permian succession on the E seaboard of the Coles Bay Peninsula, 11 miles S of Bicheno. Access to the area is quite easy.

Of the area concerned, about half (90 acres) is Crown land, and an equal area was sold to J. A. Hood in 1925, and is now owned by Swanwick Estates. The whole area comes under E.L. 5/61 in force until 24.8.1969 held by Industrial & Mining Investigations Pty. Ltd. for reserves of coal and limestone.

SUMMARY OF PREVIOUS INFORMATION

Information from Nye's reports which were quoted by Hughes suggests that, assuming 200 feet of limestone is available over 200 acres, reserves total 80,000,000 tons.

Analyses quoted show—

	(1)	(2)	(3)
SiO ₂	15.4	18.4	7.8
Fe ₂ O ₃	2.15	2.29	0.4
Al ₂ O ₃	0.45	2.51	0.3
CaCO ₃	82.40	76.50	88.80
MgCO ₃	0.29	0.65	0.60

Sample (1) was taken from 70 feet of limestone on the W of the spur N of Saltwater Lagoon, sample (2) was from 150 feet of underlying limestone on the E of the spur and sample (3) was a rough overall collection from 200 feet of the limestone succession. Present rock exposure does not allow a similar representative collection.

The conclusion reached was that although the percentage of CaCO₃ is within acceptable limits for cement production the proportion of SiO₂ (in particular the ratio SiO₂ to combined Al₂O₃ + Fe₂O₃) is critically high and hence material for blending would need to be abnormally high Al₂O₃, low SiO₂ clay in order to produce an acceptable Portland cement mixture. Average kaolin clays are generally about 40% Al₂O₃, 45% SiO₂.

Specifications for Portland cement

Approximately 75% CaCO₃

Approximately 20% SiO₂ + Fe₂O₃ + Al₂O₃ (but with % SiO₂ approximately equal to % Fe₂O₃ + % Al₂O₃)

Remaining 5% Mg and alkalis etc. but with less than 2.7% MgCO₃ and less than 1% P₂O₅.

(ref. Minerals for Chemical and Allied Industries: Johnstone and Johnstone, 1961. p. 298-301.)

PRESENT SURVEY

The present survey showed the coastal ridge of NS trending hills N of Saltwater Lagoon to be a fault-block capped by limestone at the S end and dipping 2 or 3° NNE. Keid referred to limestone outcropping among Permian strata further W but this was not located although original shelly beds, now leached of carbonate, are preserved as silicified siltstone rich in fossil moulds.

On the steep bluff N of Saltwater Lagoon about 200 feet of bedded limestone appear in the succession about 150 feet above sea level. This overlies coarse conglomerate and grit and is overlain at 350 feet on the crest of the ridge to the N by some 100 feet of abundantly fossiliferous siliceous siltstone. The limestone is a clean, coarsely crystalline rock, variably cream, white or pale grey in colour, with local horizons rich in fossils and occasional quartz and (?) Pre-Cambrian quartzite and schist erratics.

Gullies running S and W dissect the ridge and expose 30 to 50 feet cliffs of limestone, conspicuously bedded into units 1 foot to 6 feet thick. Elsewhere outcrop consists of diminutive scarps, platforms and numerous loose slabs, without evidence of intervening beds of contrasting lithology. The cliff-faces display nearly horizontal deep-raked bedding planes, indicating preferential erosion. As removal of material has been most severe on planes between beds, rather than on selected bedding units, it appears that these planes represent impure shaley horizons.

SELECTION AND ANALYSES

A sample as representative as possible was obtained from the best cliff-exposure located which was on the W facing side of the spur N of Saltwater Lagoon (locality 4 fig. 2). Clean fresh fragments, including some fossiliferous material and rare quartz pebbles were obtained. Sampling of the eroded layers proved impracticable.

Only 50 feet of the succession was accessible and analysis of the samples represents an accurate assessment of 90% of this, but whether the remaining 10% is more or less pure remains in doubt. Surface sampling of the remainder of the succession was considered purposeless.

