Notebook 36



Edmund D. Gill

Continues from Notebook 34

Continued in Notebook 42

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Port Fairy

Caravan Park, S. Beach

27/1/72

Sewerage exavation to toilet behind dunes S edge of Park W. of James St.

Map: Showing sewer excavation locations, laundry block, pumping station in relation to beach and Campbell St & James St.

Basalt boulders at varying heights from surface Widespread occurrence of well-preserved gray sand shells Katelysia along all excavations in flats.

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Diagram: Showing vertical section of ground.

6” Very dark brown 10YR 2/2 loamy

sand

24” pale brown 10 YR 6/3 sand

4” Black clayey loam 10 YR 2/1

12” light gray N7 sand grading to

1’ 2” dark gray 5Y 4/1 sand grading to black silty sand. Stillwater marine shells.

Water table at 4’6” (1.37m)

Excavated to 5’

Shells throughout judging by spoil heaps but more numerous in some places than others.

Spoil heaps show gray sandy to black silty sediments thick with shells two valves commonly together. Sediments are chemically reduced (seaweed

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still present in places) & shells have lost their colour.

Diagram: Vertical-section with interpretation

Most shells fresh-looking but some old, worn & blue. Many pairs of Homalina have brownish-green seaweed in them as well as mud.

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28.1.72

Tides Daylight Saving Time (clocks advanced one hour)

H.W 1.46am 0.9m

L.W. 3.39 pm 0.1m

one tide

Corrected to Pt. Fairy

Checked sewerage excavations along W. side of James Street S. of township, also 2 branches to toilet & amenities (p. 1). All with shells. Samples collected for C14

Port Fairy

Excavation of sewerage line in Presbyterian Church grounds (W. Side of William St., S. of Bank St.) PORT FAIRY revealed + 2m sand & shells over basalt. L/IGl 4m sea? Date shells.

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Port Fairy Lighthouse

Between l'house & Moyne R basalt slopes seaward (NNW of l'house). Surface so regular that from a distance appears to be man-made. On site not so regular, but pillars (columns) with abrasion spaces between. Dip c10$^{o}$

Shells & grit on top of small headland where vegetated with boxthorn, shiny-leaf etc. The three small headlands in this area are all structural.

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South Beach Dunes

For roads, parking areas & sewerage many excavations. All reveal uncompacted mobile dunes without soils. No palaeosols as at Tower Hill Beach & Dennington. The dunes are therefore presumably very young. The basalt rises high within them so they are not thick, i.e. their volume is not great.

This shown by seaward & landward outcrops & by sewerage excav. (p. 1 W toilet on top of dune). The last mentioned showed basalt to level of toilet wh. is c. 25' above SL. thus when the shell beds on the flats at the Caravan Park were being laid down, the deposit was a stillwater one because of the basaltic barrier.

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Dunes hardly present then. Seas would wash over or at least splash over in storms. Bore dunes & get shell grit far dating from between sand & basalt.

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Griffith Island

A sandy bay lies S of the lighthouse (sandy beach & bay floor which is intertidal) with a high basalt bar Rampart of columnar basalt without horizontal joints & so very resistant.

Star patterns of blasts, so quarrying there

1. Top of flow bec. so vesicular
2. Top of flow bec. of surface features such as tumuli, pressure ridges & such.
3. Terra rossa in Pt. Fairy Calc shows is last L'Gl surface as so little reduced since then expect same hold for time of eruption to L/IGl
4. Victorian basalts unusually vesicular.

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Erosion of Pt. Fairy-Reamur Basalt Coast

1. Relict Pt. Fairy Calcarenite in the joint planes of the basalt proves that since the last I/Gl there has been no change in the ~~essential~~ basic geometry of the coast. Hence more or less the original lava flow slope is preserved & there are no cliffs.
2. THE CHANGES that have occurred since the Flandrian Transgression are

a. Removal of calcarenite
b. Transform. of rest into calcrete which is presently being dissolved & abraded
c. Comparatively rapid corrosion in channel, potholes & pools. (pp. 56-84).
d. Quarrying – proved by calcarenite tracers.

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e. Building up of boulder ramps.
f. Small scale general erosion by abrasion, solution, putting biotic attack, subaerial weathering.

3. Therefore Postglacial Higher SL unlikely to leave a record on such hard, heavy & resistant rocks. Erosional evidence unlikely but may be traceable:
    a. Where rapid channel corrosion has occurred
    b. Where pothole erosion has occurred followed by a significant shift in zones.
4. Depositional Evidence may be present in the form of:

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a. Shell beds deposited in protected stillwater marine environment not now accessible to the sea. The species & sediment types prove the facies while C14 provides the age! No boulders.
b. Shell grit (emplaced as a function of the high energy open ocean coast environment) may occur beyond the reach of the present sea another aspect of zone shift. Can be dated by C14. Boulders present. The presence of a stratigraphy assists chronology as also does the existence of a paleosol inferring stability of conditions cf. Cape Reamur area.

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c. Channel boulders deposited where they are now out of reach of the energetic waters capable of operating them. With marine shells & grit.
d. Horizontal sand spreads beyond the reach of the swash that makes such sand spreads. Shells & grit & sand in varying proportions as in the present beach.
e. Boulder beds (ramps & trains) with or without shells & shell grit cf L/IGl deposits on Princes Hwy at corner of Bank St.

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Supratidal Platforms not bevelled back to the sea as a ramp but to the channels:

Diagram: Showing supratidal platform between two channels.

Gravity operating in high S.G. boulders + Energy of the surf zone in these exposed positions causes the powerful corrosion that produces channels potholes & pools.

Thus there are the

1. Light Tools of pebbles, sand & shells swept across the platform, & the
2. Heavy Tools of plucked slabs, heaved boulders from LWL & quarried rocks that

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plane the platform but not in a localized manner. Where the wear is localized one gets potholes, pools & channels.

Internal Structures appear to be the chief factors in siting channels & other gravity-controlled deep erosion features.

Greater storminess could be a factor in emplacement of boulder beds now emerged but Wilson & Hendy show expect less storminess during higher sealevels, the stormy periods would be the Glacials when S.L. far below the present level.

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Basalt Ramparts

Diagram: Columnar Basalt

Columns without horizontal joints at Cape Reamur hold up erosion. Much lower behind & so a kind of rampart. On Griffith Is. & at Cape Reamur this feature developed to varying degrees. In a couple of places single columns standing out of the sea. These probably mark the sites of former ramparts now almost demolished.

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Eustasy

1. has occurred
2. It must have left effects on the coast even if we have not learnt to recognize them.
3. Hard rock coasts show little essential change in 10,000 y.
4. Depositional rather than erosional structures are more likely therefore to preserve a clear record.
5. On an irregular basalt coast there is quarrying, pothole erosion, fretting & such that are related to SL but we have yet to identify the work of several sealevels of small range difference. Our task is the more difficult be. SL is ever changing & there has not been

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a small number of levels at which the sea has stood still.

6. Channels & potholes are the most rapid forms of erosion & so are the most likely to carry the eustatic record, if we can decipher precisely their relationship to present sealevel.

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20.3.72

K/Ar Dating Specimens

coll. with Dr. Ian McDougal

Cape Grant Q., Portland, basalt ~ 3 my. Woodbine Basalt

1. Specimens from Cape Reamur
2. Griffith Is.
3. Tyrone Q. of Shire of Belfast

Gnotuk Basalt

1. Riordans Quarry S. Turn E at Chocolyn School N. of Camperdown & run for c. 1mi. Q on S side of road 7-10m deep. Mostly vesicular but some massive. Olivine common. A bluish-green “mineraloid” common. Poorly columnar. Very variable in texture and mineralogy. Suite of specimens taken from round large Q. – E.S. & W.

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2. Q. on N side of road where crusher is c. 7m rock. Few specimens.

Argon atom large & so not easily escape from lattice.

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Sat. 1/4/72

Flat Rock

Map: Showing coastal location of Flat Rock in relation to Peterborough & Mt. Misery.

Turnoff Nirranda Rd on W side of RC. church (Par. of Nirranda between sections 38 & 39A). Mt. Misery now blown out into dunefield & bay largely infilled. Flat rock ~~probably~~ remnant of L/IGl shore platform. On W side of the minor headland is old shore platform with beach rock

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Diagram: Showing cross-section of monor headland

Heavy swell & rough shore surf

Table: Showing tidal data for April 1, 2 and 3 1972

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2.4.72

Broken Bay – The Gardens

Went with John & Andrew Halford.

Diagram: Showing Childers Cove, and other coast line along "The Gardens"

Broken Bay Collapse With seams to 7" of crystalline secondary calcite.

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3.4.72

Rate of Retrogradation

1.

Diagram: Showing fallen rock with stick figure behind it chest deep in water.

Fall following development of tension crack.

Fallen Block dropped off cliff face along vertical cleavage at BURNIES BEACH. I saw it in place and waded behind it up to chest in water in 1933 or 1934. Wilbur Mathieson now 62 remembers that the block fell when he was a boy ~ 50 years ago.

