Consulting Geologists
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RGR

STATUS OF SILICA SAND DEPOSIT, KING ISLAND.

PREPARED ON BEHALF OF NORTH BROKEN HILL PEKO LTD.

JULY 1991

KING ISLAND SILICA SANDS DEPOSIT

1. Introduction.

This report on the status of the silica sands deposit on King Island has been prepared at the request of I J Mathison, Senior Project Geologist, Geopeko - Tasmania. Attached to the report are a number of documents copied from files held at the Gordon office of North Broken Hill Peko Ltd.

2. History.

Hooker Resources approached Peko in early 1988 concerning what it believed to be a potentially exploitable deposit of silica sand on King Island Scheelite's Mining Lease. Hooker offered marketing expertise and contacts with potential customers, and suggested that a joint venture should be established subject to satisfactory preliminary evaluation of the deposit. Peko was amenable to this approach, and arranged for a number of samples to be collected by King Island Scheelite and delivered to Hooker for analysis.

It was concluded from this programme that 2.0-3.0 million tonnes of high quality (low iron) silica sand was available on the Mining Lease, but that exploitation of the resource was critically dependent on the cost and feasibility of shipping the product. Consulting Engineer Macknight Pty Ltd was therefore commissioned to provide some answers on this matter.

Macknight's initial report (February 1989) suggested that use of the Grassy wharf to ship sand at the rate envisaged by Hooker (0.25-0.5 million t.p.a.) was likely to be unattractive both from a cost and from a practical viewpoint. A second report was commissioned in May 1989 however I have not been able to locate either report at Gordon, and am not aware of the conclusions of the later report.

At this stage, only the sand on KIS's Mining Lease was under consideration. It was known that the deposit continued to the west on to a License then held by Pimex Pty Ltd, however the project did not proceed to the point of having discussions with Pimex. As a precaution, Hooker applied for a strip of land between Pimex's tenement and one held by the Naracoopa Joint Venture partners north of Seal Bay.

The project lapsed sometime in mid-1989, either because it was regarded as being non-viable or as a result of Pioneer's acquisition of Hooker's interests. In December 1989, I suggested to Argo Kuru that it should be re-examined to ascertain whether Geopeko's acquisition of the ground formerly held by Pimex had improved the project's viability. I am not aware whether any action eventuated.

3. Resource estimate.

On the basis of air photos and old records, Hooker made a preliminary estimate of approximately 2.5 million tonnes of low iron silica sands on the Mining Lease and 10-20 million tonnes on Pimex's ground. A single grab sample taken by Hooker assayed 0.013% Fe and 0.25% Ti. In order to make a better assessment of the quality of the sand, Paul Balind (King Island Scheelite's Mine Geologist) hand augered 15 holes into the deposit and despatched the samples to Hooker for analysis. Hooker provided Peko with sizing and analyses (Fe_2O_3, Al_2O_3, TiO_2, Cr_2O_3) of the samples, details of which are included in the attached documents (Hooker provided results for 20 holes. I am uncertain of the source of the other samples).

The preferred grain size parameter for silica sand is no more than 10% passing 425µm. The King Island sand is slightly coarser than ideal, and Hooker considered that the top 10-15% would have to be scalped off. Iron content was considered to be very low, the samples averaging 0.006% Fe_2O_3. Other metals were present in minor to trace amounts. It should be noted that the analyses were carried out after a bromoform float, thus presuming the inclusion of a gravity treatment circuit as part of the mining operation.

From observations made by Paul Balind it appears as though the extent of the areas of high quality sand on the Mining Lease might be slightly greater than Hooker's estimate, but that the thickness of the deposit is less (~1.6m versus Hooker's estimate of 3m). Paul made no revised estimate of tonnage.

4. Quality of estimate.

Exploration carried out to date has not been comprehensive, and a tonnage estimate of (say) 2.0-3.0 million tonnes should be regarded as indicative only. The sizings and analyses provided by Hooker were carried out by Readings of Lismore, a company experienced in this field, and were appropriate for the early stage of an investigation (Fe_2O_3, Al_2O_3, TiO_2 and Cr_2O_3 are those normally assayed for). It is unlikely that any contamination of the samples occurred during collection since Paul was aware of the risk and used an aluminium auger provided by Hooker to ensure that no rust contacted the sand.

Overall I would suggest that the estimate should be classified no better than an Inferred Mineral Resource.

5. Discussion.

To summarise, by the time the project lapsed in mid-1989, preliminary investigations had indicated the presence of a few million tonnes of low iron silica sand on King Island Scheelite's Mining Lease, however the cost and logistical difficulties of establishing shipping facilities were considered to mitigate against the project in view of Hooker's estimate of the value of the sand ($10-15/tonne ex-Grassy) and the market available. At that time, the additional 10-20 million tonnes thought to exist west of the Mining Lease was on ground held by another party. Geopeko has since acquired the ground, however in that time King Island Scheelite has ceased operation and potential cost saving through sharing of facilities and activities are no longer available.

The key to this project appears to be the **market**. Even if (say) 20 million tonnes of high quality glass sand is available, if its value is only ~$10-15/tonne ex-Grassy, then economics would presumably dictate large volume production and the slim potential profit margin would be unlikely to justify establishment of an operation which would be technically risky and in which North Broken Hill Peko has no experience or expertise. If however the value of the sand was substantially greater and the production rate could be restricted to that which could be handled by the existing Grassy wharf facilities, both costs and risk would be markedly reduced and the project could become attractive.

The main markets for silica sand, in order of increasing requirements for purity, relate to containers, tableware and optical glasses, with maximum Fe_2O_3 contents ranging from approximately 0.03% for containers to <0.01% for optical uses. The King Island sand meets these standards although it probably falls short of the quality required for premium optical glass of <0.002 Fe_2O_3. Most silica sand produced in Australia is sold to customers in Japan and South-East Asia, and there appears to be little potential to sell within Australia (I understand that ACI manufactures glass tableware in Melbourne - this may be worth investigating). Silica sand marketing is not an area in which North Broken Hill Peko traditionally has expertise, and if this project is to be taken further I would suggest that it would be worthwhile supplementing research generated internally with advice from experts in the field. As a first pass I would suggest consulting Peter Stitt and Associates, a company with which NBHP has an established working relationship.

Although the project did not reach the stage of examining mining problems, it should be noted that the narrowness of the high grade sand layer and the fact that it is sandwiched between contaminated sand above and below (and humus above) would mean that extraction would have to be carried out very carefully. There are also environmental aspects to be considered as I believe that some of the few remaining stands of original King Island vegetation are in the area of the sand dunes. Treatment of the sand would almost certainly have to include on-site screening and washing to remove roots and other contaminants, and gravity separation to reduce the heavy mineral content.

6. Recommendations.

On the assumption that NBHP wishes to re-examine the viability of this project, I would recommend as follows:

6.1. Research market aspects of the project to establish:

- required quality parameters
- market volume available
- probable unit value

I understand that Rodney Scotford of NBHP - Gordon, has some information on these matters, however I would suggest also seeking external advice.

6.2. If 6.1. provides sufficient encouragement, carry out a reconnaissance sampling programme covering both the Mining Lease and the adjoining tenement. The aim of this programme should be to confirm the **quality** of the highest grade sand, so great care should be taken to ensure that no contamination of the samples occurs (for example, use of a stainless steel auger). The samples should be sized and analysed for Fe_2O_3, Al_2O_3, TiO_2 and Cr_2O_3, and the work should be carried out at a laboratory experienced in silica sands analysis.

6.3. If, as a result of the findings of 6.1. and 6.2. (and taking into account Macknights' reports on shipping) the project appears to be promising, implement a sampling programme to establish the **tonnage** of sand available, and commence the activities necessary to begin an indicative feasibility study.

7. Shelburne Bay.

In a recent conversation with Peter Stitt of Stitt and Associates, he mentioned that the Shelburne Bay high grade silica sand deposit on the east coast of Cape York, which has been stymied by environmental and aboriginal objections, may still (in his terms) be rescueable. Geopeko is of course no stranger to the problems of the Cape York area, however given the size and quality of the Shelburne Bay deposit, it may be worth at least having a "quiet chat" with Stitt on the project.

P R Stephenson

July 1991

Consulting Geologists

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To: A.Kuru
From: P.R.Stephenson
Copies: M.J.Crow, E.Lovett, B.T.Williams

RTW	IWC	GHS	RJW	SES
	22/12/89 RECEIVED 17 JAN 1990			

5K55-01 Silica Sands JV General

KING ISLAND SILICA SAND PROJECT

Approximately twelve months ago, Hooker Corporation approached Peko concerning what it believed to be a potentially exploitable deposit of silica sand on King Island Scheelite's Mining Lease. Hooker and Peko drew up a preliminary Joint Venture document, but decided not to sign it until initial technical and economic studies had been carried out. These were duly done and showed that:

- the quality of the sand is excellent
- the quantity of sand on the Mining Lease (from memory, I believe approximately three million tonnes) is small for a new silica sands operation
- the project would be marginal or non-viable mainly because of the low value of the product.

It appears that Pioneer have since acquired Hooker's interest. Errol Lovett and I clarified a couple of points recently after you forwarded the letter received from Pioneer to him, and Errol now intends to inform Pioneer that we have no interest in proceeding further with the Joint Venture.

The purpose of this memo is to acquaint you with a changed circumstance which may affect the economics of the project.

At the time of our discussions with Hooker, the ground immediately to the west of KIS' Mining Lease was held under Exploration License by a small speculative exploration company - Pimex Pty Ltd. The silica sand on the Mining Lease extends on to this ground, and Hooker guesstimated that the EL contained approximately twenty million tonnes of sand. Pimex has now dropped the ground, and Geopeko has applied for it.

With such a low value product, it is possible that the greater tonnage of sand now potentially available could result in economies of scale which improve the viability of the project. It is also possible however, that market restrictions, foreseen by Hooker, would restrict the production rate of a new project.

In any event, given the change in technical parameters, and the fact that NBHP would now have 100% of the project rather than 65% as under the old proposed Joint Venture, it is suggested that a brief reassessment of the project is warranted in order to ascertain whether it now has a chance of being a viable proposition.

P. Stephenson

PEKO-WALLSEND LTD.

(INCORPORATED IN NEW SOUTH WALES)

METALLIFEROUS MINING DIVISION
25 MERRIWA STREET, GORDON, N.S.W., 2072, AUSTRALIA
P.O. BOX 217, GORDON, N.S.W. 2072
TELEPHONE: (02) 498 4566 FACSIMILE: (02) 499 2315 TELEX: AA24622

3rd May 1989

Mr A Macknight
Macknight Pty Ltd
Level 3 Kenlynn Centre
457 Upper Edward St
BRISBANE QLD 4000

Dear Alex

KING ISLAND SILICA SANDS PROJECT

Following our recent discussions on the King Island silica sands project, we now request Macknight Pty Ltd to prepare a preliminary technical study and cost estimate for the construction and operation of a ship loading facility at Grassy Harbour, based on the following criteria:

- Export of a minimum of 250 000 to a maximum of 500 000 tonnes per annum of silica sand.
- Shipping by export vessel direct to the consumer (Japan).
- Ship capacity to be the largest technically and practically feasible (anticipated to be in the order of 20 000 tonnes).
- Existing harbour facilities to be used, with construction of new facilities kept to a minimum.
- Loading facilities to be restricted to a conveyor (no storage shed required).
- Capital and operating costs to be minimised. As a guide, you may assume that capital costs should not exceed $5 M.
- Particular attention to be paid to the technical and practical feasibility of operating a sizeable export vessel in the restricted area available, taking into account the erratic and often adverse weather conditions at Grassy.
- Other criteria to be as per those governing Macknight's initial shipping study dated February 1989.

We understand that the study will involve approximately one week's work by Macknight Pty Ltd and that a report should be available within 3 weeks. The cost is expected to be in the order of $3 500 to $4 000. We would appreciate initiation of the study as soon as possible, and we should be advised at an early stage if it appears that the cost could significantly exceed $4 000.

I also wish to advise that as from this date, Mr Errol Lovett will take over from me as North Broken Hill Peko's representative on this project and all future correspondence should be directed to Mr Lovett. His address is:

North Broken Hill Peko Ltd
GPO Box 1903R
MELBOURNE VIC 3001

Tel: (03) 820 000
Fax: (03) 829 0122

Regards

P.R. Stephenson
Chief Geologist
Metalliferous Mining Division

cc: MJ Crow (KIS)
R Knight (NBHP-Sydney)
J Hann (Hooker Resources)
E Lovett (NBHP-Melbourne)

PRS:sk

METALLIFEROUS MINING DIVISION

INTER OFFICE MEMO

From: P.R. Stephenson

25 Merriwa Street,
Gordon, 2072.

To: R. Knight

Date: 4/4/1989

Copies: M.J. Crow/ B.T. Williams

Proj 9-3

KING ISLAND SILICA SAND PROJECT

I met with John Hann at Hooker Resources' Sydney office on Thursday, 30th March, in order to discuss the status and future of the King Island silica sand project.

Main points arising:

- At a product value of (say) $15/tonne, and with a limited available market of 250 000 to 500 000 t.p.a., the project cannot stand a high capital cost. Hann estimates that capital costs would have to be less than $10M, of which approximately $4M would be required for a dry plant.

- Estimates prepared by Macknight, the cheapest of which included a capital component of $25M, show that construction of a new ship loading facility for the project would not be economically feasible.

- The project would stand a chance of being viable if bulk loading from the existing wharf or breakwater facilities, using a (minimum) 20 000 - 30 000 tonne export vessel, and with a capital cost requirement of less than $5M were possible. This was one of the options being considered for the Naracoopa project, although David Gillett tells me that is no longer being actively pursued.

I would like to discuss the matter further with Alex Macknight before we make a final decision on the project (he is unavailable until next week). If the Grassy harbour option still appears a possibility, I would suggest that we commission Macknight to prepare a preliminary technical study and cost estimate. Hann is agreeable to deferring a decision while this option is being studied.

P.R. Stephenson

PRS:sk

HOOKER RESOURCES

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Telegrams & Telex HOOKCO AA22894
FAX G3 (02) 239 2600 DX 839 Sydney

OUR REF 10JAN2/JH5:cl

YOUR REF

10th January 1989

Mr Pat Stephenson
Peko-Wallsend Limited
Metalliferous Mining Division

Fax: 499 2315

Dear Pat

RE: MARINE CONSULTANTS REPORT - KING ISLAND

Ron Haile and myself have perused the consultants report and the following comments are appropriate:

1. Slurry Pumping:

   a) There are no technical problems to our knowledge in delivering wet sand to the vessel, provided the vessel is equiped with suitable de-watering pumps. A final moisture content of 5% should be easily achieved on a voyage to Japan.

   b) Special vessels are required to handle slurry loading and de-watering. This effectively increases the freight costs.

2. Pneumatic Loading:

   a) The sand would need to be dried prior to loading, adding considerable cost to the operation. Although, there may be an opportunity to negotiate with end-users who require a dried product.

   b) Pneumatic loading of silica sand would involve a dust handling problem, particularly in regard to worker health regulations.

Yours faithfully
for and on behalf of
HOOKER RESOURCES

JOHN HANN
DIvisional Manager
Exploration & Development

10/11/88

For the option of exporting through Grassy Harbour it will be necessary to include the capital and operating costs of trucking products from the mine and the cost of additional storage facilities at the Port.

The second mining operation to be investigated is the export 250 000t (up to 1,000,000t) of low iron silica sand directly overseas. Discussion with Mr Crow of King Island suggest that the mine will be near Sandblow Point to the south of Grassy Harbour.

One possible option for loading of the silica sand is by pumping offshore to a single buoy mooring (SBM). Assuming that the sand can be pumped as a slurry this option could provide an economical solution to the export operation.

The SBM enables the vessels to moor at sea and load material in a wide range of weather conditions and expensive breakwater protection is not necessary. Slurry is pumped via flexible hoses and provided the specific gravity is high enough the sand should settle quickly and excess water would decant over the side.

The traditional ship loading option will also be considered but will depend heavily on sea conditions and potential downtime. A shiploader could be located 300m off Sandblow Point in 15m of water but if downtime is too high and breakwater protection is necessary then the cost of this option could be excessive.

The range of alternatives will be defined after visiting the site and in discussions with Peko-Wallsend.

Ranking will take place on broad costing and operational aspects to eliminate unfeasible alternatives leaving a number of potentially suitable options for further

25th October 1988

Mr. A. MacKnight
Alex MacKnight and Associates
457 Upper Edward Street
BRISBANE. QLD. 4000

Dear Mr. MacKnight,

Peko-Wallsend Ltd, through King Island Scheelite (KIS), operates a tungsten mine at Grassy, King Island, Tasmania, and is currently, in conjunction with joint venturers, evaluating two sand mining projects on the island. These are

* Naracoopa mineral sands (with National Mineral Sands),

* Grassy silica sands (with Hooker Mining).

National Mineral Sands is the Operator of the Naracoopa JV for the project feasibility study; Peko's Metalliferous Mining Division will handle the feasibility study for the second project.

The feasibility of both projects hinges to a greater or lesser extent on the capital and operating costs associated with loading and shipping the various products. Before either joint venture commits significant funds to resource assessment and engineering studies, Peko wishes to commission a preliminary study of the technical and economic feasibility of marine loading and shipping requirements.

The most likely annual tonnages of product from the two operations are

* Naracoopa JV

  - 15 000 tonnes rutile
  - 20 000 tonnes zircon

  either

  - bagged/palletised and/or bulk in container,
  - bulk shipments up to 5 000 tonnes, if practicable

  for

  - transhipment in Melbourne, or
  - shipment direct to overseas consumers.

  Some consideration is also needed of the shipment of ilmenite in bulk. The joint venturers have placed no value on this mineral.

* Grassy JV

  - minimum 250 000 tonnes low-iron silica sand. The potential market may be as great as one million tonnes.
  - in bulk
  - shipment direct to overseas consumers.

King Island lies in an exposed position within Bass Strait. Shipping facilities are limited to the port of Grassy which is serviced by the M.V. 'Straitsman' en route from Stanley to Melbourne. This vessel carries King Island's present exports of scheelite (1500 - 2000 tonnes/year) and agricultural products. It does not have the capacity to handle commodities in significantly greater bulk. Mineral sands have been exported in times past using a primitive unprotected wharf facility at Naracoopa.

Before proceeding with detailed studies on its present projects, Peko wishes to ascertain

* whether bulk exports on the scales nominated above are in the first instance a practical consideration,

* the nature and mode of operation of the port and handling facilities required to handle such tonnages,

* their order-of-magnitude capital and operating costs.

We are seeking to retain the services of a specialist consultant for this assignment. We would like confirmation of your interest in this work together with

* a copy of the CV of the engineer(s) nominated to undertake the assignment,

* a preliminary description of the approach to be taken, together with a budget estimate of cost and timing.

I shall be overseas for three weeks from this date, returning Wednesday, 16th November. In my absence, further information on local conditions may be obtained from Mr. Michael Crow, Manager of Operations, King Island Scheelite, telephone (004) 61 1200, facsimile (004) 61 1114.

I would appreciate confirmation of your interest in this assignment along the lines requested above by my return date.

Yours sincerely,

R.K. Knight
Group Executive
Metalliferous Mining Division.

FAX TRANSMISSION

HOOKER RESOURCES

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388 George Street,
SYDNEY, NSW., 2000
AUSTRALIA

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TELEX AA 22894
DX 830 SYDNEY
FAX (G3) 239.2600

To ..Pat Stephenson........Date...............Time..............
Chief Geologist
Metalliferous Mining Div.

Address..~~Peko~~ Wallsend LTD FAX No.....499 2315.........

....

....

From......John Hann.....

Number of pages
to follow..........1..........

If transmission is faulty
please call...

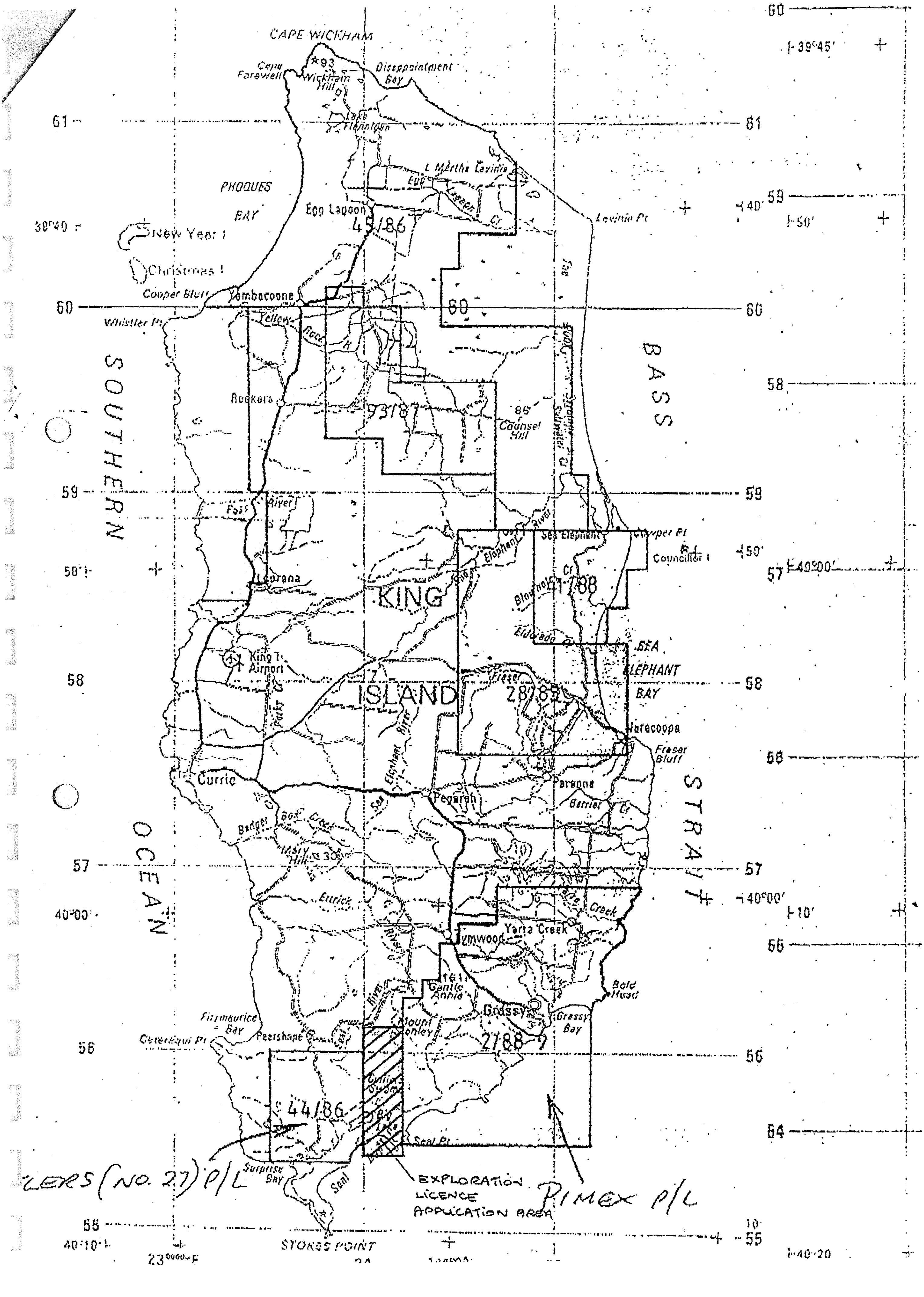
Please use this space for short messages

Pat,

As discussed today, attached is a map showing the area applied for on King Island, to cover additional silica sands for the J.V.

Regards
J. Hann.

Faxed to M. Crow.
28/10/88



CAPE WICKHAM
Cape Farewell
Wickham Hill
Disappointment Bay
Lake Flannigan
L Martha Lavinia
PHOQUES BAY
Egg Lagoon
45/86
New Year I
Christmas I
Cooper Bluff
Yambacoone
Whistler Pt
Lavinia Pt
60
BASS STRAIT
SOUTHERN OCEAN
93/87
Counsel Hill
Reekara
Loorana
KING ISLAND
41/88
Sea Elephant
Councillor I
King I Airport
28/89
SEA ELEPHANT BAY
Naracoopa
Fraser Bluff
Currie
Pegarah
Parenna
Mary Hill
Yarra Creek
Lymwood
Gentle Annie
Grassy
Grassy Bay
Bold Head
Fitzmaurice Bay
Peerhsape
2188-9
44/86
Seal Pt
Surprise Bay
STOKES POINT
EXPLORATION LICENCE APPLICATION AREA
PIMEX P/L
LERS (NO. 27) P/L
39°45'
40°00'
40°10'

P.R. Stephenson

R. Knight 6/10/88

cc: M Crow
BT Williams
I Calder

NOTES ON A MEETING HELD WITH HOOKER RESOURCES AT GORDON ON 23RD SEPTEMBER 1988, FOR THE PURPOSE OF DISCUSSING THE KING ISLAND SILICA SANDS PROJECT

Present: R Knight
PR Stephenson
R Haile (Divisional Manager, Industrial Sands & Minerals, Hooker Resources)
J Hann (Divisional Manager, Exploration & Development, Hooker Resources)

1. **Review of check hand auger drilling results**
(carried out by P. Balind in June 1988)

- Quality of sand excellent with very low Fe content
- Grain size acceptable, although some scalping of oversize would be required
- Reserve potential on ML 17M79 thought to be around 2.5-3.0 million tonnes.

2. **Suggested parameters for a mining operation** (Hooker)

- 250,000 tonnes per annum
- Ship to Burnie in 2,000-4,000 tonne ocean-going barges
- Ship from Burnie in (minimum) 20,000 tonne vessels (any smaller, and freight rates probably unacceptable)
- Main market - Japan
- Probable capital cost - $2 million +
- Probable FOB value ex Grassy - $12/tonne
  ex Burnie - $20/tonne.

3. **Assessment of probable viability** (Hooker)

- A mining operation could be viable. The critical factor is <u>shipping</u> (logistics and cost).

4. **Agreed procedure** (Peko and Hooker)

- Draw up a short form Heads of Agreement (Peko)

  - Equity: Peko 60% and Operator
    : Hooker 40% (Hooker Mining Pty Ltd)

  - Hooker wish to retain the right to assign a portion of their equity to a Japanese consumer.

- Prepare a scope of work for a feasibility study for discussion once the Heads of Agreement is signed, the critical component of which will be a shipping study (Peko)

- Investigate Pimex Pty Ltd (Peko & Hooker).

5. Also discussed

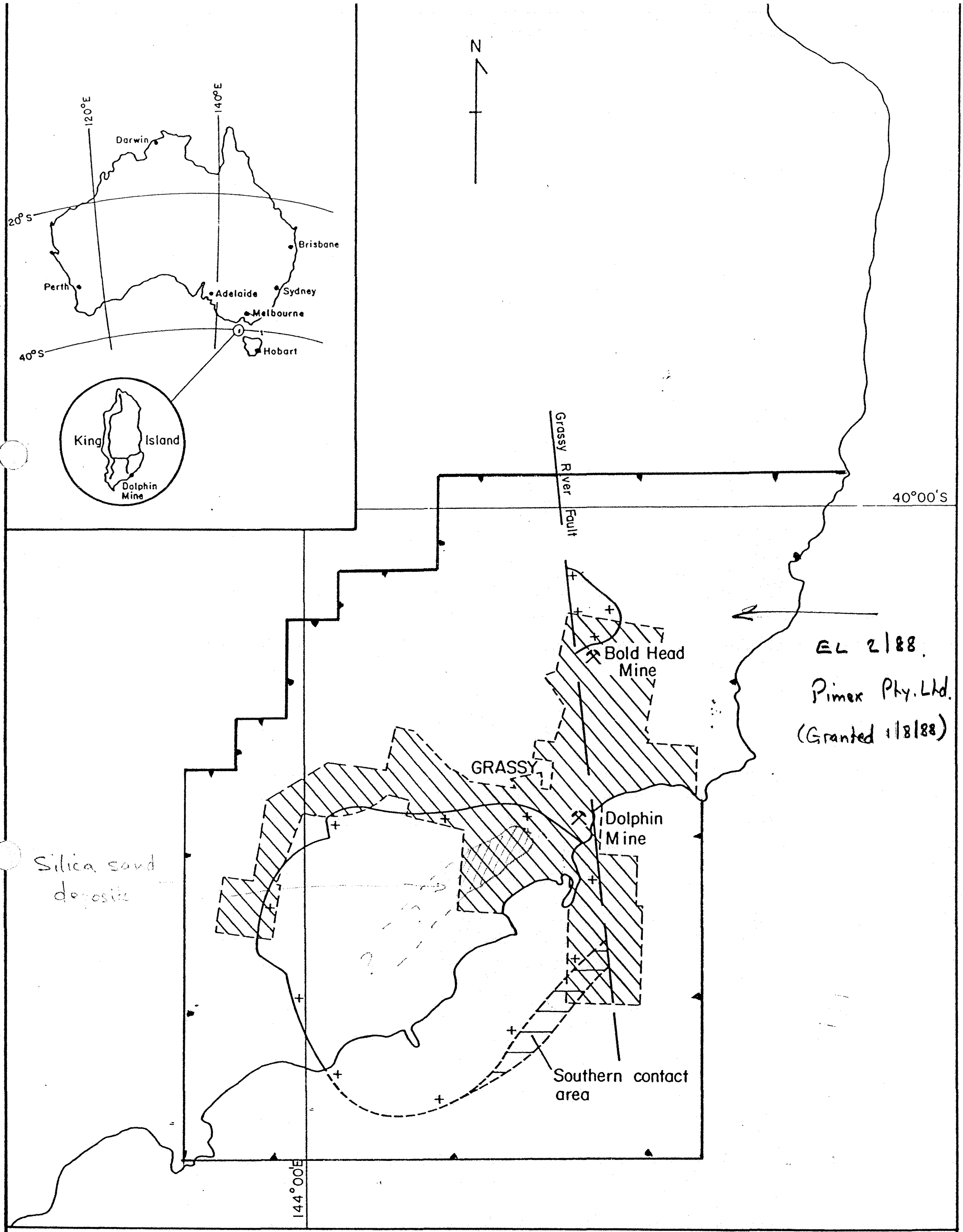
- Marketing of product. Hooker have established contacts and indicated a desire to handle the marketing.

- The possibility of dealing with Pimex and establishing a larger operation from the outset.

P. Stephenson

P.R. Stephenson

PRS:sk



LEGEND

M.L. 17M/79

Granite

Scale 1:100,000

0 1 2 3 4 5

KING ISLAND SCHEELITE

LOCATION PLAN

M.L. 17M/79

Conversation with J. Hann.   22/8/88

Prelim. economics on basis of 0.5M tpa not favourable. Port upgrade unattractive.

Now considering double-handling option (possible due to high quality) involving shipping on (say) 20,000 t vessel to Burnie, stockpiling & reshipping on larger vessel. Prelim. figures look possible but margin is fine.

Considered loading via slurry pipeline to shipping standing offshore. Concerned about difficult weather / sea conditions, & also requirement for special vessel.

Will contact again later this week.

PRS.

