THE TERTIARY SEDIMENTS AT

MACQUARIE HARBOUR

TASMANIA

3rd November 1958

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3rd November, 8.

To: Mr. G.F. Hudspeth.

The Tertiary Sediments at Macquarie Harbour, Tasmania

In the course of the mapping of S.W. Tasmania carried out by personnel of the Lyell - E.Z. Explorations, the Tertiary sediments at Macquarie Harbour were found to be masking part of the Dundas Group, this Group forming host rock for many of the sulphide deposits on the West Coast of Tasmania (i.e. the mines at Rosebery and Queenstown). Also these young sediments were found to extend continuously from the Harbour southwards to the Wanderer River, covering an area of approximately 225 square miles. Consequently it became necessary to examine and understand their nature and extent.

With the exception of the bore commenced at Farm Cove by the Department of Mines in 1902, previous work was found to contain but little information, obviously owing to the difficulty of access to this area in the past. The first recorded observations were by Lempriere (1954) who was Commissariat Officer at Sarah (Settlement) Island for part of the time 1835-1839. His observations relate to the poor nature of the soil at Phillip Island and Farm Cove, and the coal at Coal Head. In the period 1850-1890, many prospectors used Farm Cove as a starting point for their journeys into the West Coast Range but no records are known for this era. Later workers, R.M. Johnston (1888), A. Montgomery (1893), T.B. Moore (1894) and Loftus Hills (1914) make reference to the Tertiary sediments on the north-east

shore of the Harbour, between Kelly Basin and Coal Head. Relatively recently Blake (1936) refers to these sediments at the Wanderer River.

During the summer of 1957-58 sections were measured by R.G. Elms at the Wanderer River, by P. Rodda at the Spero River and by B. Scott elsewhere. Apart from these detailed localised studies work of a general nature was carried out by way of helicopter reconnaissance and the examination of aerial photographs (Plate P25). In the mapping of these unconsolidated sediments they were marked "Tertiary and Recent" as it was found undesirable to differentiate between the two. However, except between Strahan and the Ocean, the sediments practically wholly belong to the Tertiary era.

During discussions on the area as a whole the term Macquarie Basin was found to be a useful term to signify the general locality and environment of the deposition.

Tertiary sediments are known elsewhere in Tasmania as in the north-west of the State and on King and Flinders Islands in the Bass Strait (Banks 1957). Other areas include the Launceston Basin, the lower Derwent valley and the Lake Pedder area.

Stratigraphy

The localities are indicated on Plate P25.

A. Wanderer River (Localities A and B)

The generalised Tertiary sequence of the Wanderer River area, which has been built up for a study of six different sections, is shown in Column I: three of the sections were measured north and three south of the Colin River[1]. The distance apart of these two localities A and B is approximately

[1]Named after Colin Mackenzie Pitt, Surveyor General of Tasmania (1939-1953)

4 miles and the sections correlate surprisingly well over this distance.

The sequence consists of a series of unconsolidated sands, pebble and cobble gravels[i], with less extensive bands of clay/lignitic clay. The colour varies from the dark grey of the clays to the cream/yellow pink of the larger grain sizes. The bulk of the particles are of a quartzose nature consisting of light grey to brown quartzites with a few micaceous or hematitic varieties. Chert, dark shale and quartz mica schist also occur occasionally. Lithologically these particles could have been derived from the nearby outcrops of Precambrian and Owen Conglomerate; it is interesting to note that no particles were seen which could be identified with the Dundas Group. The particles are generally rounded.

The base of the sequence was noted in the Wanderer River immediately to the west of location B at an elevation of 148 feet above sea level[ii]. Here, a thickness of cobble gravel lies unconformably on Dundas Group pyroclastics. It will be noted that the column of 358 feet has been divided into seven stages. Each stage (except stage 7) represents a cycle characterised by:

TOP — Well to medium sorted sands/small pebble (less than 1") gravel (location B), or clay with fragments of vitrainous wood material (location A)

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Poorly sorted, medium pebble (to 2") to cobble (to 8") gravel — BOTTOM

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[i] Sand is used to define an aggregate of mineral of rock grains greater than 1/16 mm. and less than 2 mm. in diameter, gravel denotes a size range of + 2 mm. (Pettijohn 1949)

[ii] All elevations were measured by aneroid barometer.

It is considered that the bottom of each of these cycles represents a relative lowering in the level of the basin of deposition. Initially this basin would receive the poorly sorted gravels but as the relative difference in levels diminished the particle size would become smaller and the deposits better sorted. This hypothesis receives additional support by the fact that at Location A the sand horizons of stages 2-5 of location B are represented by clay horizons which contain fragments of vitrainous wood material. This must surely indicate that at this location A the surface was at or above water level.