	Upper 25' sample	Lower 25' sample
SiO ₂	6.51	6.00
Fe ₂ O ₃	0.76	0.59
Al ₂ O ₃	0.11	0.10
MgCO ₃	0.76	0.20
CaCO ₃	87.6	91.6
P ₂ O ₅	0.13	0.07

The limestone quality from this restricted range of sampling is substantially better than that indicated from previous analyses.

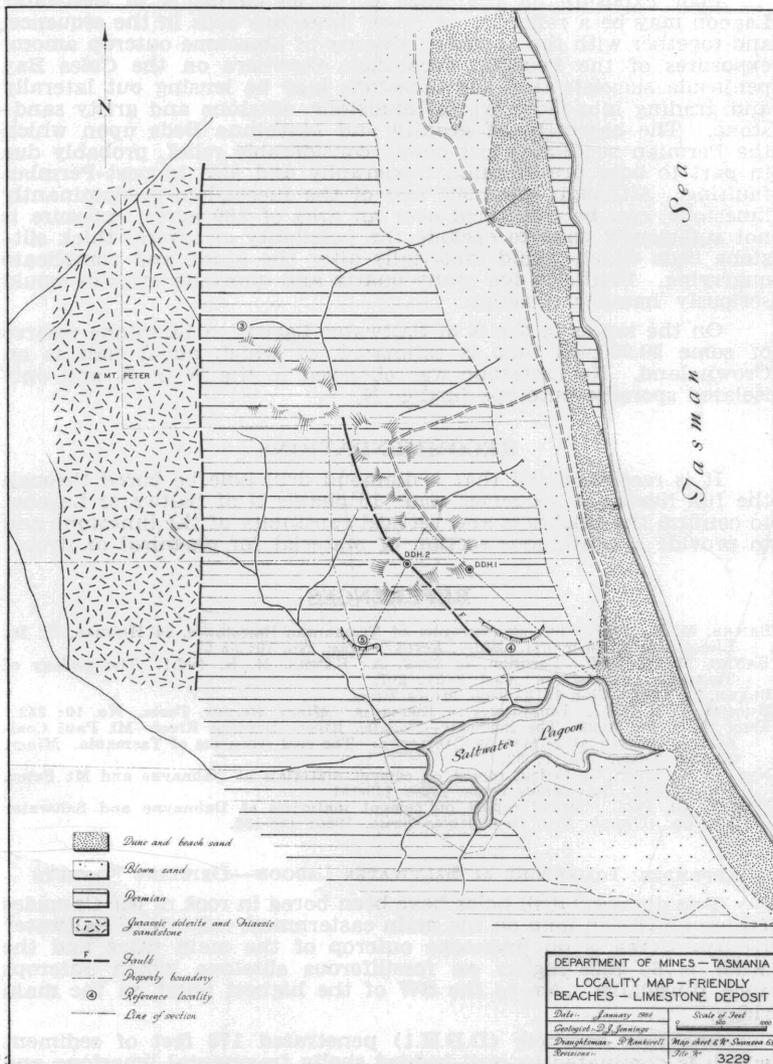
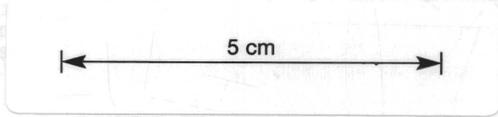


FIGURE 2.



EXTENT OF LIMESTONE RESERVES

Poor exposure on the ridge 60 to 80 chains N of Saltwater Lagoon may be a reflection of fewer limestone beds in the sequence, and together with the apparent absence of limestone outcrop among exposures of the Permian succession elsewhere on the Coles Bay peninsula suggests that the limestone may be lensing out laterally and grading into more typical mudstone, siltstone and gritty sandstone. The basement of granite and Mathinna Beds upon which the Permian succession lies shows considerable relief, probably due in part to bold pre-Permian topography and also to post-Permian faulting. Although some 200 feet of the succession, predominantly limestone, can be confirmed over an area of 180 acres, exposure is not sufficiently good to exclude the possibility of several thick siltstone beds which would materially alter the grade and complicate quarrying. Similarly too many quartz and quartzite erratics would seriously hamper crushing.