READINGS ID	1	2	3	4
HOOKER ID	KI 10	KI 9	KI 9	KI 8
INTERVAL	1.0 - 1.85M	3.3 - 4.7M	0.3 - 3.3M	0.75 - 1.35M
% +1.0mm	0.22	0.68	0.36	0.34
% FINES	3.39	4.52	1.61	1.15
% SAND	96.39	94.80	98.03	98.51
% HEAVY MINERALS	0.52	0.40	0.69	0.41
SIZING:				
%+850	0.1	1.3	0.1	0.3
%+600	1.0	9.0	1.7	3.7
%+500	3.5	11.5	3.7	7.5
%+420	9.3	15.5	9.8	14.3
%+300	35.6	31.0	35.9	38.4
%+212	32.4	23.8	32.9	25.0
%+150	14.3	2.8	12.3	6.2
%+106	3.5	4.7	3.1	4.4
%-106	0.3	0.4	0.5	0.2
TOTAL	100.00	100.00	100.00	100.00

READINGS ID	5	6	7	8
HOOKER ID	KI 7	KI 6	KI 7	KI 5
INTERVAL	2.75 - 3.5M	0.3 - 1.6M	0.55 - 2.25M	0.3 - 2.1M
% +1.0mm	0.05	0.04	0.03	1.97
% FINES	1.27	1.17	1.16	1.57
% SAND	98.68	98.79	98.81	96.46
% HEAVY MINERALS	0.82	0.83	0.67	0.48
SIZING:				
%+ 850	0.0	0.1	0.0	0.2
%+ 600	1.0	1.0	0.8	1.2
%+500	3.5	3.4	2.9	2.7
%+420	8.9	7.5	9.7	7.9
%+300	30.9	26.0	33.7	29.6
%+212	30.2	30.6	31.4	36.0
%+150	21.6	27.9	18.1	18.2
%+106	3.6	3.1	3.2	3.1
%-106	0.3	0.4	0.2	1.1
TOTAL	100.00	100.00	100.00	100.00

HOOKER RESOURCES

READINGS ID	9	10	11	12
HOOKER ID	KI 4	KI 4	KI 3	KI 1
INTERVAL	0.2 - 3.0M	3.0 - 3.6M	1.0 - 3.0M	0.25 - 1.5M
% +1.0mm	0.20	0.01	0.22	0.08
% FINES	1.14	1.37	0.83	2.98
% SAND	98.66	98.62	98.95	96.94
% HEAVY MINERALS	1.62	1.29	0.63	0.34
SIZING:				
%+850	0.0	-	0.4	2.2
%+600	0.3	-	5.3	0.1
%+500	0.9	0.2	10.5	6.1
%+420	2.9	1.9	20.8	13.7
%+300	21.8	33.4	40.2	37.2
%+212	38.2	45.9	18.2	26.2
%+150	31.3	15.3	2.2	10.6
%+106	3.8	3.1	2.2	3.5
%-106	0.8	0.2	0.2	0.4
TOTAL	100.00	100.00	100.00	100.00

READINGS ID	13	14	15	16
HOOKER ID	KI 2	KI 15	KI 14	KI 15
INTERVAL	0.25 - 0.8M	0.65 - 2.3M	2.3 - 3.35M	2.3 - 3.0M
% +1.0mm	0.05	2.90	0.42	1.61
% FINES	0.36	1.27	1.17	2.88
% SAND	99.59	95.83	98.41	95.51
% HEAVY MINERALS	0.27	0.87	0.40	1.20
SIZING:				
%+850	0.1	1.2	0.3	0.5
%+600	1.9	5.4	2.2	3.3
%+500	4.3	6.3	4.2	4.9
%+420	9.6	11.1	8.8	10.1
%+300	35.3	29.7	36.7	30.0
%+212	32.9	27.1	33.9	29.6
%+150	12.9	15.2	11.7	17.5
%+106	2.9	3.6	2.1	3.8
%-106	0.1	0.4	0.1	0.3
TOTAL	100.00	100.00	100.00	100.00

HOOKER RESOURCES

READINGS ID	17	18	19	20
HOOKER ID	KI 14	KI 13	KI 11	KI 12
INTERVAL	0.5 - 2.3M	0.5 - 1.05M	0.6 - 2.0M	0.5 - 1.6M
% +1.0mm	0.53	7.18	0.03	0.60
% FINES	0.88	0.89	1.11	1.72
% SAND	98.59	91.93	98.86	97.68
% HEAVY MINERALS	0.49	0.14	0.53	0.54
SIZING:				
%+850	0.4	2.4	-	0.7
%+600	2.8	13.6	0.3	7.2
%+500	4.3	16.1	1.0	10.6
%+420	9.3	19.9	4.9	15.9
%+300	29.7	29.5	33.6	36.1
%+212	31.7	12.9	40.0	17.5
%+150	19.3	1.1	17.3	9.8
%+106	2.3	4.3	2.8	2.0
%-106	0.2	0.2	0.1	0.2
TOTAL	100.00	100.00	100.00	100.00

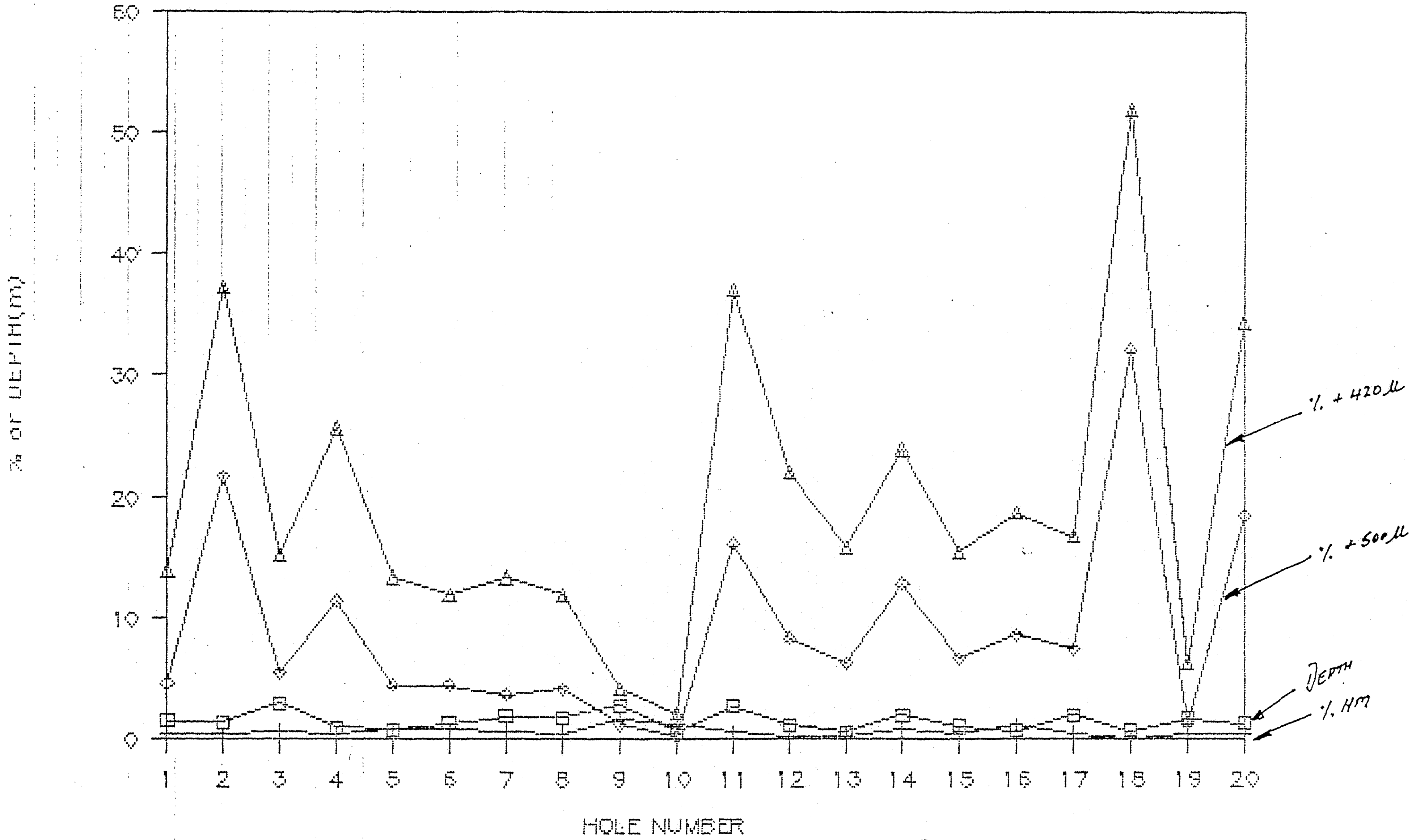
READINGS ID				
HOOKER ID				
INTERVAL				
% +1.0mm				
% FINES				
% SAND				
% HEAVY MINERALS				
SIZING:				
%+850				
%+600				
%+500				
%+420				
%+300				
%+212				
%+150				
%+106				
%-106				
TOTAL				

)OKER RESOURCES

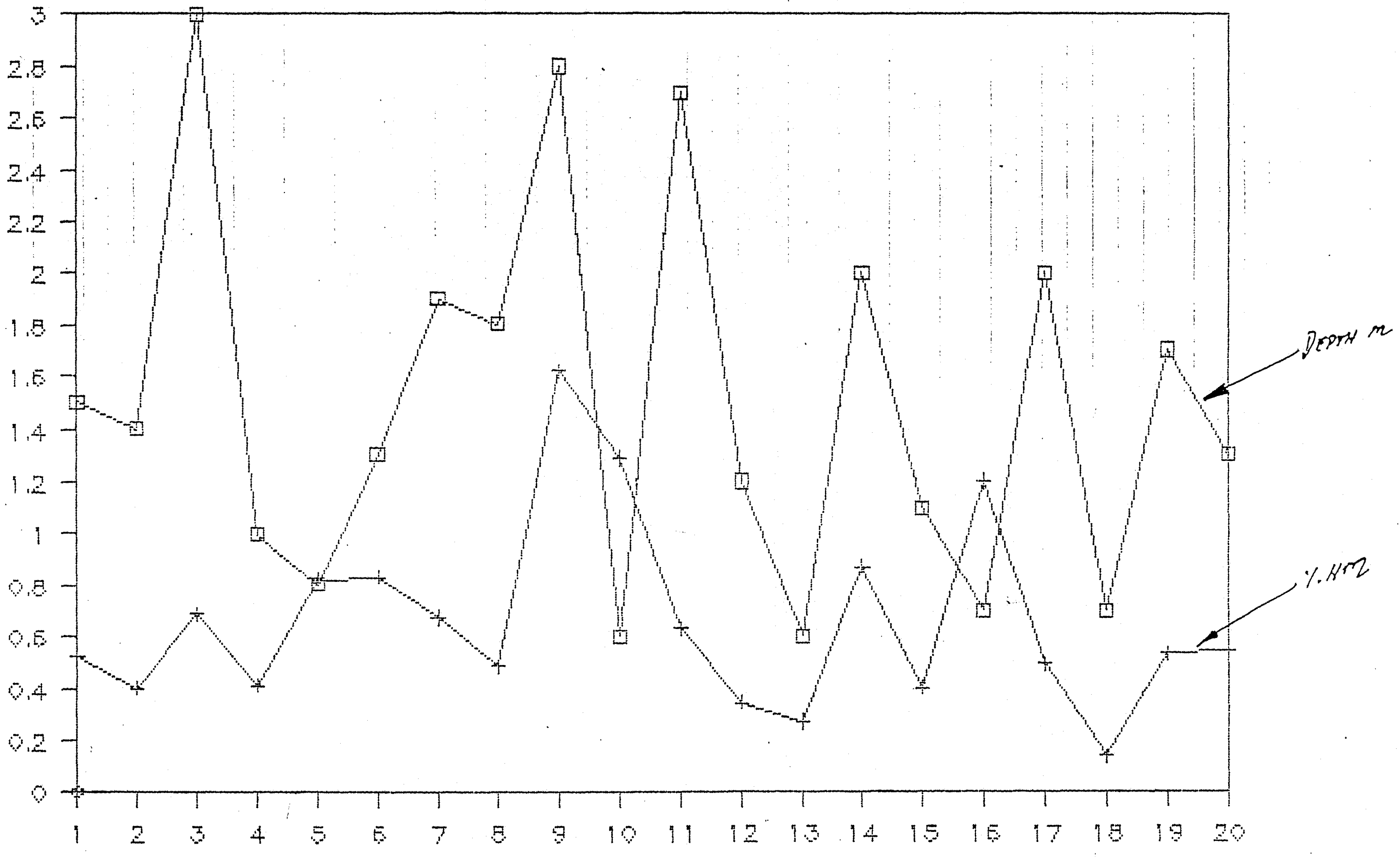
KING ISLAND JV SAMPLING

)LE NO.	DEPTH m	+ 1mm %	FINES %	+ 500u %	+420u %	HM %
1	1.5	0.2	3.4	4.6	13.9	0.52
2	1.4	0.7	4.5	21.8	37.3	0.40
3	3.0	0.4	1.6	5.5	15.3	0.69
4	1.0	0.3	1.2	11.5	25.8	0.41
5	0.8	0.1	1.3	4.5	13.4	0.82
6	1.3	0.0	1.2	4.5	12.0	0.83
7	1.9	0.0	1.2	3.7	13.4	0.67
8	1.8	2.0	1.6	4.1	12.0	0.48
9	2.8	0.2	1.1	1.2	4.1	1.62
10	0.6	0.0	1.4	0.2	2.1	1.29
11	2.7	0.2	0.8	16.2	37.0	0.63
12	1.2	0.1	3.0	8.4	22.1	0.34
13	0.6	0.1	0.4	6.3	15.9	0.27
14	2.0	2.9	1.3	12.9	24.0	0.87
15	1.1	0.4	1.2	6.7	15.5	0.40
16	0.7	1.6	2.9	8.7	18.8	1.20
17	2.0	0.5	0.9	7.5	16.8	0.49
18	0.7	7.2	0.9	32.1	52.0	0.14
19	1.7	0.0	1.1	1.3	6.2	0.53
20	1.3	0.6	1.7	18.5	34.4	0.54
VERAGE	1.5	0.9	1.6	9.0	19.6	0.7

KING ISLAND



60
50
40
30
20
10
0
% OF DEPTH(m)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
HOLE NUMBER
% + 420μ
% + 500μ
DEPTH
% HM


3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
DEPTH m
% HM2

SAMPLE NO.	% Fe_2O_3	% Al_2O_3	% TiO_2	% Cr_2O_3
1	<0.01 (0.003)	0.029	< 0.01 (0.008)	< 0.001
2	<0.01 (0.008)	0.037	0.017	< 0.001
3	<0.01 (0.005)	0.031	0.011	< 0.001
4	<0.01 (0.005)	0.031	<0.01 (0.005)	<0.001
5	<0.01 (0.006)	0.034	<0.01 (0.008)	<0.001
6	<0.01 (0.007)	0.037	<0.01 (0.009)	<0.001
7	<0.01 (0.007)	0.032	<0.01 (0.007)	<0.001
8	<0.01 (0.004)	0.028	0.010	<0.001
9	<0.01 (0.006)	0.036	0.010	<0.001
10	<0.01 (0.008)	0.072	0.011	<0.001
11	<0.01 (0.005)	0.041	<0.01 (0.008)	<0.001
12	<0.01 (0.006)	0.034	0.012	<0.001
13	<0.01 (0.005)	0.029	<0.01 (0.008)	<0.001
14	<0.01 (0.006)	0.047	0.012	<0.001
15	<0.01 (0.008)	0.060	0.011	<0.001
16	<0.01 (0.006)	0.048	0.015	<0.001
17	<0.01 (0.007)	0.041	<0.01 (0.008)	<0.001
18	<0.01 (0.005)	0.043	<0.01 (0.009)	<0.001
19	<0.01 (0.006)	0.040	0.013	<0.001
20	<0.01 (0.007)	0.040	0.010	<0.001

Prelim results Silica sand

Grain size. Mod to good. Slightly coarser than the best in Australia
Scalp off 10-15%.

Chemical analyses. Excellent.

(Top quality) Prem. quality glass sand av 0.01 - 0.02 % Fe_2O_3

Grassy - highest 0.008 %
Av. 0.006 %

Profitability. based on $1 M for port

20 - 30,000 tonne vessels

May be poss to load smaller vessels because of high quality ∴ higher price.

If can upgrade port < $2M - possible.

P.O BOX 217, GORDON, N.S.W. 2072 TELEX AA24622

PEKO-WALLSEND LTD.
(INCORPORATED IN NEW SOUTH WALES)

METALLIFEROUS MINING DIVISION
25 MERRIWA STREET, GORDON, N.S.W., 2072, AUSTRALIA. TELEPHONE 498 4566

27th June 1988

→ PRS

Mr. J. Hann,
Divisional Manager - Exploration & Development,
Hooker Resources,
GPO Box 2724,
SYDNEY. NSW 2001.

I suspect, we will need to consider an offshore loading facility based on a single point mooring and a slurry line. How critical is moisture content of product? PR

Dear John,

SILICA SANDS - KING ISLAND

During a visit to King Island last week, I discussed the silica sands project with Michael Crow, Manager of Operations at King Island Scheelite Ltd. Michael pointed out several operational limitations related to the wharf at Grassy, of which you should be aware.

The wharf was designed in the early 1970's and was intended to handle the 900-1000 tonne (200 ft) capacity ships then in use. Allowance was also made for a 4000 tonne (400 ft) ship to berth at the breakwater, however, because of the presence of shallow areas within Little Grassy Bay, anything larger would have great difficulty in maneouvering within the Bay, and would have to stand off-shore. The 'Straitsman' (1200 tonnes) is the only vessel which regularly uses the Grassy Wharf. The 'Mobil Australis' (26,000 tonnes) which brings in the island's oil supplies, stands off the wharf at Naracoopa, and discharges via a pipeline.

If an operation based on a 4000 tonne vessel was envisaged, transport and loading facilities would need to be constructed along the breakwater. Allowance would also have to be made for bad weather as, while the 'Straitsman' is normally able to enter the harbour under most conditions, a larger ship would be adversely affected more frequently.

Yours sincerely,

P. Stephenson

P.R. Stephenson,
Chief Geologist,
Metalliferous Mining Division.

c.c. R. Knight, MMD
M. Crow, KIS.

INTER OFFICE MEMO

From: PAUL BALIND

To: PAT STEPHENSON

25 Merriwa Street,
Gordon, 2072.

Date:
16th June 1988

SUBJECT: SAMPLING OF "OLD" DUNE SANDS - SILICA SANDS PROJECT - KING ISLAND.

Attached to this memo are brief geological logs and sampling details for a limited hand auger sampling programme undertaken from 6th-11th June 1988 as a first past effort to evaluate the potential of silica sands within King Island Scheelite's mining lease.

Observations suggest that the three areas outlined in red on the aerial photo (King Island Run 9S 1085-91) are probably joined (i.e. continuous) with the western boundary extending to the granite outcrop. Mapping in greater detail than time allowed for this exercise would define this boundary quite accurately. Overlap of new dunes on old dunes to the east were particularly noted in the area of sample KI:13.

The overlying humus layer generally averaged 25 to 30cm in thickness with leaching effects occurring down to one metre depth. The base of the white, typically fine grained quartz rich sands averaged 2.2m and ranged from 0.8 to 3.7m. Underlying the white sand is a variable thickness of grey-stained wet sand followed by brown to chocolate coloured clayish sand. The sample holes were generally terminated in this zone due mainly to poor and very difficult auger penetration rate.

P. Stephenson

for PAUL BALIND

HOLE DESCRIPTION

Sample No.	Location Co-ordinates	Depth(m)	Description
KI:1	218800E/563900N	0-0.25	Humic layer: degraded leaves, bracken, etc.
		0.25-1.5	White fine grained quartz rich sand; well sorted, equigranular
		1.5-1.87	Very dark blackish brown clayish fine grained sand, very slow penetration with hand auger
		1.87	End of Hole (E.O.H.)
KI:2	218930E/563810N	0-0.25	Humic layer
		0.25-0.80	Very pale pink to white fine grained well sorted equigranular quartz rich sand
		0.80-1.00	Dark brown to very dark brown clayish fine grained sand. Very slow penetration with auger
		1.00	E.O.H.
KI:3	218970E/563690N	0-0.25	Humic layer
		0.25-1.00	Pale grey fine grained quartz rich sand with common plant fragments, roots, etc.
		1.00-2.20	White, fine grained, well sorted, equigranular quartz rich sand. A 15cm wide clayish humic layer is found at 1.50m
		2.20-2.30	10cm wide humic clayish zone
		2.30-2.60	Grey to brown grey fine grained sand; some plant matter noted, weakly clayish
		2.60	E.O.H.

HOLE DESCRIPTION

Sample No.	Location Co-ordinates	Depth(m)	Description
KI:4	219010E/563580N	0-0.25	Humic layer
		0.25-3.60	White fine grained, well sorted equigranul or quartz rich sand. Colour changes to slightly greyish after 2m
		3.60-3.90	Dark brown clayish humic looking fine grained sand
		3.90	E.O.H.
KI:5	218480E/563660N	0-0.30	Humic layer
		0.30-2.10	White to very pale grey quartz rich sand, fine grained well sorted, etc.
		2.10-2.20	Impervious ? rock; no sample return. Very hard, well indurated
		2.20	Hole abandoned
KI:6	218700E/563520N	0-0.30	Humic layer
		0.30-1.30	White fine grained well sorted quartz rich sand
		1.30-1.45	Clayish humic layer, dark brown and abundant plant matter
		1.45-1.60	White to often grey fine grained quartzose sand; some plant fragments. Greyness possibly due to leaching
		1.60-1.75	Very dark brown clayish humic looking quartzose sand; partially consolidated (lumpy). Poor penetration with auger
		1.75	E.O.H.

HOLE DESCRIPTION

Sample No.	Location Co-ordinates	Depth(m)	Description
KI:7	218650E/563440N	0-0.56	Humic layer
		0.56-3.50	White fine grained, well sorted quartz rich sand
		3.50-3.70	Very pale brownish grey fine grained sand; wet
		3.70-4.00	Wet very dark brown to coffee coloured weakly clayish quartzose sand. Poor auger penetration
		4.00	E.O.H.
KI:8	218540E/563120N	0-0.75	Humic layer
		0.75-1.35	White fine grained well sorted quartz rich sand
		1.35-2.00	Pale grey brown to chocolate brown quartzose, slightly clayish fine grained sand
		2.00	E.O.H.
KI:9	218410E/563110N	0-0.40	Humic layer
		0.40-0.75	Pale yellowish grey fine grained quartzose sand
		0.75-2.65	White fine grained well sorted equigranular quartz rich sand
		2.65-2.75	Very pale yellowish brown quartzose sand
		2.75-4.70	Predominantly white quartz rich sand, occasionally very slightly grey or brown. The sand is fine grained down to 3.75m and medium grained thereafter. The sand is wet at 3.75m and very wet by 4.0m. Auger penetration is slow after 3.0m and very poor after 4.5m with sand washing in at depth
		4.70	Hole abandoned

HOLE DESCRIPTION

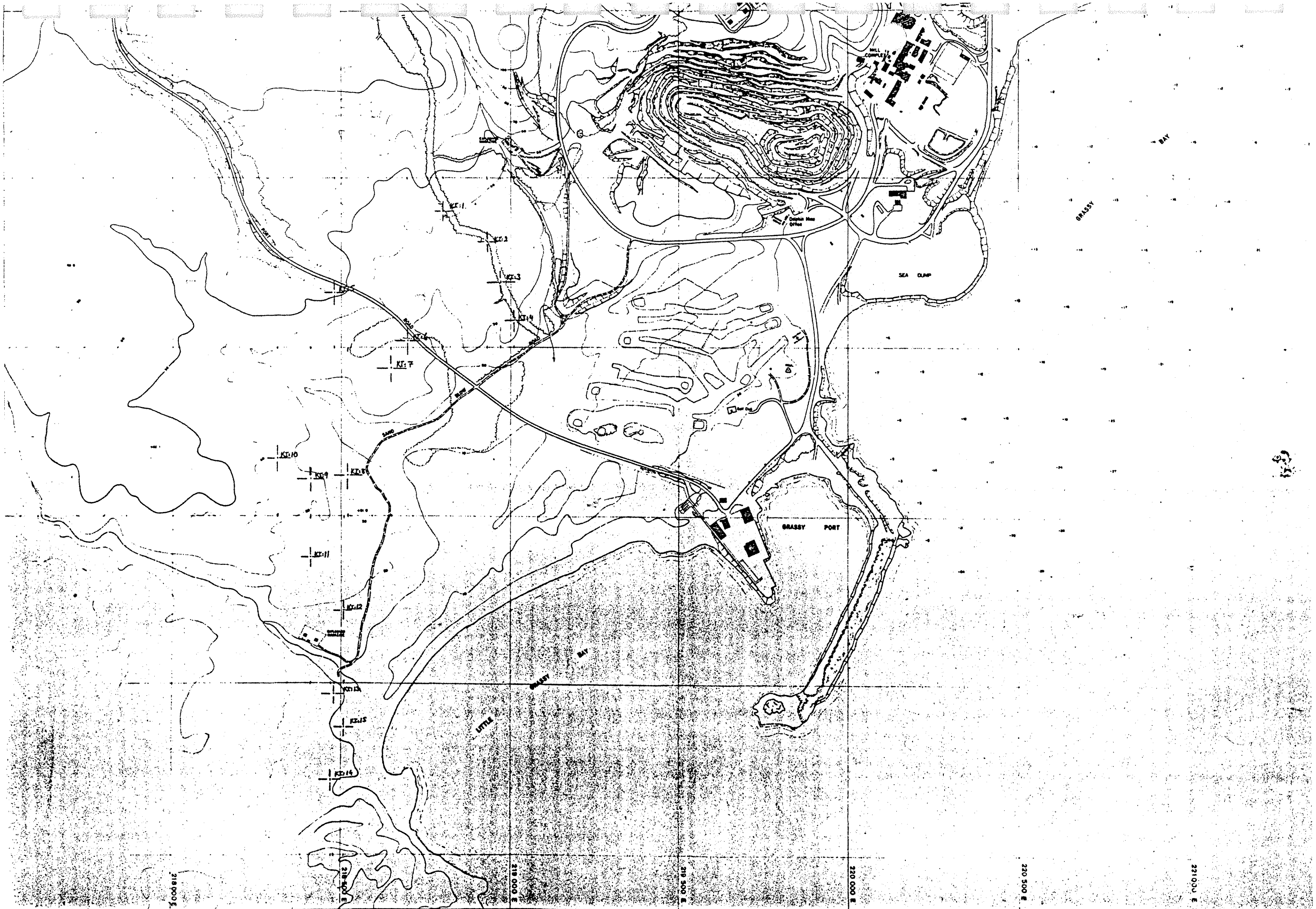
Sample No.	Location Co-ordinates	Depth(m)	Description
KI:10	218310E/563110N	0-0.40	Humic layer
		0.40-1.00	Pale grey to pale greyish brown to white fine grained sand with common plant fragments
		1.00-1.85	White fine grained well sorted equigranular quartz rich sand with patches of very pale grey coloration. The sand is moist at 1.75m and very wet by 1.85m
		1.85-1.95	Very wet pale brownish-grey white fine grained quartzose sand
		1.95	Hole abandoned. An impervious layer was struck at this depth and there was no sample return
KI:11	218410E/562880N	0-0.30	Humic layer
		0.30-0.60	Grey-brown stained white fine grained sand with common plant fragments
		0.60-2.00	White fine grained equigranular well sorted quartz rich sand
		2.00-2.80	Chocolate coloured fine grained moderately clayish fine grained quartzose sand
		2.80	E.O.H.
KI:12	218510E/562270N	0-0.25	Humic layer
		0.25-0.50	Grey stained white fine grained quartzose sand with common plant fragments
		0.50-1.60	White fine grained well sorted quartz rich sand. Wet at 1.50m
		1.60-1.90	Grey fine grained quartzose sand; weakly clayish and wet
		1.90-2.00	Chocolate coloured clayish very wet fine grained sand
		2.00	E.O.H.

HOLE DESCRIPTION

Sample No.	Location Co-ordinates	Depth(m)	Description
KI:13	218480E/562470N	0-0.30	Humic layer
		0.30-0.50	Grey stained sand with plant matter
		0.50-1.05	Greyish white fine to occasionally medium grained well sorted quartz rich sand, moist towards the base
		1.05-1.40	Chocolate brown to very dark grey (almost black) very clayish fine grained quartzose sand, generally wet
		1.40	Hole abandoned. Impervious layer at 1.4m; no sample return
KI:14	218470E/562220N	0-0.30	Humic layer
		0.30-0.50	White to grey fine grained quartzose sand with plant matter
		0.50-3.35	White fine grained well sorted quartz rich sand. Moist at depth. Occasionally slightly greyish
		3.35-3.45	Grey to brown stained fine grained quartzose sand
		3.45-3.85	Very clayish brown fine to medium grained moist sand
		3.85	E.O.H.
KI:15	218510E/562370N	0-0.45	Humic layer
		0.45-0.65	Grey stained white quartzose sand with plant fragments
		0.65-3.00	White fine grained well sorted equigranular quartz rich sand
		3.00-3.20	Wet greyish white quartz rich fine grained sand
		3.20-3.65	Very wet greyish white quartz rich sand
		3.65	Hole abandoned due to a) loss of sample from auger b)washing in of sand at depth

SAMPLING DETAILS

Sample No	Interval Sampled
KI:1	0.25-1.5m
KI:2	0.25-0.80m
KI:3	1.00-2.20m
KI:4	0.25-3.60m
KI:5	0.30-2.10m
KI:6	0.30-1.60m
KI:7	0.56-3.70m
KI:8	0.75-1.35m
KI:9	0.75-2.65m
KI:10	1.00-1.85m
KI:11	0.60-2.00m
KI:12	0.50-1.60m
KI:13	0.50-1.05m
KI:15	0.50-3.35m
KI:16	0.65-3.00m



GRASSY AND ENVIRONS

KING ISLAND SCH

1 cm = 15 000 cm
150 m

42 ×

4.2 × 150

① 60 × 20

② 25 × 10

③ 30 × 30

① 900 × 300 = 270,000 m²

② 370 × 150 = 55,500 m²

③ 450 × 450 = 202,500 m²

528,000 m².

Area of Hooker's sand deposits (Type 3) within KIS ML

= 528,000 m²

Assume av. thickness of 3 m = 1,584,000 m³

Assume SG of 1.5 = 2.4 M tonnes

PRS. 10/6/88.

INTER OFFICE MEMO

From: P. R. Stephenson

25 Merriwa Street,
Gordon, 2072.

To: R. Knight RK ✓ → PRS/File

Date: 24.5.88

Copy: M. Crow

SILICA SAND PROJECT - KING ISLAND

A meeting was held on the 18th May between myself and John Hann, Divisional Manager - Exploration and Development for Hooker Resources, to discuss preliminary assessment of the sand deposits on King Island Scheelite's mining lease.

Hooker has identified 3 main types of sand dune deposits in the Grassy area:-

1. Recent deposits forming the present-day beach and occurring inland for a short distance.

2. Older recent deposits, occurring immediately inland from type 1 deposits.

3. Old deposits, occurring further inland again.

In terms of potential sources of high quality silica sand (<0.02% Fe), type 1 deposits are the least attractive and type 3 deposits the most attractive, since the older the deposit, the more likely are the impurities to have been been leached from it.

From aerial photography work and reference to old reports (report by J. Jennings, 1958 attached), Hooker has identified areas within the Grassy portion of the KIS mining lease apparently underlain by type 1 deposits (under and east of the golf course), type 2 deposits (under the golf course) and type 3 deposits (west and south of the golf course). (See attached aerial photograph and overlay). Extensive dune deposits of all types have also been identified on the adjoining exploration license held by Pimex.

It has been estimated that in order to establish a viable silica sand mining operation in this area, a minimum of 5 million tonnes of high quality sand would be required, i.e. capable of producing 0.5 million tonnes per year for 10 years. Hooker believes that there may be approximately 2.5 million tonnes of type 3 deposits within the Grassy portion of the mining lease (although this figure is very tentative), and at least 10-20 million tonnes within Pimex's ground. Hooker wishes to evaluate the quality of the sand on the mining lease and, if appropriate, to establish a working relationship with Peko before entering into discussions with Pimex.

Approximately 10-12 carefully taken samples from type 3 deposits on the mining lease are required for analysis, together with observations as to visual contaminants, thicknesses and surface extent. A request to carry out this work has been sent to Michael Crow. In the meantime, Hooker will commence preparatory economic modelling and will approach us again when the results of the sampling programme are known.

P. Stephenson.

P. R. Stephenson.

New Series, No. 11.

RECORDS OF THE QUEEN VICTORIA MUSEUM,
LAUNCESTON

THE COASTAL GEOMORPHOLOGY OF KING ISLAND, BASS STRAIT, IN RELATION TO CHANGES IN THE RELATIVE LEVEL OF LAND AND SEA

By

J. N. JENNINGS

(Manuscript received 17th July, 1958)
(Published 15th March, 1959.)

ABSTRACT

The solid geology and general relief of King Island are outlined as a background to a regional presentation of the coastal geomorphology from which conclusions about the physiographic history are derived. From the east coast there are rather slight indications of a 225-ft. sea-level stand and stronger evidence for one at 120-150 ft. from the same area. Whether these emergences affected the whole island uniformly cannot be determined. Later and lesser emergences did so and correlation with N.W. Tasmania suggests they may have been eustatic in character. Widespread constructional and erosional features of the Old Shoreline System give evidence of a falling sequence of levels from 65 feet down to the present level with most marked halts at 40-50 feet and 20-30 feet. They are provisionally inferred to belong to the Last Interglacial. The Old Dunes formed during this time. When the sea level stood at 30-50 feet, the climate was probably slightly warmer, but plant remains from a deltaic deposit indicate that, by the time the sea level had fallen to the present level or below it, the climate was very similar to that of today, perhaps slightly wetter or cooler. In the subsequent Last Glacial Period the former sea cliffs were degraded by subaerial weathering, probably aided by frost action. A few features point to lowered sea levels which may relate to this period. In the Holocene the New Dunes have formed, probably beginning before sea level had risen as high as the present level but continuing to form right down to today. The associated New Shoreline System is considered to relate to a Mid-Recent 10-ft. sea-level stand and the emergence from it. So far no evidence of climatic variations in the Holocene is to hand.

INTRODUCTION

Within an area which permits the whole shoreline to be examined conveniently, King Island possesses a good variety of coastal landforms, both erosion and constructional, though there are the drawbacks of the lack of a topographical survey of the island and the survival of thick scrub over some critical parts. In connection with black sands deposits, S. W. Carey began a study of the north-east coast between Naracoopa and Lavinia Point; in 1954 and 1955, the present writer did further work in this sector and extended it to the rest of the coastline. Certain aspects of the coastal geomorphology have already been discussed (Jennings, 1956, 1957a, 1957b). Incidental comments (Jennings (1955) have been made on the relationship of some of the constructional shorelines to available fetch, wave and wind regimes; it is clear that these need revision in relation to recent work by J. L. Davies (1959). This will not be undertaken here and only such references to these special aspects as are necessary to the present purpose will be made. That purpose is to present a general picture of the coastal physiography whereby changes in the relative level of land and sea can be assessed.