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2. At Stanhopes Bay similar block fell c. 1918 and has been reduced in the last 10 years to a piece of rock in the sea, & no longer a leaning block. Time 72-18=54 years. Both the above pieces were earthy limestone. Wilbur has noted that the nodular limestone is more resistant.
3. Hempels Rock (well remembered because a favourite fishing site) goes back before living memory for sure & tradition says was there when district first settled.
   Since Hempels Rock, Murnanes Rock & such have fallen the cliffs have been re-etched to depth.

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Port Fairy/Pt. Reamur Bay ¾ (Leura) 25/1/72

2 Photos are comparisons between ordinary and telephoto photos showing rock differentiation.

Quarrying assisted by

1. Weakening of rock by high vesicularity
2. Gas channels
3. Rock differentiation. Above vesicular zone is tachylytic layer with a net of small joints 3" – 6" diam parting is between these two layers.

Photo: Abandoned basalt platform with shell grit behind 2 – 3 ch. boulder field. Behind is shell grit tce in which 3' excavation made. Beyond is the boulder field, beach & dunes of Reamur Bay (No.1)

Photo: E side Cape Reamur N end of curved lava tunnel. Dip 25° telephoto.

Photo: Dipping basalt & small dome of columns at W entrance to Bay. (end of Goose Lagoon track).

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Cape Reamur

Photo: E side Cape Reamur N end of curved lava tunnel. Dip 25° Telephoto. Cape Reamur calcified Port Fairy calcarenite filling enlarged joint planes. Some are further enlarged by stripping of cortices of weathered rock (basalt).

Photo: W side Cape Reamur yellow rock below (mostly without boulders) is Pt. F. Calcarenite. Red rock above with boulders is terra rossa developed in same. Therefore boulders are L/IGl calcrete in tumuli also

2 Photos: Telephotos of section with rhizomorphs (?) in beach section W side of Cape Reamur oppos N. end of boulder field.

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Photo: Tumulus on W side of Cape Reamur structural gutter between photographer & Tumulus.

Port Fairy 26.1.72

Extreme W end of S beach beyond last house & fence on Ocean Drive. Land surveyed for building blocks.

2 unlabelled Photos of boulder bed.

Channel with basalt boulders, shells, shell grit & sand.

Diagram: Showing Sand, basalt, tumulus, drain and house.

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See p. 32

2 Photos: Pitting of basalt.

Photo: "Boulders" in situ being abraded by loose blocks. E side of Leura Bay (No.4)

Photos: Dipping pavement (left by quarrying) & rocky shore E end Clapp Beach beside outlet Goose Lagoon drain.

Photo: View N from path to Lighthouse Griffith Is., Pt. Fairy.

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Port Fairy S. Beach

Caravan Park – S. side next dune

Photo: Excavation for sewer at inspection pit near toilet. At base muddy sand with numerous shells then sand with a few shells. Above that a black swamp deposit with snails, then sand (washed or blown in). At surface juvenile soil. Above that the spoil heap.

Skenes Creek

Gentle Annie Lookout on road to Beach Forrest.

Two telephoto shots: Shore platrom looking to left. Opposite "Homelea" NE of Skenes Cr. Shore platform SW of Skenes Creek.

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Photos: looking W. from Thunder Point to Middle Island Warrnambool. Dunes cut through crestline. Dips landward.

TABLE CAVE acc. to Tom Wicking (Historical Socy) = Picnic Cave. Collapsed Jan. 2nd (fortunately not 1st when crowds there).

Thunder Pt so called (acc. to T.W.) bec. of thunder of waved in cave below.

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Photos: Titan Bridge between Thunder Point and Point Pickering. Cave collapse. Entrance to former cave at Titan Bridge. Tide in.

See Bk 35: 121-126 for Flaxmans Hill, The Gardens, Broken Bay, Fallen blocks.

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Pitting Of Basalt

See p. 28

3 Photos: Top of left – hand piece = sawcut to show degree of vascularity other surface shows the extensive & deep pitting. Cape Reamur.

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Bay Of Islands

W. of Peterborough

7 unlabelled photos

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Potholes

7.1.73

See pp. 56-85

1. Significant erosion factor in certain zones:
    a. Top side turn-round zone of shore platform which also much energy from storms on microtidal coasts.
    b. Edge of waterfalls eg. Phantom Falls in Otways, on rapids. All high energy sites.
2. Begins by localization of a grinder once formed it constitutes a trap for sand, pebbles and further grinders. The abrasives changed from time to time according to material available & the changing dynamics. However,tend to get heavy grinder or grinders that stay, as is shown by the fitting of grinder to hole.

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3. Subject neglected
   Strahler Phys. Geogr. In Rivers only
   Leet & Judson Phys. Geol. In Rivers only
   Thornbury Princ Geomorph. Not in Index.
   Sparks Geomorphology Not in Index.
   Geikie Textbk. Geol. Not in Index.
   Twidale Geomorphology Not in Index
   Guilcher Coast. Submar. Morph. mentions only coastal ones in hard l'st.
   Longwell, Flint & Sanders Phys. Geol. p. 209 River potholes. Illus p. 210
   657 Glossary – Definition
   "A cylindrical hole drilled in bedrock by turbulent stream."
    a. Cones as well as cylinders.
    b. Does not have to be bedrock
    c. No mention of abrasives (i.e. means of drilling)
    d. Excludes coastal potholes as only streams are mentioned.

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Fairbridge Encycl. Geomorphology p. 888 "More or less circular depression worn out by gyratory abrasion of pebbles or boulders rotated under the energy of moving water, either of streams (Holmes, 1965, p. 507) or of the few on abrasion platforms (Wentworth, 1944)."

a. "Circular" is 2 – dimensional whereas a 3 – dim. term needed.
b. "Depression" not give sufficient sense of depth. Use "hole" or "cavity"
c. Abrasives not name sand which often important.

"Hydraulic potholes appear to be favoured by granular rocks, usually sedimentary such as coarse sandstones & siltstones

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but also deeply weathered igneous rocks such as granite. The most remarkable potholes develop in uplift areas where vertical erosion energy has been accelerated & where a supply of boulders has been assured…Vertical fluting may result from the same process."

a. Also fresh basalt etc
b. Fluting on general terrain also eg. Hawaii Limestone.

Classifications

A. On process Hydraulic solution
B. On ecology Marine, Riverine
C. On Morphology Regular, Irregular

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3.Classification

a. Hydraulic potholes
b. Solution pots (Wentworth sugg. not include these but writers do)

In limestone both processes so can name by dominant process or use hydr./sol. This classif. regards "pothole" as a landform and classifies by processes easily determined or if genetic aspects eschewed can define on morphology. Solution potholes not as regular & have definite karst features.

or a. Marine b. Riverine } classif. on environment.

4. Dynamics. Sufficient energy (gm/cm/sec) for a sufficient time. Pothole only formed when rotatory abrasion rapidly exceeds other form of erosion at that locus.

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a. Microtidal coast concentrates energy in a given plane. See Bass Strait paper.

Diagram: Showing plane of attack on a microtidal coast.

Diagram: showing pothole zone on this coast

Where an irregular platform there is not such a well-defined zone because energy level modified (qualified) so much by the morphology. Increased energy where water stream narrowed. Decreased by impediments.

b. Only on particular types of rocks. Hard granular (igneous or sedim.)

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c. Dynamics indicated by size of pothole rel. to resistance of rock.
d. Climatic factor – effect of weathering gradient.

Quantify by

1. Survey of shore (or river) profiles. Define zone
2. Map number, size & type (what controls number?)
3. Measure & weigh grinders & other abrasives
4. Measure pothole and calculate volume = amt. of rock eroded. What weight?
5. Define shape of pothole Ratios ht/width at various levels

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7/1/73

Back Passage, Pt. Fairy

Diagram: Map showing tumuli along Back Passage

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Mon 8/1/73

Killarney Beach

Diagram: Map showing location of 11 tumuli along the beach

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Counted 14 tumuli

Tumulus 1 First S from car park. Diam. 2 chains. Dips $12^o – 13^o$. On border of beach & sea (LW). Remains of concrete bathing shed on top.

Tumulus 2 Further S, same relation to sea & c. same diam. Both rise 2m above LWL.

Diagram: Showing a line of weakness in tumulus 2.

This trough followed by sea. Seen in many tumuli & also in other places eg Bay 1 N side E of Cape Reamur.

Tumulus 3 c 3 ch diam.

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Sand of two colours with intergrades.

a. Light brown & calcareous
b. Light gray & appear non-calc. Latter occurs where a kelp trap. The great quantity of organic matter gives gray colour & provides acids for leaching. Cemented in places cf. W side Cape Reamur gives gray calcrete.

Evidences of quarrying and minor pothole formation. Joints well excavated. Much sand forms abrasive. Shells cemented in joints on landward side of T8 appear to be postglacial in age. Galeolaria in places although now at lower level only. Survey to LWL & date.