On the ridges to the N of Saltwater Lagoon, a limestone reserve of some 50,000,000 tons is estimated, of which about half is on Crown land. No limestone was observed to the W or S, and only isolated sporadic outcrops further N.

RECOMMENDATIONS

It is recommended that a diamond drill hole be bored through the full limestone sequence, some 15 chains N of Saltwater Lagoon, to confirm the thickness and vertical continuity of the limestone and to provide a continuous section of material for chemical analysis.

REFERENCES

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APPENDIX: LIMESTONE AT SALTWATER LAGOON—DRILLING RESULTS

Two diamond drill holes have been bored in rock of the Cascades Group on Crown land on the main easternmost ridge N of Saltwater Lagoon. One is on limestone outcrop of the main ridge and the other is 60 feet higher on fossiliferous siltstone which outcrops on a subsidiary ridge to the SW of the highest point on the main ridge.

The first borehole (D.D.H.1) penetrated 178 feet of sediment which is dominated by well-bedded shelly fragmental limestone and porcellaneous lime mudstone. The hole continued through siltstone, conglomerate and arkosic sandstone to granite bedrock, and located the pre-Permian basement level at a depth of 749 feet. Low core-recovery between 90 and 113 feet is probably due to an incomplete succession of poorly consolidated bryozoan siltstone with gaps caused by solution of carbonate beds. A sequence of intercalated

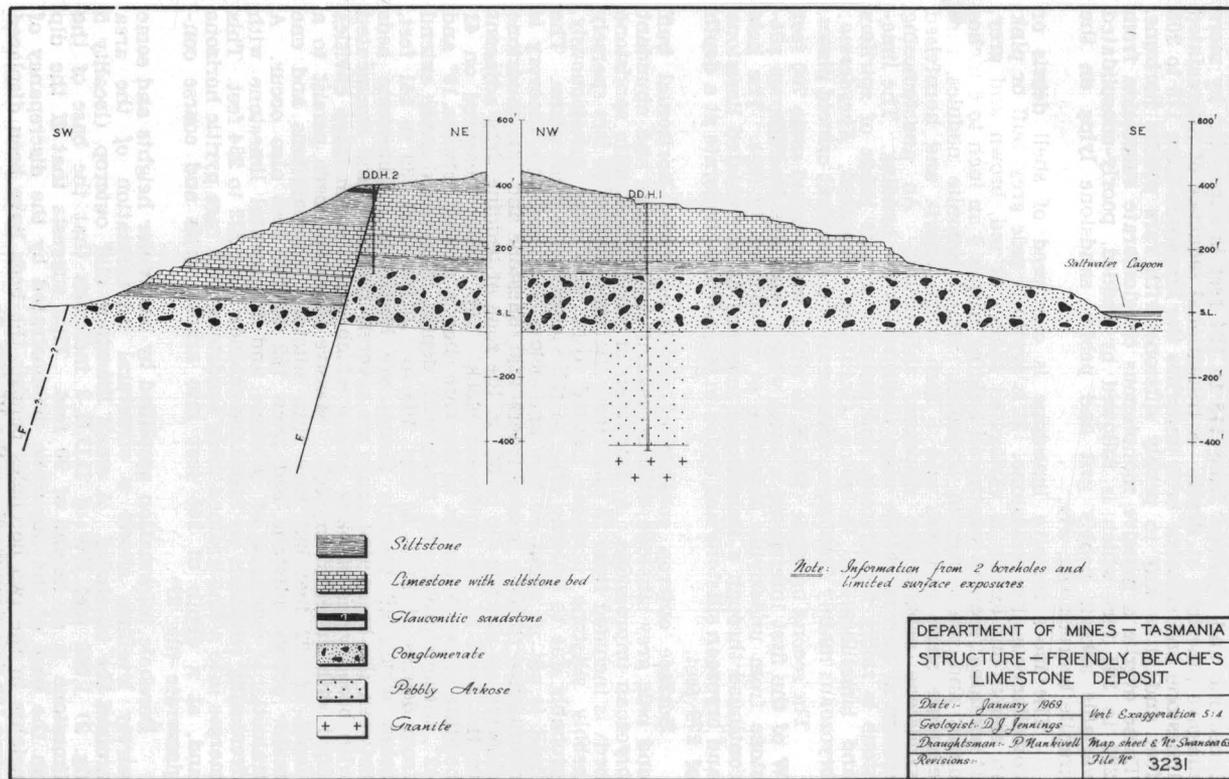
limestone and siltstone from 113 to 124 feet is succeeded by more massive limestone at depth. A transitional sequence of intercalated limestone and siltstone beds underlies the limestone from 178 to 205 feet and gives way to pebbly siltstone with rare pyritic horizons. These overlie a massive monotonous conglomerate succession from 220 to 395 feet which is followed by bedded, poorly-consolidated variable arkosic pebbly grit and pebbly sandstone lying on the granite bedrock (fig. 27).