36417

rip maps of all significant geomorphological detail, prepared under the stereoscope from 1/15,000 l air photo cover, were amended in the light of field work when the whole coastline was ied on foot. These strip maps were consolidated into a six-sheet map of the whole island. a framework of points enlarged from the Lands Department cadastral plan on a scale of ches to one mile. The various maps illustrating this paper were reduced from this compila-

ie absence of any triangulated heights or bench marks was a serious handicap. Heights were established by aneroid traverses running inland from HWM and returning to it after a interval to enable corrections to be made. Only with the lower features close to HWM could ethod give an accuracy greater than ± 5 feet. A few short traverses with hand level were and in addition four lines, varying in length from one-third of a mile to seven miles, were l with a Kern GK-1 Level at critical localities. Similarly, hand borings were put down cted important places.

ight observations were related to HWMOST because this is the datum most easily recognized shores of King Island; Fairbridge and Gill (1947) have advocated the use of LWMOST but as not practicable in this study. Tidal data for King Island are meagre. Admiralty Chart 404 spring rise of 3 feet for Seal Bay, Franklin Road and Councellor Island (Sea Elephant this seems rather low in relation to local observations. Records kept for several years at by Mr. C. Richardson have an average range of spring tides of 5 feet. Mr. J. Skipworth is opinion that the same figure is applicable to City of Melbourne Bay. At Naracoopa tidal ements kept between 15 May and 15 June, 1952, by Mr. W. Lightfoot, ranged from between in. and 5 ft. 9 in. On this basis the tidal range for King Island generally is taken to be at springs and 3 feet at neaps.

llections of mollusca (Appendix II) were identified by Miss J. M. Macpherson (National m of Victoria); Mr. A .C. Collins examined a number of samples of foraminifera (Appendix Dr. S. Duigan (University of Melbourne) dealt with microflora from a deposit which also yielded specimens identified by Mr. H. D. Ingle of C.S.I.R.O. Forest Products Division (Appendix I); Crespin examined a Tertiary limestone. The collaboration of these specialists is gratefully vledged.

r. E. D. Gill (National Museum of Victoria) has kindly arranged for the C-14 dating of the wood ned above. Dr. M. D. Garretty placed boring records and other data relating to the black sands Elephant Bay at our disposal. Many King Islanders, too numerous for all to be mentioned ave invaluable help in all sorts of ways. Mr. Jack Skipworth, of City of Melbourne Bay, Mr. Drake, of Pearshape, and Mr. D. Bowling, of Surprise Bay, and their families, require my ılar thanks.

nally, I must pay a special acknowledgment to Professor S. W. Carey, of the University of nia, who introduced me to King Island and made available to me his mapping of the north-ast.

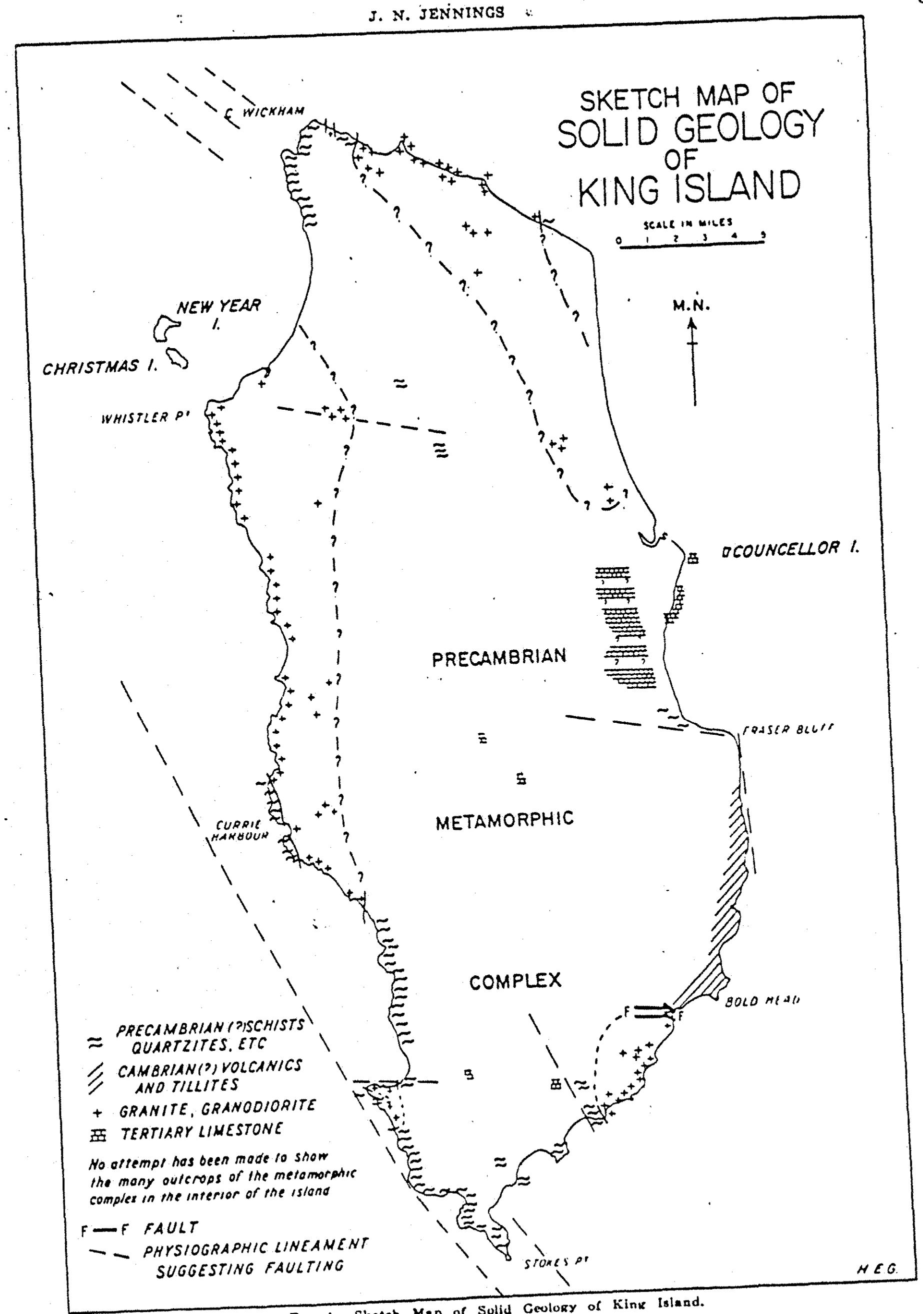


FIG. 1.—Sketch Map of Solid Geology of King Island.

OUTLINE OF THE SOLID GEOLOGY.

ce much of the island is covered by Pleistocene Recent superficial deposits, the solid geology : well known. Fig. 1 is based on published ial, together with some observations made this study.

lerlying most of the island and outcropping he high country of the centre, south-east and -west is a folded metamorphic complex of tain age but generally thought to be late nbrian (Carbine Group). Debenham (1910) he following rocks: quartzites, slates, phyl- various schists, granulites, porphyroids, and merates. In general the dips are high and rike never far from N-S.

veen Naracoopa and Grassy the complex upward into a series of glacial and volcanic dipping east at 40°. Tillite and banded dolo- occur at the base of the series and are in by a thick suite of lavas, with subsidiary and tuff. The series is late Precambrian- ian in age; Carey (1946) and Scott (1951) uggested correlation of these volcanics with ones of Upper Middle Cambrian age in indas Group at Zeehan. It is these rocks give rise through contact metamorphism to rassy Series of hornfels, calc-flints and in which occur the ore bodies of the scheelite mine (Edwards, Baker & Callow, The strike here is W-E and the dip to ith is in association with the local faulting.

plutonic rocks, probably of the Tabberab- Orogeny, intrude the basement complex. nits of the Grassy granodiorite with much rthoclase and little biotite are the best (R. Callow, personal communication). On st coast grey biotite granite is more extensive as been mapped previously. The Cataraque granite is small in area and is interrupted septum of metamorphics on the southern f the point itself. It is the southern end ong belt of granite running from Admiral Whistler Point. Granites in Camp Creek, es north of Currie aerodrome, in Porky in a quarry east of Pearson's Swamp and e North Road where it drops to the Yellow . plain, suggest that this belt is a broad one.

he north coast, though there are gneissic in the basement complex farther west, in mass of granite begins on the western Disappointment Bay. All outcrops of solid stwards, both along the coast and in the ls inland of the dunes are granitic until ct is made with slates at the small headland f Pennys Lagoon. Since granite outcrops Mt. Counsel and at the great bend in the phant River, it is possible that the north anite extends southwards as an important suggested in the map.

icted occurrences of Tertiary limestone rve to tell something of the long geological from these old rocks down to the Pleisto- he chief outcrop known is at The Blowhole. les north of Naracoopa, where horizontal limestone occurs as a shore platform, by solution to give rise to small blowholes (B. Spencer, 1888;* Chapman, 1912). The rock can be traced a quarter of a mile up to the bed of the Blowhole Creek and half a mile northwards along the shore at LW. Seaweed patterns indicate that the limestone reaches underwater right to Cowper Point.

Superficial deposits obscure the inland extent but, running north from the Fraser River, a little behind the coast, there is a strip of country about one mile wide with a photo pattern dominated by swamp hollows of circular to oval plan. In the field these are seen to have flat peaty or clay floors depressed 2-3 feet beneath the flat sandy plain around. They seem to be sinkholes due to solution of Tertiary limestone below. The belt certainly reaches to the Sea Elephant River but beyond that there are many more dunes and these supposed sinkholes cannot be confidently distinguished in the photos from the axial hollows of old parabolic dunes. The sinkhole strip lies approximately between 50 and 90 feet above the sea.

Some way up the Sea Elephant River valley in the middle of the island, Tertiary limestone has been met in a well in the Avondale property; it has been met again in a Rural Bank Land Settlement bore nearby. Crespin (1944) attributes the first occurrence to the Balcombian (Middle Miocene). The altitudes are unknown but may be as high as 200 feet.

Debenham (1910) and Chapman (1912) reported bryozoal limestone at an unknown altitude along a tributary of Seal River less than a mile north of the Big Swamp; the fossil content did not permit dating within the Tertiary. In a well on Mr. O. H. Drake's property, about half a mile SE of Pearshape Lagoon and approximately at 250 feet, a bryozoal limestone was encountered 4 feet down; Miss I. Crespin (Bureau of Mineral Resources) reported that a sample was of Miocene age.

GENERAL DESCRIPTION OF THE RELIEF

The relief of the island has been described in general terms already by Debenham (1910) and Stephens and Hosking (1932). Aneroid traverses along some of the roads and tracks across the island permit a rather fuller account here, necessary in the absence of a topographical survey.

In essence, King Island (fig. 2) consists of an inclined plateau of subdued relief, surrounded by a rim of coastal sand dunes. The highest part** of the plateau, rising to 550 feet, is in the SE between Mt. Stanley and Naracoopa. Here the surface is gently rolling with low hills of convex profile rising above swamp flats. Its aspect conforms well with the Davisian concept of a peneplain of normal erosion but it cannot be assumed that the surface developed under humid

* B. Spencer confused Pleistocene-Recent aeolianite with Tertiary marine limestone so that not all his localities for the latter can be accepted.

** Mount Stanley, lying near the track running south from the Loop Road to the Red Hut headland, rises little above the surrounding plateau. Though reputedly the highest point in the island, it is (with an approx. altitude of 500 feet) definitely lower than two more pronounced hills rising to approximately 550 feet just north of the Forestry Reserve at the southern junction of the Grassy and Loop Roads.

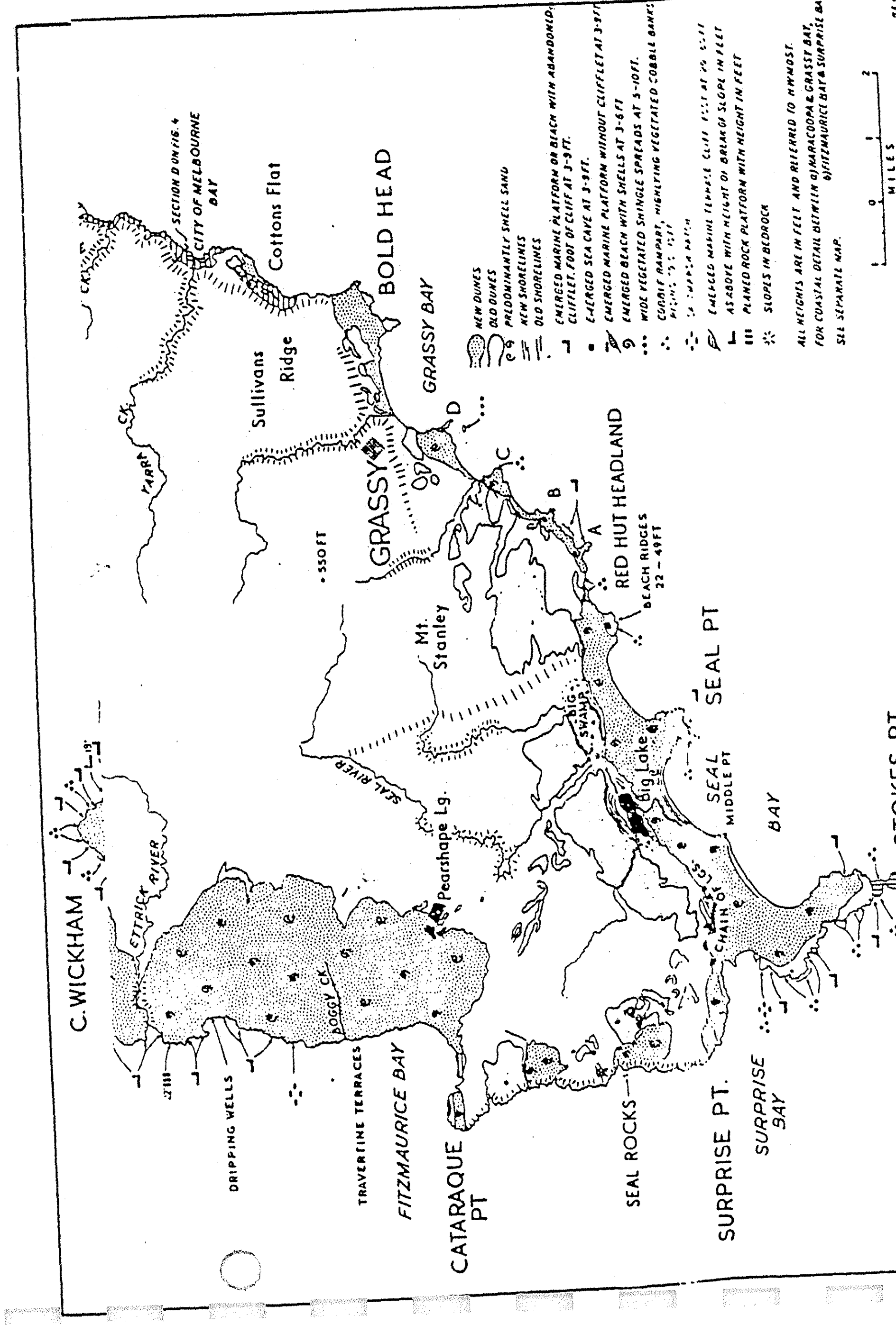


Fig. 2. Coastal Geomorphology of King Island.

temperate climatic conditions, since it carries small residual patches of lateritic ironstone (Stephens & Hosking, 1932; Hubble, 1947).

The rolling country runs north to the Pegarah road between Currie and Naracoopa, where the hills hardly reach 400 feet. East of this drainage divide, the plateau remains high right to the coast. Grassy township has a height of 430 feet within half a mile of the shore; Sullivan's Ridge, beyond Grassy Creek, is 450 feet high close to the coast and, even at Fraser Bluff, the plateau lies at 250 feet. Because of this, the creeks here are sharply incised: Grassy and Yarra Creeks for about two miles from the coast, Conglomerate Creek and Barrier Creeks for about a mile.

South of Grassy, the plateau margin runs inland to leave lower country diversified by rounded granite hills between itself and the coastal dunes. A fairly high ridge, however, runs south from the Mt. Stanley area to the granite hills near the Red Hut headland. The steep western scarp of this connecting ridge is continued north towards the northern junction of the Grassy and Loop Roads to form a marked linear western margin to the high plateau. From the northern end of this scarp, high ground at about 250 feet extends SW through Pearshape into the lower plateau behind the Cataraque Point-Surprise Point coast. This small plateau slopes gently eastward to enclose a lowland embayment between itself and the ridge to the Red Hut headland. In descending to this embayment the Seal River develops some incised meanders.

In the north-east, the high plateau ends abruptly in a steep scarp which extends some five miles west-north-west from Fraser Bluff and is markedly incised by north-north-east draining streams.

Towards the north-west and west, however, the plateau declines gently in height. As a monotonously level surface it reaches northwards to a WNW-ESE line about a mile south of the Yellow Rock River: here it is 100-150 feet high and falls off moderately steeply to the plains of Yellow Rock River and South-East Lagoon. Mount Counsel stands out from the general plateau level at its north-east corner: south to the Fraser River there is not a very clear eastern margin to the plateau.

The westerly drainage, such as the Ettrick River and Porky Creek, has not cut down much into the plateau since the latter is in fact falling in that direction.

This western flank of the plateau from Fitzmaurice Bay to Cape Whistler is buried beneath a broad belt of dunes, much of which is two to three miles wide. They are generally higher south of Currie, but this is mainly due to the greater height of the basement there. Thus, a little south of the Kentford Road, a dune was ascertained to have a height of 450 feet, but the sand thickness here was probably only about 100 feet. North of Currie it is unlikely that the dunes anywhere exceed 250 feet in absolute height; the highest ones occur just south of Pass River and at Whistler Point. Beneath the coastal dunes the plateau surface declines in height so that the bedrock is below sea level on the coast or, at most, 20-30 feet above. There are, however, outcrops at 50-100 feet just south of Whistler Point close to the coast. These suggest that the rather high dunes of Whistler Point may have gathered around granite hills rising above the general basement of country rock. Valleys in this basement also are discernible beneath the obscuring blanket of sand, e.g., east of the Dripping Wells and along Boggy Creek (Jennings, 1956).

North of Whistler Point to Mt. Counsel, the solid rocks are almost everywhere beneath young superficial deposits and are probably below sea level over most of the area. There are the exceptions of the low granite hills arranged WNW-SSE behind the coastal dunes from Disappointment Bay to Lake Martha Lavinia. The lowest country of this northern end of the island is in the centre where there are extensive flat plains underlain by young estuarine sediments, parts of which are covered by the peaty soils of former shallow lakes and swamps—Reedy Lake, Egg Lagoon, and South-East Lagoon. This depressed interior is surrounded by a rim of coastal dunes so that one can look right across the island from the dunes of the one coast to those of the other. The west coast dunes are broader and higher, probably reaching to 250 feet west of Lake Flannigan. Elsewhere the Three Sisters, conspicuous dunes south-east of Rocky Point, are the highest and do not quite reach 200 feet, though they are of sand right down to sea level.

It is only necessary to note in general terms the effects of the coastal dune rim on the drainage of the island (see Jennings, 1957a, for details). Some rivers have maintained their courses through the dunes as these were built up and in this way "gorges of construction" have developed with steep walls of dune sand. Thus, Debenham says the Ettrick Gorge is as much as 250 feet deep. Other rivers have had their mouths deflected, most noticeably in the case of the Sea Elephant River, where it amounts to a deflection of two miles. Damming of drainage by the sand dunes has led to extensive swamps and lakes. Thus, Pearsons Swamp, an area of deep peat now drained, occupied the part of the Bungaree Creek drainage inside the dunes. The Seal River and its major tributary enter the Big Swamp behind the coastal dunes. The drainage is deflected westward into Big Lake from which the river winds deviously through the dunes to the sea. In other places surface drainage has been completely blocked and has been replaced by underground seepage through the dunes. This is best exemplified now by Lake Flannigan, but the more extensive Egg Lagoon formerly drained westward through the high dunes there, though it is now drained artificially to The Nook and Sea Elephant River.

Little can be said of the age of the major relief features of the island. Debenham regarded it as being a horst but there is still no positive evidence of young faulting to hand. However, the physiographic description given does fit in with the conception of an old peneplaned surface, fractured along two sets of trends (fig. 1) and tilted down to the north and west. Laterites of various dates are known on the Australian main-

l. Nevertheless, widespread laterization seems
ıave belonged to the middle or early Tertiary
the ferruginous bauxites of the Launceston
:ict are pre-Miocene (Carey, 1947). Provi-
ally, the King Island surface, with its lateritic
stones may be regarded as Mesozoic-lower
iary in age. If all the Tertiary limestones
ıg to the one Miocene formation, the occurrence
ıin limestone outcrops on top of the plateau
'ell as on what seem to be downthrown blocks
ests that the dislocation was later than this
sgression. In central Tasmania, although the
ır Tertiary movements preceded the Miocene
strine sedimentation, later faulting is known
rbridge, 1948).

THE DUNE SYSTEMS (Fig. 2)

regional description of the coastal features
ficant for the purpose of this paper is given
, but it will facilitate that description if the
s are considered as a whole at this stage.
they exhibit a common general pattern and
merged shoreline features are intimately and
ficantly associated with them. The dunes fall
ly into two major systems designated the Old
the New Dunes.

e New Dunes form a more continuous rim
ıd the island. Though for the most part fixed
s, they retain everywhere a vigour and fresh-
of relief which betokens little change in their
s since that fixation by vegetation. For the
part they consist of parabolic or U-dunes
l stages of development ("elongate" and
drift" dunes of Melton (1940): "transgres-
dunes of Gardner (1955)). The parabolic
s may occur in open pattern or complexly
iated, often nested one within another. Simple
ıl dunes occur occasionally, probably residuals
parabolic dunes. The axial trends of the
olic dunes have been examined in relation
ind regime elsewhere (Jennings, 1957b).
e it to say here that on the west coast the
generally advanced WSW-ENE but, in
dance with varying aspects of the shore,
d from SW-NE to WNW-ESE, whilst the
ıl trend on the east coast was from E-W,
varying with aspect from NE-SW to SE-NW.
ıland margin of the New Dunes, often lobate
nsonance with parabolic dune pattern, is
t universally such a steep and continuous one
heir limit is readily discerned both on the
d and in air photographs.

onstitution, they exhibit a simple distribution
n. The west coast New Dunes are predomin-
calcareous, ranging from completely uncon-
ed creamy-yellow shell sand with a minor
tion of quartz sand to a typical aeolianite
exhibits its usual variable degree of consoli-
by secondary calcite. From Cape Wickham
inia Point the calcareous content remains
most of the way but declines as aeolanite
s cease to be seen in section, only calcareous
ıcrustations. Aeolianite persists from Stokes
nearly to Grassy but eastwards the shell
content falls off rapidly. Stephens and
g's Currie Sand soil type, with its poorly-
ped profile, apart from some organic addition
to a surface horizon, is characteristic of the calcareous New Dunes: exceptionally, a podsol has developed on New Dunes near Currie, which have a substantial shell sand content (Stephens & Hosking, 1932, p. 26).

The east coast New Dunes are in contrast predominantly of quartz sand, slightly reddish-yellow in colour. Their soils vary from a completely undifferentiated profile to a shallow, weakly-developed podsol, which constitutes one phase of Stephens and Hosking's Naracoopa Sand soil type. Hardpans are not strongly developed and A and B horizons together are rarely deeper than 3 feet. Below is the reddish-yellow unbleached dune sand. Ferns are often dominant on these soils in contrast with the grasses, herbs and rushes of the calcareous New Dunes.

It is possible to divide up the New Dunes of particular coastal sectors into two, sometimes three, separate dune belts, each consisting of parabolic dunes in depth; these belts advanced successively inland, probably with appreciable halts between. But attempts to correlate these belts from one area to another have failed and, therefore, it is not thought that they have any general significance. It is true, however, that active blowouts, the first stage in parabolic dune development, are most common in the most seaward and latest belt immediately behind some of the larger sandy bays of the west and south-east coast. However, active blowouts occur in scattered fashion throughout those New Dunes which are intensively grazed and the detailed distribution of these blowouts in relation to gates, fences, cols, &c., indicates that they are due to grazing animals, aided by burning-off. But the most mobile areas are on the whole the only areas in the calcareous New Dunes still partly in the scrub which almost certainly covered the whole of these dunes before settlement. It seems likely then that these mobile areas were also active before settlement and clearance. In other words, the New Dunes constitute a series which has continued to develop naturally right up to the present.

The Old Dunes are much more sporadically occurring though they are found all around the island and reach farther inland. In the northern part of the island, they are found right in the middle, admittedly in small groups and as individuals there rather than covering large areas. In form they are usually subdued and rather characterless, ranging from low, gentle swells to whaleback mounds and smoothed ridges. Their limits are much less reliably and readily mapped, except, of course, where the New Dunes abut upon them. However, the characteristic parabolic dune plan is quite frequently recognisable in the air photos (less frequently on the ground) and, where clear, the inland limit of these Old Dunes shows the same lobate pattern as the New Dunes. It is evident that most of the Old Dune areas are parabolic dune systems modified by weathering and colluviation over a long time. For the most part the Old Dunes advanced inland with a direction closely comparable to that of the New Dunes of the same coastal sector. The wind regime at the time of formation of the Old Dunes cannot have been very different from the present one.

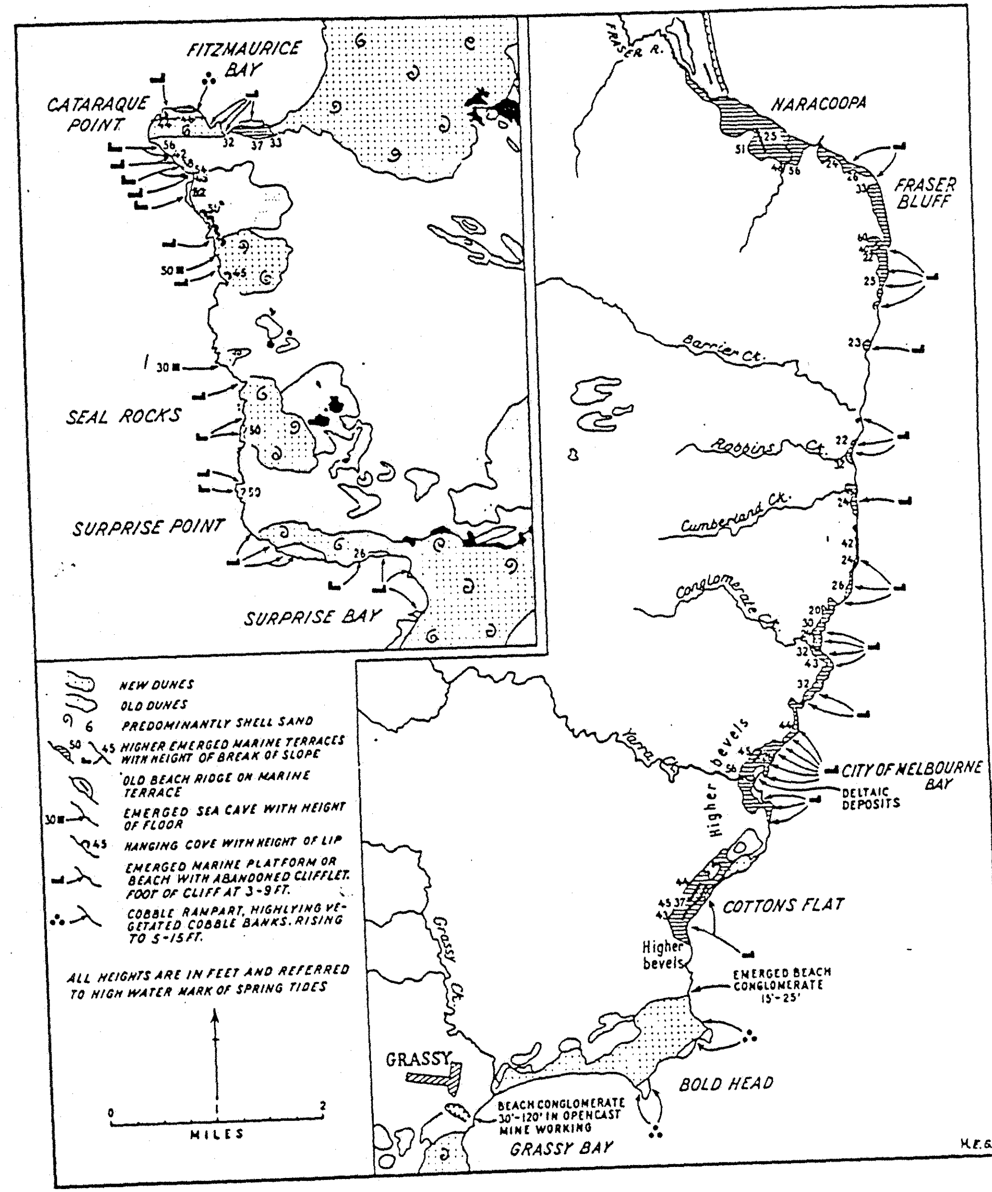


FIG. 3.—Coastal Geomorphology of S.E. and S.W. Coasts of King Island.

'he constitution of the Old Dunes does differ n that of the New Dunes and is rather complex pattern. In the first place siliceous dunes are :h more widespread amongst the Old Dunes. :ir quartz sands are much more deeply leached; act, no unleached yellow quartz sand was seen where in the Old Dunes. In bores and pits c-brown hardpans were several feet deep eath grey-white sand and well-developed when ountered at all. In several sections, many feet white leached sand overlay many feet of "coffee rock", humus-bound sandrock; both layers into the tens of feet thick in the southern of the Grassy scheelite mine opencut. In the these profiles were regarded as the A and B zons of a giant podsol (cf. G. Hubble in Gill anks, 1956, p. 13). Recent publications by drake (1955) and McGarity (1956) show that all sandrocks of this general type are of this n. Further work would be necessary to substiate this view of the King Island examples. the rather indistinct cross-bedding seen at cer- points and the fact that the Grassy opencut section was on a steep slope suggest that a rizon may be the correct interpretation of at some of them. Stephens & Hosking map their coopa Sand soil type over much of the area ie Old Dunes but here it must represent a ent phase from that of the New Dune areas.

lcareous Old Dunes are restricted to the iern half of the west coast from Currie north- s but even here they are interrupted. Near Lagoon a lobate area of siliceous sands is inset een adjacent calcareous lobes and east of 1-East Lagoon, some of the leached quartz ; there have advanced from the west to ock with others form the east coast. Also en Yellow Rock River and Bungaree Creek poradic Old Dunes are of quartz sand and ed inland of calcareous Old Dunes farther in the Bungaree Creek-Pass River area.

: calcareous Old Dunes carry characteristically ambacoona Soil type of Stephens and Hock- his has a depth of up to 4 feet of red-brown us sand, sometimes with nodular limestone , overlying yellow calcareous sand or aeolia- The most likely origin of this soil type is t is residual from the calcareous Old Dunes much more prolonged leaching than the eous New Dunes have yet experienced. Des- his leaching, some of the calcareous Old have retained their original form more than iceous Old Dunes and in parts are still quite

re does not seem to be any basis either in aphy or in the nature of their sands to ise any major subdivision of the Old Dunes is of successive periods of formation. Inland avinia Point, however, their relationship to d shorelines suggests at least two phases of ment (p. 16 below) comparable in status e phases recognised in the New Dunes.

ough in certain parts the Old and the New are separated by an intervening strip of , in general the New Dunes overlap the d the way in which some lobes of the New project beyond the local limits of the Old whilst nearby ones merely reflect that limit along a more seaward line makes it likely that New Dunes must overly the Old Dunes in parts. There is some direct evidence of this. Just north of Pennys Lagoon there is a small headland of granite breaking the long sand cliff coast from Boulder Point eastwards. The actively eroded sand cliff, which is as much as 50 feet high on either side of this headland, consists mainly of yellow New Dunes, which appear to have a significant shell sand content from the presence of calcareous root inctrustations but which reveal former podsolic soil horizons up to 2 feet thick undulating laterally. But there occur also at the base of the cliff exposures of Old Dune profile 6-15 feet high, with red-brown sandrock overlain and replaced laterally by deep grey-white leached sand. Also in the floors of hollows near the eastern margin of the high calcareous dunes south of the Ettrick River on the west coast there occur patches of grey leached siliceous sand, which suggest the presence of siliceous Old Dune material beneath; eastwards there is only a narrow fringe of Old Dune outside the foot of the New Dune wall.

The Old Dunes do occur right down to present sea level and it is probable that they may underlie the New Dunes quite substantially. Therefore the aeolianites exposed within the calcareous New Dunes may not always belong to that system but as yet no means of distinguishing different aeolianites has been found. This general point finds its importance in relation to fossil finds in the dunes. Bones which do not belong to the animals now living on the island are reported from blowouts in various parts of the island but only from the northern end of Stokes Point have such finds been recorded through the efforts of Mr. J. Bowling. Three collections have been described and are consolidated in the following list:—

Dromaeus minor Spencer (Spencer & Kershaw, 1910; Anderson, 1914). The King Island Emu was alive in the island in 1802.

Vombatus ursinus Shaw (Spencer & Kershaw, 1910; Anderson, 1914). This wombat is still found on Flinders Island.

Dasyurus bowlingi Spencer & Kershw (Spencer & Kershaw, 1910; Anderson, 1914).

Dasyurus ? maculatus Kerr (Anderson, 1914).

Macropus ruficollis Desmarest (Anderson, 1914).