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N. of Killarney Beach car park

Diagram: Showing breaker line of tumuli.

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Cape Reamur

Diagram: Showing tumuli on section line from survey

Basalt on point columnar. Synformal structure.

Diagram: Showing a dip in basalt with L I/Gl calcrete

Spring tidal rise at Pt. Fairy 0.91m so rise of 1.7m shows top of Galeolaria not measure of MSL here.

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Notes 8/1/73

Table: Showing Survey data for Cape Reamur To Tumulus 2

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Table: Survey data from BM Tumulus 2 To W. Side Cape Reamur

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10.1.73

Cape Reamur Shell Grit Tce Excavation

West Site Photos p. 148

Diagram showing tumulus 1 & tumulus 2 with excavation marker.

Mesembryanthem etc covers ground. Excavated by EDG & John Coventry.

0 – 0.34m Light gray 7.5YR 4/0 – 5/0 sand with shell discarded.

0.34 – 0.39m Do. Sample 1 for C14 3 pebbles of basalt 4, 4.5, & 8cm max. diameter.

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Sample 4/1973

0.39 – 0.47m Do. discarded

0.49 -0.535 C14 Sample 2 do.: 1240±75 SUA-188.

5 pebbles ~ 1.5cm diam.

3 pebbles ~ 1 cm diam

0.535 – 0.59m Discarded

0.59 – 0.705 C14 Sample 3 do.

Greater thickness taken because large "boulder" prevented digging half of area. Pebbles:

1 ~ 3cm diameter (max.)

2 2cm

4 1.5cm

1 1cm

0.705 – 0.9 C14 Sample 4

N. end of section.

Finished on solid basalt.

Pebbles:

1 ~ 6cm Diam

2 4

2 3.5

3 2.5

10 2

7 1.5

11 1

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The size of pebbles in the deposit are related to the dynamics of the waves that threw them there.

The sediments taken from the stratigraphic thickness noted in the log above were put through a ¼" sieve and only the (shell carbonate) residue retained i.e. the coarse fraction. The fines may be remanie but not the whole shells and larger pieces.

Diagram: Showing cross section of shell grit layer and the excavation point in relation to the basalt layer.

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see p. 148

Excavation of Shell Grit T'ce on W Side of Bay 1 (Horseshoe Bay)

~ ½ mile E of Cape Reamur

Diagram: map showing detailed excavation site markers

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55 x 40m

Terrace thus 178' wide and 133' long (c50 x 40m). Covered with continuous Mesembryanthemum etc.. Excavation boarded up with drift wood.

Diagram: Showing trench.

In letter from Syd. Univ. Lab (Gillespie) 2/8/73

0 – 14.5cm Discarded

14.5 – 24 cm C14 SAMPLE T1: SUA-190: 960 ±75 Sample 6/1973

Gray shell grit & sand (shell whitish) 0 – 60cm N4 Dark Gray = 7.5YR 4/0 merges to 60 – 84.5 light brownish-

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gray 10YR 6/2

84.5+ Grayish brown 10YR 5/2.

Pebbles in T1 sample:

1 ~ 90 cm diam.

1 80

2 60

1 50

1 40

7 3.5

9 3

3 2.5

13 2

3 1.5 Smaller not counted.

Dynamics higher than behind Tumuli at The Cape.

12 pieces of squid skeleton 1X 2cm diam piece of rhizomorph of cylindrical shape.

24 – 46cm Discarded

46 – 61 C14 Sample T2 Pebbles of basalt 14cm, 11.5, 9, 4 of 8 of 7.5, 1 of 5 smaller ones numerous but not counted.

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Numerous fragments of

Loligo

61 – 73cm Discarded

73 – 84.5 C14 Sample T3

Loligo common. Rabbit bone & signs of old burrow at this level so date may not be accurate. Calcrete pebble c3.5cm. Basalt do. of 4.5, 3.5, 3, 2 x 2.5cm diam. Remainder not measured (smaller)

84.5 – 99.5cm Discarded.

99.5cm – 1.12m C14 Sample T4:

SUA 189: 1460±75

Plentiful Loligo. 2 calcrete pebbles 3.5cm diam, 1 cemented sand 3cm. Basalt 5cm, 2 x 3cm, 4 x 2cm. Remainder not measured.

Sample 5.1973

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11.1.73

Pothole Zones

Also pp. 34-40

Between Horseshoe (round) Bay 1 and Closed Bay 2 (rectangular) E. of Cape Reamur.

Section line surveyed from top of Durvillea zone at a tumulus on the E side of Bay 1 to yellow dot on basalt boulder at edge of “25ft” L/IGl platform.

Section line N. 25$^{o}$ E approx. normal to edge of basaltic platform.

MLW (Durvillea) to edge of platform surveyed on this section as 6.8+m

Section 96m long. This the width of the basalt “platform”. Sighting to Durvillea at 10:44am official LWL 10:40am. Weather calm. Low swell.

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Table: Survey data for Cross-Section of Basalt Platform

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Table: Survey to Emerged Potholes Bay 2

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Pothole 1

(High Relict)

Diagram: grinders in pothole

Table: Diameter &weight of 5 boulders (grinders?) (a) – (e).

Two very well-rounded boulders are probably original grinders viz (a)(b)

They have soil level marks on them. Others have not & are more angular.

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Direct wave action needed to activate an 8 lb boulder. Soil can never accumulate in an active pothole because of its high dynamics. This pothole is 5.63m above present LWL and is never active.

Pothole 1 bottom is 0.7m below the highest part of the rim where the yellow dot is. The depth at the lowest part of the rim 0.5m.

Height 6.755 – 1.125 = 5.63m above MLW

39m from BM

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Pothole 2

High SL (Relict)

Diagram: various measurements of diameter of pothole.

Partly rounded boulder 13cm diam & weighing 5lbs.

c. 6cm soil in bottom. Bottom 15cm of hole is brownish gray whereas the rest is black. Rounded bottom. High in lichen zone. "Daisy Saltbush" beside pothole & extends 2.3m lower acc. to exposure. Succulents extend 1m lower.

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Pothole 3 (active)

Furthest W. surveyed a.m. Many well formed holes without grinders & with water & biota. These not included. All chosen can indubitably be classified as active potholes with grinders. No soil. A little sand, seaward & 3 Haliotis shells. Two large grinders related to the shape of the floor.

a. 0.5 x 0.23m Estimated 90 lbs.
b. 0.47 x 0.14m Estimated 60 lbs. Also smaller ones.
c. ~ 70 x 30 cm wedged in
d. 37 x 25 Estim. 35lbs. Depth varies on diff. sides but ~ 1m

Twin hollows all the way down, so prob the two large boulders there from the start. Must have

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big when first started. Surfaces dark gray to black in pothole. Reaches 0.94m below yellow dot to which surveyed.

4.875m below B.M.

= 1.88m above MLW

Dips in basalt up to 34$^o$ but potholes always cut vertically. This demonstrates gravity control.

The steeply dipping basalt (to 34$^o$) in Horseshoe Bay (Bay 1) permits a more facile determination of the zone of potholes formation than on an undulating surface with variations in exposure.

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Pothole 4 (Active)

Deep (c5') pothole photographed previously, but no dot. For series 4 – 17 of active potholes. Level on high rocks in middle & all surveyed from this position. Heights based on large yellow dot of Pothole 3 (4.875 below B.M)

Height back to 3 – 2.03m 4.875(P3)

Back to 4 – 1.27m 76

Therefore higher by .76 = 4.115m below BM

6.755 – 4.115 = 2.64m above MLW

Distance 221 – 186 = 35m back

Direction to 3 When N is 263$^o$ 50'

= 22$^o$ 53' therefore E 29$^o$S

Direction to 4 therefore E 7$^o$S

Width 0.54m at top

Depth to rocks in bottom 1.3m

Heights are of tops of potholes on yellow dots.

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Pothole 5 (Active)

Height back 2.29 – 2.03 (P3)m

= 0.26 diff. (lower)

= 5.135 (4.875 +.26)m below BM

= 1.62 (6.755 – 5.135)m above MLW

Distance "239 – 229" 10m back

Direction 9° 50' = E 16° 50'S

Diameter ~0.5m but irregular

Depth 0.3m

Grinder One large stone

0.42 x0.21m

Estimated wt. 50lbs

Active wear of boulder against boulder common in this zone. Clapp (when down every day for cows) says in storm loud grinding and crashing with widespread movement of boulders. Marked by small yellow dot.

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Pothole 6 (Active)

Marked by small yellow dot. Twin hole. NW hole (with dot) worn through long axis 0.9m; short 0.62m at bottom of NW hole is shell grit, & small pebbles in bottom of SE one.