The more massive limestone is composed of shell debris or porcellaneous lime mudstone. It is typically pale grey, buff or pink in colour but locally is variegated shades of red, brown and grey. It contains frequent weathered bedding planes $\frac{1}{2}$ an inch to 6 inches apart and zones rich in stylolites. Small limonite nodules, rare elongate shale granules and 1 inch ovoid quartz and hornfelsed sandstone pebbles are dispersed throughout. An anastomosing system of narrow calcite veins transgresses the bedding. The limestone is richly fossiliferous, and contains a wide range of spirifers and lamellibranchs including *Grantonia*, *Terrakea*, *Eurydesma*; bryozoans mainly *Stenopora*; rare corals and abundant crinoid plates.

The second borehole (D.D.H. 2) which was situated some 700 feet W of the first intersected a fault which separates fossiliferous siltstone from underlying limestone at a depth of 70 feet. The hole continued through a transitional sequence of intercalated limestone and bryozoan siltstone and ended in massive conglomerate at a depth of 278 feet.

Surface outcrop consists of poorly-preserved horizontal buff and pale grey siltstone with occasional shell moulds and abundant bryozoan impressions. A succession of shelly glauconitic sandstone beds is included from 15 to 27 feet. Between 60 and 70 feet sparsely pebbly siltstone provides limited core and dips conspicuously, probably due to bedding drag in the vicinity of a fault plane. The fault is cut at about 70 feet and below this good core recovery is maintained through bedded fragmental limestone and lime-mudstone showing an average dip of 32° in the zone of bedding drag adjacent to the fault in the upthrown block. Dip values measured on 41 bedding planes apparent in the core show a scatter between 19° and 42° , without progressive trend with depth. Brecciated zones extend from depths of 72 to 80 feet, 108 to 110 feet and 139 to 141 feet, below which all bedding planes are horizontal. Limestone beds between the brecciated zones are severely fractured and recemented with broad veins of clear calcite which often retain large cavities lined with euhedral crystals. Massive limestone beds persist to a depth of 222 feet but rare thin siltstone intercalations and one major pebbly siltstone bed from 152 to 160 feet also occur. A transitional sequence of siltstone and fragmental limestone with decreasing emphasis on limestone extends from 222 to 254 feet. This merges into a fine-grained dirty sandstone with rare pyritic horizons and, at a depth of 265 feet into arkosic grits and coarse conglomerate (fig. 27).