Macropus anak Owen (Scott, 1905).

Sthenurus atlas Owen (Scott, 1906, 1917).

There is some discrepancy about the matrix of the finds. Spencer and Kershaw describe their finds as coming from dune sands set in motion by grazing and burning; winnowing left the bones exposed on the blowout floor and sheep bones were found along with the indigenous species. Scott's account of the matrix "soft, friable shell limestone rock of marine origin" can be safely interpreted as implying aeolianite. Certainly, there is much aeolianite exposed today in the area of the finds, the blowout now being generally fixed. But Anderson maintained that the bones occur mainly in a red-brown sandrock though some few come from overlying aeolianite which he regarded as contemporaneous. This sandrock he thought to be marine but the cross-bedding on which this idea rests could quite well be aeolian. The sandrock

seems more likely to be of Old Dune provenance, perhaps covered by New Dune aeolianite. Some of the finds thus seem to belong to the older system; there is, however, a strong likelihood that finds from very different horizons have been brought together by winnowing action in the blowout.

REGIONAL DESCRIPTION OF THE COASTAL GEOMORPHOLOGY

Some of the details of the coastal geomorphology will now be set out in terms of a number of sectors which possess a certain degree of homogeneity. Such a treatment will be longer than to discuss successively features at different altitudes over the island as a whole. But the local distributional relationships of features at different altitudes are significant for their interpretation; a regional treatment will make these relationships more obvious. Moreover, the validity of the interpretative synthesis which follows can be more readily assessed if the data are not presented in the framework of that synthesis. The high coastal sectors are considered before the low coasts and the east coast units before the west coast ones. On the west coast, which is the weather side of the island subject to more violent wind and wave action, features from earlier phases of the physiographic history have been more liable to obliteration by erosion or burial whereas on the leeward east coast there has been both more separation and more survival of coastal features related to different stands in the relative level of land and sea.

A. The High Coasts

1. *From Naracoopa to Grassy* (fig. 3).

This is the major sector of high coast in King Island, at one time having the local name of "The Wall" (B. Spencer, 1888). Yet it is high coast only in the sense that high ground varying from 300 feet in the north to 400 feet in the south approaches very close to the shore. It is an actively cliffed coast over one mile alone of the dozen involved. A coastal terrace of varying but generally narrow width today separates the sea from the steep scarp of the plateau. The scarp typically has slopes of 30-35°, whereas the terrace varies from quite a flat surface to slopes of 5°. The terrace consists essentially of emerged marine platforms and the scarp is a degraded emerged sea cliff.

Along a little more than a mile of the coast running south from a point a mile south of Fraser Bluff modern erosion has removed the marine terraces consistently, though there are occasional interruptions of the latter elsewhere. But the modern cliff is generally only 10-20 feet high, rising at points to 30-40 feet. As a result the whole fall from the plateau to the sea here takes on the character of the "two-cycle" cliff of Cotton (1951) or the "hog-back" cliffs found in Devon and Cornwall (Balchin, 1946; Arber, 1949).

Elsewhere the break of slope between the two features, the terrace and the old cliff, which is the measure of the former stand of the sea in relation to the land, is frequently obscured by mass slumping promoted by the seaward dip of the rocks and by steep, coarse alluvial fans emerging from gullies in the scarp. Even away from these obscuring features the old cliff-foot is somewhat rounded by vegetated talus and so it is impossible to determine the back of a platform with any degree of precision; values for a given sea level are bound to vary 5-10 feet on this count alone. Nevertheless, the range of height of the former cliff-foot from a little over 20 feet to 60 feet shows that the main terrace is composite. Moreover, subsidiary breaks of slope in the terrace can be seen at some points where fragments of higher platforms survive surrounded by lower ones. Platforms rising to 20-30 feet and 40-50 feet are most common but the marked scatter cannot be overlooked.

The terrace is generally low (20-30 feet) along the most exposed coast between Fraser Bluff and the bluff half a mile north of City of Melbourne Bay. The wider, higher terraces need further comment. Behind Naracoopa the terrace is about a quarter of a mile wide and rises generally to about 50 feet. It carries a good deal of sand arranged in steps or berms trending NW-SE and the foot of the most marked rise at least represents an old shoreline at 27 feet.

From the bluff half a mile north of Yarra Creek, for a mile and a half southwards, the old cliffline recedes a quarter to half a mile from the shore. Around City of Melbourne Bay the main coastal terrace with its back at 45-50 feet is well defined. Section, D, fig. 4, shows a levelled profile across the terrace a little north of Yarra Creek. It crosses a shallow, swampy depression, now drained, at the foot of the main scarp and which is enclosed in part of a low curving sand ridge, in part by subdued Old Dune sand and low rock projections. Here there was a small lagoon on the terrace enclosed by beach ridges. Below the sand ridges a further shoreline is traceable at 26 feet.

City of Melbourne Bay is surrounded by Old Dune ridges which are cliffed on the bayside, revealing 5-10 feet of loose, grey-white quartz sand over 8-12 feet dark-brown sandrock. Beneath this dune material are deposits at HWM to + 4 feet, which are very variable, both laterally and vertically. South of the creek there are isolated small outcrops of gravel and of clay with boulders in it. North of the creek the deposit is more continuous and contact with the bedrock was visible at several points. Well rounded boulders and gravel, in parts with ferruginous matrix, lie at the contact. These pass upwards into grey silts, sandy silts or clayey sands. In these occur large timbers, abraded and *non in situ*. Where the timber is most common, the matrix is a laminated sand and peaty clay. At two points, boulders and gravel are intercalated between the driftwood layer and the overlying sandrock. All these materials can be matched in the present bed of the Yarra Creek upstream and there can be no doubt that they represent former deltaic accumulation by the creek. Sea level may well have been lower when they were deposited but could not have been higher because of the lack of any consistent bedding and absence of marine shells. In time they must have been deposited before the close of Old Dune formation and after the erosion of the marine terrace and the building of the constructional features between 38 and 22 feet.

he plant identifications from the deltaic deposit le by Dr. Duigan and Mr. Ingle are listed in endix I. The steep walls of the Yarra Creek ge above are the most likely part of the drainage n to have provided the material; the present fall is about 60 inches annually. The high entage of the fern spores is not surprising; Spencer (1888) describes similar valleys incised the plateau near Naracoopa as "fern gullies" in the accompanying floral list, F. v. Mueller rds a number of fern species, including the fern, *Dicksonia*. Tree ferns still grow on the ad today, e.g., in the Seal River valley. The inance of Celery-top Pine (*Phyllocladus aspleni-us*) is interesting since it is often regarded as ricted to the main island of Tasmania (Curtis,). It was not recorded in the collections made Baldwin Spencer's party last century and is known growing on the island today. Never-ess, it seems to have been present before the strous forest fires of last century. An early ription of the island (*Govt. Gazette*, 31 March, , quoted in *Proc. Roy. Soc. Tas.*, 1873, p. 50) itions "celery-leaved pine" growing there and ng the clearance of secondary forest near Yarra Creek as part of the Rural Bank Land lement Scheme a few years ago, celery-top logs and stumps were found to be thick on ground in certain parts (O. H. Drake, *in litt.*). the other hand, there is no record at all of *hofagus cunninghamii* (Tasmanian Beech) and *nys lanceolata* (Mountain Pepper) in the island or last century. The beech is, of course, the inant of the Tasmanian temperate rain forest occurs sporadically in humid high altitude lities in the South Eastern Highlands on the nland; the mountain pepper has much the e sort of discontinuous distribution. The il flora is thus not very different from the orical and present-day flora and there is little cation of climatic change. The Yarra Creek e is vegetationally near to temperate rain st now and was then. Perhaps we can infer er slightly wetter or slightly cooler conditions, cooler conditions making rainfall more effec-

he southern end of the recess in the old cliffline his neighbourhood is known as Cotton's Flat, appropriate local name since it consists of an llent development of the main terrace with a -defined inner margin at 45-50 feet. The hern part has an Old Dune cover but elsewhere gently ribbed by low sand ridges and swampy essions.

uth of Cotton's Flat the old cliff returns to the e and is actively undercut some 10-15 feet. the main terrace is meagrely represented by efined steps in the spurs. In one inlet a se conglomerate is exposed with an irregular visible at 12-15 feet and rises at the surface 5 feet. It is an unfossiliferous beach boulder with a matrix of iron-cemented sand and s to belong to a lower phase of the cutting he main terrace.

ie steeply-dipping volcanic rocks of Bold Head been planed by marine erosion at higher levels than the present but the platforms pass r the vigorous development of New Dunes h have here climbed up the south-facing slope of the plateau. Farther west to Grassy Creek they form a narrow belt and there is a corridor between them and the plateau scarp; the bedrock features are, however, obscured by smaller developments of Old Dune sands.

Above and below the composite main terrace there are features significant for the present purpose. At the southern end of this sector at Grassy the old cliffline runs westward with the present coast diverging southwards. The opencut of the scheelite mine runs along the face of the cliffline. Between the thick cover of Old Dunes and the bedrock, a boulder bed 10-15 feet thick has been exposed at various points and has been commented on several times (Nye, 1939; Nye and Knight, 1953; Edwards, Baker, and Callow, 1955). Nye speaks of the deposits as lying at heights of 120-150 feet. In 1953, when examined by R. Callow and J. N. Jennings, they were to be seen in the 90 and 70 feet mine levels and consisted of subangular to well-rounded gravel and boulders, varying from ½ inch to 3 feet in maximum dimension, with greenish-grey, silty clay matrix in parts. Granite, as well as the many metamorphic rocks of the mine itself, was represented. Several mineworkers stated that similar beds had been encountered at various levels as high as 120 feet and as low as 30 feet. The general disposition of these unfossiliferous beds makes it clear they are shoreline and not fluvial deposits; thus they were still visible in 1953 at the eastern end of the backwall of the cut at the 90-ft. level with no gully in the slope and virtually no catchment at all on top of the plateau. All observers agree that they are high sea level beach deposits, though the height of the associated strandline is now not closely determinable. Indeed, from the height range of the deposits, it seems likely that they related to a succession of strandlines.

However, much higher levels than those of the main terrace are involved and around the City of Melbourne Bay-Cotton's Flat recess in the old cliffline, there are certain morphological features, admittedly not well defined, which may relate to the same phase. The broad bulge in the coast between City of Melbourne Bay and Cotton's Flat is backed by ground higher than the main terrace developments north and south. This greater altitude is only partly due to the spreads of Old Dune sand and a narrower belt of sharp new parabolic dunes on the south; the bedrock also rises higher in irregular fashion to a break of slope with the old cliffline at 120-130 feet. This break of slope seems to be represented farther north by a series of flattenings in the spur profiles. These steps, though distinct, are themselves steeply inclined, and determinations of the significant break of slope are very subjective; aneroid values ranged from 144 to 127 feet. South of Cotton's Flat there were some further small steps in the old cliffline at 130-140 feet.

Three other steps at still higher levels aer significant (1) on the bluff half a mile north of Yarra Creek (break at 225 feet) ,(2) just south of the City of Melbourne Bay road (227 feet), (3) on the bluff south of Cotton's Flat (238 feet). The first two carried patches of well-rounded grave, 1 inch to 1 foot in size and mainly of quartz. These were unrelated to any present stream drainage and may be littoral.

The present shore of the Naracoopa-Grassy sector consists in the main of irregular rock reefs projecting a few feet above HWM. Active cliffs, even low ones as little as ten feet high, and well-developed shore platforms are few. This does not seem to be entirely due to the emergence of the main marine terrace. There are frequent and clear evidence of unattacked clifflets behind equally uneroded rock platforms, often carrying vegetated and undisturbed beach materials. The cliff foot is usually very well defined and lies a few feet above HWM, ranging from 3 to 9 feet but most commonly about 6 feet. One example is shown in Section D, fig. 4. Generally the clifflet just trims the outer edge of the main terrace but at a few points it eliminates that terrace altogether. Thus just south of Barrier Creek, the 6-feet platform is 50 yards wide, with a cover of sand, shingle and boulders, overgrown by bushes and the cliff behind also vegetated rises to a maximum height of 30 feet, pinching out the main platform. There is a similar development at the northern end of the little bay into which Conglomerate Creek debouches. Nevertheless, the general rule is for very narrow platforms and clifflets only a few feet high; they are well scattered along the coast in both exposed and sheltered positions and definitely show no sign of present-day wave attack.

At four points around Bold Head banks of weathered and vegetated beach cobbles, 0 to 20 yards wide, rise to 10-15 feet above HWM. Parts of these banks lie under thick shrubbery and, although they may grade downwards into active cobble and shingle banks, they are interpreted as belonging to the same phase which fashioned the 6-feet platforms and clifflets. The associated constructional features would, of course, rise higher than the cliff foot nip.

A further related feature is the occurrence of vegetated and unattacked shingle and cobble fills at the heads of marine erosion inlets or geos; these occur even where modern cliffing is most active, e.g., north of Barrier Creek.

Sandy shores backed by sand dunes are of restricted occurrence in this sector but do occur over short stretches. Active sand cliffs are common here but there are also some occurrences of fixed dune clifflet with vegetated sand platform in front, e.g., half a mile south of Fraser Bluff and along the shore of Cotton's Flat. These are in New Dunes but similar features in Old Dunes occur at the north-east corner of City of Melbourne Bay and just south of it. These again give a cliff-foot height within the range of the 6-feet platforms and are regarded as contemporaneous with them.

Barrier Creek leaves its gorge by a small waterfall of a few feet to enter the sand-barred lagoon at HWM. Similarly, Conglomerate Creek hangs 5-6 feet in rapids above HWM at its mouth on the shore. This lack of adjustment could be due to the small recent emergence. Grassy Creek is very different although the dam for water storage for the scheelite mine obscures the situation. Over its last quarter of a mile the steep valley walls appear to converge in a thalweg which is below the present sea level. This suggests downcutting when sea level was lower, followed by a positive movement and some aggradation.

2. *From Surprise Bay to Fitzmaurice Bay* (Fig. 3)

Though its adjoining plateau (100-190 feet) i much lower than in the case of the coast jus described, the Surprise Point-Cataraque Point secto is more truly a high coast. It is broadly simila in character but the marine terraces have bee largely removed and the old cliff is much mor under modern attack. Active cliffing 30-60 fee in height is common and at a number of point the hogback cliff is being eroded right to the to (100-170 feet). This is particularly true of th middle section north of Seal Rocks where inlet and geos are under violent modification right t their heads which in some cases consist of vertica cliffs 150 feet high. This greater amount o present-day cliffing is readily understandable i terms of exposure to the west from which th storms mainly come. At the same time the coas has something of the character of a "plungin cliffline" for the real break of slope is not a sea level, but some 20-35 fathoms down (Jennings 1959, in press). A plunging cliffline is usuall regarded as under weakened attack because of wav reflection (Cotton, 1951).

At a number of points the old hogback cliff i not only vegetated but carries a thin skin of breccia The angular rock fragments are cemented by matrix of ferruginous sand, but elsewhere th consolidation is due to calcium carbonate derive from the clifftop dunes. This would appear to b the product of subaerial weathering in differer climatic conditions from the present ones, possibl periglacial (cryergic) conditions of a Pleistocen glacial period.

Evidence of former shoreline levels is not entire lacking through more fragmentary and less clea cut than on the high east coast. Inclined ste or "bevels" in the cliffline, very imperfect rem nants of emerged marine platforms, are mo frequent in the north near to Cataraque Poi but some occur south of Seal Rocks. Some these carry dune sand and thick, nearly lev spreads of the breccia mentioned above. This m have been mistaken for the raised beaches, whic Stephens & Hosking (1932) cite; in fact it has muc more the character of periglacial "head". T backs of these "bevels" are far from clearly defin and the values given them vary from 23 feet 59 feet, most being at 40-50 feet. To be correlat with these bevels are certain "hanging coves small recesses in the cliffline with their lips a floors at 45-50 feet. Most do not receive a appreciable drainage from the plateau nor ha they the nature of landslip scars (cf. "erosi amphitheatres" of Baker (1950); see also Edwar (1945)). The most likely origin seems to marine erosion at a higher sea level stand. Furth indication of these stands is to be seen in t high-lying sea caves in the most exposed parts this sector. There is one square-cut, shallow ca with its floor at 50 feet in the southernmo granite headland: there are also two much deep fissure caves, with floors at approximately 30 fe in the strike of the schists at an extremely expos salient north of Seal Rocks (Jennings, 195 The details show they are unattacked and must relict features from higher sea levels.

he short west-east reaches from Surprise Point Surprise Bay and from Cataraque Point to maurice Bay are less exposed than the coast 'een the two headlands. In consequence, the cliffline is still set back from the modern shore. in the southern case, New Dunes have extended onto the plateau from WSW and W and ely obscured the relief in the country rock. s, towards the west there is an irregular in the rock in front of the dunes but this ppears beneath the sand with no possibility etermining the height of any former shoreline. er to Surprise Bay there is a small rock shelf part of the old degraded bedrock cliff unob-d by sand and the break of slope is about eet. There are more vestiges of the lower with a back at approximately 6 feet and elated vegetated clifflet is found in the solid, olianite and in New Dune sand.

e Cataraque Point-Fitzmaurice Bay stretch is less obscured, though around the two bays iting it sand has blown over from the wind-side to obscure any high terraces. But to west and east these are preserved quite y; to the west the back is at 45 feet, whereas e east 35 feet was the usual figure; the e here carries a very fine granite stack. Along at deal of this northward-facing coast there elict narrow platforms of the 6-feet level, boulder beds and small clifflets. At two active erosion has exposed cemented boulder at 10-15 feet; these must belong to the main e.

evidence of this western high coast is less reserved and on its own much less decisive that of the Naracoopa-Grassy coast. But eals essentially the same story and argues it any east-west tilting during the time to the emerged coastal features relate.

E Low Coasts.

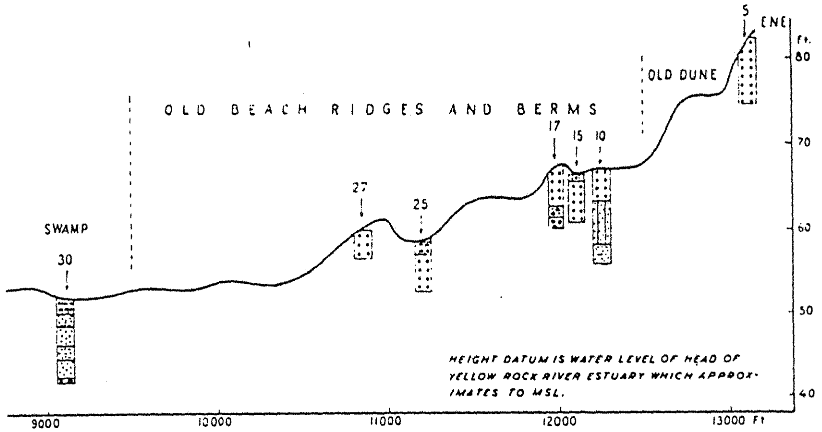
m Naracoopa to Lavinia Point (fig. 2).

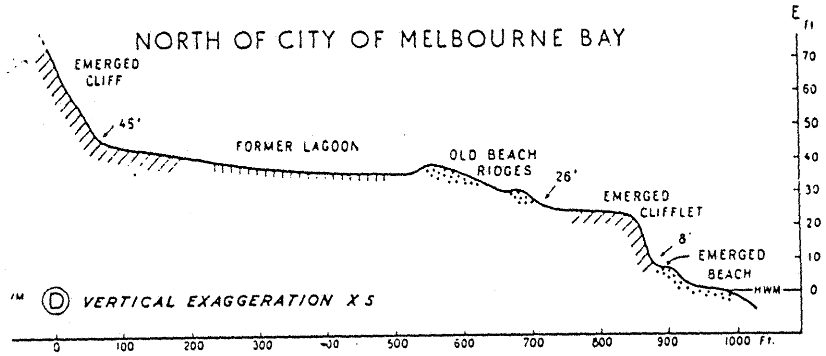
long low coastal sector is almost entirely a constructional one, with the brief exception Tertiary limestone of The Blowhole. It is lmost everywhere prograding at the present The exception is the southern side of Cowper where there is an active sandcliff; possibly ere is a balance between accumulation and about three miles north of Cowper Point. l, there is an accentuation of the Sea nt Bay and the bay north of Cowper Point. ets of strandlines can be traced in almost en continuity over the whole sector; the orelines are associated with the Old Dune and the New Shorelines with the New Dunes. lationships of the different features vary he coast and it is necessary to discuss the in three parts—(*a*) Sea Elephant Bay, (*b*) Point, (*c*) Sea Elephant River to Lavinia

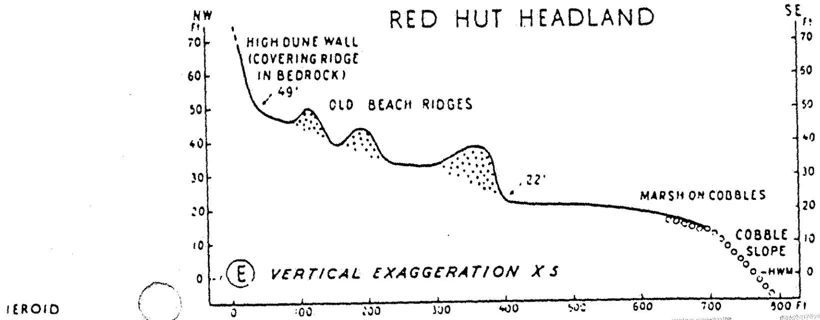
Sea *Elephant Bay* (fig. 2, fig. 3). Behind mmetrical arc of sand beach is a low vege-and terrace, some 50 yards wide, in front ed sand cliff 20-30 feet high. The cliff-foot ly at 3-6 feet above HWM. Long low sand 3-5 feet high and as many as 4 in number, diversify the low terrace over most of its length. Each represents a very early stage in the development of a foredune on top of a beach or berm. Davies (1957) has recently provided the most satisfactory account of Tasmanian sand ridges of this type. Together with the cliffing, these constitute the New Shorelines here and the fact that progradation succeeded retrogradation over the full length of the bay in a uniform manner is indicative of an important general change in coastal conditions such as a small emergence.

Inland from the cliff which is cut in older, deeply leached sands, there is a belt some 300 yards wide where the air photographs reveal linear patterns suggestive of further strandlines parallel to the lower features. They are clearest and most continuous behind the middle of the bay. On the ground they are seen to be low ridges or berms of leached quartz sand, separated by wetter depressions; the height difference is only a few feet and the surface rises gently as a whole inland. Where the first stream north of Fraser River cuts across this belt, the ridges bend backwards into the mouth of the valley as might be expected of shoreline features and on its southern side develop into subdued dune forms. These sand ridges appear to be degraded older equivalents of the sand ridges of the New Shoreline system. The rear margin of this higher belt of Old Shorelines was generally not well defined; it takes the form of a steeper rise, particularly where there are Old Dunes. At one of the sharpest of these breaks an aneroid height of 45 feet was obtained. Farther inland is the zone of sinkholes on Tertiary limestone with a scatter of sporadic Old Dunes, some of which exhibit parabolic form.

(*b*) *Cowper Point* (fig. 5). Between Blowhole Creek and Sea Elephant River, the strandline features confined farther south to a narrow belt broaden out to a depth of two miles in a fine cuspate foreland. North of The Blowhole a broad swamp flat not much above mean sea level intervenes between the Old Shorelines and the New. Seaward of this flat there is a narrow New Dune belt, 50-60 feet at its highest, which broadens northwards to a big mass of parabolic dunes rising to heights of over 100 feet behind Cowper Point. Within this mass linear patterns in the air photos prove to be former clifflines frequently interrupted by later parabolic dunes advancing across them. Along the southern part of the shore from The Blowhole to Cowper Point, the front of the New Dune belt is a fixed cliff equivalent to the fixed cliff in older sands behind Sea Elephant Bay, and below this cliff are one or two low sandridges. These change northwards into a well-developed foredune with an active sandcliff. This sandcliff rises higher northwards and erosion supervenes to pinch out this last foredune. The coast is retreating and local residents report the complete disappearance of quite high dunes in the last 30 years. The other flank of Cowper Point is prograding and here is a series of narrow foredune ridges, 5-10 feet high, running NW-SE. On the southern flank of Cowper Creek, these foredunes are being truncated by erosion but on the northern flank they are successively reaching farther northwest to form a spit deflecting Sea Elephant River northwards. Between 1946, when the air photo







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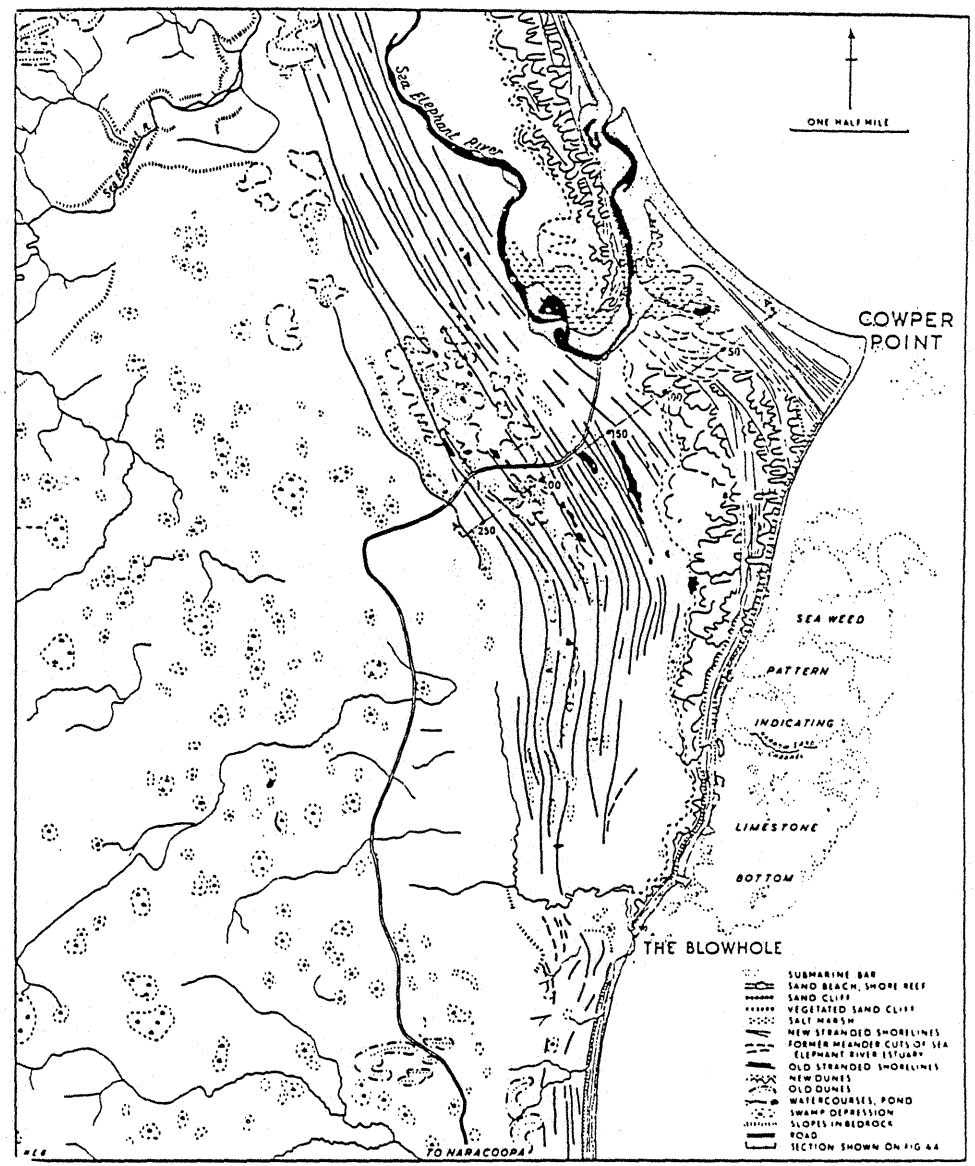

FIG. 5.—The Cuspate Foreland of Cowper Point.

over was taken, and 1954, this spit has grown nd caused the river to debouch even further to he north. Behind the spit is a protected area f salt and freshwater marsh and also a complex attern of former meanders of the Sea Elephant iver.

The New Dunes of Cowper Point encroach onto ıe Old Shorelines, which here reach a maximum idth of a mile. These also form a blunt fore- nd with a nose about a mile south of Cowper oint. Section A, fig. 4, shows the general nature the Old Shorelines here. This section was mpiled from details of borings for a black sand vestigation in 1952, which were kindly provided Dr. M. D. Garretty; the levelling was done as rt of the present study and shell fragments ere collected from the bore spoil (see App. II.). is section crosses some of the new foredunes, rmer estuarine channels of the Sea Elephant ver and the main new parabolic dune complex a fairly narrow point. Behind these dunes ere is a ti-tree swamp below HWM in which pears the first of the old strandlines. These nsist of very low sand ridges and berms; they nerally rise 2-3 feet with a maximum amplitude 7 feet and in width vary from 10 to 65 yards. venteen of these features were crossed in the tion line, rising steadily from just below HWM about 40 feet above; then they remain level the last third of a mile. Behind the last ridge ere is a depression (bottom at 29 feet) which is dily traced laterally; inland there is a gradual into the belt of sinkholes or solution hollows. e ridges and berms consist of grey-white quartz d, which underlies the area for 15-30 feet. The ervening hollows carry some sandy peat, at st three feet deep. They are generally swampy may have intermittent shallow ponds, some which are clearly due to combustion of peat a result of burning-off practices. Very subdued, d Old Dunes obscure the ridge pattern in parts a parabolic pattern is discernible in some these low dune mounds.

rom the boreline, most of the samples of llusca (Appendix II.) came from the New Shore- s and comparatively few from the Old, but no ificant differences in the assemblages are arent. Quite a large proportion of the finds of sandy and sandy-mud bottom dwellers a number of intertidal rock species are present, ther with submerged weed inhabitants. This gests open beach conditions with a mixture of ns transported from different habitats, and firms the conception of a continuously develop- sand foreland with varying exposures of lime- e reefs. All the species were marine with the ption of a *Salinator* species from a swale bore he New Shorelines; again this is consonant the present conditions.

) *Sea Elephant River to Lavinia Point* (fig. 2, 6).—Northwards from the estuary of the Sea hant River a flat depression separates the r and the newer systems of coastal features.

e New Dunes broaden and grow higher hwards and so does the belt of low foredunes, h constitute the New Shorelines here. The or two ridges of the southern end multiply er 20 towards Lavinia Point where they reach half a mile inland. The seaward three are here only partly colonised by shrubs and grasses, but the others are completely fixed either by bracken or open gum woodland in accordance with the incidence of burning-off. The ridges are only a few feet higher than the hollows, though both rise gradually inland so that the innermost depressions lie at 10-15 feet above HWM.

Near Lavinia Point the New Dunes fall into three sets. Behind the full set of New Shorelines there are comparatively low parabolic dunes about half a mile wide. Then a later and higher group, reaching well over 100 feet, cut across at least eight of the New Shorelines. They eventually overlap the first set of parabolic dunes completely and cut across the head of the intervening depression to advance onto the Old Dune system. This set constitutes the main body of the New Dunes and significantly postdate the oldest of the New Shorelines. Lastly, at Lavinia Point itself, a very young and small group of parabolic dunes cuts across the ends of nearly all the remaining New Shorelines.

At their southern end the New Dunes and Shorelines have deflected the Sea Elephant River southwards and many meandering river channels, some still used at flood time, can be traced in the flat corridor behind them. In this corridor, salt marsh near the estuary gives way to freshwater marsh and north of the Sea Elephant River it becomes an elongated belt of ti-tree swamp and small lagoons known as The Nook. A bore in the dry bed of a lagoon about 1½ miles from the northern end showed grey quartz sand extremely rich in marine mollusca beneath 70 cm. of structureless dark-brown peat and organic mud. A much smaller assemblage of mollusca than at Cowper Point still ranges from intertidal rock to sandy-mud bottom forms but a high proportion of small weed-living forms are indicative of a sheltered inlet. The presence of *Salinator* and *Assiminea* also points to the transition to estuarine conditions. These sands must have been deposited after the development of the spit and New Dunes on the seaward side.

From the Cowper Point foreland the Old Shorelines reach north to the outfall of Egg Lagoon where they are cut across by Old Dunes. They decline in number and width though retaining the same character. The Sea Elephant River cuts through them down to underlying granite. They are also interrupted at several places by dune-covered projections of higher ground from the west; the recurved pattern of some of the Old Shorelines suggests shallow bays between these dune-covered headlands. At the northern end the strandlines are divided into two groups separated by a broad swampy depression; the seaward group is accompanied by Old Dune formation. On the line of "The Cords" crossing of The Nook, the mean of two aneroid traverses gave a rather unreliable height of 27 feet for the back of the highest berm of the Old Shoreline series.

The Old Dune development behind the coastal sector is meagre from Mt. Counsel southwards, but, farther north, Old Dunes reach in a broad belt right across towards South East Lagoon, where they meet other parabolic dunes blowing from the west and give rise to some special dune forms.