Depth SE 0.67m

NW 0.65m before worn through

To shell grit 0.91m

Distance 2m Back

Direction 326° 22' = N62° 32'E

Height 2.03 (P3) – 1.96 = 0.07

higher = 4.805m below

B.M. = 1.95 above MLW

(4.875 – 0.07 = 4.805)

Potholes in supratidal zone as is shown by the presence of Melanerita = Littorina (abundance in Pothole 6)

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Pothole 7 (Active)

Twin holes

Height 2.7m – 2.03 = 0.67 diff lower. 4.875 + 0.67 = 5.545m below BM. = 1.21m above MLW

Direction 292$^{o}$ 50’ = N 29$^{o}$ E

Diameter Long axis 1.3m

Short axis S hole 0.54m

N hole 0.57m

Depth 1.75m to top (yellow dot)

N hole bottom 1.11m

S hole bottom 1.28m

One Melanerita present.

Bottom is below MLW

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Pothole 8 (Relict ? Lower SL)

Marked by small yellow dot.

Height (to dot) 2.71 – 2.03 = 0.68 diff

lower. 4.875 + 0.68 = 5.555m below B.M. =1.2m above MLW

Depth 0.72 = 0.48 above MLW

Direction 118$^{o}$ 50’ = S3$^{o}$ W

Diameter 0.75m x 0.85m at top c0.65m at bottom, which a broad low curve. Galeolaria completely covers bottom and c 23cm up sides Small limpets and barnacles higher up. No Melanerita. Galeolaria here reaches above mid-tide.

Could have worn down from supratidal level then let in sea on breaching wall.

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Pothole 9 (active)

Marked with small yellow dot. Forward of level i.e. westwards

Height 2.43 – 2.03 = 0.4 diff.

lower therefore 4.875 + 0.4 = 5.275 below BM = 1.48m above MLW.

Distance 246 – 238 = 8m

Direction 193° 15' = W. 29° 25'N

Depth 0.67m

Diameter 0.33m

Grinder ~ 30lb. Seaweed present also. One Melanerita.

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Pothole 10 (Active)

Height (to small yellow dot) 2.09 – 2.03 = 0.06

lower than P3 = 4.935 below B.M. = 1.82m above MLW

Distance = 214 – 204 = 10m

Direction = 198° = W24° 10'N

Twin hole with two large grinders, with 3rd superimposed and grinding the others.

Diameter Long axis = 0.51m

Short axis = 0.34

Depth c0.56 yellow dot to bottom

Melanerita present

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Pothole 11 (Active)

Height 2.20 – 2.03 = 0.17m diff

Lower therefore 4.875 + 0.17 = 5.045m below BM 6.755 – 5.045 = 1.71m above MLW

Distance 229 – 211 = 18m

Direction 189° 45' = W15° 55'N

Diameters 0.27 x0.13m at top

Depth c0.54m

Many small boulders ~5cm diam. At bottom

Marked by small yellow dot.

Melanerita present.

Here opposite centre of bay & entry from ocean, so gets full force of storms.

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Pothole 12 (Active)

Height 2.03 – 1.95 = 0.08m diff.

higher 4.875 – 0.08 = 4.795m below BM 6.755 – 4.795 = 1.96m above MLW

Distance 2.05 – 1.85 = 20m

Direction 192 $^{o}$ 20’ = W18 $^{o}$ 30’N

Diameters 0.43 x 0.37, at top

Depth 0.7m

Two large elongate boulders and one small one. In under one side, tunnelling is a subsidiary grinder (c.10lb) in hollow. Melanerita present.

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Pothole 13 (Active)

Height 2.03 – 1.80m = 0.23m diff

higher 4.875 – 0.23 = 4.645m

below BM 6.755 – 4.645 = 2.11m above MLW

Distance 197 -163 = 34m

Direction 188 $^{o}$ + 96 $^{o}$ 10’ = 284 $^{o}$ 10’ = W 14 $^{o}$ 10’

Diameters 0.65 x0.38m Oval at top

Depth 0.6m

One boulder ~ 100lb. Melanerita present. Marked by small yellow dot.

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Pothole 14 (Active)

Not marked with a yellow dot.

Height at top 1.77 (2.03 – 1.77) 0.26 diff.

higher. 4.875 – 0.26 = 4.615m below BM 6.755 – 4.645 = 2.11m above MLW

Distance 197 – 157 = 40m

Direction 188 $^{o}$ 11’ + 96 $^{o}$ 10’ = 284 $^{o}$ 21’ = W14 $^{o}$ 21’N

Diameter 0.35 at top, 0.15 bottom

Depth 0.4m

Two small boulders & some shell at bottom:

a. 0.9 x 0.07 x 0.04m ~ ¾ lb
b. 0.095 x 0.55 x0.4 thick ~ ½ lb

Melanerita present

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Pothole 15 (Active)

Marked by small yellow dot

Height 2.03 – 1.97m = 0.06 diff

higher

4.975 – 0.06 = 4.815m
4.976 below B.M.
4.977 6.755 – 4.815 =

1.94m above MLW

Distance 227 – 167 =60m

Direction 187$^{\circ}$ 52' + 96$^{\circ}$ 10' = 284$^{\circ}$ 2'

= W 14$^{\circ}$ 2'N

Diameters at top 0.61 x 0.42

Depth 0.3+m Too full of boulders to measure largest ~ 150lb

Two other grinders estim. 20 & 15 lbs

Melanerita present.

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Pothole 16 (Active)

Height 2.20 – 2.03 = 0.17 diff

lower

4.875 + .17 = 5.045m

Below BM

6.755 – 5.045 =

1.71m above MLW

Distance 255-185 = 70m

Direction 188$^{\circ}$ 49' + 96$^{\circ}$ 10' = 284$^{\circ}$ 59'

= W 14° 59' N

Diameters 0.46 x 0.35m at top.

Depth 0.25m

Flattish boulder 0.222 x 0.13 x 0.06m ~ 2lb.

Marked with small yellow dot. Basalt at steepest dip there. Measured 34° S. Like an inclined cliff, cf. sandfall face of a dune.

Melanerita present

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Pothole 17 (Relict low sealevel)

Height Back 3.47 – 2.03 = 1.44 diff.

lower

> 4.875 + 1.44 = 6.315
> 4.876 below B.M.
>
> 6.755 – 6.315 =
>
> 0.44 above MLW

Distance 354 – 339 = 15m

Direction 20° 48' + 96° 10' = 116° 58' =

E 26° 58' S.

Diameters 0.84 x 0.7m at top

Depth Top of Galeolaria zone to bottom c.0.45m

Hole & grinder now overgrown with Galeolaria calcareous algae etc. Many limpets and one Dicathais above worn tubes Grinder 0.48 x 0.25 x0.2m Oval brown.

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Pothole 18 (Relict High S.L.)

W. of Pothole 1

Height 3.50m 350 – 1.395 =

> 2.125 below B.M.
> 2.126 0.98m below Pothole 1
>
> 4.63m above MLW

Distance 3 56 – 344 = 12m

Diameters 0.6m at top

c. 0.35m at bottom

Depth 15 – 40 cm

A little soil, some sticks, 6 seashells & fragments

No grinder

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Definition of Pothole Zones

Diagram Page 79 - 80: Showing 3 pothole zones

1. TOP of the pothole is the significant level. There the hydraulic abrasion began and through the orifice at that level it has continued.
2. The present Active Zone is ~ 1 - 3m and is activated by a sealevel with tides ~ 0-1m (and storms above that.

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3. Sealevel of 3m was therefore involved to form the potholes in the 4-6m range, if the same order of conditions was involved, which one can reasonably infer. Similarly.
4. Sealevel at -2 to -3m is involved to form potholes -1 to +1m.

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5. The Present Active Zone is all in 1.2 – 2.1m range with 2.64 (the very deep one) as an exception most potholes therefore within a 1m range. Perhaps No. 4 was initiated during a slightly higher sea.
6. Abrasive Zone would be a good term for Zone 2 because in addition to potholes, there are trapped boulders & extensive rock/rock wear. Abrasive hollows (not cylindrical or conical)
7. ROCK TYPE important if wear too readily, coast retreats before potholes developed far. These resistant rocks

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have not changed in gross morphology in the past 6000 yr as is shown by L/IGl sediments in joints. heavy S.G. also see (9)

8. Slow Formation see (15) is therefore indicated. This gives point to (5). There are no complications in their evolution due to rapid wear of the rocks. Conversely, all potholes in aeolianite must be comparatively young. They are affected also by (a) the rock being highly soluble, and (b) a different mode of platform evolution.
9. Specific Gravity also important

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because vertical holes in rocks dipping 34 $^{o}$ shows gravity control. Therefore S.G. assist wear through this resistant rock.

10. Exposure critical because high dynamics necessary to provide the hydraulic forces to agitate boulders weighing up to 200 lbs.
11. Pothole zone corresponds with ~~a~~ tidal & biotic zones. Supratidal zone, characterised by Melanerita, this due to microtidal coast?
12. Function of Storms Coast under observation on calm & windy days &

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days with big S.W. swell. Yet grinders not moved. John Clapp (herding cows there every day) says when big storm on the boulders grate and grind loudly (see 15), Enormous energy needed to operate the grinders and they are in the Supratidal zone. To jiggle a 200lb boulder at the bottom of a cylindrical hole in this zone requires great energy.