Borehole information amplified by barometer heights and some survey levelling allows a structural interpretation of the area around the boreholes. A small limestone cliff outcrop (locality 5 fig. 2) 1,000 feet SW of D.D.H. 2 indicates that the base of the limestone is at height of 90 feet. This suggests that if the dip on the base of the limestone demonstrated by the discrepancy of heights in the two boreholes persists the beds have been displaced some 130 feet downwards to the W (fig. 3).



Limestone slabs at a height of 400 feet on the hill ridge 1,000 feet N of D.D.H. 2 (some 40 feet higher than anticipated) may be derived from poorly developed or badly exposed limestone beds in the upper siltstone sequence to the S or may indicate that the main limestone succession is again upthrown in this direction.

A steep creek bed 3,300 feet NW of D.D.H. 2 (locality 3) is incised in about 80 feet of Permian rocks at a height of 300 to 380 feet above sea level. This sequence of medium to coarse-grained shelly glauconitic sandstone and siltstone frequently contains fossils preserved in calcite but no crystalline limestone occurs. A study of the fossils suggests that the rocks are higher in the succession than rocks further SE (see M. J. Clarke, p. 135). If the horizontal to shallow NE dips indicated by outcrops and the limestone base level in the boreholes persists, fossiliferous siltstone of the type in D.D.H. 2 would be anticipated. It is concluded that a further fault with downthrow to the NW has affected this area, isolating locality 3 from exposures in the SE of the area.

RE-ASSESSMENT OF RESERVES

Absence of a contoured topographical map of the limestone deposit complicates the assessment of total reserves, and information from drill holes is confined to the southern part. However the survey of levels and redefinition of property boundaries carried out in conjunction with the drilling programme, allows a re-assessment of reserves to some 40 million tons, and a redistribution to 10 million tons on Crown land, and 30 million tons on private land to the north. Evidence from Crown land is good, and from private land, inadequate.

Deterioration in average grade of limestone from 70% CaCO_3 at D.D.H. 1 to 60% CaCO_3 at D.D.H. 2, demonstrates that quality variation is rapid laterally and indicates that further drilling is required to prove the limestone quality and thickness in the area to the N, and confirm the direction of the fault intersected in D.D.H. 2.

TABULATED RESULTS

Results of drilling and chemical analyses were processed by Olivetti Programma 101 to provide aggregate core-recovery values and aggregate grade values for the limestone intersected. Where core recovery was less than 100% the balance was included in the calculation with an arbitrary value of 50% CaCO_3 (Tables 1. and 2.).

CONCLUSION

The limestone deposit at Saltwater Lagoon, Friendly Beaches, appears inadequate both in tonnage and in quality for industrial application or cement production but may prove a useful source of limestone for agricultural purposes.

TABLE 1
LIMESTONE DEPOSIT: FRIENDLY BEACHES

D.D.H. 1

Grade of Deposit

Depth ft in				% Core Recovery	Aggregate % Core Recovery	% CaCO ₃	Aggregate % CaCO ₃ *	% MgCO ₃	% SiO ₂	% Fe ₂ O ₃	% Al ₂ O ₃
0 0	(Datum: bore-hole collar)										
0 0	(top of limestone)										
3 11	..	..	..	72.3	72.3	62.2	58.8	0.6	35.3	1.0	0.3
10 6	..	..	..	70.9	71.4	73.2	63.6	0.8	24.8	0.7	0.5
20 3	..	..	..	91.5	81.1	72.7	67.0	0.9	25.5	0.8	0.7
30 0	..	..	..	89.7	83.9	72.8	68.2	1.0	24.1	1.0	0.9
41 6	..	..	..	92.8	86.3	73.2	69.1	0.8	24.4	0.8	0.7
51 2	..	..	..	100.0	88.9	61.5	67.7	0.7	36.1	1.2	0.5
61 2	..	..	..	81.7	87.7	78.2	68.5	0.7	19.5	1.0	0.4
65 1	..	..	..	93.6	88.1	72.3	68.7	1.1	24.5	1.1	1.0
71 2	..	..	..	100.0	89.1	87.2	70.3	1.0	10.6	0.8	0.5
81 2	..	..	..	83.3	88.4	85.2	71.4	0.8	12.4	1.0	0.6
91 2	..	..	..	65.0	85.8	70.7	70.5	0.7	26.8	1.2	0.7
101 2	..	..	..	0.0	77.3	0.0	68.5	..	..	..	..
112 0	..	..	..	83.1	77.9	32.7	65.3	1.0	60.2	3.2	2.2
121 2	..	..	..	100.0	79.6	64.0	65.2	0.8	33.0	1.5	0.9
130 11	..	..	..	98.3	81.0	61.7	64.9	0.9	34.9	1.6	0.7
140 7	..	..	..	100.0	82.3	79.0	65.9	0.7	19.0	1.2	0.5
150 5	..	..	..	100.0	83.4	87.3	67.3	0.7	10.6	0.8	0.3
160 8	..	..	..	100.0	84.5	88.7	68.7	0.7	9.5	0.8	0.3
169 5	..	..	..	100.0	85.3	83.8	69.4	0.6	14.0	1.2	0.4
178 2	..	..	..	98.1	85.9	71.3	69.5	0.6	24.6	2.4	1.0