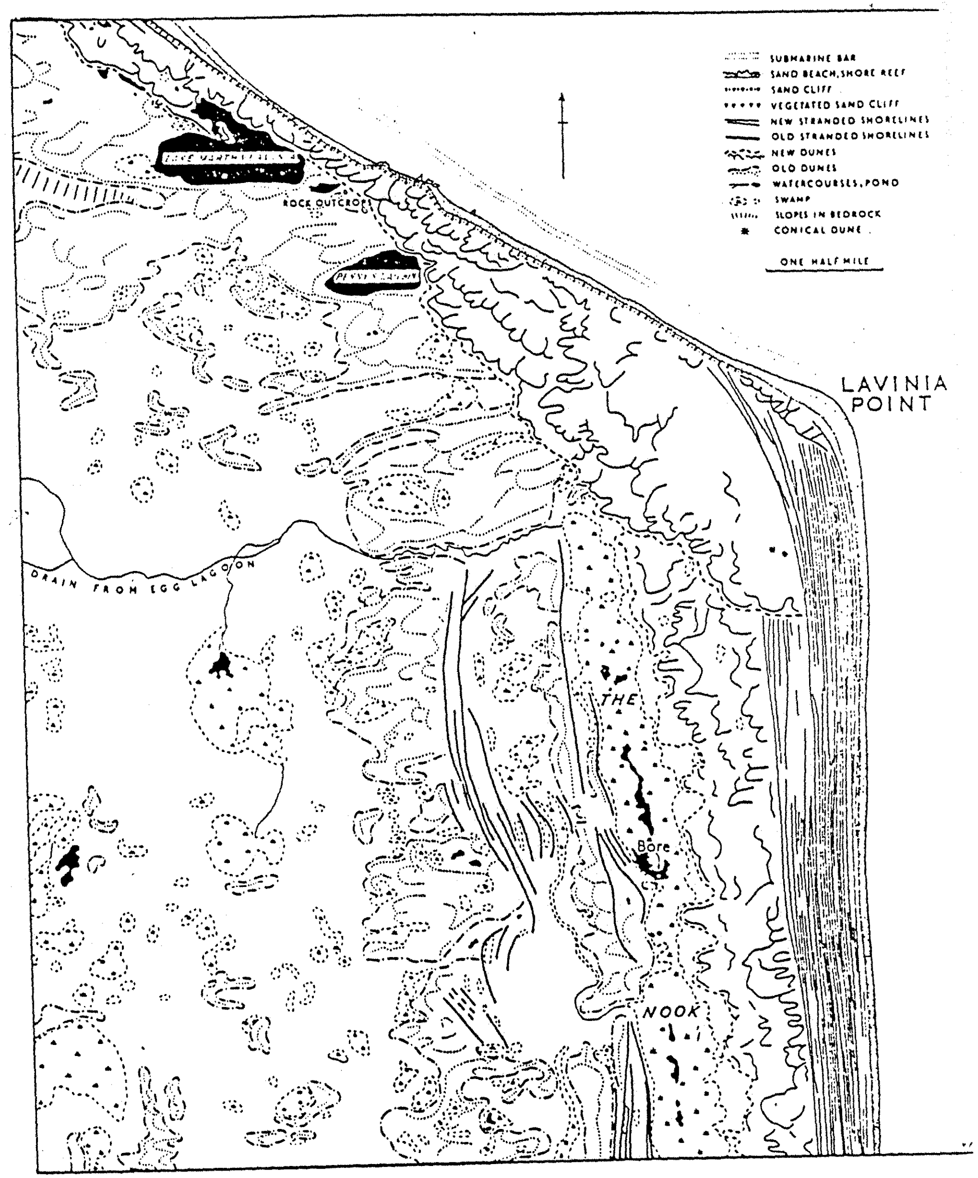

FIG. 6.—Coastal Geomorphology of Lavinia Point.

m Lavinia Point to Whistler Point (fig. 2).

: is a sandy constructional coast for the ›art. The north coast is interrupted by the ck headlands of Rocky Point, Boulder Point, ' a small outcrop north of Pennys Lagoon; here is the longer section of low rock coast the western side of Disappointment Bay : to the northern end of Phoques Bay.

g the western side of Disappointment Bay, are absent for half a mile, the granite hill gradually down to the shore. This coast exposed to the north-east where the length n is short and so an absence of cliffing is to ›ected. Consequently, although there are mall emerged marine platforms, they are ll defined. In three places the lowest level :sented by breaks of slope at 4, 7, and 8 feet HWM, whilst higher platforms have their t 22, 29 and 39 feet. A narrow foredune of leached quartz sand rests on the forward the last one, which occupies a recess in slope close to the steep wall of unleached ınes which has swept over from the west. Farther west the New Dunes reach to the efs in parts; in others a fixed dune cliff ı rock platform in front but the cliff here be surely interpreted as belonging to the stand. Great banks of vegetated cobbles : no sign of present-day disturbance, e.g., : Wickham itself, do belong to that stand. ·. Between Cape Wickham and Phoques :re is more active erosion, with small cliffs o 15 feet at a maximum to be found in The dunes, generally, rise immediately the reefs here but at a number of points ndond clifflet and rock platform or beach 5-feet level are to be seen. At one point et can be traced laterally from metamor- ısement rocks, through old spring tufa into aeolianite. At three points, small :s, a few feet above HWM and developed contact of the metamorphics and tufa- d breccia, are no longer attacked by the ach shingle in the caves confirms marine unabraded roof fall, earth, plant growth ·rows show their relict character at the time. They are quite distinct from hollow- he aeolianite, which are due to wind action.

emainder of this sector needs little com- nce it consists for the most part of active iff and sand beach, apart from three —a stretch of about one mile between ırtha Lavinia and Boulder Point, nearly s of the coast lying symmetrically between Point and Rocky Point and the projecting :eland west of the Yellow Rock River The first two are very similar. Grassy ›-covered dune cliffs, which rise to a n of about 100 feet, are separated from the a low terrace with simple sand ridges or bby foredunes. These are more numerous /ider western end of the terrace, where cretion and new sand ridge formation has ıg on since 1946, as the air photos reveal ırison with the 1954 position. Where the t foredune or ridge is not banked against ıdoned cliff, the swale bottom lies only t above HWM. The Yellow Rock Foreland also has an old fixed cliff, though much lower one, separating the main mass of parabolic dunes from low sand ridges which represent a phase of sand accumulation under different shoreline conditions. On the north of the foreland there is one low foredune in front of the cliff, whereas on the west there are four very low simple sand ridges. The features of these three localities clearly correlate with the Newer Shorelines of the Naracoopa-Lavinia Point sector.

New and Old Dune Belts almost completely ring this sector of the coast advancing from both west and east. The one break is found in the granite hills between Lake Flannigan and Disappointment Bay. Similar low granite hills lie between Egg Lagoon and the north coast, though these also are partly covered by Old Dunes. Numerous lakes occur at the contact of the dunes with the granite rises or along the boundary between the two dune systems or within the dune systems, particularly the Old Dunes; some of them have been discussed elsewhere (Jennings, 1957a) and the others belong to similar types. It is necessary, however, to consider rather more fully here certain aspects of the major drained lakes of the area. The former Reedy Lake, Egg Lagoon and South-East Lagoon all form part of a plain of young sediments enclosed by the granite rises on the north, by the west and east coast dunes to those flanks and by the northern margin of the metamorphic plateau of the island on the south. The inner part of this plain from Egg Lagoon to South-East Lagoon lies just about 50 feet above HWM; a levelled line from South-East Lagoon to the Yellow Rock River estuary shows that the plain declines gradually westward. It is still at 45 feet where it is crossed by the North Road, but it loses height rather more rapidly farther west to a level of 20-30 feet where the Yellow Rock River has incised 10-15 below it. As will be seen from evidence to be presented, this plain consists mainly of young estuarine-marine sediments overlain in parts by freshwater and swamp deposits.

Though the former relative proportions of open water and ti-tree swamp cannot now be determined, Egg Lagoon, prior to its drainage, was certainly the largest extent of lagoon and swamp in King Island. No geological records survive from the draining but Mr. H. Graves, of Three Rivers, who worked on the draining and bore-sinking, states that generally over the Lagoon floor there was about 8 feet of black clay above 8-12 feet of sand with sea shells. Mr. W. A. Steele, who, in recent years has put down fresh bores for the Rural Bank Land Settlement scheme, confirms the general occurrence of marine sands. His log on No. 1 Block, "Koreen", is typical:—

0- 2 feet	Top soil
2- 5 feet	Brown sand
5- 8 feet	Brown pug
8-24 feet	Sand
24-60 feet	Grey sand: abundant sea shells, including oyster at 40 feet
60 feet	Granite.

From a recent bore less than half a mile south of Egg Lagoon, Mr. H. Lot, the owner of the property, preserved shells from a depth of 50-60 feet; four marine specimens were identified (App. II.).

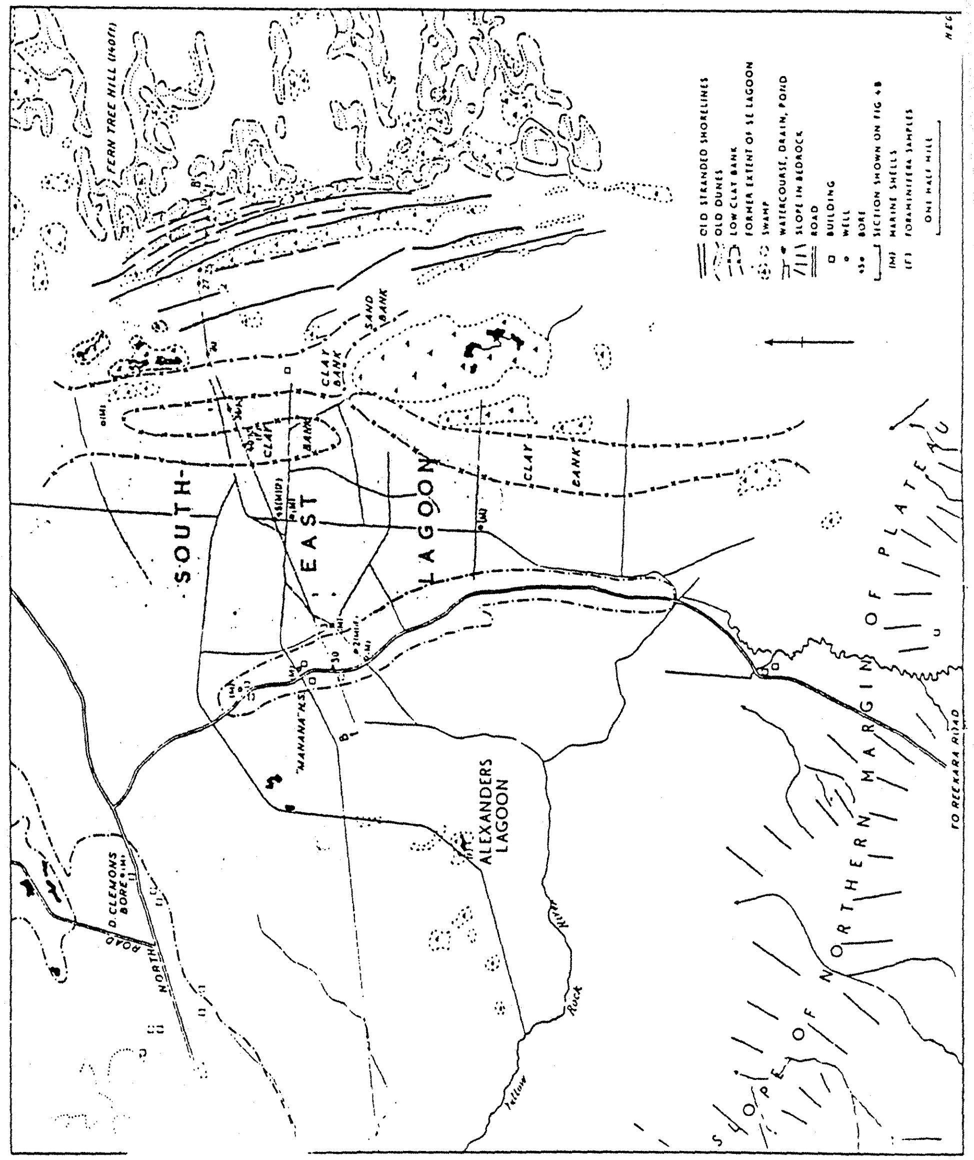

FIG. 7.—Geomorphological Features of S.E. Lagoon Neighbourhood.

wo finds of giant marsupials have been made in Lagoon. Scott (1912) identified *Nototherium ıanicum* Scott bones which he received from F. H. Stephenson, of "Yambacoona" Station. H. Graves informs me that this find was ally made in 1911 by his brother on a slightly .er islet on Plot No. 12 at the western end of Lagoon. This islet is readily identifiable today a bore was put down giving the following rd:—

0- 13 cm.	Highly humified black peat
13-110 cm.	Mottled grey and buff silty clay
110-125 cm.	Brown silty clay
125-155 cm.	Black silty clay
155-180 cm.	Dark-brown silty clay with fine gravel
197-280 cm.	White gritty shell sand.

ι the field the bottom deposit was estimated as aeolianite ground up in the borer. This is ırmed by the foraminiferal report (App. III.). ɔngst the foraminifera were specimens of a *:arina* sp., a tropical genus not known in Bass .it today.

he second find is recorded in detail by Keble :5) and was made by Mr. J. G. Haynes in 1927. :h and jawbones of *Diprotodon australis* Owen ɜ found scattered over a quarter of a mile of n at the centre of Egg Lagoon in clay underg black swamp soil. A hand bore was made ıin the site area during the present field k:—

0- 10 cm.	Clayey peat
10- 30 cm.	Black peaty clay
30- 70 cm.	Grey clay with fine gypsum crystals
70-125 cm.	Brown and grey silty clay with rootlets
125-340 cm.	Variably grey silty clay and green-grey clay silt, with an increasing content of fine gravel downwards.

he giant marsupials belong to the freshwater se succeeding the previous estuarine-marine ditions. Although the modern lagoon appears ıe dammed at the extreme western end by New ıes, it cannot be assumed that the freshwater ditions did not develop till New Dune times. e the New Dunes may well overly Old Dunes his point. Old Dunes enclose the western part this lagoon fairly completely otherwise, and vill be seen later that South-East Lagoon to south must date back to Old Dune times. All t can be said, therefore, as to the age of the Lagoon finds is that they may reach back to Dune times, but could relate to a considerably r date on present evidence.

etween Egg Lagoon and South-East Lagoon, re is flat ground a few feet higher than the ɔon floors with Old Dunes to the west and east. This is part of the same plain of ıarine-marine sedimentation. A bore on Mr. D. mons' property lies close to the margin of the :n just inside the Old Dunes on the west and ched down into these sediments; only two :ine mollusc species were identifiable from the ɜ spoil, however (Appendix II.).

'he drained floor of South-East Lagoon (fig. 7) mainly within the "Manana" Estate, and on the evidence of deep drains and a number of wells. Mr. J. Lewis, the manager, reports that the general sequence of deposits is as follows:—

Surface	Black Peat
	Black clay
	Fine grey sand, with cockles and mussels
— 20 feet	Grey clay, with sea shells, including oysters.

The levelled line of bores in Section B, fig. 4, confirms and elaborates this for the shallower horizons.

Between the former lagoon floor and the Old Dunes, to the east, there is interposed a series of berms and low ridges, trending NNW-SSE, but with a tendency to concavity towards the west. There are as many as seven such features with a total range in height of 51-65 feet above HWM. They are fully comparable with the Old Shorelines of the east coast, except, of course, that their gradual slopes face west and their steep slopes east. The intervening swales vary from 1-3 feet in depression and may have a couple of feet of sandy peat on top of the leached quartz sand and well-rounded fine gravel which make up the bulk of the series. In bore 10, 120 cm. of sand overly 160 cm. of highly-humified black silty peat on top of silty clay. In this case the sand ridge has been rolled back over a previous swale swamp. Well developed podsols occur on the ridges. There can be no doubt that these are shoreline features and their significance will be discussed later.

In front of these sand ridges are certain low broad clay banks which rise 2-3 feet above the former lagoon floor, with very gradual western slopes and steeper eastern ones. There is a good deal of gypsum in the clay. There are two such banks in the north and one in the south; the inner bank on the north runs into the outermost sand ridge of the series just described. These banks appear to define the eastern margin of the former South-East Lagoon, whereas on the west the old lake floor is bordered by a long sand ridge, some two miles long and 200-400 yards across in the form of a flat arc concave to WSW. It rises 5-6 feet above the lagoon floor and is markedly asymmetrical in cross-section, gradually sloping westwards and steeply to the east. Two bores show it to be of well-rounded, coarse sand, deeply podsolised, resting on deposits flooring the lagoon generally. This ridge reaches neither to the plateau slope on the south nor the Old Dunes on the north.

Very little peat remains on the lagoon floor, though the thicknesses of ash testify to a considerable depth in the past. Below there is generally black clay up to 3-4 feet in thickness, which includes a fair amount of plant debris. It seems likely that some at least of the finds of the surveyor, K. M. Harrison, from "a drained swamp on King Island" (Scott, 1920, 1923) came from these horizons of South-East Lagoon. The species of Harrison's interesting, but ill-documented, collection include:—

Nototherium mitchelli Owen
N. victoriae Owen
Macropus anak Owen
Zaglossus Harrisoni Scott.

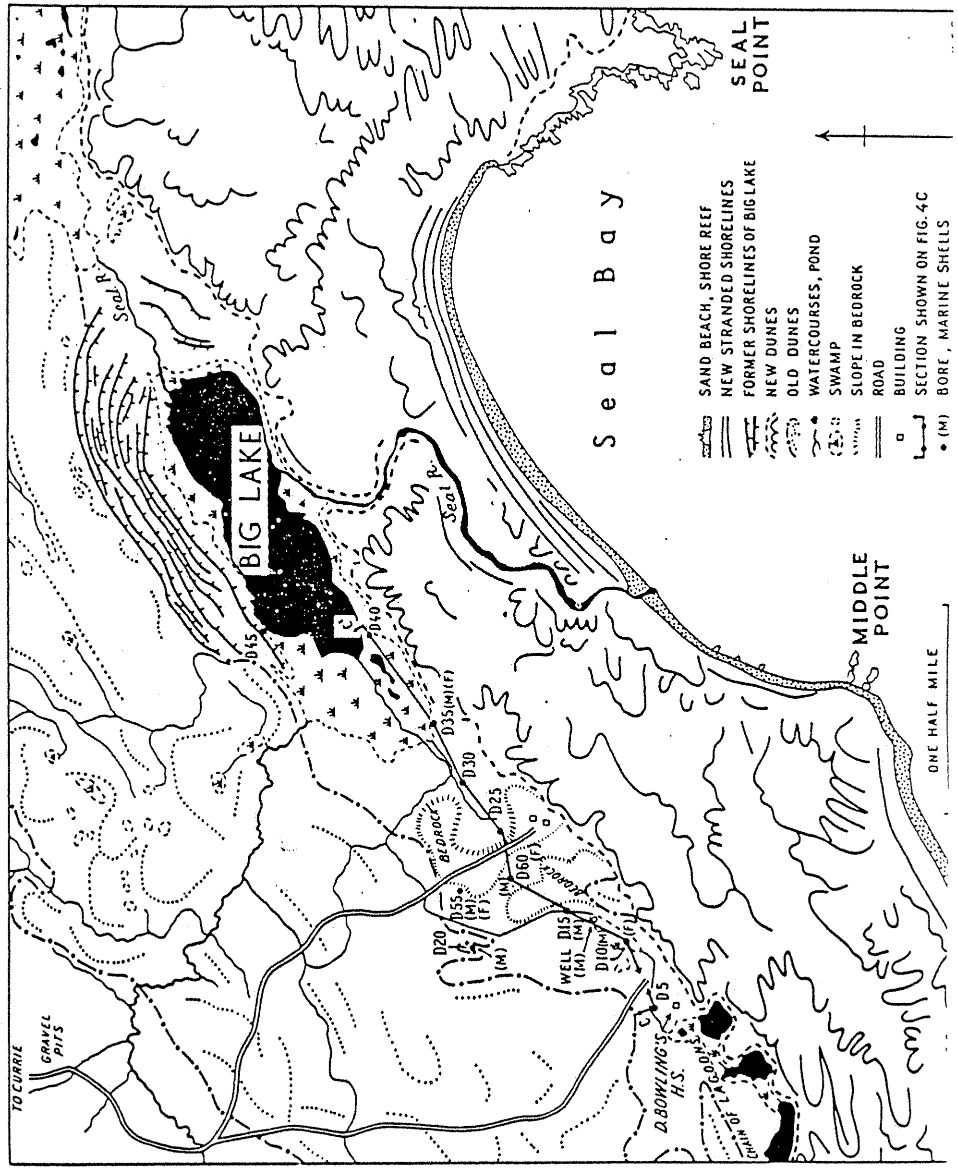

FIG. 8.—Geomorphological Features of Neighbourhood of Big Lake.

ɩeath the clay to the full depth of the hand there was an alternation of grey silty and grey or brown micaceous silt. The ation varies from less than a cm. to tens of ı scale. The coarser layers become prepon- t downwards. Thin horizons of shell marl rganic muds were also encountered. Several ended in sand and fine gravel when water ıted further penetration with the available nent.

r foraminiferal samples (App. III) from these ınd clays were indicative of three types of :ions:—

ı) Fully marine, with open-sea forms swept in to mingle with local quiet water species;
ɔ) Brackish water, but with open sea access to allow for certain forms. A tidal estuary;
:) Brackish water, with only occasional incursions of salt water. A brackish lake.

ɔ of these samples were adjacent in the bore, with the more marine one on top of stuarine one. The alternations in the sedi- ; would then seem to reflect variation in width epth of entry from the sea into this partially ɜed bay with the physiographic vicissitudes ɜ spits, bars and dunes protecting it.

ː marine mollusca (Appendix II.) from the borings and well spoil form a mixed assemb- ɔointing to transport of forms from different ɪts as at Cowper Point. However, here there ɪroportionately fewer rock reef species and small species which favour weedy areas in ɪred inlets. This agrees with the geomor- gical and foraminiferal evidence, yet there is indication of the intermittent brackish water tions shown by the foraminifera.

st of the "Manana" sand ridge the plain still almost entirely scrub-covered and not y examined. Examination of two drains, ɜ-W and one NE-SW, showed that it con- of clays and silts, with a few short sand ; rising a few feet above its surface. A bore ɩe drained bed of Alexander's Lagoon was ɩed in clays at 8 feet; few foraminifera were in it (App. III.) and freshwater conditions ɓly persisted for a long time over the lagoon

ɜ interpretation placed on the South-East ɪn data can now be presented. The sand ; east of the lagoon cannot be lacustrine, they rise higher than anything between ɜelves and the sea to the west. Therefore, are regarded as littoral features at the head ı estuary when the clays, silts and sands of rine-marine nature beneath the lagoon floor being laid down. The fact that these ridges ɔt extend farther north than they do implies when they were forming Old Dunes already ded some way south from the Cape Wickham te hills, although the gap in the Old Dunes of the main plateau was probably broader at present.

the middle of this estuary, the "Manana" ridge was built up by wave and wind action ı offshore bar (or barrier island). On emergence the plain behind this ridge became a freshwater swamp and lake. Possibly the clay banks belong to an early phase of this lacustrine phase and aeolian action on the intermittently dry floor may be involved in their construction.

Old Dune formation continued after the emergence of the estuarine-marine plain at 40-50 feet because some of them lie entirely below that level. At this point it is appropriate to mention the only marine layer found interbedded in the Old Dunes of King Island. This was in the right bank of the Yellow Rock River where it is incised in the Old Dunes immediately above the disused Yellow Rock River Cheese Factory. It is a horizontal layer predominantly of shells with some sand, 1-2 feet thick, only a few feet above the contact of the dune with the underlying granite and lying at about 15 feet above sea level. This bed must register a point in the descent of sea level from the high South-East Lagoon littoral features, a descent more fully recorded by the Old Shorelines of the east coast. The mollusc assemblage (App. II.) is similar to that from South-East Lagoon, with a rather higher proportion of littoral rock species and without the small weed dwellers.

3. *From Grassy to Surprise Bay* (fig. 2, fig. 8).

This coastal sector consists of sandy bays alternating with low rocky headlands. East of the asymmetrical ridge running south from Mt. Stanley to the Red Hut headland, the plateau slopes gradually down to the coast but is diversified by granite hills well forward of it. Along here rock coast preponderates over the constructional sections; New Dune development is exiguous. West of the ridge the south-eastward slope of the plateau lies well back from the coast, much more of which consists of sandy bays; there is a broad and continuous belt of New Dunes. Old Dunes are found extensively behind the whole sector though not without interruption. Both dune systems show more pronounced variation in the direction of advance of the parabolic dunes than elsewhere; this is partly due to the more varied bedrock relief of the sector. The main characteristic is that the parabolic dunes curve in from the sandy bays laterally behind the bases of the rocky headlands. The features close to the shore will be dealt with first, from east to west and later those behind the New Dune belt will be discussed. Because of the lack of local placenames a number of the lesser headlands have been lettered on fig. 2 for convenience.

In the bay between headlands C and D there is an island which consists entirely of cobbles above HWM and these are vegetated in their central parts. On headland C there are two high-lying cobble banks completely vegetated at the rear. All these are considered relict features unadjusted to present sea level.

From headland B most of the way to headland A, there is an inactive vegetated aeolianite cliff cut in the front of the New Dune belt. Behind headland B there is a very recent low foredune in front of this cliff, but farther west this is replaced by an emerged platform in granite, with beach boulders, in various stages of overgrowth by vegetation. At one part this is 20 yards wide with

dense scrub on it. The sharp nick at the cliff-foot was determined at two points as 6 and 7 feet above HWM. The peninsula of headland A carries a detached mass of aeolianite largely bereft of any loose sand; its seaward face is abruptly cliffed above bevelled granite. Shrub-covered cobbles are banked at its foot to 10 feet above HWM. Farther seaward on the peninsula is a stack of granite with a well-marked and partly shrubbed erosional shelf on its southern side. These various features are attributed to the 6-feet sea-level stand.

The bay between headland A and the Red Hut headland has a rocky shore and is backed by the steep slope of a high granite hill. Along its middle portion the New Dunes are absent and Old Dune sand covers the granite slope. This gullied sheet of Old Dune is overlapped on the west by new parabolic dunes which have advanced from the next bay right over the top of the bedrock hills behind the Red Hut headland. A large mutton-bird rookery extends over the junction of the dune systems and the contrast in colour of the sand thrown out of the burrows, grey-white on the east and yellow on the west, is very marked. This arrangement of the New and Old Dunes here side by side in relation to the coast, is important in relation to the features of the Red Hut headland itself.

The New Dunes have an abrupt margin overlooking this low broad headland but numerous rock outcrops in this slope show that here there is a partly buried cliff in the metamorphic and granite basement (Section, E, fig. 4). The low rock platform seaward of this feature has a very low new duneline on its western side and a low granite ridge at its eastern end. Between these two extend three parallel sand ridges in rising sequence from 22 feet of the lowest to 49 feet in the swale behind the highest. These ridges are similar in character to the Old Shoreline features of the east coast north of Naracoopa but their position in relation to the New Dunes will need discussion later (p. 28). Above the present-day shore reefs of much of this headland, great banks of cobbles, up to 1-2 feet in diameter, reach to 10-15 feet above HWM. On the seaward slope they are still actively abraded, above they are first covered in lichens and obviously undisturbed, then they pass under marsh vegetation and soil for as much as 30-40 yards. These banks are thought to belong to the 6-feet sea-level stand.

Seal Point is largely dune-covered; it is necessary to note, however, several broad vegetated cobble banks on the west, a small example of unattacked rock shelf and clifflet at 6 feet on the south and certain geos with vegetated cobble banks at their heads on the east.

Behind Seal Bay east of the mouth of Seal River, there is a fixed dune cliff in the New Dunes, with up to three foredunes in front. These are comparable in general nature and age to the New Shorelines of the east coast between Naracoopa and Lavinia Point, but since they are partly telescoped one against another, the swales between are very irregular in height.

Stokes Point has sand dunes right down to the shore reefs on most of its eastern side, whereas on the west there is a belt of rock exposed in front of the dunes. This is of varying width and consists generally of rocky hummocks rising irregularly to the middle of the peninsula, with some very flat areas near the shore. The shore consists of low reefs for the most part and shows occasional small 6-feet benches and clifflets. There is a more extensive planed rock platform at the southern tip of the peninsula which includes a flat islet cut off at high tide; this emerged platform is only backed by a recognisable clifflet at its north-west corner where the break of slope is at 9 feet above HWM. More striking than these erosional features are the broad shingle ridges and cobble ramparts which line much of this western shore of the promontory. Their crests lie between 6 and 15 feet above HWM and they are generally vegetated; some of them embank ephemeral lagoons. The coarsest material is often angular and unabraded as if quite quickly thrown into the ridge and thereafter left undisturbed.

East of the Red Hut headland, the New Dunes generally abut on the Old Dunes which, in the main, advanced WNW up to the bedrock slopes. But behind the bay between headlands C and D there is a swampy depression in the rear of the New Dunes; this rises gradually to a sharp break of slope at 20-25 feet against low granite hills and Old Dunes; this appears to be an old shoreline.

West of the Red Hut headland there is a broad depression between the New Dunes and the Old Dunes. These latter take on a different character from the usual dominant pattern of subdued parabolic dunes. Here they rise from approximately sea level to between 50 and 100 feet up the south-eastern slope of the plateau in a series of SW-NE ridges, which appear to be degraded but formerly quite substantial foredunes. The depressions between are often swampy and are occupied by a number of streams which join the Seal River and its major tributaries at right angles (see fig. 7, Jennings, 1957a). Parabolic dunes are subordinate in this area. Gravel in pits by the road south of the Black Forest lie at about 50 feet behind most of these Old Dunes; they may be marine.

The Big Swamp occupies the eastern end of the depression between the two dune systems. Low sand ridges at its eastern face face its full length and relate to a phase of open water over the extent of Big Swamp which now has only small patches of open water amongst the ti-tree swamp. There is practically no gradient in Seal River between the Big Swamp and Big Lake (fig. 7). The latter is approximately at HWM since local residents relate that kelp is carried up into the lake along the Seal River from Seal Bay at very high tides. Around the northern side and eastern end of Big Lake are arranged a series of very low sand ridges, a few inches to at most 2-3 feet in height and 5-10 yards across. There is no general rise in ground level across the belt of ridges. Their disposition makes it clear that they relate to the lake and are not seashore features of the time of Old Dune formation. The assemblage registers a contraction of the lake by progradation at its present level under the influence of south and west winds. They have ceased to form since freshwater marsh vegetation now surrounds the open water. Behind the sheltered western shore there is a deeper belt of ti-tree swamp.

ıst of this ti-tree swamp there is gently rising ed ground to the foot of a group of rock s which rise to 20-35 feet above the lake level Section C, fig. 4). Between these ridges and e west as far as Mr. D. Bowling's homestead, is level and in parts swampy ground. Beyond e Chain of Lagoons, a series of small lakes ı rise in level westwards and lie between the Dunes on one side and on the other the au slopes, here partly covered by Old Dunes.

line of bores from the Big Lake to Mr. D. ing's homestead, together with other scattered , reveals thin young sediments on the bedrock at levels of 15-30 feet above HWM; they are ly sands and fine gravels, though some silty occur near the surface. Near the surface and is quartzose but lower down the propor- of shell sand increases markedly. These sands extremely rich in marine mollusca, furnishing 70 species (App. II.). Forms from many ent habitats occur. However, intertidal rock es are much higher in proportion, sandy and y-mud bottom dwellers much lower than at h-East Lagoon and Cowper Point, suggesting rock in the vicinity of this beach deposit. corresponds closely with the geomorphological nce. Foraminiferal samples from D10, D15 D60 indicate open beach sands (App. III.) 55 similar species show by their state of preser- n that they accumulated in a stagnant lagoon: site is in fact more protected from a sea to south-east. The fossil remains, therefore, ; to an open coast of rocky reefs and pocket hes when sea level reached up to 30 feet er than at present. The fauna is in general al of Bass Strait today with the significant ptions of two warmer water foraminiferal es from D60 and one further one from D55.

low the rock ridges the sediments close to sea have fewer mollusca (three small marine es) and the one foraminiferal sample from is indicative of a marine swamp. No sea level ıges are indicated but the seaward dune er must have been less complete than now Big Lake must have been a salt lagoon.

om Whistler Point to Fitzmaurice Bay.

ıough this is the longest coastal sector, it least interest for our present purpose because massive New Dune development has covered nost evidence of earlier physiographic events. most of the sector these dunes abut directly ne shoreline, which mainly consists of low rock ;, long strike ribs in the metamorphic complex, rounded joint-controlled blocks in the granite. e are also numerous open sandy bays of ing size.

this context of a dune cover resting on a basement of slight relief, which declines ly westwards to intersect with the sea at a low e, certain types of shore profile occur which be regarded as normal to it in the first ysis.

) In the sandy bays, sand beaches front active cliffs, where any vegetation cover suffers tant modification with the vicissitudes of wind wave.

(*b*) Behind low rock reefs, an actively worked beach of sand and shingle leads to a gradual dune slope fixed or partially fixed by vegetation.

(*c*) At the most exposed points, the reefs are replaced by active low cliffs in the solid, 10-15 feet high, on which the dunes rest, e.g., just north of Currie Harbour and near Whistler Point.