13. Pothole Zones Table showing elevation of 18 surveyed potholes.

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Zone 1: Above MLW 4.63 – 5.63m
Zone 2: 1.2 – 2.64
Zone 3: 0.44

14. Table: Zones of Marine Action
15. Clapp says rocks at Reamur grate & grind only c. twice a year when heavy storm & king tide therefore takes hundreds even thousands of years to form these potholes.

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11.1.73

Shore Platform Temps

SW cnr. Bay 2 (rectangular) in lichen some c. 1km E of Cape Reamur weather fine and sunny, no rain.

Barometer 9am 1019.7

3pm 1014.6

Max. Temp. 22.5 $^{o}$ C

Table: Showing Rock temp in sun and shade through a morning

Relatively cool day so temperature gradient low

Read by K.W. Gill

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Fri. 12.1.73

Thunder Point Warrnambool

Photos p. 151

Low tide 11:02 am summer time 0.2m but appeared lower as the Durvillea stood so high out of the water. ~~Swell~~ Surge made it hard to measure but was ~ 0.5m

Platform pitted as at Middle Is. but not so deeply. Sea lettuce & brown algae in high points.

Diagram: Showing cliff profile of nip

Nip 2.7m Strongly pitted with small honeycomb (photos) also recesses = start of tunnels &/or caves.

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Platform with very numerous limpets & some Dicathais. On latter reddish & purplish calcareous algae. Chitons near cliff & white calc. algae. Few Cominella

Platform breaking up by solution & collapse. Channel near cliff with slump blocks. Rich in algae. Undercut landwards & hinged seawards side. Outer edge highest water washes over edge to channel from which it drains.

As round the corner E from Titan Bridge, the nip reduced to 1.3m.

Facing sea before enter embayment 2.7m again

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Diagram: Map of Table Cave area showing footprint site and solution/abrasion potholes

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Diagram: Drawing of left foot of bird print with dimensions

Ratite – left foot

Hallux cf. bird footprints at Venus Bay.

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Eagle Rock

Diagram: Showing visor, nip and undercut in relation to water level

W. of Eagle Rock is a fallen block with a platform 0-1m wide. Some undercutting of platform.

General platform in embayment in old age-channels pools & slump blocks.

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Goose Lagoon

8km W. of Port Fairy

Diagram: Map of location of bore of Bill Edwards

Bore to 46’ for water. At “about 36’” sand with fragments of marine shells. Apparently the Port Fairy Calcarenite passes under the aeolianite.

Over this was a brownish gray clay and black peat, thicknesses unknown. Apparently a dune formed over a swamp, probably in a swale.

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Average Low Tide (MLW)

Portland 1973

Top of Durvillea zone claimed to mark MLW. What is this statistically? For 1973:

Table of MLW for Jan-Dec 1973.

Av. for year 1973 = .28M

Durvillea therefore stands ~28cm (c10”) above LWL

Jan am/pm even, Feb-Jly pm larger, Aug-Dec am larger. Biggest diff in Oct. with Spring tides. In monthly average Dec-Jan 0.22, Feb-June

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rises .23 - .41 Then falls away to Oct/Nov .18/.19 (Spring tides).

The datum at Portland is 0.27 feet above Indian Spring Low Water therefore kelp datum is 28cm + 8.2cm = c.36cm above ISLW

The datum for Pt. Phillip Heads is 0.29 feet below the level of Indian Spring Low Water.

The difference between these datums is therefore 0.56 ft. = 17.1 cm

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15.1.73

Dura (Clapp’s) Beach 3 mi W of Port Fairy W of entry track

Diagram: Showing 6 tumuli on coastline and in lagoon.

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Active Potholes in exposed areas (Tumulus 6, W. side) in supratidal zone.

Relict Potholes in areas not now activated by the sea eg. in dicot zone at back of Tumulus 4. Plant with blue flowers, grasses and Mesembryanthemum 2 colours (types) of lichen on rock.

Abraded hollow (should this be called a porthole?) just below Melanerita zone on W side of Tumulus 6. At junction of joints.

Diagram of hollow with dimensions. photo 37 p. 155

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L/IGl Calcarenite with fossils including aggregations of barnacles (photos) in lichen zone i.e. higher than opposite Clapp's track (described 1972) where in Melanerita zone. Another rock with barnacles nearby. Gray because weathered.

Pothole zone is the zone of maximal abrasion which makes it a slightly lighter colour (fresher rock faces)

Holdfasts of Durvillea examined in large numbers in this coast since 6/1/73 and none had rock attached. High SG makes sink. Also strength of rock makes separation difficult. However, most have white calc. algae on them.

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Pt. Fairy Calc. in many joint planes. At seaward end of tumulus 6 the joints are enlarged & are crammed with boulders. Joint excavation rather than pothole formation.

Large Boulders (0.9 x 0.65 x 0.35) in Melanerita zone grinding into contiguous boulders. Photo 5 Tumulus 6.

Potholes only where marine frontal attack (highest energy) absent on NE side of tumulus sheltered from SE gales. Pothole in Dicot zone. One of group of 3 in Tumulus 4 (photo 6). Others nearby.

"Dura" Clapp's Beach opposite where track meets shore. Overturned

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boulder with barnacles previously described now turned over. Rhizomorph still there but most of Port Fairy Cale stripped from base rock – only hard calcrete left. Two other boulders turned over since one year ago. They reveal more rhizomorphs. This in Melanerita zone, area of highest dynamics. When the seas are at their highest activity, they hit the coast in Mel. zone & not lower down.

Other upturned boulders further E. with Pt. F. Calc. underneath – barnacles, molluscs, Spirorbis noted all in present Mel. zone.

At E end of the flat is a

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channel with inward dips on both sides. E of that is another tumulus (1) with its top in the lichen zone.

Diagram: Map showing Tumulus 7 close to sea.

Potholes and extensive general abrasion in Melanerita zone.

Diagram: Drain Bay to Goose Lagoon and Tumulus 8

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Diagram: Map of tumulus 8 & 9 with drain between them.

In lichen zone, much evid. of wear of basalt boulders ag. bedrock, but it is the potholes that have a more precise relation to S.L. & so can be used to prove zone shift. Nevertheless abrasion is zoned.

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In soft rocks the evidence of abrasion does not remain long enough to prove zone shift in the distant past. In aeolianite the potholes of the past are rapidly dissolved & eroded so that evidence is destroyed. In resistant basalt, the evidence of marine activity of millenia ago is preserved.

At the E. end of Drain Bay is a complex of tumuli and channels. Pt. Fairy Calcarenite present in both horizontal and vertical joints fossils incl. barnacles. Quarrying and abrasion in Melanerita zone. Just below Mel. zone are worn hollows but no deep cylindrical or conical potholes.

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Diagram: Map of Drain Bay E. of Clapp's Farm showing tumuli 12 – 17, point '+' and off shore rocks.

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Tumuli offshore cause waves to break. They excavate deep pools on shoreward side which are favoured for fishing.

The point at the E end of Drain Bay is a complex of tumuli with some horizontal areas (see left edge of page). At '+' large joint blocks. Triangular block with sides 13'6" another polygonal block 11' x 9'.

T17 has overturned ~~block~~ boulder with leached (light gray) Pt. Fairy Calc. with masses of barnacles.

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Tuesday 16/1/73

E of Cape Reamur Bays 1 (Horseshoe Bay) & 2 (Rect.)

One tide only

HW 1.21am (Summer time) 0.9

LW 1.26pm (Summer time) 0.1

(Pt. Fairy)

Tide down to Caulerpa level

Chitons & Dicathais exposed. 0.4m below top of Galeolaria.

Just below bottom of Galeolaria.

Top of cerise (reddish) purplish alga exposed. A little below top of Durvillea holdfast zone. in Horseshoe Bay.

At bottom of limpet zone.

Diagram: Showing various biotic zones in shore profile.

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16/1/73

Emerged Calcrete platform

Diagram: Showing Horseshoe Bay with tumulus, section line, Durvillea datum locations.

Platform of calcrete with pitting on top as in exposed limestone platforms. This being etched by F.W. in places towards filagree. Also eroded by both storms and freshets of ephemeral stream. On platform at sides is beach or sand rise cemented calcarenite with v. low dips & no fossils seen.

(Survey Data) Back to Durvillea

holdfast level 54m 2.98m

Dir. 96° 50’ when

N = 342° 43’ = 114° 07’

= E 24° 07’S

For’d to Platform 1.01m

32m

1.97m

~2m above MLW

323° 12’ when

N = 342° 43’ = N 19° 31’E

But see Bk 42, p. 105

When formed beach or under higher water. Very flat top beaches dip. C14 dates needed of (a) shells from calcrete & (b) shells from grit prob. thrown up at later time i.e. far beyond present limit.