* Unrecovered core assumed 50% CaCO₃

TABLE 2

LIMESTONE DEPOSIT: FRIENDLY BEACHES

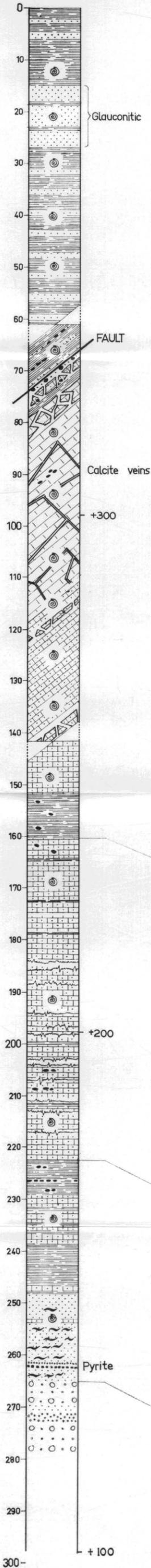
D.D.H. 2

Grade of Deposit

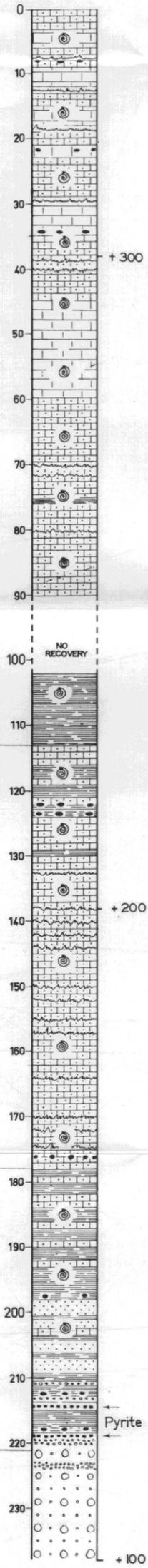
Depth ft in	% Core Recovery	Aggregate % Core Recovery	% CaCO ₃	Aggregate % CaCO ₃ *	% MgCO ₃	% SiO ₂	% Fe ₂ O ₃	% Al ₂ O ₃
0 0	(Datum: bore-hole collar)							
74 2	(top of limestone)							
80 1	94.4	94.4	75.5	74.1	0.3	22.8	0.5
89 8	94.8	94.6	56.6	63.1	0.8	37.0	2.3
98 9	97.2	95.6	58.2	61.2	0.8	36.4	2.1
102 5	77.3	93.2	34.3	58.2	1.4	55.8	3.7
112 5	97.5	94.3	47.7	55.4	0.7	47.6	1.4
122 5	47.5	84.6	50.4	54.4	0.5	46.0	1.1
127 5	71.7	83.4	69.3	55.2	0.6	27.1	1.1
130 8	35.9	80.7	55.5	55.0	0.8	38.7	2.1
141 6	54.6	76.5	71.3	56.1	0.9	23.1	2.0
150 8	94.5	78.6	62.7	56.8	1.0	29.3	2.5
160 8	90.0	80.0	21.6	53.1	2.0	60.4	7.8
170 8	85.0	80.5	57.7	53.4	1.3	30.4	5.0
180 5	100.0	82.3	50.3	53.1	2.7	33.8	6.9
190 8	100.0	83.8	79.6	55.5	1.1	15.0	1.4
200 0	100.0	85.0	80.7	57.3	1.2	12.3	1.7
210 0	100.0	86.1	82.1	59.2	1.0	9.6	1.4
222 6	100.0	87.3	75.0	60.5	1.1	17.3	1.8
232 6	100.0	88.1	53.6	60.1	1.8	29.1	6.0