(*d*) A further common coastal profile is due to the intervention of lime-rich water seepage from the dune foot at the contact with the rock. This gives rise to a strip of tufa-marsh between beach and dunes; this densely vegetated slope builds up and becomes convex through precipitation of tufa.

But, additionally, there are certain features which clearly do not relate to the present shoreline dynamics. Thus on several of the short projecting headlands small areas of exposed rock are planed off at levels 10-25 feet above HWM; similar areas occur south of Eel Creek and south of Ettrick River. They pass under gently-rising dune slopes behind. These appear to be the lower parts of marine erosional platforms, mainly still buried by the later New Dune development. At only one point is it possible to recognise a high former shoreline on this west coast sector. This is about three quarters of a mile south of the mouth of Porky Creek on Block 49/3/39 and neighbouring blocks where the very narrow New Dune belt lies in front of or banked up against an old cliffline with its foot at 35-40 feet. Behind this degraded cliff there are scattered Old Dunes.

There are also small fragments of 6-feet rock shelf and associated cliffet, colonised by plants in various degrees and showing no signs of erosion today. They are less frequent and less clearcut than those of the Naracoopa-Grassy coast. Associated with these are stretches of unattacked aeolianite cliff with narrow vegetated beach in front of them. These are very well developed south of Pass River where they are as much as 20-30 feet high. At the Dripping Wells, a mile south of the Ettrick River, a portion of such cliff has been covered by an overhanging apron of spring tufa, which creates shallow caves with stalactites and stalagmites immediately behind the beach (Jennings, 1955). In addition, the Boggy Creek tufa terraces or rimstone dams must be mentioned. These are forming between tidemarks and above HWM behind the protection of low rock reefs.

Similarly protected are a number of small patches and strips of salt marsh, e.g., near the mouth of Bungaree Creek.

A prominent feature of certain sections of this coast, e.g., on Blocks 49/3/39 and 201/3/24 south of Pork Creek and for a mile south from Currie Harbour are the wide vegetated shingle platforms at 3-10 feet above HWM. At many points these have been extensively quarried for road metal over several decades. Yet there is no evidence of refill by modern wave action: they are, indeed, colonised by various herbs and bushes, even where the pits reached right to the active beach. There are also many cobble and shingle ramparts rising to 10-15 feet above HWM; these in some cases have bushes several feet high on them. In two instances only was fresh shingle seen thrown up onto such ramparts.

At two points emerged beach deposits were seen in section. At the north-west corner of the enclosed semi-circular bay immediately south of Netherby Bay, active erosion has provided an excellent section. An exposure 25 feet long reveals a beach platform cut into and backed by semi-consolidated New Dune. The cliff-foot lies sharply at 5-6 feet above HWM. On the platform rests the beach deposit; the lower 6 inches consists of fine gravel, sand and shell fragments, above is 18-24 inches of shingle and cobbles, with some shells and sand. The mollusca numbered ten marine species, all rock reef and rock pool inhabitants (App. II.). The second occurrence is on the south side of the bay into which Three Rivers Creek flows. Below a steep dune there is a bank of beach shingle resting on a granite platform; in front are an active shingle beach and low rock reefs. Along the front of the bank erosion is exposing the stranded beach deposit at 3-5 feet above HWM over an interrupted exposure of 30-40 feet. The pebbles and occasional shells had a sandy matrix, cemented in parts by secondary calcite and in parts by iron oxide. The mollusc collection (App. II.) yielded only four species, three of which live on rocky shores between tidemarks. At both sites, the mollusca are all species of the present-day shores and no change in climatic conditions is implied: they are taken to indicate a small negative movement in the relative level of land, sea.

The most striking point about this whole sector lies in the high proportion of it where there is no marked feature of erosional activity either in the form of a low rock cliff or active dune cliff. Much of the actual beach is protected by a wide belt of low rock reefs. In view of the storminess of the sea to the west, this is hard to understand except in terms of this recent small shift in the relative level of land and sea. The presence of such features as the Dripping Wells, the Boggy Creek tufa terraces and the fragments of salt marsh underlines particularly this dichotomy between the character of this shoreline and its exposure to marine attack.

South of Currie there are a number of well-enclosed, semi-circular bays; most of these seem to be due to the partial removal of a fill of beach shingle in hollows in the rock basement, protected by a slightly higher seaward rib of rock which now forms the "hammer-headed" promontories between the bays. Netherby Bay and particularly the bay immediately to its south are rather different. Their semi-circular beaches lie partly below 10-15 feet cliffs in semiconsolidated calcareous dunes; these dune cliffs have the appearance of descending below the sea level in the inner part of the bay and in these cases it seems to be the removal of calcareous dune material from hollows in the bedrock which has given rise to the bays. If this is so, a lower sea level than the present one is implied at the time of formation of the dunes.

DISCUSSION

The evidence for changes in the relative level of land and sea from the island can now be considered as a whole and internal difficulties considered prior to a comparison with similar data from other parts of Australia when the questio of dating can also be taken up.

1. *The 225-feet Sea Level Stand.*

Waterhouse (1915) has suggested that the lowe parts of the King Island plateau, usually extremel well planed, have been smoothed by marine erosion It is true that quartz pebble gravels can be foun on flat divides well away from modern strean courses; there is, for instance such an occurrence at 220 feet on the plateau top west of Fraser Bluff In support of this idea the present study can onl point to rather indecisive spur profile steps, wit inner breaks of slope at about 225 feet, at thre points around the City of Melbourne Bay-Cotton Flat coastal embayment.

2. *The 120-150-feet Sea Level Stand.*

Similar spur flattenings in this area suggest sea level stand at 120-150 feet and this find stronger support in the Grassy scheelite mine beach boulder bed, which in the earlier stages of the open cut were observed at 120-150 feet. Buria of this boulder bed by Old Dunes makes this still-stand earlier than the time of formation of this dune system.

When a topographical survey has provided a framework of fixed heights and contours, close morphological analysis of the plateau and rivers can be brought to bear on these possible stands of base level; at the present time further discussion is not warranted.

3. *The Old Shorelines, 65 feet to Present Sea Level.*

From 65 feet above HWM downwards, evidence for former high sea level stands is extensive, varied and indubitable. But difficulties remain because the relevant features—emerged shell beds, estuarine-marine sediments, sand ridges and berms, marine terraces, sea cliffs and sea caves—occur at nearly every height below that figure. Some of this variation is, of course, due simply to inaccuracy of height determination, especially where the aneroid is used. Also when it is a question of estimating the level of a degraded cliff-foot, rounded by weathering and obscured by colluvium, the same shoreline at different places may be allocated several heights. Constructional littoral features can be built to varying heights above a given shoreline making estimation of the related sea level imprecise. These and many other difficulties which have been set out by D. W. Johnson (1932) make marine level correlation hazardous.

The relationship of the emerged shoreline features in this height range to the two major dune systems of the island provides the basis for an initial division.

The Old Shorelines from Naracoopa to Lavinia Point are intimately associated with the formation of the Old Dunes. The latter may have begun to form before the innermost shoreline of this series developed but they certainly continued to form during the period of falling base level registered by the sequence which here occurs continuously from about 40 feet down to present sea level. Though lying higher than this series, the Old Shorelines east of South-East Lagoon, together with the associated wide plain of estuarine-marine ments at 50 feet, must be correlated with them e the two series abut onto the one intervening e system. Subsequent discussion below sugs that the difference in height of the two is is not due to subsequent tilting. Differences idal range between the open shore of the east the partially enclosed waters of the west seem illy likely to explain it and the discrepancy t await more detailed work to account for it. marine shell bed at 15 feet in the Old Dunes the Yellow Rock Cheese Factory corresponds some lower point in the east coast sequence. the southern end of the island the Old Dunes ind the Big Lake-Big Swamp depression, although of the nature of foredunes and do not allow any precise formulation of the associated sea ls, yet do indicate once more that sea level Old Dune times has fallen from something of the r of 50 feet down to present sea level. The ly beach deposits on Mr. D. Bowling's farm t of Big Lake register fairly accurately sea level ids at 20-30 feet in part of this fall.

ll these constructional features so far discussed attributed to the Old Shoreline sequence lie iward of the New Dunes. There is, however, the d ridge sequence at 22-49 feet on the Red Hut dland lying in front of the New Dunes. Nore else are such high sand ridges found in it of the New Dunes on the island. They not be features younger than the New Dunes elevated to this abnormal altitude by local ft, since there is no evidence for faulting in bedrock ridge or in the New Dune system ind the headland. Morover, New Shoreline feas at their normal height also occur on the dland and as will be seen later there can be e time interval, if any, between the formation he New Dunes and such features. The explana- already given that the New Dunes advanced n west to east across the base of the headland failed to cross the headland itself to remove bury these older sand ridges is regarded as correct one, though it seems a lucky chance t the features in question survived in this way. support of it the air photos do show a rocky tom with little sand around this and many er headlands; the bays are the chief source sand for dune develepoment and this plays a ge part in the directions of parabolic dune ance along this coastal sector (Jennings, 7b).

'he marine terraces in the bedrock can now considered, first where best developed between assy and Naracoopa. The breaks of slope at the k of these terraces are scattered over a range m 60 feet down to 3 feet above HWM; neverless, they do fall into three predominant classes: at 40-50 feet; (2) at 20-30 feet; (3) at 3-9 feet. e last class is very much fresher in appearance, er carries deeply leached sand either as sand ges or true dunes but does occur quite often front of New Dunes. All the higher terraces ve a much older and degraded aspect; in certain es they carry Old Dunes and low sand ridges i berms similar to those of the Old Shorelines the Naracoopa-Lavinia Point sector. They are refore correlated with the constructional Old orelines though the possibility that the highest terraces, at least, may be older cannot be ruled out altogether.

Between Grassy and Little Grassy Creek a terrace at 20-25 feet occurs between the New Dunes and the Old Dunes and these higher marine terraces (22-39 feet) are also represented west of Disappointment Bay, one example carrying an Old Dune on its lower part.

On the west coast similar high terraces must generally have suffered burial because of massive dune development there. Between Cataraque Point and Surprise Point, however, the dunes are on top of the cliffs and here the terrace remnants, chiefly at 40-50 feet, associated "hanging coves" and abandoned sea caves, must also belong to the Old Shoreline system. So also does the better preserved terrace at the less frequent altitude of 35 feet east of Cataraque Point in the shelter of Fitzmaurice Bay. On the north side of Surprise Bay there is the small 26-feet terrace remnant in front of the New Dunes, the assumption being that the latter have passed right over it. This again is an exceptional case; more such cases would cast doubt on the standpoint taken here that the marine terraces from 20 feet upwards antedate the formation on the New Dunes.

It will be evident that the different levels in this older emerged shoreline sequence occur in an unsystematic fashion at the northern and southern ends of the island and on the western and eastern sides, though for reasons given they are less well represented on the western side. This unsystematic scatter at various levels argues against any tilting or other tectonic deformation of the island during or since the formation of the Older Shorelines. On the present evidence the features are regarded therefore, as belonging to a single progressive emergence which affected the island uniformly.

Climatically the evidence testifies to conditions not very different from todays. The marine fauna is close to that of the present Bass Strait, the plant remains at City of Melbourne Bay on the whole correspond with the historical Yarra Creek flora and the axial direction of the Old Dunes agree closely with those of the New Dunes and both can be shown to have close relation to the present wind regime (Jennings, 1957b). Two qualifications have to be made. The warmer water foraminifera from the 15-30 feet beds west of Big Lake indicate a slightly warmer climate, whereas the *Nothofagus* and *Drimys* from the City of Melbourne Bay deltaic deposit, which relates to a sea level at least as low as the present one and yet is covered by Old Dunes, indicate, if anything, slightly wetter or cooler conditions. Thus some climatic deterioration seems to have accompanied the fall of the sea relative to the land.

The breccia, resembling periglacial "head", on the hogback cliffs of the south-west coast may be the product of subsequent colder conditions.

4. *The New Shorelines.*

The New Shorelines are best expressed between Naracoopa and Lavinia Point where, in geographical continuity, they are represented by fixed and abandoned clifflines in both New Dunes and Old Shoreline sands, by definite, though modest, foredunes and by low sand ridges and berms which

Berms as wave-built structures should be clearly distinguished - incipient foredunes by presence of sand-binding veg.

at best are incipient foredunes. Contemporaneity with the New Dunes is demonstrated by the relationships of the shorelines and the dunes at Lavinia Point and at Cowper Point. Moreover, the absence of New Dunes from Sea Elephant Bay south of the Blowhole is most readily explained by regarding the cutting of the cliff into the emerged slope of Old Shorelines as simultaneous with the development of New Dunes elsewhere. Only where the New Shorelines are represented by low sand ridges do the intervening swales give a good idea of the asociated sea level; the innermost depression in these circumstances is usually between 3 and 9 feet above HWM.

Similar features are found in the constructional coasts of the eastern part of Seal Bay, at the Yellow Rock Foreland and to the east and west of Boulder Point.

All these occurrences could be the result of simple progradation of the coast without any change of sea level, particularly as most of them relate to the more sheltered aspects of the island's coast. But against this possibility are numerous other features all around the island which must be correlated with them. On all the rocky shores, both low and high, and on all aspects of the coast, are low clifflets a few feet high, steep and fresh, but vegetated and giving no evidence of present-day marine attack. Occasionally, they become cliffs 20-30 feet high. Bedrock, aeolianite and tufa are cliffed in this way. They lie behind narrow rock platforms or beaches, which apparently are equally inactive. In a few localities small sea caves, no longer reached by waves, are found. The cliff-foot lies between 3 and 9 feet above HWM. Though occurring sometimes in quite exposed positions, these unattacked platforms, beaches and clifflets are more frequent in protected localities, particularly so where they occur in the most exposed south-west coast.

It is clear from the facts given that these features do not fall into the category of storm-wave platforms recorded, for example, from Victoria and New South Wales, where they have occasioned vigorous discussion as to whether they are relict features of a higher sea level stand or the product of the present wave regime.

Additional in the present connection there are to be noted:—

(*a*) Cobble ramparts and high-lying shingle banks, between 6 and 15 feet above HWM, on some of the low rocky coasts. They show no signs of movement and are in various degrees of vegetative colonisation.

(*b*) Wide shingle platforms of the west coast, with old quarries unmodified by wave action.

(*c*) Small patches of salt marsh amongst the low reefs of the exposed west coast.

(*d*) The Dripping Wells tufa cliffs with their stalagmites and stalactites facing the open ocean and the Boggy Creek rimstone dams reaching below HWM.

(*e*) Vegetated cobble packs at the heads of geos and erosional inlets on some of the most exposed parts of the coast.

The most surprising characteristic of the King Island coast is that so much of it does not show the signs of strong marine attack; yet the storminess of its waters is well known and many of its placenames commemorate shipwrecks. Two explanations offer—a small negative movement or marked reduction in storminess of the surroundin seas. The fact that the phenomena concerned ar very generally distributed around the whole islan seems to favour the former explanation rathe than the latter. A small emergence of the orde of 10 feet affecting the island uniformly is th interpretation preferred here.

4. *Low Sea Level Stands.*

A small island, liable to strong marine erosio at times of high sea level and lacking major rive valleys where aggradation may bury low sea leve deposits, is not favourable to determining positiv movements of sea level; this is true of King Islanc Four points only need to be mentioned:—

(*a*) The disposition of cliffed dune sand an aeolianite around two small bays on the west coas suggest that these terrestrial deposits reach belov sea level.

(*b*) A submerged stream channel can be seen i air photos crossing the Tertiary limestone sea floo between The Blowhole and Cowper Point.

(*c*) The lowermost part of Grassy Creek valle seems to be incised slightly below sea level.

(*d*) On the southern part of the west coast ther is a submarine cliff with its basal break of slop at 30-35 fathoms, which David (1923) interprete as a Pleistocene low sea level marine cliff. I seems likely that this is a tectonic feature. However, there are offshore reefs and islets which als rise steeply from the sea floor at that level an the general evidence from Bass Strait (Jennings 1959, in press) suggests that David's view is acceptable and not incompatible with the feature bein a fault scarp also.

Where this submergence evidence fits into th emergence already discussed is not as yet determinable, but clearly the low sea level or level must precede the formation of the New Shorelines

CORRELATION AND DATING.

No direct evidence of the timing of the physiographic events described is as yet available; an attempt to date them must be based on inferenc and comparison with other Australian coasts.

The early work of Johnston (1877, 188) remain the best account of the Furneaux Group. Emerge beach shell beds underlie aeolianite ("Helicida Sandstone") at 40 feet on Badger and Green Islands; similar beds at undesignated but lowe heights lie beneath more recent dunes on Badge and Flinders Islands; from Arthur River valley on Flinders there is separate mention of an oyste bed at 30 feet. All these can be correlated with th Old Shorelines of King Island. Edwards (1941) quotes Johnston (1888) as recording a raised beach deposit at 100 feet on Mt. Chappel Island. Thi is a misreading; only aeolianite is described at thi level by Johnston.

From a study of a great length of the coast o N.W. Tasmania, Edwards (1941) concludes tha there are three emerged levels at 100 feet, 45-50 feet and 5-15 feet. He also mentions some coasta terraces at 30 feet. The altitudinal correlation with the King Island data are obvious.

Within this area the more detailed results o Gill and Banks (1956) come from the Duck Bayowbray Swamp area. Inland of the swamp are e Christmas Hills, old dunes with deeply leached :artz sand above sandrock; Gill and Banks regard ese as two separate deposits but quote Hubble's inion that they may constitute a giant podsol. neath the Mowbray Swamp peats, from the base which come important nototherian and other :tebrate remains, there is the marine Mella nd rising to 50 feet. Gill and Banks correlate s sand with the Rocky Cape emerged sea caves ich, in their view, were formed by a 70-feet level. But Edwards maintains that it is :essary to allow for a very thick midden fill the caves and that the relevant sea level at 50-60 feet. Gill and Banks attribute the lla Sand to the Upper Pleistocene since a C14 e from the overlying peat is >33,760 years.

'he Mella Sand plain declines seawards where :arries an "Ancient Series of Sand Ridges", ch, from their description, are very similar to Old Shorelines of Cowper Point. The mapped es lie between 30 and 15 feet but apparently ›re drainage of the swamp they occurred at ıer levels still. Farther seaward is a "Holocene es of Sand Ridges" to be compared with the Shorelines of Cowper Point. These are re-led as forming during the emergence from a -Recent 10-feet sea level. The similarity of sequence with the evidence from the north King Island is striking and not solely altitu-l.

ıe correspondence between the data from the :antial area comprising King Island, Furneaux ıp and N.W. Tasmania, in particular the close ›arability between King Island and the Mow- Swamp area, makes a provisional case for ·ding the emergences of the Old and New elines as eustatic. This is, of course, the pretation which Edwards, Gill and Banks put ıeir own data.

fering views on the origins of successive al dune systems have been held in Australia. ously, following the work of Sayles on Ber-n dunes, the view was held that the coastal systems were formed at the time of Pleisto-glacial low sea levels when the retreating xposed the marine sands of the shelf floor ›lian attack (Coulson, 1940; Gill, 1943; Fair-:, 1947; Teichert, 1947). But, from their :ndent studies of the coastal dune ridges of .E. Province of South Australia, both Hoss-1950) and Sprigg (1952) came to regard dunes as forming at the high sea level ; of Pleistocene interglacials or interstadials. related each dune ridge to a single maxi-sea level, whereas Hossfield thought some l to maxima and others to halts in the rom these maxima. Moreover, Teichert and idge (1952) revised their earlier views in the ›f studies of soil horizons within the West lian aeolianite dunes. They also came to the sion that beach conditions similar to present 'ere sufficient for dune formation and that ›elts could form during any halt in the :ene glacioeustatic oscillations. Unless tec-novements are involved, the dunes on the ırface will belong to interglacials or inter-;, whereas any dunes of glacial periods will ıd submerged on the continental shelf.

The King Island evidence shows clearly the association of the dune systems with high sea level shorelines and supports the second standpoint.

The immaturity of soil profile development on the New Dunes of King Island and their freshness of form precludes their having survived a glacial low sea level period even if that were only the final advance of the Last Glaciation. They belong to the Holocene. The pronounced degradation of form and greater maturity of soil profile presumes a much greater age on the part of the Old Dunes and the intervention of a glaciation or a glacial stadium between the formation of the two systems. It is logical, therefore, to attribute the Old Dunes to either the last interstadial or the Last Interglacial. Reasons will follow for preferring the latter alternative.

Claims for a 10-feet Mid-Holocene eustatic high sea level come from such widely-scattered localities around Australia and are based on such diverse shoreline features that they are not easily set aside. From West Australia there are Teichert's and Fairbridge's studies of benches in aeolianite and coral reefs; from Victoria, Coulson and Gill have employed emerged shell beds; from the black sand seams of the coasts of New South Wales and Queensland, Beasley and Gardner independently derived a 10-feet Recent level. The New Shoreline features of King Island are therefore regarded as a further expression of this Recent 10-feet stillstand and of the succeeding emergence.

According to Gill (1956) evidence for a 25-feet level stand is the most widespread higher level in Victoria. Through Carbon-14 dating this is attributed to the Last Interglacial; mollusca and foraminifera suggests a warmer climate. Baker (1950) mentions briefly marine terraces and notches at 40 feet and 60-70 feet from W. Victoria.

Teichert and Fairbridge (1952) ascribe the Cowaramup Bay Conglomerate and other deposits in West Australia at 5-15 feet to the last Wurm II/III interstadial. The Peppermint Grove Formation of Perth is regarded as indicating a 25-feet sea level stand of the earlier Wurm I/II interstadial. These attributions are based mainly on the unsatisfactory basis of altitude correlation with England and N. Africa. Moreover, the Guildford Clay is correlated with the Peppermint Grove Formation and as the former is described as rising to 50 feet, it upsets the altitude correlation in any case. Gardner (1955) finds evidence for high sea levels of 20 feet and 45 feet along the north N.S.W. coast; the former belongs in his view to the last Wurm interstadial and the latter to the Riss-Wurm Interglacial, with the earlier Wurm interstadial unrepresented.

In this context any correlation of the King Island Old Shorelines is uncertain but the closest correspondence is with the Mowbray Swamp sequence. This sequence has the advantage of a C-14 dating. On this basis, the Old Shoreline sequence of King Island with its range of erosional and constructional features from over 60 feet down to sea level, but with more important halts at 40-50 feet and 20-30 feet is provisionally attributed as a whole to the Last Interglacial. A Carbon-14 dating of the wood from the City of Melbourne Bay deltaic deposit will provide a useful test of this correlation.

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APPENDIX I.—PLANT REMAINS FROM DELTAIC DEPOSIT EXPOSED IN CLIFF OF CITY OF MELBOURNE BAY

Fossil Wood (Identified by Mr. H. D. Ingle, C.S.I.R.O. Division of Forest Products)

Eucalyptus sp.
Nothofagus sp.
Hardwood, not either of the above.

Fossil Pollen and Spores (Identified by Dr. S. Duigan, University of Melbourne)

POLLEN		
Phyllocladus aspleniifolius	91.5 %	Expressed as % of total pollen count
Drimys lanceolata	4.5 %	Expressed as % of total pollen count
Nothofagus cunninghamii	1.0 %	Expressed as % of total pollen count
Myrtaceae	0.5 %	Expressed as % of total pollen count
Unknown dicotyledons	2.5 %	Expressed as % of total pollen count
SPORES		
Unknown ferns including *Dicksonia ?* sp. & *Todea ?* sp.)	17.5 %	Expressed as % of total pollen count
Cyathea [illegible]	2.5 %	Expressed as % of total pollen count
Polypodium sp.	[illegible] %	[illegible]

APPENDIX II.—MOLLUSCA FROM KING ISLAND.

J. Hope Macpherson
(National Museum of Victoria)

+ denotes species present.
J denotes juveniles only of species present.
? denotes uncertain identification.

OWPER POINT:

	New Shorelines and Dunes									Old Shorelines		
Bore No.	8	70	71	72	73	77	100	101	106	186	196	204
Sample No. 15	A	B	C	D	E	F	G	H	J	K	L	M
nculus floridus Philippi	..	..	..	..	..	+	..	..	..	..	..	..
strocochlea adelaidae Philippi ..	+	..	..	..	..	..	..	..	+	+	+	..
constricta Lamarck	+	..	..	..	..	..	..	..	..	..	..	..
odontis Wood	..	..	+	..	..	..	..	+	..	..	..	..
ntharidus ramburi Crosse	..	..	..	..	..	..	..	..	..	..	+	..
bninella undulata Solander	+	+	+	..	+	+	..	..	..	+	..	+
crastrea aurea Jonas	+	..	..	..	..	..	..	..	..	..	..	..
asianella sp.	..	..	..	..	..	..	..	..	..	..	?	..
ventricosa Swainson	..	..	+	..	..	..	..	..	+	..	..	..
apatella calyptraeformis Lamarck ..	..	..	..	..	..	..	..	..	..	..	+	..
pponix sp.	..	..	..	..	..	..	..	..	?	..	..	..
conica Schumacher	+	+	..	..	..	..	..	..	..	..	+	..
icumantus cerithium Q. and G. ..	+	..	+	..	+	+	..	+	..	..	..	..
rritella sp.	..	..	+	..	..	..	..	..	..	..	..	..
rbonilla mariae T. Woods	..	..	..	..	..	..	..	..	..	..	+	..
atriria merces Iredale..	+	..	..	..	..	..	..	..	..	..	..	..
nitrella semiconvexa Lamarck ..	..	..	..	..	..	..	..	..	..	..	+	..
ninella lineolata Lamarck	+	..	..	..	..	..	..	..	?	..	..	..
cospira marginata Lamarck ..	..	..	..	..	..	..	..	..	?	..	..	..
petterdi Tate	..	..	..	..	..	..	..	..	..	..	+	..
rginella sp.	..	..	..	..	..	..	..	..	+	..	..	..
formicula Lamarck	..	..	..	..	..	..	..	..	..	..	+	..
rita metralis Adams and Angus ..	..	..	..	..	..	..	..	..	..	..	+	..
raconus anemone Lamarck	..	..	..	..	..	..	..	+	..	..	..	..
inator fragilis Lamarck	+	..	..	..	..	..	..	..	..	..	..	..
cymneris sp.	..	..	..	?	..	..	..	..	..	..	?	?
radians Lamarck	?	?	?	..	..	..	..	+	..	?	..	..
triatularis Lamarck	..	..	..	..	..	..	..	..	+	..	..	..
rea angasi Sowerby	..	..	..	..	..	..	..	..	+	..	..	..
iericardia calva Tate	..	..	..	..	..	..	..	..	..	?	..	..
ukia crassilirata Tate	..	..	..	..	..	..	..	+	..	..	..	..
atei Angas	+	..	..	..	..	..	..	..	..	..	..	..
dium sp.	..	?	..	..	..	..	..	?	..	..	..	..
iphina undulosa Lamarck	+	+	..	+	+	+	..	?	..	..	..	..
elysia sp.	..	..	..	..	..	..	..	..	..	?	..	..
peroni Lamarck	..	..	..	?	..	..	..	..	..	..	..	..
scalarina Lamarck	+	+	+	+	+	..	..	+	..	..	..	..
rhytiphora Lamy	+	+	+	+	+	+	+	+	..	..	+	..
era galinula Lamarck	..	..	..	+	+	+	..	+	..	+	+	..
pissa Deshayes	..	..	..	..	..	..	..	..	..	..	+	..
ospisula trigonella Lamarck ..	..	..	+	..	..	..	..	..	..	..	..	..
odesma angusta Reeve	..	..	..	..	..	..	..	+	+	..	..	..

THE NOOK: 100–290 cm. Samples Nos., 42, 45, 59 and 61

Clanculus aloysii T. Woods	+
Astraea sp.	J
Elachorbis cf. *caperatum*	+
Laevilitorina mariae T. Woods	+
Diala lauta A. Adams	+
D. pulchra A. Adams	+
Assiminea brazieri T. Woods	+
Zeacumantus cerithium Q. and G.	+
Retusa amphizosta Watson	+
Cominella eburnea Reeve	+
Cylichnina iredaleana Hedley	+
Salinator sp.	+
Melliteryx hemsi Hedley	+
Katelysia peroni Lamarck	+

SOUTH EAST LAGOON AND NEIGHBOURING BORES:

Bore No.	2	2	2	3	35	40	Well in middle lagoon	Old mill well	D. Clonon's Bore	H. Lot's B...
Depth		44–48″	48–52″	60–66″	3–3.5m	2.7–3.1m				
Sample No.	63	64	35	65	66	50	68	70	56	13
Clanculus plebejus Philippi	+	..	+	..	..	..	..	..	..	..
Hypotrochus monachus Crosse and Fischer	..	..	+	..	..	..	..	..	..	..
Subninella undulata Solander	..	..	..	..	..	..	..	..	..	+
Estea tasmanica T. Woods	..	+	+	..	..	..	..	..	..	..
Laevilitorina mariae T. Woods ..	..	..	..	..	+	+	..	..	..	..
Diala pagodula A. Adams..	+	+	..	..	..	..	..	..	..	..
D. pulchra A. Adams	..	+	+	..	..	..	..	..	..	..
Assiminea brazieri T. Woods	..	..	+	..	..	+	..	..	..	..
Cithna angulata Hedley	..	..	+	..	..	..	..	..	..	..
Rissoa sp.	..	..	+	..	..	..	..	..	..	..
Cerithium sp.	..	+	+	..	..	..	..	..	..	..
Eubittium insculptum (Reeve)	..	..	+	..	..	..	..	..	..	..
Odostomia metcalfei P and Gat.	..	+	..	..	..	..	..	..	..	..
Zemitrella sp.	..	..	J	..	..	..	..	..	..	..
Z. semiconvexa Lamarck	?	..	..	..	..	..	..	..	..	..
Nassarius sp.	..	..	?	..	..	..	..	..	..	..
Parcanassa sp.	..	..	?	..	..	..	..	..	..	..
P. pauperata Lamarck	..	..	..	..	..	..	..	..	..	+
Microvoluta sp.	..	..	J	..	..	..	..	..	..	–
Marginella sp.	..	?	..	..	..	..	..	..	..	..
Ostrea angasi Sowerby	..	..	..	..	..	..	..	..	..	+
Notomytilus rubra Hedley..	..	+	..	..	..	..	..	..	..	..
Venericardia sp.	..	J	..	..	..	..	..	..	..	..
Melliteryx helmsi Hedley	..	..	..	..	..	+	..	..	..	..
Cardium sp.	..	..	..	..	..	..	..	..	?	..
Katelysia sp.	..	..	..	?	..	..	..	..	..	..
K. peroni Lamarck	..	..	..	..	..	..	+	..	..	..
K. scalarina Lamarck	+	..	..	..	..	..	..	..	..	..
K. rhytiphora Lamy	+	..	..	..	..	..	..	+	?	+

LOW ROCK CHEESE FACTORY: Sample No. 56.

Amblychilepas javanicensis Lamarck	+	*Glycymeris radians* Lamarck	+
Sophismalepas oblonga Menke	+	*G. striatularis* Lamarck	+
Haliotis sp.	?	*Ostrea angasi* Sowerby	+
Cellana tramoserica Sowerby	+	*Cardium* sp.	?
Micrastrea aurea Jonas	+	*Gomphina undulosa* Lamarck	+
Hipponix conica Schumacher	+	*Tawera gallinula* Lamarck	+
Pleuroploca australasiae Perry	+	*Notispisula trigonella* Lamarck	+
Floraconus anemone Lamarck	+	*Mesodesma angusta* Reeve	+

OWLING'S FARM (between Chain of Lagoons and Big Lake).