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Boulders at high level W of section line are not in situ rock but have been strongly eroded into one another. If moved would have lost this intimate relationship therefore they provide evidence of the position of the supratidal zone at a time in the past.

Back to B.M. 0.55m

24m

Dir. 235° 28'

when N = 123 ° 28' = E 22 ° S

For'd to boulders 2.41m

44m

(1.86 lower)

Dir. 63 ° 55' when

N = 123 ° 28 =

N 59 ° 33'W

BM 6.755 above MLW

<u>1.86 lower</u>

4.895m

Boulders therefore 4.9m above MLW in what was once the supratidal zone. Action of 4m sea? (see Gill & Amin) Springs tidal range 0.9m

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16/1/73

Horseshoe Bay

Survey of Structure along section line MLW to BM.

Tumulus at seaward end of section is divided by channels.

Diagram: Showing Horseshoe Bay with section line and tumulus divided into three segments by channels.

Enlargement of joints on tumulus a feature noted also at plateau level. Tops of rocks etched at back of tumulus. Smoother as near LWM. A few wedged rocks but no free boulders

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Landward of the pool is a ramp of large boulders.

Boulders also cover the floor of the pool. Bubble trains in all directions, proving the rocks have been displaced. Boulder with Pt. F. calc. + fossil barnacles. PFC shows some these boulders have been where they are since L/IGl i.e. it is in part a Pleistocene ramp.

At change to rising ground in situ basalt appears. More fossil barnacles above present zone of occurrence.

In Mel~~anerit~~araphe zone, the joints are not excavated as they are in the tumulus & in the ancient platform ~7m above LWL. Some free boulders. Rocks wearing

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into one another. Mel. cuts out as orange lichen comes in.

Lichen Zone has in situ rocks & deposited boulders, both with considerable etching.

Up to 2m boulders & sand above BM level. Slow rise inland of platform.

Photos 17-21 of emerged calcrete platform p. 106.

Closed Bay.

Bay 2

[Enclosed rectangular]

Collapse feature with inward dips. Floor of shell grit & sand. Shells include open ocean marine molluscs, Haliotis, echinoderms, so most of the material must have been thrown up by the sea. Occurs in places

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among rocks & also emplaced on platform above S. Wall forms a rampart to the sea ~3m. No direct access of the sea. Water enters through joints.

N wall dip = $25^{o}$

where measured. Below the lichen zone is a zone of potholes & other abrasion features but Melaraphe greatly reduced in numbers compared with exposed areas.

Flotsam logs high on slope. Stormy seas roar over rampart. Lichen zone etched.

Pothole N side Bay 2 in base of lichen zone which not as sharply defined as on the exposed parts of the coast.

See photo 22.

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Depth 0.7m

Diam 1.0m at top

Grinders (a) Lower 0.8 x 0.6 x 0.4m

~300lb (calculate from S.G)

(b) Upper 0.6 x 0.5 x 0.4m

~200lb

On platform at top of rise the joints are widely excavated. Some very large joints (0.25m)

NE corner Bay 2 conglomerate of small boulders in PFC calcrete, so the conglom. is of Pleistocene age. Shows again the remarkable longevity of these basaltic structures

Character changes E of Bay 2. Wide boulder bed of gentle slope. Some very large boulders at top, estimated at 20-40 tonnes

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Closed Bay

Survey of High Level Potholes N. Side Bay 2 in lichen and dicotoledon zones

Table: Survey results.

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Potholes at Bay 2 (High Level)

Diagram: 11 Pothole placements in relation to MLW.

Survey of high level potholes above Melanerita zone (supratidal) & in lichen & dicot zones on N side of Bay 2. Base of lichen zone not as sharply defined as in more exposed situations. Level on fence line that cuts W end of Bay 2.

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Pothole I

Site 5m E of fence that cuts Bay 2 near W. end.

Diam 0.5 m

Depth c0.3m

soil & water in bottom.

Very etched – cf. VIII

2 Photos: Pothole I.

Pothole II

Diam 0.22m

Depth 0.22m

On top of huge boulder surrounded by lichen

Photo: Pothole II.

Pothole III

Diam 0.8m

Depth 0.2m

Top in lichen zone.

Photo: Pothole III

~~Grinder 0.7 x 0.65~~

~~~ 400 lb~~

~~Joins another one~~

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Pothole IV

Depth 0.7m at top, 0.14 at water

Diam. 0.6m

0.25m at water level

Smooth grinding surface with etching through it & some behind it.

2 Photos Pothole IV

Pothole V

Diam. 1.5m ~~0.75m~~

Depth 0.5m

Top of lichen zone (below Dicot zone)

Grinder 0.7 x 0.65 x 0.4m

~ 400lb

Calc. from SG

Joins another one

2 Photos.

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Pothole VI
~~~

Photo

Circular

Diam 0.75

Depth 0.25

In pavement on plateau

Pothole VII

In emerged pavement

Diam 0.6 x 0.45m

Depth 0.2m

Excavated soil and plants from this pothole.

See photo.

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Pothole VIII

Depth 0.5m

Diam 0.9m at top

Etched part without

Lichen 0.5m diam

0.22m deep

Water 0.1m deep

Pothole IX

Recessed

Diam 0.4

Depth 0.4

Elev. 3.925m

Diagram: Pothole IX showing round shape with flat bottom

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Pothole X

Just E of E end of Bay 2

Diam. 0.3m

Depth 0.12m – 0.27m deep

Well etched

Grinder .36 x .2 x .2

Pothole XI

Four in situ columns of basalt have been eroded. Huge boulder in pothole c. 1.07 x 0.8 x 0.6m E. end of boulder fits grinding surfaces there but others not. These etched or boulder shifted from grinding W faces to grinding E faces. Or not belong?

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Coast E. from Horseshoe Bay.

Diagram: Map showing shape and composition of coastline.

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Diagram: Showing tumulus B (with potholes X and Y) and Leura Bay

Pothole X (ex)

Depth 0.9 – 1.3 (diff. sides)

Diam. 1m at top

Lower part 0.9m deep & 0.5m diam. In lower lichen zone 2 grinders (large).

~~.36 x .2 x .2 (c. .27m deep)~~

Shell grit on top of tumulus and in joint planes. Date?

Extensive abrasion in Melaraphe zone.

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Pothole Y in Tumulus B S. side, below Galeolaria zone. Grinder 0.5 x 0.35 x 0.25m. Similar to one at this level in Horseshoe Bay.

Diam 0.55 x 0.7m at top.

Depth 3.5m

Calc. algae on grinder & base. Mossy calc. alga on floor of pothole (as at H. Bay). Not active now.

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Thurs 18/1/73

The Craigs

Photos p. 144

Diagram: Map showing roads, milepost, dunes and coast

One tide 1.56am (Summer time) 1.0m

5.53pm 0.1m

Aeolianite in cliffs and islands soft sand inside, calcrete pedogenic crust & L/IG1. Under SE dune paleosol at platform level. Indurated it forms a large part of the main platform opposite the entry point, where in the low cliffs it holds a supratidal

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or higher level, i.e. it rises landward through the beach zone. It also rises in the NW dune. Above it is another paleosol, the configuration of which provides the entry geomorphic low.

Diagram: Cross section at the entry showing 2 Paleosols in between NW & SE dunes.

Paleosols red, sandy, - contain flecks of charcoal. Some soil pipes present

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Beach section at "The Craigs"

Diagram: Showing cross-section with vegetation, postglacial sand, and Paleosols 1 & 2

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The Craigs

Diagram: Showing interpretation of beach cross-section

Significant contribution of a paleosol to the supratidal and intertidal geomorphology

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A small island or large stack at NW corner of entry bay = part of NW dune. Dips (as elsewhere) landward i.e. inner part of dune. Island platforms further seaward are relicts of the rest of the dune and earlier platforms cut in it.

Island has a tunnel thro' it parallel to coast. On NW & N sides of this island are small platform remnants

Diagram: Island and two platforms.

that are very pitted & with strong nip an seaward side. At 1 tunneling up to 3m in this nip. Potholes &

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pools present. At 1 in spite of being in senescence stands 1.6m above low platform of present. Nip is 1.0m high. Large fallen blocks on it.

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Potholes

Definition is a problem. At what stage ceases to be a concave abrasion face & becomes a pothole?

Grinders abrade down in joint planes. So what extent do the walls have to become concave before it is a pothole?

A grinder can abrade down but there may be one section of the circle missing.

There are indubitable potholes & structures that indubitably are not, with doubtful features in between. For the present purpose it is a matter of establishing that strong marine abrasion continued with a certain relationship to sea level over a long period.

Page 131 – 132

Closed Bay

Survey of lower level potholes on N. side of Bay 2, E. side of Horseshoe Bay.

Table: Showing survey results.