* Unrecovered core assumed 50% CaCO₃.

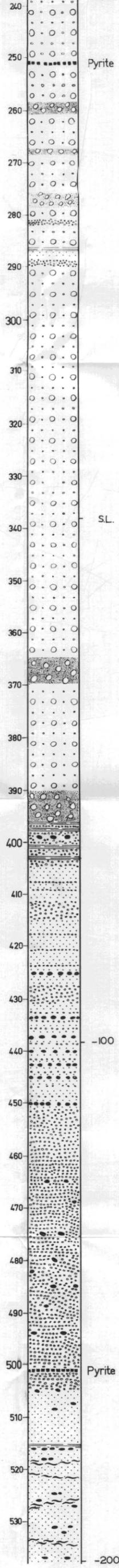
DDH. 2



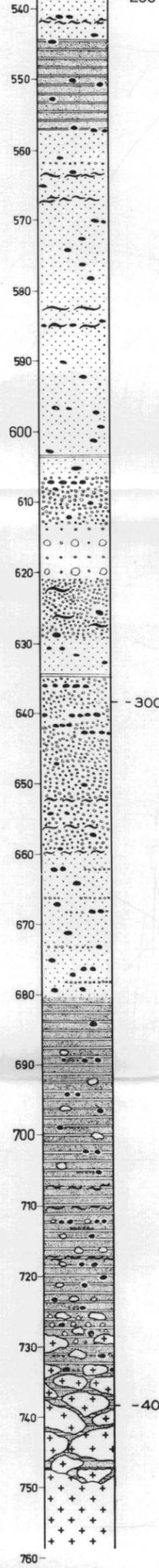
DDH. 1



D.D.H. 1 (cont.)



D.D.H. 1 (cont.)



- SILT-SHALE-MUDSTONE ETC.
- SANDSTONE
- FRAGMENTAL LIMESTONE
- FRAGMENTAL LIMESTONE BRECCIA
- LIME MUDSTONE
- ARKOSIC GRIT
- COARSE CONGLOMERATE WITH ARKOSIC GRIT BASE
- LESS COARSE CONGLOMERATE WITH SAND BASE
- POORLY SORTED GREYWACKE SANDSTONE
- FOSSILS
- PEBBLES (DISPERSED)
- PEBBLE BANDS
- GRIT BANDS
- PYRITE ZONES
- STYLOLITES
- IMPERSISTANT MUDDY PARTINGS
- BIG GRANITE BOULDERS
- GRANITE

LOCALITY MAP



5 cm

DEPARTMENT OF MINES — TASMANIA
LITHOLOGICAL SECTIONS
CASCADE GROUP — DDH.1 & DDH.2
FRIENDLY BEACHES

DATE	JANUARY 1969	VERTICAL SCALE OF FEET	0 10 20 30
GEOLOGIST	D. J. JENNINGS		
DRAUGHTSMAN	T. R. BELLIS	MAP SHEET & N°	SWANSEA 63
REVISIONS		FILE N°	3233