	Higher Sediments								Lower Sediments	
Bore No.		D10	D15	D15	D20	D55	D55	D60	D35	D35
Depth	well	1.5–1.9m.		1.45–1.6m.	1.75–2.45m.	1.15–1.36m.		1.05–1.6m.	1.55–1.65m.	1.7–1.8m.
Sample No.	40	47	49	52	58	41	55	38	44	37
...mulepas crucis Beddome	..	..	..	..	..	+	..	..	..	..
...nga Menke	+	..	..	..	..	..	..	..	..	..
...chisma tasmaniae Sowerby	..	..	..	..	..	+	..	..	..	..
...is roei Gray	..	..	..	..	..	..	+	..	..	..
...er Leach	..	..	+	..	..	..	..	+	..	..
...dus aloysii T. Wood	..	..	..	..	..	+	..	+	..	..
...ejus Philippi	+	..	..	..	..	+	..	+	..	..
...a sp.	..	..	..	..	..	..	..	+	..	..
...opoma aspersa Philippi	..	..	..	..	..	+	..	..	..	..
...otrochus sp.	..	..	?	..	..	?	..	..	..	..
...nius Perry	+	..	..	..	..	+	..	?	..	..
...ria fasciata Menke	..	..	..	..	..	..	..	+	..	..
...ridus ramburi Crosse	+	..	..	..	..	+	..	..	..	..
...cochlea adelaidae Philippi	..	..	+	+	+	+	+	..	..	..
...stricta Lamarck	+	..	+	..	..	..	..	..	..	..
...ntis Wood	+	..	+	+	..	+	+	+	..	..
...ochus monachus C. and F.	..	..	..	..	..	..	..	+	..	..
...rochus sp.	..	..	?	..	..	..	..	..	..	..
...ella undulata Solander	+	..	..	..	..	+	..	..	..	..
...trea aurea Jonas	..	..	+	+	..	+	+	..	..	..
...nella sp.	..	..	..	+	+	..	..	..	..	..
...ricosa Swainson	..	..	+	..	..	..	+	+	..	..
...tia subquadrata T. Woods	..	..	..	..	..	+	..	..	..	..
...rbis harriettae Petterd	..	..	..	..	..	?	..	..	..	..
...euca calamus C. and F.	..	..	..	..	..	..	..	+	..	..
...solida Blainville	..	..	+	..	..	..	..	..	..	..
...ŭnaea sp.	..	..	..	..	..	?	..	?	..	..
...ida alticostata Angas	..	..	..	..	..	+	..	..	..	..
...torina mariae T. Woods	..	..	..	..	..	..	..	..	+	+
...rissoina tasmanica T. Woods	..	..	..	..	..	..	..	..	..	+
...tella calyptraeformis Lamarck	..	..	..	..	..	..	..	+	..	..
...bia foliacea Q. and G.	+	..	+	..	+	?	..	+	..	..
...ix conica Schumacher	+	..	+	..	..	..	+	..	..	..
...erithium serotinum A. Adams	..	..	..	..	..	..	..	+	..	..
...antus cerithium Q. and G.	..	..	..	..	+	..	..	..	..	..
...a angasi Crosse and Fischer	..	..	..	..	..	..	..	?	..	..
...na petterdi Crosse	..	..	..	..	..	..	..	+	..	..
...illa hofmani Angas	..	..	..	..	..	+	..	..	..	..
...iae T. Woods	..	..	..	..	..	..	..	+	..	..
...cori Pilsbry	..	..	..	..	..	+	..	..	..	..
...ella lesueuri Iredale	+	..	..	..	..	..	..	+	..	..
...icosa Reeve	+	..	..	+	..	+	..	+	..	..
...oraea angustata Gmelin	..	..	+	..	..	..	..	..	..	..
...ia merces Iredale	..	..	+	..	..	..	..	..	..	..

D. BOWLING'S FARM: *continued—*

	Higher Sediments								Lower Sediments	
Bore No.		D10	D15	D15	D20	D55	D55	D60	D35	D35
Depth	well	1.5–1.9m.		1.45–1.6m.	1.75–2.45m.	1.15–1.36m.		1.05–1.6m.	1.55–1.65m.	1.7–1.8m.
Sample No.	40	47	49	52	58	41	55	38	44	37
Litozamia brazieri T. Woods	..	..	..	..	..	+	..	+	..	..
Lepsiella reticulata Blainville	..	..	..	+	..	..	?	..	..	..
Zemitrella austrina Gaskoin	..	..	..	+	..	..	..	..	..	..
Z. semiconvexa Lamarck	+	+	+	+	+	+	..	..	..	..
Z. tenebrica Reeve	..	..	..	+	..	..	..	..	..	..
Reticunassa mobilis Hedley and May	..	..	..	..	..	..	..	+	..	..
Tavaniotha tasmanica T. Woods	..	..	..	..	+	..	..	+	..	..
Cominella eburnea Reeve	..	..	..	..	+	..	..	..	..	..
C. lineolata Lamarck	..	..	+	..	..	+	..	..	..	..
Alocospira lineata Kiener	..	..	..	..	+	..	..	..	..	..
A. marginata Lamarck	+	..	+	..	..	..	?	..	..	..
A. petterdi Tate	..	..	..	..	..	+	..	..	..	..
Marginella sp.	..	..	?	..	?	..	..	..	..	..
M. formicula Lamarck	..	..	..	+	+	..	..	+	..	..
M. inconspicua Sowerby	..	..	..	+	..	..	..	..	..	..
M. ovulum Sowerby	..	..	..	..	..	+	..	..	..	..
M. pygmaea Sowerby	..	..	..	?	..	+	..	+	..	..
Austromitra angasi Brazier	..	..	..	..	..	+	..	..	..	..
Floraconus sp.	..	..	..	..	?	..	..	..	..	..
F. anemone Lamarck	..	..	+	..	..	..	..	..	..	..
Pseudodaphnella modesta Angas	..	..	..	..	..	?	..	..	..	..
Terebra ustulata Deshayes	..	..	..	..	..	..	..	+	..	..
Siphonaria diemensis Q. and G.	..	..	..	..	..	+	..	+	..	..
Glycymeris sp.	..	..	..	..	..	?	..	..	..	..
Arca pistachia Lamarck	..	..	+	..	..	..	..	..	..	..
Mytilus sp.	..	..	..	..	..	..	?	..	..	..
Modiolus pulex Lamarck	..	..	..	..	..	..	..	+	..	..
Cardita calyculata Linne	..	..	..	..	..	..	..	+	..	..
Melliteryx helmsi Hedley	..	..	..	..	..	..	..	..	+	..
Mysella donaciformis Angas	..	..	+	..	..	..	..	..	..	..
Tawera gallinula Lamarck	..	..	..	..	..	+	+	..	..	..
T. spissa Deshayes	..	..	..	..	..	..	..	+	..	..
Hiatella australis Lamarck	..	..	..	..	..	+	..	..	..	..

THREE RIVERS: Sample 31.

Austrocochlea sp.	?	*Micrastraea aurea* Jonas	+
Cellana solida Blainville	+	*Pleuroploca australasiae* Perry	+

BAY SOUTH OF NETHERBY BAY: Sample 16.

Austrocochlea adelaidae Philippi	+	*P. victoriana* (Singleton)	+
A. constricta Lamarck	+	*Patellanax peroni* Blainville	+
A. odontis Wood	+	*Dicathais textiliosa* Lamarck	+
Subinnella undulata Solander	+	*Zemitrella semiconvexa* Lamarck	?
Patelloida alticostata Ongas	+	*Cominella lineolata* Lamarck	+

APPENDIX III.—REPORT ON FORAMINIFERAL SAMPLES FROM KING ISLAND, TASMANIA

A. C. Collins

oling's Farm, Surprise Bay.

Sample 38, Bore D60. Dark-grey shell and quartz sand, 105-160 cm.

Residue after washing is almost entirely calca-us; bryozoan fragments are dominant; there also small mollusca, echinoid spines, sponge ;ules, worm tubes, ostracoda. Many foramini-a are present, over 100 spp. Some small sharp-ed quartz grains occur.

'loatings mostly consist of the lighter bryozoan gments with foraminifera, ostracoda and gas-opod molluscs. The foraminiferal assemblage that of an open-sea beach sand as found on mainland at places like Torquay with the ex-tion of two species. *Quinqueloculina monynensis* so far been recorded only from the warm-water istocene shell-beds of Port Fairy. *Poroeponides* *ralis* is a tropical species. One specimen only found, poorly developed, but otherwise typical.

Sample 41, Bore D55. Grey shell sand, 115-136 cm.

Residue after washing and floating similar to se of sample 38. The foraminiferal assemblage about 70 spp. is that of an open-sea beach sand composition but not in preservation. Many of miliolid tests are stained grey or black, in ie cases the whole test being a polished jet-ck. This suggests deposition under reducing iditions, e.g., material derived from adjacent illow-water being carried by waves or high es into a stagnant lagoon.

Two specimens of the foraminifera, *Fabularia* sp. *lata* Collins were found in this material, both ck-stained like other miliolids. The only pre-us record for *F. lata* is from warm-water Pleis-ene shell beds at Port Fairy, Vic., while a sely-similar, if not identical, form has been orded from shallow water off Kingston, South stralia. The genus has in general been recorded m warm-water deposits from the Eocene on-rd. This record suggests rather warmer climatic iditions at the time of deposition than at sent.

Sample 47, Bore D10. Shell and quartz sand, 150-190 cm.

Residue after washing consists of clear quartz id, grains well rounded, with a good deal of ll debris, echinoid spines, bryozoan fragments, aminifera, &c.

'loatings consist mainly of foraminifera, about spp., of recent shallow-water Bass Strait facies; o there are the lighter fragments of bryozoa, racoda and small mollusca. The material is a ical open-sea beach sand.

Sample 38, Bore D35. Grey quartz sand and gravel with occasional shell fragments, 170-180 cm.

Residue after washing consists mainly of quartz sand, larger grains rounded, smaller angular, also some larger fragments of greenish fine-grained rock. A good deal of carbonaceous matter is present, adhering to the sand grains and giving the material its dark colour.

Floatings contain a fair number of foraminifera, of about 55 spp. and a normal shallow-water Bass Strait facies. Specimens are mostly rather small, with surfaces dulled or eroded and in some cases dark-stained. Other organisms include discoidal diatom tests, sponge spicules, ostracoda and coxi-ellid gasteropods.

Foraminiferal and other evidence suggests condi-tions of normal salinity but somewhat sapropelic bottom conditions, not very favourable to the growth or preservation of foraminifera, e.g., a marine swamp.

South-East Lagoon.

Sample 34, Alexander's Lagoon. Grey clay, 92-96 in.

Residue is mostly sharp clear quartz grains. Floatings consist mainly of a matted accumulation of a bright-green stellate desmid alga. One speci-men of a foraminifera was found—*Fissurina* sp., in poor condition, possibly adventitious.

Evidence is negative only; the deposit is presum-ably freshwater.

Sample 35, Bore 2. Dark-grey silty clay, with shells, 58-52 in.

Residue after washing is mostly shell debris with fibrous carbonaceous matter; there are some fine quartz grains and a good deal of mica.

Floatings include small mollusca, with many coxiellids, ostracoda, and very many specimens of a species of the foraminiferal genus *Streblus*, so common as to make up about a quarter of the entire float. Five spp. of the genus *Elphidium* were present, the remaining 19 spp. being all such as are found in the shallow waters of Bass Strait, with no arenaceous miliolid forms.

The preponderance in numbers of the species of *Streblus* and *Elphidium*, genera known to have species tolerant of low salinities, combined with the paucity of other species, suggests brackish-water tidal conditions, as in an estuary.

Sample 36, Bore 2. Green-yellow clay-gyttja, with shells, 44-48 in.

Residue after washing consist mainly of mollus-can shell-fragments, clean and well preserved, with ostracoda, echinoid spines, &c., and a good deal of mica. Some fairly large quartz grains are subangular or sharply facetted.

Floatings consist largely of small foraminifera, well preserved and unstained, with a strong ele-ment of large specimens of *Elphidium* sp. sf.

crispum (L). There are also some large specimens of *Streblus* sp., but they are not common. The smaller species are of similar facies to sample 35.

This is an assemblage which almost suggests two separate provenances—a local quiet-water marine element consisting of the larger species, and a current-transported assemblage of the smaller and lighter forms from an open-sea source. Corio Bay, Vic., has shore-sand assemblages domi-nated by this species of *Elphidium*. There does not seem to be any strong evidence of low salinity. Mineral contents suggest short travel of the quartz and mica fraction. The development and good pre-servation of the larger foraminiferal and molluscan shells seems to be at variance with sapropelic bottom conditions as suggested by the identifica-tion of the deposit as clay-gyttja.

Sample 50, Bore 40. Grey clay-silt, with shells, 270-310 cm.

Residue after washing is a fine-grained calca-reous sand, with shell debris, foraminifera, ostra-coda, small mollusca, echinoid spines, sponge spi-cules and some clear quartz grains.

Streblus sp. is dominant in the floatings, which also contained coxiellid gasteropods. Other fora-minifera, about 50 spp., were of shallow-water open sea facies, with some grey-staining and erosion. The foraminiferal and other evidence suggests brackish-water conditions with open sea access, e.g., tidal estuaries.

Sample 53, Bore 45. Grey silt with shells, 255-268 cm.

Residue after washing is mostly of angular quartz grains with mica flakes.

Floatings consist almost entirely of coxiellid shells, with a few foraminifera dominated by *Streblus* sp., grey-stained and eroded. The evi-dence suggests brackish-water lake conditions with occasional access by the sea.

Egg Lagoon.

Smple 54. White shell sand, 197-260 cm. Bore at *Nototherium* site (whereas all above are estuarine-marine sediments, this may be an aeolianite mashed up in the auger).

The material consists mostly of calcareous frag-ments with some quartz grains, rather angular. Shell fragments and foraminifera have a rather "frosted" appearance, including those which are naturally glassy and translucent. The material compares rather closely with an aeolianite from Cape Grim, Tas. (coll. E. D. Gill), and is probably of similar provenance. There are about 60 spp. of foraminifera, all Bass Strait forms, with the exception of *Calcarina* sp. cf. *calcar* d'Orb. *Calcarina* as a genus is tropical in distribution. Specimens found are not well preserved but are rather like a form found in Western Australian and Barrier Reef waters. Genus was recorded also from the Pleistocene of Port Fairy. It is not known as recent in Bass Strait.

The ecological indications vary from probable fresh-water deposits to marine beach-sand. The only evidence of climatic difference is given in the occurrence of *Quinqueloculina moynensis* and *Poroeponides lateralis* in Sample 38, of *Fabularia* sp. cf. *lata* in Sample 41, and of *Calcarina* sp. in Sample 54. These invite comparisons with the climate of the last Pleistocene warm period. They also, indirectly, give some age evidence, since to the best of my knowledge these species do not occur in the Bass Strait area in the recent state. Other-wise all species appear to be of recent Bass Strait facies.

LIST OF SPECIES IDENTIFIED

NOTE—"Discorbis" s.l has recently been subdivided into a number of genera by Bermudez.. These records are ver kept under the names recorded in the literature for convenience in reference. All are well-known species.

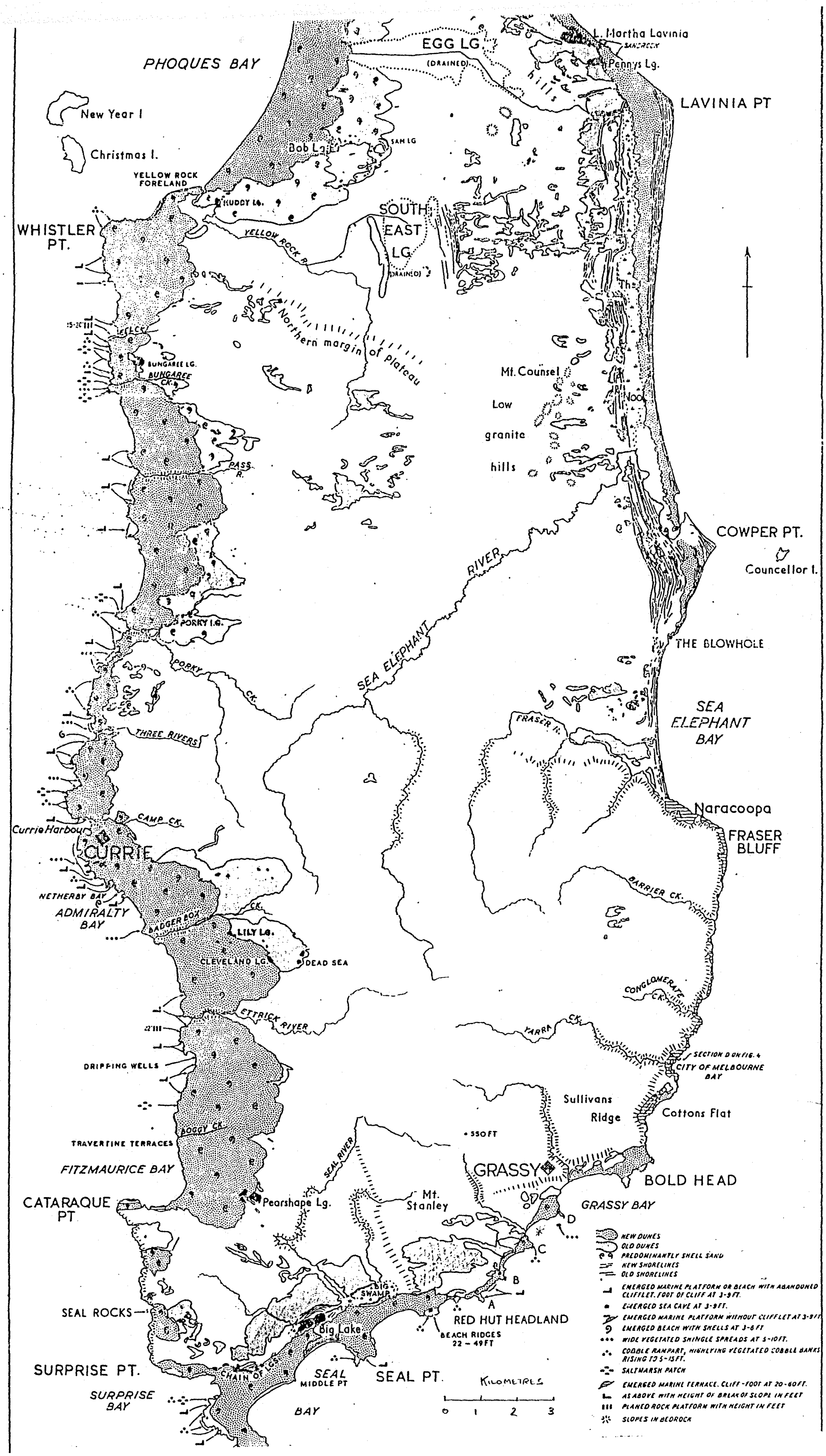
+ denotes species present. ≈ denotes dominant species.

	Samples								
	38	41	47	37	35	36	50	53	54
aria agglutinans d'Orb.	..	+	..	..	..	..	..	..	..
udogramen Chapman and Parr	+	..	+	+	..	..	..	..	..
ittula Defrance	+	+	+	..	..	..	..	..	..
yina (Pseudogaudryina) hastata Parr	+	+	+	+	..	..	..	..	..
ina difformis Brady	+	..	..	..	..	..	+	..	..
eloculina costata d'Orb.	+	..	+	..	..	..	..	..	..
iguyanathi Parr	+	+	+	..	..	..	..	..	..
lyana Cushman	+	..	..	..	..	..	..	..	..
arckiana d'Orb.	+	+	..	..	..	..	..	..	..
nensis Collins	+	..	..	..	..	..	..	..	..
polygona Parr	+	+	+	..	..	..	..	..	..
culina angusteoralis Parr	+	..	..	..	..	..	..	..	..
Cushman and Todd	+	..	+	..	..	..	..	..	..
lina australis (Parr)	+	..	+	..	..	..	..	..	..
lina labiosa d'Orb.	..	..	+	..	..	..	..	..	..
oblonga (Montagu)	+	+	+	..	..	..	+	..	..
rinata d'Orb.	+	..	..	..	..	..	..	..	..
nula (Lamarck)	+	+	+	+	..	..	..	..	+
totrigonula (P. and J.)	+	+	..	..	..	..	..	..	..
epressa (d'Orb.)	+	+	+	+	..	..	..	..	+
lobulus Parr	..	+	..	..	..	..	..	..	..
nella globula (Born.)	+	+	..	+	..	..	..	..	+
ia sp. aff. lata Collins	..	+	..	..	..	..	..	..	..
ia coronata (Millett)	+	..	..	..	..	..	..	..	..
la funalis (Brady)	+	..	..	..	..	..	..	..	..
lina crepidula (F. and M.)	..	+	..	..	..	..	..	..	..
(d'Orb.)	+	+	+	..	..	..	..	..	+
ulus) suborbicularis Parr	..	..	..	..	..	..	..	..	+
ria australis Chapman	+	..	..	..	..	..	..	..	..
ina vertebralis Parr	+	..	..	..	..	+	..	..	..
nsis Parr	+	+	+	..	..	..	..	..	..
is Brady	..	..	..	..	..	..	+	..	..
oryne scalaris (Batsch)	+	+	+	+	..	..	..	..	+
laevis (Montagu)	..	+	..	+	..	..	..	..	..
na-margaritifera P. and J.	+	+	..	..	..	..	..	..	+
na-margaritifera var. victoriensis Parr	+	+	..	..	..	..	..	..	..
losa Chapman	+	+	+	+	..	+	+	..	+
a (Walker and Jacob)	+	..	+	..	..	..	..	+	..
cida (Montagu)	..	..	..	..	+	..	..	..	..
uticosta Parr	..	..	..	..	..	..	+	..	..
mpulla-distoma (R. Jones)	..	..	..	+	+	..	..	..	..
a (Williamson)	+	+	..	..	..	+	..	..	..
a (Montagu)	+	+	+	+	..	..	..	..	..
ona (Williamson)	+	+	+	+	..	..	+	+	+
osa (Montagu)	+	..	..	..	..	..	..	..	..
a (Brady)	+	..	+	..	+	..	..	..	..
a clathrata (Brady)	..	..	..	..	..	+	..	..	..
ta (Burrows and Holland)	+	+	+	+	..	..	..	..	+
nato-perforata Seguenza	+	+	+	..	..	..	..	..	..
yana (Seguenza) var.	+	+	+	+	..	..	..	..	+
ides (Williamson)	..	+	..	..	..	..	..	..	..
udrata Parr	+	..	..	..	..	..	..	..	..
(Williamson)	+	..	+	..	+	..	+	+	..
iata (Walker and Boys)	+	..	+	..	..	+	+	..	+
rina quadrata Parr	..	..	+	..	..	..	..	..	..
lactea (W. and J.)	+	..	+	..	..	..	..	..	+
na d'Orbigny	+	..	..	..	..	..	..	..	..

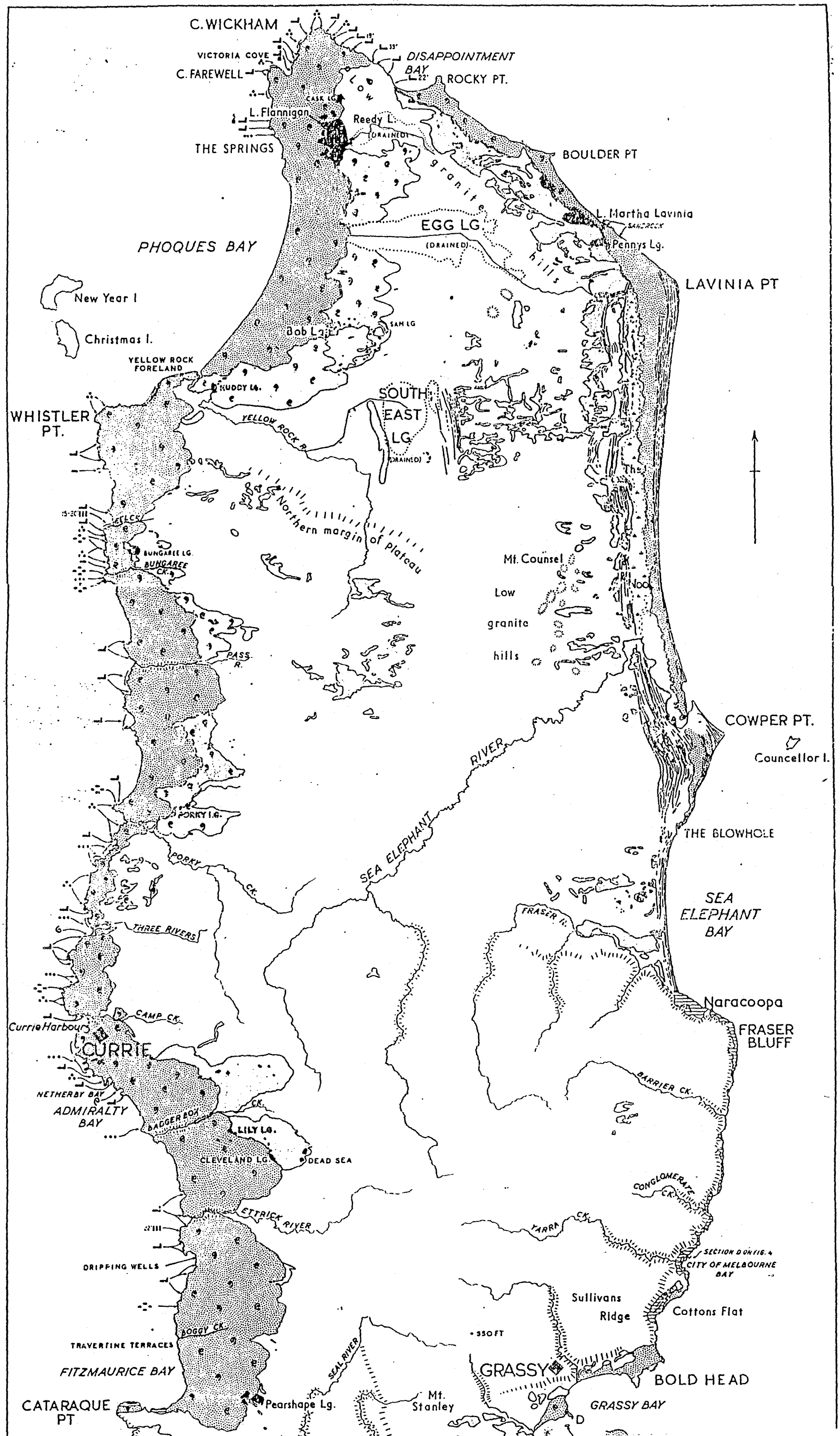
	Samples								
	38	41	47	37	35	36	50	53	54
G. regina (Brady, Parker and Jones)	+	+	+	..	..	..	+	..	..
Globulina gibba d'Orbigny	+	+	..	+	..	..	..	..	..
Polymorphina howchini Cushman and Ozawa	..	+	..	..	..	..	..	..	..
Sigmoidella kagaensis C. and O.	..	..	..	..	..	..	..	..	+
S. elegantissima Parker and Jones	+	+	+	..	..	..	..	..	+
Bolivinella folium (P. and J.)	..	..	..	..	..	..	..	..	+
Buliminella madagascariensis d'Orbigny	..	..	+	..	..	+	..	..	..
Bulimina marginata d'Orbigny	+	+	+	+	..	..	..	..	+
B. sp. aff. *elongata* d'Orb	..	..	..	..	+	+	..	..	..
Virgulina sp. aff. *pauciloculata* Brady	..	..	..	..	+	+	..	..	..
Reussella sp. aff. *simplex* Cushman	+	+	+	+	..	..	..	..	+
Bolivina compacta Sidebottom	..	..	+	..	+	+	+	..	..
B. pseudoplicata Heron-Allen and Earland	+	..	+	+	+	+	+	..	+
Uvigerina bassensis Parr	+	+	+	+	..	..	+	..	+
Siphogenerina raphanus (P. and J.)	..	+	+	+	..	..	..	..	..
Angulogenerina angulosa (Will.)	+	+	..	+	..	..	+	..	..
Trifarina bradyi Cushman	..	..	..	..	..	..	..	..	+
Cassidulina delicata Cushman	..	..	+	..	..	..	..	..	..
Spirillina inaequalis Brady	..	..	..	..	..	..	+	..	..
S. denticulata Brady	..	..	..	+	..	..	..	+	..
Patellina corrugata Williamson	..	..	..	..	+	..	..	..	..
Patellinella inconspicua (Brady)	+	..	+	+	..	..	..	..	..
"*Discorbis*" *williamsoni* Chapm. and Parr	+	+	..	..	..	..	..	..	..
"*D.*" *rarescens* (Brady)	+	..	+	+	..	+	..	..	..
"*D.*" *globularis* (d'Orbigny)	+	..	+	..	+	+	..	..	..
"*D.*" *australensis* H-A. and E.	+	+	+	+	..	..	+	..	+
"*D.*" *pulvinatus* (Brady)	+	..	+	..	..	..	..	..	+
"*D.*" *patelliformis* (Brady)	..	..	..	..	..	..	..	..	+
"*D.*" *dimidiatus* Parker and Jones	+	+	+	+	..	..	+	..	+
Discorbinella biconcava (P. and J.)	+	+	+	+	..	..	+	..	+
D. disparilis (Sidebottom)	+	+	+	+	..	..	..	..	+
Heronallenia lingulata (B. and H.)	+	..	..	+	..	..	..	..	..
H. translucens Parr	+	+	..	..	..	..	..	..	+
Poroeponides lateralis (Terquem)	+	..	..	..	..	..	..	..	..
Valvulineria collinsi (Parr)	+	+	..	..	..	..	..	..	..
Streblus sp. (?2)	+	+	..	+	≈	+	≈	+	+
Calcarina sp. cf. *calcar* d'Orb.	..	..	..	..	..	..	..	..	+
Globigerina bulloides d'Orb.	+	+	+	+	..	+	..	..	+
Globigerinoides conglobatus (Brady)	+	+	+	+	..	..	+	..	..
Orbulina universa d'Orbigny	+	+	+	+	..	..	..	..	..
Sphaeroidina bulloides d'Orb.	..	..	..	+	..	..	..	..	..
Globorotalia crassula Cushman and Stewart	+	+	+	+	+	..	+	..	+
Truncorotalia truncatulinoides (d'Orbigny)	+	+	+	+	..	..	..	..	+
Tretomphalus concinnus (Brady)	+	..	..	..	..	..	..	..	..
Cibicides lobatulus (W. and J.)	+	+	..	..	+	..	+	..	..
C. psuedoungerianus Cushman	+	..	+	..	..	..	..	..	..
Dyocibicides laevis Parr	+	+	+	..	..	..	..	..	..
Planorbulina rubra d'Orb.	+	+	..	..	..	..	..	..	..
Acervulina inhaerens (Schultze)	+	+	..	..	..	..	..	..	..
Gypsina vesicularis P. and J.	+	..	+	+	..	..	+	..	+
Elphidium sculpturatum Cushman	+	..	+	+	..	..	+	..	+
E. macellum (Fichtel and Moll)	..	+	..	..	..	..	..	..	+
E. macellum var. *limbatum* (Chapman)	..	..	..	..	+	..	..	..	..
E. crispum (Linne)	..	..	..	..	+	≈	+	..	..
E. sp. aff. *articulatum* (d'Orb.)	+	..	..	..	+	+	..	..	..
E. argenteum Parr	+	+	+	..	..	..	+	..	+

+ denotes species present. ≈ denotes dominant species.