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Classification

1. Active
2. Inactive
   i below active zone
   ii above active zone
   a. unweathered
   b. weathered

Presence of sediments (lower) or soil (higher)

Pothole XII

Diam. 0.45m Conical

Depth 0.42

Grinders 0.18 x 0.22 x 0.2

0.28 x 0.18 x 0.14

Pothole XIII

Diam 0.55 x 0.5m

Depth 0.35

Grinders 0.46 x 0.31 x 0.24

Includes 4 rocks in situ and 2 appar. not in situ.

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Pothole XIV

Diam 0.4m

Depth 0.3

Grinders 2. sticks and sediments present. Bottom of lichen zone.

Pothole XV

Diam 0.5m

Depth 0.4

Grinders 2 large & 3 small with sediments.

3 in situ rocks involved in base, so involves a number of joints.

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Pothole XVI

Diam. 0.7 x 0.5m Double hole

Depth 0.6

Grinders 2 large. Base of lichen zone

Pothole XVII

Diam. 0.85m

Depth 0.74m

Grinders None, but hole well rounded

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Pothole XVIII

Diam. 0.5m

Depth 0.32

Grinders one 0.16 x 0.13 x 0.16

Involves 3 in situ blocks

Pothole XIX

Diam. 1.2 x 0.5m

Depth 0.7 or 1m (as interpret)

Grinders Huge, subquadrilateral

0.5 x 0.38 x 0.6

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Pothole XX

Diam. 1.1 x 1.5m

Depth 1m

Grinders one, occupies almost entire space

1.0 x 1.2 x 0.8m

Base of lichen zone

Pothole XXI

Diam. 0.66

Depth 0.52

Grinders none

Base of lichen zone

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Pothole XXII

Diam. 0.7m

Depth 0.35

Grinders none

Base of lichen zone

Pothole XXIII

Diam. 0.7m

Depth 0.82

Grinders None

Low in lichen zone

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Pothole XXIV

Diam. 0.5m

Depth 0.25m

Grinders None. Supratidal zone.

Pothole XXV

Diam. 0.85 x 0.78m

Depth 0.5m

Grinders None. Low in lichen zone. Base strongly etched. “Little Beauty” KWG

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Pothole XXVI

Diam. c.1m

Depth c. 0.5m

Grinders main one 1 x 0.5 x 0.5

3 other large ones assoc.

Complex. Base of lichen zone. Note how potholes tend to be in groups. Why?

Pothole XXVII

Diam. 1m

Depth 0.7m

Grinders 0.85 x 0.6 x 0.25m over which is another 0.7 x 0.3 x 0.4m Base of lichen zone.

What determines max. size of pothole?

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Potholes N side Bay 2

Table: Showing elevation of 27 potholes

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Potholes

Table: Showing heights above MLW(m) and Depths(m) of 45 potholes

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Synopsis – potholes bays 1-2

Diagram showing relative elevations of potholes in an open bay and a closed bay

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The Craigs

See p. 124

18/1/73

Photos 1-2: Aeolinite cliff at NW end of beach (p. 124) Hard Calcrete crust on top over hangs. As usual, a low dip compared with sandfall 33° morphologic depression. Rhizomorphs but not as well developed as at McKechnies Craigs.

Photos 3-4: Large stack off above point.

Photos 5-6: Undercut platform resistant because carbonate-enriched from a paleosol. Zone of rills & potholes in calcrete of B horizon of lowest paleosol.

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Photos 7-14 (6 unlabelled)

Photo 7: View from cliff showing strong etching.

Photo 9: Low tide stack (small)

Photo 8: Undercutting on landward side of platform. Shoreline channel developed.

Photo 10: Etched shoreline rocks & variety of rock stacks.

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Large stack NW end of beach. Relatively high platform at outer end of island.

Photos 15 – 16: Platform block at outer edge undercut broke & tilted. Channel betw. platform & island with boulder floor (v. high dynamics) (15)

Kelp (Durvillea) marks MLW (16)

Photo 17: Wide flat platform

Photo 18: Two paleosols, top one double in swale.

Photos 19-20: Evidence of breakup of platform.

Photo 21: calcrete top of dune at NW end of beach

Photo 22: NW of The Craigs, rock replaced by beach Same SE

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Photo 23: NW end of aeolianite

Photo 24: Do. Platform backed by mobile sand, then all beach

Photos 25-26: Paleosols

Photo 27: Shore zonation:

- platform
- shoreline channel
- - beach
- - zone of calcrete with rills & potholes = B horizon of Paleosol 2.

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Cape Reamur shell grit excavation

See pp. 46-49, 52

Photos 1-4: Excav. of shell grit terrace on basalt vegetated & beyond zone of wave erosion. Site N 32$^{o}$W to pole on summit of tumulus 2 E. side of Cape Reamur. Post = 1.1m View of site looking E. to dune.

Photo 5: View of site NNE. towards dune. John Coventry excavating at terrace W side of Horseshoe Bay. Note stone wall. See p. 52

Horseshoe Bay

Photos 6-7: Similar terrace on W side of Horseshoe Bay at seaward end of stone wall = boundary between Clapp's Farm and ICI property.

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11/1/73

Photos 8-9: Survey line p. 57 across basalt platform E side of Horseshoe Bay. Top of platform in foreground stick at right = BM 6.8m above LWL on rounded edge of 7.5m platform.

Photos 10-11: 11/1/73 Potholes at Closed Bay = Bay 2.

Photo 12: Horseshoe Bay Pothole survey. Level tripod at pothole in Melanerita zone. Platform = top of flow ~7m. Stick = B.M. at 6.8m. Slope of basalt = dip slope.

Photos 13-14: Low level pothole at low tide covered with worn Galeolaria Active potholes are in supratidal zone but this in lower intertidal zone.

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Photos 15-17:

14-17: A second LWL pothole with grinder & base with whitish calcareous alga. No longer active.

Indicated change of relations of land and sea. S.L. then 1+m lower to bring this into the supratidal zone.

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12.1.73

Thunder Point Warrnambool

See pp. 87, 30

Photos 18-19: Titan Bridge Cave that collapsed behind indurated entrance.

Photos 20-21: Notch at Thunder Pt. 1. Irregular in general morphology with evidence of solution & abrasion.

Photos 22-24: 2. Irregular also in detail (23-24). Bedding sub-horizontal = Port Fairy Calcarenite

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Photos 25-26: Small stack. W. side of embayment (little bay) on E side of Thunder Point L.W.L. Potholes in E wall of baylet. See p. 89.

Photo 27: ~~W~~ E. side of baylet under Eagle Rock. Solution in visor & also at platform level giving horn poking out at base.

Photo 28: Stack in baylet E side Thunder Pt.

Photo 29: Rock pool with boulders at entrance to baylet on W side.

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Photos 30-31: View of stack 5 at water level and from cliffs.

Diagram: Showing 5 stacks and pothole locations in Baylet.

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Horseshoe Bay

14.1.73

See pp. 57, 106

Photos at 3pm Summer time

2pm EST

Tides Pt. Fairy EST

Only one tide

High 0202 0.8m

Low 1040 0.1m

Photos: View from top of dune on W. side of Horseshoe Bay.

Photo 32: Looking E. towards Pt. Fairy

Photo 33: Looking W. towards Cape Reamur.

Photo 34: Looking S. seawards across the flat of revegetated shell and boulders.

Strong SW wind & swell following the storm of the day before.

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Diagram: Showing Horseshoe Bay in relation to Tumulus, potholes, beach and pool.

Photos 35-36 (unlabelled)

Photos 37-38: 15/1/73 Dura Bay potholes on larger tumulus (No. 6, p. 95). See drawing of 35 on p. 96.

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Closed Bay

Oblong bay unconnected to sea E of Horseshoe Bay.

Photos 1,3,4: Closed Bay

Photo 2: Weathered emerged pothole.

Photos 5-19: Weathered pothole.

Photo 10: Closed Bay.

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Photo 11: 7.5m emerged shore platform.

Photio 12: Closed Bay from dune.

Photos 13-14: Closed Bay from stranded dune

Photos 15-16: Calcrete on basalt in former gulch. Honeycomb on surface of marine calcrete L/IGl?

Photos 17-18: Fossiliferous calcrete. N end of Horseshoe Bay.

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Photos 19-30: Potholes

Photo 23 : Pothole XV ?

Photo 24 : Pothole XVI ?

Photo 25 : Pothole XVIII

Photo 26 : Pothole XIX

Photo 27 : Pothole XX (p137)

Photo 28 : Pothole XXI (p137)

Photo 29 : Pothole XXII

Photo 30 : Pothole XXIII (p138)

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Photos 31: Pothole XXIV

Photo 32 : Pothole XXV

Photo 33 : Pothole XXVI

Photo 34 : Pothole XXVII

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Port Fairy

Earle, William 1896. Earle's Port Fairy.

First publ. at The Gazette office in 1896 re-published with a foreward & annotations by J.W. Powling & edited by C.E. Sayers. Olinda. 93 pp.

p.24 "The sand drift along Belfast East was beginning to become a troublesome matter, & the impossibility of preventing cattle wandering upon the hummocks led to the tabling of a resolution in 1865..."

p.25 "Barron von Mueller, ever eager to promote the advance of agriculture science, forwarded to the council some plants for experimenting as sand-stays, but little effort was made locally to second the Baron's desires. They were certainly planted out but no further attention given."