L. G. SHEA, GOVERNMENT PRINTER, TASMANIA



PHOQUES BAY
EGG LG.
(DRAINED)
L. Martha Lavinia
Pennys Lg.
LAVINIA PT
New Year I
Christmas I.
Bob Lg.
SAM LG
YELLOW ROCK FORELAND
KUDDY LG.
SOUTH EAST LG.
(DRAINED)
WHISTLER PT.
YELLOW ROCK R.
Northern margin of plateau
BUNGAREE LG.
BUNGAREE CK.
Mt. Counsel
Low granite hills
PASS R.
COWPER PT.
Councellor I.
SEA ELEPHANT RIVER
PORKY LG.
PORKY CK.
THE BLOWHOLE
THREE RIVERS
FRASER R.
SEA ELEPHANT BAY
CAMP CK.
Currie Harbour
CURRIE
Naracoopa
FRASER BLUFF
NETHERBY BAY
ADMIRALTY BAY
BADGER BOX CK.
BARRIER CK.
LILY LG.
CLEVELAND LG.
DEAD SEA
CONGLOMERATE CK.
ETTRICK RIVER
YARRA CK.
SECTION D ON FIG. 4
CITY OF MELBOURNE BAY
DRIPPING WELLS
Sullivans Ridge
Cottons Flat
BOGGY CK.
550 FT
TRAVERTINE TERRACES
SEAL RIVER
FITZMAURICE BAY
GRASSY
BOLD HEAD
CATARAQUE PT
Pearshape Lg.
Mt. Stanley
GRASSY BAY
D
C
B
A
BIG SWAMP
SEAL ROCKS
RED HUT HEADLAND
Big Lake
BEACH RIDGES 22 – 49 FT
SURPRISE PT.
CHAIN OF LGS
SEAL MIDDLE PT
SEAL PT.
KILOMETRES
0 1 2 3
SURPRISE BAY
BAY
NEW DUNES
OLD DUNES
PREDOMINANTLY SHELL SAND
NEW SHORELINES
OLD SHORELINES
EMERGED MARINE PLATFORM OR BEACH WITH ABANDONED CLIFFLET. FOOT OF CLIFF AT 3-9 FT.
EMERGED SEA CAVE AT 3-9 FT.
EMERGED MARINE PLATFORM WITHOUT CLIFFLET AT 3-9 FT
EMERGED BEACH WITH SHELLS AT 3-6 FT
WIDE VEGETATED SHINGLE SPREADS AT 5-10 FT.
COBBLE RAMPART, HIGHLYING VEGETATED COBBLE BANKS RISING TO 5-15 FT.
SALTMARSH PATCH
EMERGED MARINE TERRACE. CLIFF-FOOT AT 20-60 FT.
AS ABOVE WITH HEIGHT OF BREAK OF SLOPE IN FEET
PLANED ROCK PLATFORM WITH HEIGHT IN FEET
SLOPES IN BEDROCK


C. WICKHAM
VICTORIA COVE
C. FAREWELL
DISAPPOINTMENT BAY
ROCKY PT.
CASK LG
L. Flannigan
Reedy L.
(DRAINED)
THE SPRINGS
Low granite hills
BOULDER PT
L. Martha Lavinia
EGG LG
(DRAINED)
Pennys Lg.
PHOQUES BAY
LAVINIA PT
New Year I
Christmas I.
Bob Lg
SAM LG
YELLOW ROCK FORELAND
MUDDY LG.
SOUTH EAST LG
(DRAINED)
WHISTLER PT.
YELLOW ROCK R.
Northern margin of Plateau
BUNGAREE LG.
BUNGAREE CK.
Mt. Counsel
Low granite hills
PASS. R.
COWPER PT.
Councellor I.
RIVER
SEA ELEPHANT
PORKY LG.
PORKY CK.
THE BLOWHOLE
SEA ELEPHANT BAY
FRASER R.
THREE RIVERS
CAMP CK.
Currie Harbour
CURRIE
Naracoopa
FRASER BLUFF
NETHERBY BAY
ADMIRALTY BAY
BARRIER CK.
BADGER BOX CK.
LILY LG.
CLEVELAND LG.
DEAD SEA
CONGLOMERATE CK.
ETTRICK RIVER
YARRA CK.
DRIPPING WELLS
SECTION D ON FIG. 4
CITY OF MELBOURNE BAY
Sullivans Ridge
Cottons Flat
BOGGY CK.
TRAVERTINE TERRACES
SEAL RIVER
350 FT
FITZMAURICE BAY
GRASSY
BOLD HEAD
CATARAQUE PT
Pearshape Lg.
Mt. Stanley
GRASSY BAY

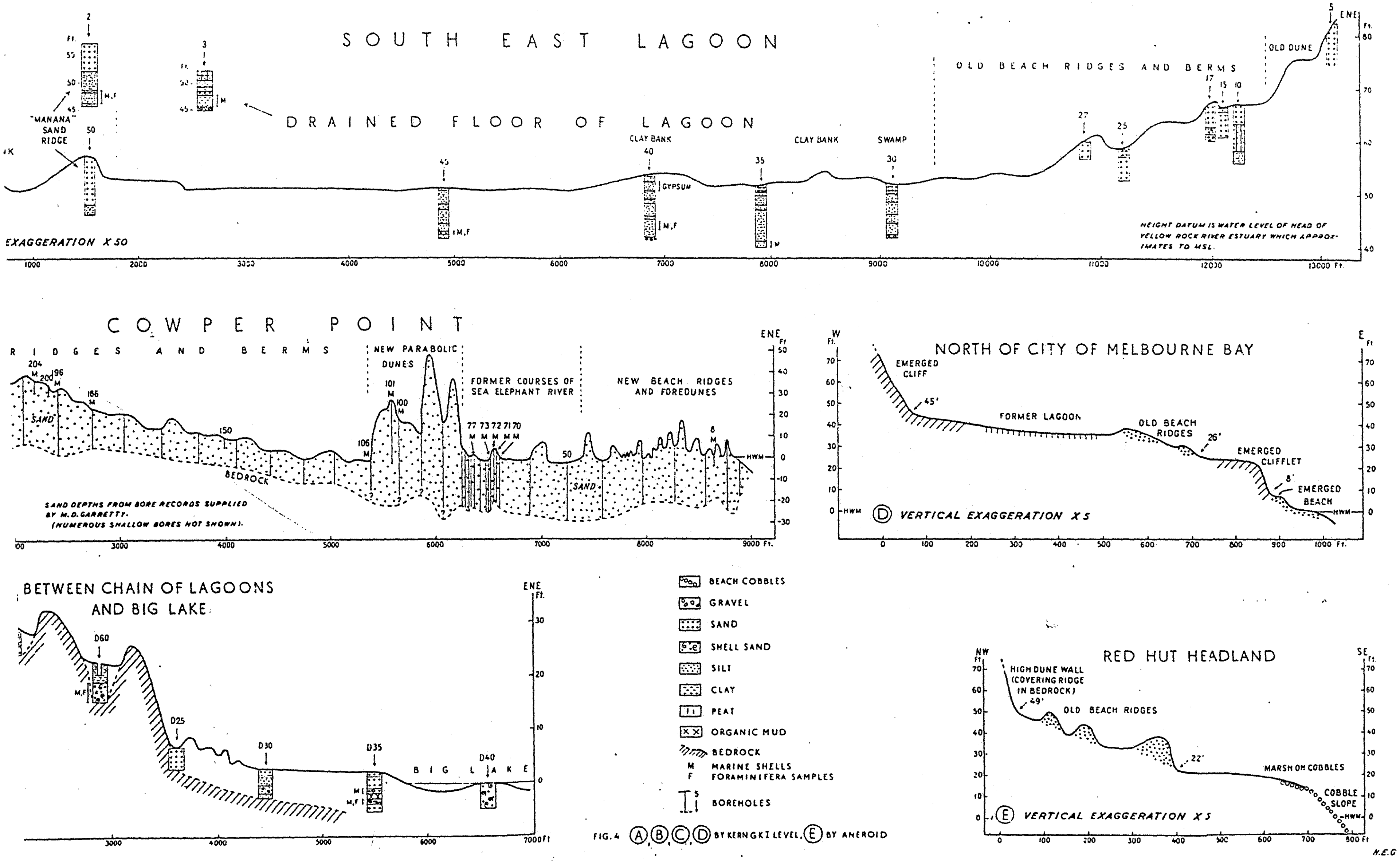


FIG. 4.—Sections and Profiles from King Island.

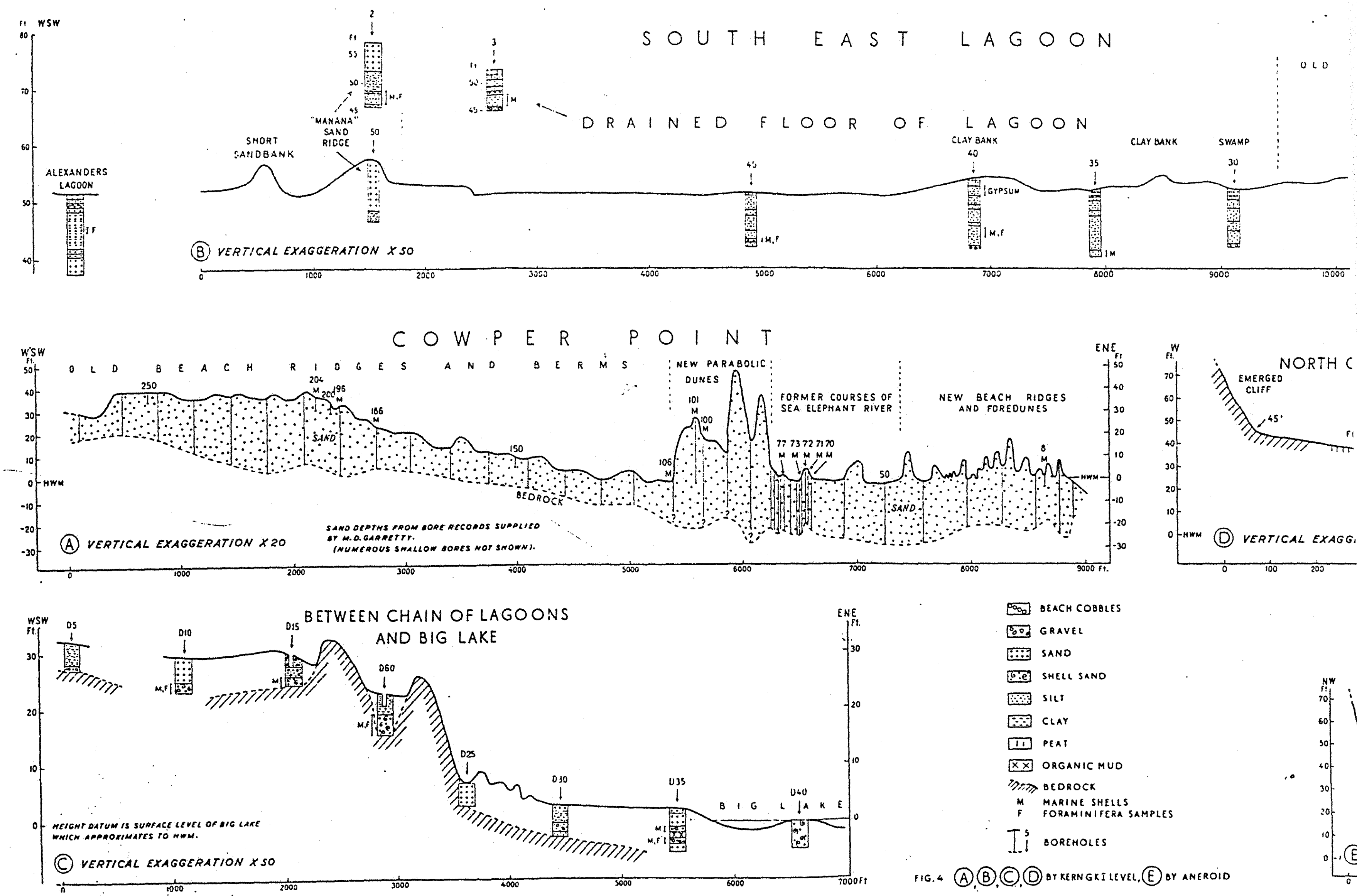
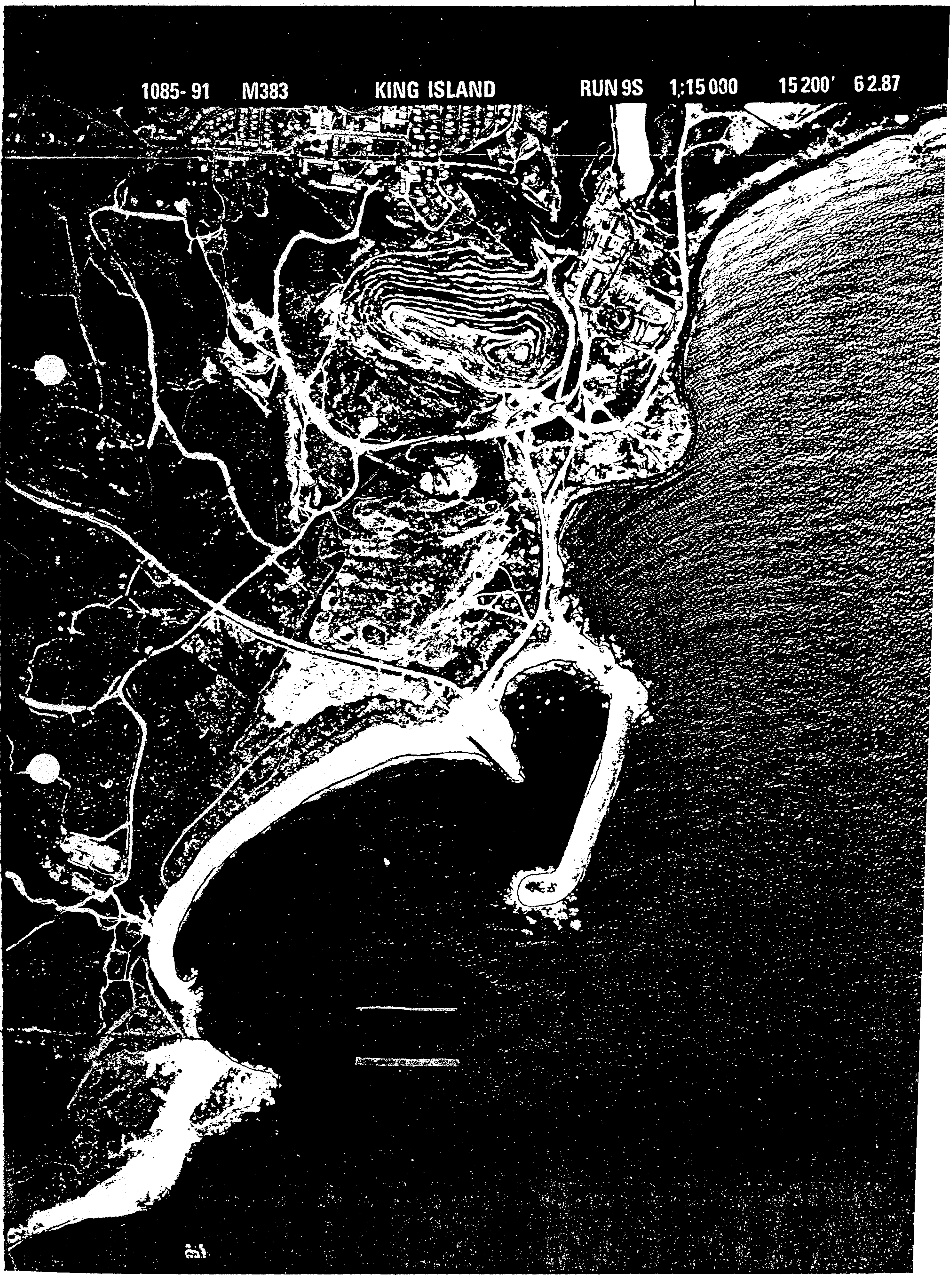


Fig. 4.—Sections and Profiles from King Island.


1085- 91 M383 KING ISLAND RUN 9S 1:15 000 15 200' 6 2.87

P. R. Stephenson

M. Crow 24.5.88

SAMPLING PROGRAMME - SILICA SAND PROJECT - KING ISLAND

(Refer to the attached memo to R. Knight on this subject).

In order to obtain an indicative measure of the quality of sand deposits on King Island Scheelite's mining lease, Hooker has requested that we undertake the following programme:-

- Collect a total of 10-12 1 kg samples from the areas of type 3 (old) sand deposits which are marked in red on the photograph overlay. Each sample should be representative of the full thickness of sand at each sampling locality. Overlying organic material and underlying "coffee rock" (if present) should not be included. The plots on the photograph overlay are tentative, and it is likely that the deposits are more extensive than shown.

- Collect using a stainless steel soil auger or an untarnished spade. It is important that no contamination, particularly rust, gets into the samples. Hooker can assist with sampling equipment if necessary.

- Log the colour, grain size and visual contaminants of the samples. Measure thicknesses and attempt to establish surface extent.

- Seal samples in plastic bags and despatch to:-

  Mr. M. Davies
  Laboratory,
  Hooker Sands,
  Captain Cook Drive,
  CRONULLA. N.S.W. 2230

I would be grateful if you could arrange for this programme to be carried out, if possible by Paul Balind. When the samples are despatched, could you ask him to forward me a map and details of the samples (and to return the aerial photograph).

If yourself or Paul have any questions on this, please do not hesitate to ring.

Regards.

PRS

P. R. Stephenson.

Encl.

Hooker Project - K.I.

3 types of dune deposits:-
- recent, closest to sea (present beach) - least attractive
- older recent, + inland a bit, possibly attractive
- old, furthest from sea, main target.

(older - more leached).

Preliminary estimates:-
~ 2.5 M tonnes of old deposits on KIS ML.
Prob. 10-20 M tonnes + of old deposits on Pimex EL

Old dune deposits on KIS ML are immediately N. of golf course + NW & W.
Golf course on older recent deposit.

Grab sample from KIS ML gave 0.013% Fe and 0.25% Ti. Good quality. Standard for clear glass - 0.03% Fe, pref. < 0.02% Fe. Stockton 0.02 - 0.03% Fe. Shelbourne 0.005 - 0.01% Fe (not proceeding - no grant of ML or export license (?))

Estimated that will require minimum of 5 M tonnes to commence operation. ie 0.5 M tpa for 10 years. Idea is to establish relationship with Peko re port, facilities etc + establish initial mineable deposit - then negotiate with Pimex. Will prob. require access to Pimex ground to establish viable operation. (apparently still a gap between Pimex EL & NMS EL)

Initial sampling:

1 kg / sample. Min. of 10-12 samples. Spade or preferably soil auger (Hooker can supply if necessary). Take several samples down profile & combine. Don't sample coffee rock, or surface organics.

Log samples - colour, grain size. Orientate by examining recent dunes & comparing. Don't sample golf course yet.

Establish boundaries of older dunes. Take more samples if necessary. Measure depths if possible. Potential on remainder of ML?

Send samples to Hookers at Cronulla. Details + map & logs to PRS → John Hann. Notify PRS or John Hann on despatch of samples. Plastic bags. Courier. ACI will prob. do quality checks.

Hookers will commence financial modelling - may approach Peko re some costs. Will prob. need a 30,000 tonne capacity ship. 1½ - 2 shipments / month.

Ron Hale, Divisional Manager Hooker Industrial Sands will want to visit KI ~ mid June if all looking OK.

KING ISLAND SCHEELITE
POST OFFICE
GRASSY, KING ISLAND. 7256

TELEPHONE: (004) 611200
FACSIMILE: (004) 611114
TELEX: 59067

DATE: 18TH APRIL 1988

FAX SEQUENCE NUMBER: 170/88

TO: COMPANY: PEKO

LOCATION: GORDON

COUNTRY: AUSTRALIA

FAX NUMBER: 02 - 4992315

FOR ATTENTION: MR. P. STEPHENSON

NUMBER OF PAGES (Including this page): (1)

COMMENTS: K.I.S. MINERAL LEASE

FURTHER TO OUR TELECON THIS MORNING K.I.S. MINERAL LEASE COVERS ALL MINERALS HOWEVER, ACCORDING TO THE ACT EXCLUDES STONE. THE DEFINITION OF STONE MEANS CLAY, SAND, GRAVEL, SERRENTINE, GABBRO, DOLERITE, BASALT, SLATE, GRANITE, FREESTONE AND ANY OTHER BUILDING STONE. HOPE THIS WILL BE OF SOME USE.

REGARDS,

M.J. CROW
MANAGER OF OPERATIONS

GEOPEKO LIMITED

KING ISLAND

SAND SAMPLING AND RESERVES

IN VICINITY OF THE OPEN CUT

by

S. GRIEVE BROWN

KING ISLAND DECEMBER, 1974.

INTRODUCTION

Following a request from the General Mining Superintendent for a brief assessment of the reserves of sand material for sand fill purposes at Bold Head and Dolphin Mines, a small program of auger drilling was carried out by Geopeko Limited in two areas close to the present Open Cut.

These areas were designated Area 1 (the large area of dunal sand lying between the Port Road and the Mine Road) and Area 3 (a narrow area of dumped overburden sand lying between the Mine Road and the Golf Course). These areas are outlined on the enclosed map.

DRILLING

The auger drilling of Area 1 was, apart from hole No.1, carried out using a Jacro drill rig equipped with 3 inch augers and using finger type bits. Area 3 and the first hole at Area 1 were drilled by the Gemco auger rig using 6 inch augers and clay bits. Both rigs have capacities to drill greater than 30.0 metres.

The program was divided into 2 stages. Stage 1 in which the holes were sampled every five feet to provide representative samples for tests to determine suitability of material for sand fill, and stage 2 unsampled holes drilled to provide a broad assessment of the total reserves available in Area 1.

Samples were taken every five feet and were obtained at the surface by 'spinning out' of the material held in the auger flights. Sample contamination is present below about 10 metres but is not considered excessive. Drilling was terminated at weathered bedrock, usually defined by the presence of grey clay in the sample.

All samples were placed in large plastic sample bags and labelled accordingly. Brief Logs of all sampled holes are enclosed in this report.

AREA 1

A total of 12 holes were drilled in the south west of this area during stage 1. These holes were drilled in a grid pattern over a large dune and have an average depth of 20.9 metres. The area outlined by these holes is about 250metres x 350metres and has an estimated total tonneage of 2.5 million tonnes of dunal sand (taking an average depth of 20 metres).

A further 4 scount holes were drilled for an average depth of 21.4 metres. These indicate an additional resource of approximately 4 million tonnes.

A 1:2500 scale map showing drill hole locations and the pattern drilled area is enclosed.

AREA 3

Only 3 holes were drilled here, the first two of which encountered what is assumed to be an old haulage road at a depth of about 7.6 metres. The third hole reached 21.14 metres before being terminated.

The sand in this area consists of overburden initially stripped from No.1 Orebody and will probably contain a percentage of boulders.

Assuming an average depth of about 20 metres the area is estimated to have a resource of approximately 900,000 tonnes.

CONCLUSION

It is apparent that there is a sizeable resource of sand close to the present Open Cut site (Area 1) which may be of suitable grade for sand fill.

GEOPEKO LIMITED

S. Grieve Brown

S. Grieve Brown.
Geologist.

AREA 1.

HOLE 1..	0 - 10ft.	Lt. Brown	moist sand.	
	10 - 20	Brown	" "	(med. grained)
	20 - 45	Orange-Brown	moist sand.	(sand through-)
	45 - 55	Brown	" "	(out hole)
	55 - 65	Dark Brown	damp sand.	
	65 - 75	Brown	slightly wet sand.	
	75 - 77	Dark Brown	wet sand with clay @ E.O.H.	
	E.O.H.			
HOLE 2.	0 - 18	White	wind blown dry sand.	
	18 - 30	Brown	dry sand.	
	30 - 50	Brown	moist sand.	(fine grained)
	50 - 70	Brown	hard boggy moist sand.	(sand through-) (out hole)
	70 - 74	Grey	hard boggy sticky clay to E.O.H.	
	E.O.H.			
HOLE 3.	0 - 10	Light brown	dry sand	
	10 - 15	White	dry sand.	(fine grained)
	15 - 65	Brown	moist sand.	(sand through-)
	65 - 72	Brown	hard boggy moist sand to E.O.H.	(out hole))
	E.O.H.			
HOLE 4.	0 - 10	White	wind blown dry sand.	
	10 - 15	Rusty-Brown	dry sand.	(fine grained)
	15 - 20	" "	moist sand.	(sand through-)
	20 - 40	Brown	wet sand.	(out hole))
	40 - 45	"	hard wet sand.	
	45 - 75	"	wet sand (Rocky @ 70' - 72')	
	75 - 85	"	heavy wet boggy sand to E.O.H.	
	E.O.H.			
HOLE 5.	0 - 5ft.	White	wind blown dry fine sand.	
	5 - 20	Rusty-Brown	dry fine sand.	
	20 - 35	" "	moist fine sand.	
	35 - 40	Khaki-Brown	moist med. grained sand.	
	40 - 55	Lt. Brown	" " " "	
	55 - 65	" "	wet med. grained sand.	
	65 - 75	Lt. Brown	heavy wet med. grained sand.	
	E.O.H.			
HOLE 6.	0 - 10ft.	White	wind blown dry fine sand.	
	10 - 15	Coffee	dry fine sand.	
	15 - 25	Brown	moist fine sand.	
	25 - 50	Lt. Brown	moist fine sand.	
	50 - 55	No return	no return.	
	55 - 58	Grey	gravelly clay, very heavy drilling (Unable to penetrate.)	
	E.O.H.			

Summary of "White" sand

Hole	From	To	Thick (ft)
2	0	18	18
3	10	15	5
4	0	10	10
5	0	5	5
6	0	10	10
9	0	5	5
10	0	10	10
11	2	7	5
12	7	[illegible]	15
13	2	[illegible]	[illegible]
14	0	7	7

Av. thickness [illegible]

% success [illegible] 70%

HOLE 7.	0 - 5ft.	Lt. Chocolate	dry fine sand.
	5 - 15	Fawny-Brown	" " "
	15 - 30	Lt. Fawn	dry med. grained sand.
	30 - 45	" "	moist med. grained sand.
	45 - 75	Brown	" " " "
	E.O.H.		grey gravelly very heavy clay at E.O.H.
HOLE 8.	0 - 5ft.	Dark-Brown	sloppy fine sand.
	5 - 65	Brown	" " "
	65 - 67	Grey	gravelly sloppy clay.
	E.O.H.	Probably clay from about 40' - sand was running in from above.	
HOLE 9.	0 - 5ft.	White	wind blown dry fine sand.
	5 - 10	Ginger-Brown	dry fine sand.
	10 - 15	Lt. Brown	" " "
	15 - 25	Brown	wet fine sand.
	25 - 30	"	dry fine sand.
	30 - 35	"	moist fine sand.
	35 - 50	Lt. Brown	wet fine sand.
	50 - 55	"	moist fine sand.
	55 - 60	Grey	moist gravelly clay.
	E.O.H.		
		Probably clay from 50'.	
HOLE 10.	0 - 10	White	wind blown dry fine sand.
	10 - 20	Brown	damp fine sand.
	20 - 35	"	wet fine sand.
	35 - 60	"	wet med. grained sand.
	E.O.H.		
		Probably commenced clay @ 58' - no clay return.	
HOLE 11.	0 - 2ft.	White-Brown	fine grained dry sand.
	2 - 7	White	" " " "
	7 - 17	Lt. Brown. heavy drilling.	Med. grained moist sand.
	17 - 22	" " " "	Med. grained wet sand.
	22 - 42	Brown	fine grained wet sand.
	42 - 62	Lt. Brown	med. to fine grained.
	E.O.H.	Very heavy drilling. Probably clay from 57'.	
HOLE 12	0 - 2ft.	Grey	fine grained dry sand.
	2 - 7	Brown to White	" " " "
	7 - 22	White	med. " " "
	22 - 37	Brown	med. to fine grained moist sand.
	37 - 57	"	fine grained wet sand.
	E.O.H.		
		Very heavy drilling. Probably clay from 53'.	

AREA 1.

HOLE 13.	0 - 2ft.	Grey-White	fine grained dry sand.
	2 - 22	White	med. to fine grained dry sand.
	22 - 27	Dk. Brown	fine grained dry sand.
	27 - 37	Lt. Brown (hard spot 29')	med. to fine grained dry sand.
	37 - 47	Dk. Brown	fine grained dry sand.
	47 - 52	"	" " moist sand.
	52 - 70	"	" " wet sand.
	E.O.H.		Very heavy drilling. Probably clay from 67'.
HOLE 14.	0 - 7ft.	White	med. grained dry sand.
	7 - 27	Lt. Fawn	" " " "
	27 - 37	"	" " moist sand.
	37 - 67	Brown	" " " "
	67 - 77	Grey	heavy moist clay.
	E.O.H.	Very heavy drilling. Probably Greenish-Grey clay commenced from 70'.	
HOLE 15.	0 - 27ft.	Off-White	med. grained dry sand.
	27 - 32	Lt. Brown	" " moist sand.
	32 - 62	Brown	" " " "
	62 - 65	Grey	moist clay.
	E.O.H.		
HOLE 16.	0 - 2ft.	Grey	fine grained dry sand
	2 - 7	Lt. Fawn	" " " "
	7 - 12	"	med. grained dry sand.
	12 - 22	Lt. Brown	" " " "
	22 - 42	"	med. grained moist sand.
	42 - 52	"	" " wet sand.
	52 - 67	Brown	" " " "
	67 - 69	Grey	" " (gravelly) sandy-clay.
		Probably clay from 62'.	

AREA 3.

HOLE 1.	0 - 5ft.	Orange-Brown to Lt. Brown.	med. grained moist sand.
	5 - 20	Brown	med. grained damp sand.
	20 - 25	"	sand & clay hard & damp.
	25 - 28	"	very slow drilling because of boulders in way.
	E.O.H.		

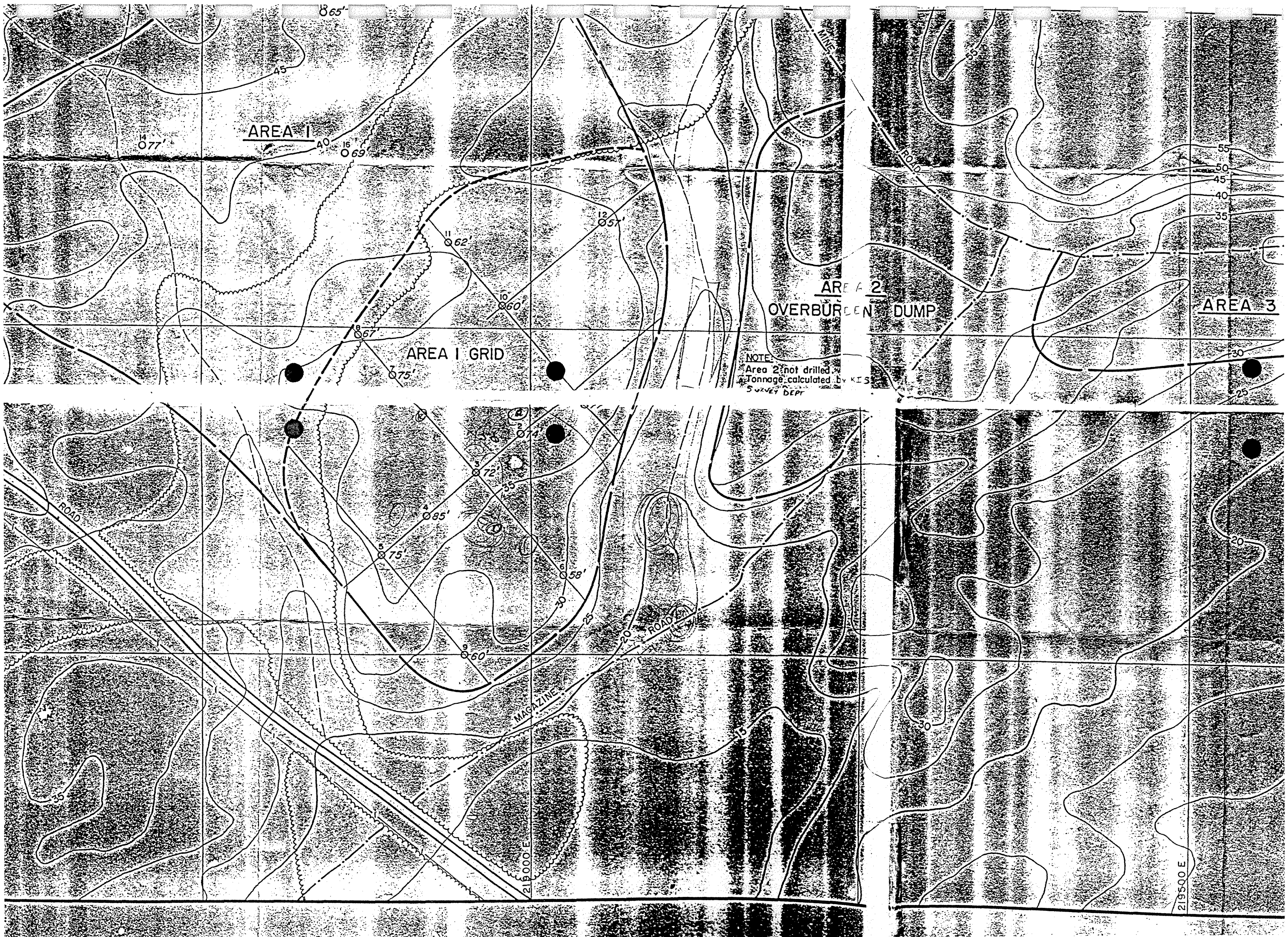
(Boulders were hite at 8', 12', 18', - 19', and 25' - 28')

HOLE 2.	0 - 5	Brown	med. grained moist sand.
	5 - 20	"	" " damp sand.
	20 - 24	Khaki-Brown	" " " "
	E.O.H.		solid rock at 24'.

(Boulders were hit at [illegible]' - 20', and E.O.H.)

HOLE 3.	0 — 5	Slt.Lt. Brown to Orange-Brown	med. grained moist sand.
	5 - 15	Brown	" " " " .
	15 - 25	Khaki-Brown	" " " " .
	25 - 30	Greyish-Brown	" " " " .
	30 - 35	" "	" " wet " .
	35 - 45	" "	very hard between 40' - 43' but med. grained damp sand & 45'.
	45 - 60	Khaki-Brown	heavy moist sandy-clay.
	60 - 70	Brown	hard heavy moist sandy-clay.

(Boulders were hit at
0-3', 5-10', 13'-14', and 19-25'.)


AREA 1
AREA 1 GRID
AREA 2
OVERBURDEN DUMP
AREA 3
NOTE:
Area 2 not drilled
ROAD
MAGAZINE
219000 E
219500 E

KING ISLAND SCHEELITE

Memorandum No. 486/74 25th July, 1974

To: Senior Planning Engineer.
Senior Surveyor.
Senior Geologist.
Mill Superintendent.

From: General Mining Superintendent.

Subject: Sand-Rock Sources for Mine Fill

A survey is to be made of the sources of sand - both dune and creek bed derived sands, and rock dump material available for mine fill.

The resources are to be categorised and tonnages computed. The main categories are currently seen as:

1.	Wind blown dune sands	- generally white and clean.
2.	Raised beach and creek bed sands	- generally brown and contaminated with fine clayey particles to a greater or lesser degree.
3.	Clean overburden rock material	- Waste from open pit workings.
4.	Rock-sand admixtures	- Various ranges of rock and sand with clay contamination.

1. Wind Blown Dune Sands

This material, if not too coarse, could form the basis of the supply of sand for cemented sand for underground fill. Sources to be investigated are the area between the golf course and the mine road and between the mine road and the open pit.

2. Raised Beach and Creek Bed Sands

A million tonnes of this material was stripped from the open pit and was dumped on top of dune sand between the golf course and the mine road; and also between the mine road and the rubbish tip. Further quantities will lie on the hangingwall of the open pit beneath the overburden dump.

Both types of sand are to be sampled by auger drilling and a size analysis of samples carried out at K.I.S. Larger samples will be sent away to Goliath and the Cement and Concrete Association in Sydney.

Geopeko will collect the samples and charge K.I.S. for work done.

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3. Clean Overburden Rock Material

A large source is present in the sea dump and a large proportion of this can be made available for fill purposes. Another smaller rock dump lies towards the west end of the open pit.

4. Rock-Sand Admixtures

Very large quantities are available between the open pit and the mine road. Some of this material may contain a high percentage of clay, and may not be suitable for fill purposes.

Survey, in conjunction with Geopeko, will calculate tonnages available in the various classes. A preliminary report is to be made available by 12th August 1974.

M. Baker
GENERAL MINING SUPERINTENDENT

Mb/hc