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1894 "the hummocks in Belfast East were fenced along the top to prevent the sand being disturbed by cattle."

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26 Aug. 1973

Warrnambool

Photos in The Historical Society's collection show an aeolianite platform somewhat dissected, in the vicinity of the viaduct – between the present yacht club house and the breakwater. It was standing about 6" (possibly a little more) above the sand. It thus appears to be at a little higher level than the present platform, so may have been cut by a slightly higher sea (in view of the method of formation of these platforms on this coast).

Viaduct filled in 1926

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Table: Factors in Rocky coast evolution grouped by rock, sea & air.

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West end of Bridgewater Bay

29-8-73

Track from Cape Bridgewater Road where it meets the sea. Cliffs of aeolianite (LIGl?) with clifftop loose postglacial dunes. In embayments these may flow down to beach level.

Abor. midden deflated & broken up. Too high to be thrown up by sea & none on cliff slopes.

Sea apparently shallow as breakers extend far out into the bay (0.5km?); up to 13 lines of breakers. Where break water only ½ intercrest deep so seafloor drops slowly.

Small headlands with planated tops must be last glacial terrain if aeolianite is LIGl.

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calcrete surfaces. Small intertidal shore platforms at headlands. Blocks in sea = cliff-falls.

Cape Bridgewater at end of Blowholes Road aeolianite overlies columnar basalt. Well developed columns indicate air cooling and so terrestrial flows. Top of basalt weathered and stripped.

Calcified red paleosol at surface of aeolianite. On high ground is the "petrified forest." Vertical sided round columns of calcrete & soil leading down to rhizomorphs show trees overwhelmed by sand then replaced by soil & calcrete.

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Chronology. If basalt is same age as at Portland is 3 m.y. = Pliocene. Descends below present S.L. so glacial or warped or both.

Aeolianite appears to be last Interglacial. If so ~2.88 m.y. between basalt and aeolianite.

Road to Bridgewater Bay

43.25 Track also at .5

.8 Aeolianite cutting

43.8 Track (p. 164). Also 44.01

44.1 Grey sand dune on aeolianite platform.

44.3 Track to Shelley Beach

44.35 Jctn to Lower Bridgewater & Bridgewater Bay

On Lower Bridgewater Road

45.25 Top of high aeolianite ridge. Ctg. on crest with soil pipes appearing as

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Circles & ovals (~1' diam.) on sloping batter.

45.8 Vertical road ctg. on next ridge with rare solidified aeolianite compared with bldg stone in Warrnambool. Much cross-bedding. Road jctn in cutting. Then deep swale. 2 ctgs.

46.3 Third ctg on rising road

46.6 Top of next ridge (in ctg.) Still rising. Low crest in next ridge (J. Wilson property). Then

47.3 High crest (in same ridge) Where ridge & road turn to follow coast. This also the road jctn for unmade road to Discovery Bay. To West is low narrow coastal strip with

Bridgewater Lakes (S end) and Holocene dunes.

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64.35 Top of Mt. Richmond. Trig. & Lookout. 747' Nat Park. Described by Alan Coulson as Pleist. Dunes on volcanic cone. What evidence apart from shape? Cone keep shape that long? Slopes low.

72.8 Nelson Road ¼ mile earlier is turn off to Swan Bay.

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West Warrnambool Pebble Bed

On NW cnr. of Princes Highway and Morriss Road sewerage excavation and 5 ft deep showed bed of large calcrete pebbles in sand with some shells.

Sand:

| | | | |
|---|---|---|---|
| Coarse BSS | 16-30 | 386.8gm | 10.55% |
| Medium | 30-60 | 2408.3 | 64.18 |
| (derived from earlier dunes?) | | | |
| Fine | 60-120 | 825.0 | 22.52 |
| Very fine | 120-240 | 23.3 | 0.64 |
| Silt/clay | 240- | 20.8 | 0.57 |
| | | 3664.2 | 98.46% |

Extends E towards shore platform & cliff cut in Miocene marine l'st below Tait Cres. In crescent clifftop dune of aeolinite, prob Warrnambool aeolianite. Sand + pebbles + shells on platform. On S side of highway extensive sand flat with numerous shells (sample collected).

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Rokewood

Basalt dated by Dr. John O'Keefe

3.2 ± 0.9 m.y.

Letter 27/6/80 provies an emended report from Geochron

1.5± 0.1 m.y.

This not in keeping with the Tertiary fossil fruit covered by the basalt.

(From p 169)Mutually exclusive sediments i.e. pebbles + wind-sorted sand.

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Aeolianite as recorder

Forms calcrete on its surface which 1. Holds the geomorphology 2. Erodes slowly 3. Protects underlying rock from leaching waters. Quartz sand has none of these virtues. 4. Calcrete provides a material for dating the period of dune stability & soil formation.

Diagram: infilling of joint in basalt by calcrete

At Cape Reamur cortex of basalt in situ & in boulders worn away before the calcarenite in the joints turned to calcrete. Shows (a) Effectiveness of calcarenite in recording past events, (b) The durability of calcrete.

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Agathis and Palaeoclimatology

Victoria Agathis leaf in retinite from Allendale shows here in Pliocene. cf wood, pollen, etc in Vict.

N.S.W. Stump in position of growth at Evans Head Last Interglacial?

Qsl'd At present Agathis occurs to Noosa Head.

The Agathis at Evans Head shows climate $5^o$ – $7^o$ warmer.

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Eustasy & Tectonics

Postglacial emerged marine shell beds in Victoria cross horsts and sunklands, without measurable displacement. This is significant because faulted Pleistocene aeolianite earth tremors etc show that the bordering faults are still active. However, the rate of movement is comparatively slow. When dunes dated by U/Th etc can use this as a 1. Measure of the amount of tectonic movement, & also 2. Its date.

Need more precise fixing of tidal range on coast & in places where still water faces deposited to get exact amount of SL change.

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Late Quaternary Palaeoclimatology

cf. Europe

Diagram: Showing  change between wet and dry periods over the last 20,000+ years in west Victoria

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Stratigraphy of Emerged Shores

North of Santa Cruz, California (see with J.W. Valentine 1965)

1. Diagram: Showing cross-section L/IG shore above present shore
2. Diagram: Showing next oldest shore

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Diagram: Showing small change in slope over 3000 feet

Present and past submarine platforms are much the same so presumably all formed the same way. Nick points at 80', 300', 580' and 780' = five platforms. Inshore part usually 100'-200'/mile. Less scatter in offshore part. Near cliff is new wear, whereas further out the profile is mature. The inshore part is affected by dip while the outer part is in equilibrium?

Wave lengths up to 1000' storm waves break at change of slope.

Tilt's in old shoreline

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1. 3'/mile
2. 5'
3. 7'

4-5. 9' in some direction.

Generally dip higher with altitude. Same in oppos. Direction i.e. doming present wh. In keeping with dome in older rocks. Movement Pliocene & Quart.

Diagram: Cross-section showing old elevated marine beach deposits.

Gravels present but they also laminated like beach sands. Obtained from rivers & by marine erosion. Pleistocene sand an ocean floor brought into energy zone of surf so can be moved onshore.

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Erosion

1. Mostly in surf zone. Varies acc. to (Intercrestal Dist./2) Wave height also critical.
2. Very little erosion offshore where relict sediments only disturbed by exceptional storm (so "relict" is a matter of degree). On macrotidal shores great energy from water exchange with estuaries esp. when funnel-shaped.
3. Can treat coastal sand ribbon (part on shore & part under sea) as one body, suffering mass movement.

In CSIRO paper I later called this the Shoreline Strip.

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Graphs Of Tectonics & Eustasy

In the movements due to tectonics and eustasy are regular then

Diagram: Showing flat uplift line over Eustatic curve

The emerged shore will be the high points of the eustatic curve, i.e. the Interglacials & (where the uplift is sufficient to get them above the surf zone before the next transgression) the interstadials, cf. Huon Peninsula emerged

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Coral reefs in New Guinea, which are too numerous to be all Interglacials (?17) so must be some interstadials too.

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Coastal Studies

For the understanding of the coast, & so knowledge of how to utilize it, one requires to know

1. The materials of wh. It is composed.
2. The morphology of those materials.
3. The processes that cause change.

Eustasy

One value of studying small changes of sea level is that it indicated the number & size of oscillations of SL to be expected at high SL peak. This can assist in interpreting variations in level found during Pleist. High SL stands. Other values are

1. Measure changing levels of attack on the land.
2. Allow interpretation of line relief of shorelines
3. Assist ~~of~~ interpretation of shoreline environment for coastal works.
4. Relate to small changes of world climate & so check a fine scale of the principle of glacio-eustasy which has been established on large scale.

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In students' graffiti at Cambridge "Exams kill by degrees."

End notebook 36.