B. Spero River (Sections C and D)

The Tertiary sequence at Spero River, which has been built up from a study of 13 different sections, is shown in Columns II.

The sediments contain a similar series of gravels, sands and clays as at the Wanderer River locality but with a size range into boulder gravels (+ 10"). Again the particles are predominantly quartzose and consist of Owen Conglomerate and Precambrian quartzites and quartz-mica schists of varying colours. The particles are generally rounded, the degree of sorting varies from good to poor from horizon to horizon.

The base of the sequence (resting unconformably on the Dundas Group) can be seen in the Spero River at approximately 900 yards and west of the locality at an elevation of approximately 270 feet above sea level. The measured sequences show a rapid variation in character as traced northwards from the Spero River. This change is apparent from the sections which show a wedging out to the north of the sandstone size and a concomitant increase in the gravel. Westwards there also appears to be a similar trend

as a section measured some 200 yards away from sections C and D and in the same elevation range shows 94 feet of predominantly sandstone size. Two other examples of the unsettled nature of the conditions of deposition are the appearance of lenses of lignitic clay up to 4 feet thick in the gravel, between sections which are only 70 yards apart and the marked variation in thickness of individual beds - the third sand bed from the bottom of section C is one foot thick in one place, 6 feet away it has doubled its thickness with a 3" band of pebble gravel in the middle.

The sand and gravel horizons show marked current bedding with measured angular disconformities of up to 13°, and evidence of gulleying.

These observations all reflect unsettled conditions of deposition and it is considered that these may be connected with movement during deposition on the western boundary fault (see Plate I) which is considered to be only approximately 900 yards west of this locality.

C. Macquarie Harbour (Localities E to H)

The Tertiary sediments are exposed in the cliffs on the N.E. shore of Macquarie Harbour and a generalised succession which has been built up from a study of 14 different sections is shown in Columns III.

In contrast to the sediments to the south of the harbour, these sections contain two distinct facies. The sandy facies is identical in most respects to the clay/sand/gravel series noted south of Macquarie Harbour but with a maximum size range of only up to the cobble gravel. Again, particles of Owen Conglomerate and Precambrian quartzose sediments are abundant but north of Coal Head (F) particles of granite and rocks of the Dundas Group are relatively common. The colour of the sediments varies

from cream to yellow, some of the iron stained sands contain sufficient iron to form a cement. The particles are generally rounded and the degree of sorting varies from good to poor from horizon to horizon. Current bedding and gulleying are common, with angular disconformation of 25°.

The shaley facies consists of essentially a thickness of brown shale with minor clay. Lignitic bands are relatively common and seams of low grade coal and pyritic mudstone are also conspicuous.

The base of the sequence has not been seen: a regional dip of 5 degrees or less, to the north exists giving the following succession:

North-West

TOP

Sandy Facies.	At least 90 feet thick:	Section E
Shaley Facies.	At least 79 feet thick:	Sections F & G
Sandy Facies.	At least 78 feet thick:	Section H

BOTTOM

South-East

A bore drilled to 571 feet by the Department of Mines is summarised in Table 1. The exact location of the collar is not known but from the description of the core it could have been near Braden Cliff (locality G). Assuming a regional dip of 5 degrees and that the hole stayed vertical, the true thickness of the succession intersected would be:

Collar

87 feet of shaley facies
481 feet of sandy facies

568 feet TOTAL

Using the results of the recent field observations with those of the drilling, the thickness of the shaley facies can be estimated at 340 feet since its

top has been seen in Braden Cliff and its base has been intersected by the drill hole.

Combining all observations a minimum figure for the thickness of the Tertiary sediments in this area can be arrived at:

North-West

TOP

Sandy Facies.	At least	90 feet
Shaley Facies.		340 feet
Sandy Facies.	At least	481 feet
Minimum thickness		920 feet (to nearest 10 feet)

It must be remembered that this figure is a stratigraphical thickness and is not a thickness represented at any one location at the present day, it represents an original thickness prior to tilting of the sediments, and before post-depositional erosion.

Further estimates on the thickness of the sandy facies would be unwise owing to the possibility of north-south faulting which would cause repetition of strata. In particular faulting is considered to extend through Farm Cove.

The lower sandy facies is well exposed at Clarks Bay cliff (at east entrance to Kelly Basin), the east shore of Farm Cove (section H) and at the south tip of Soldier Island, in Farm Cove. The section at Clarks Bay shows 78 feet of sand/gravel and this section is interesting in that it is a cut by a normal fault trending 085° true, dipping 50° south. The sections in the shaley facies at Braden Cliff (G) and Coal Head (F) correlate well and the pyritic mudstone can be traced through a section at the south end of Phillip Island and on the shore of the Harbour immediately to the north-east. However, in these two latter sections the proportion

of sand is higher than at localities F and G. Assuming that the shaley facies was once continuous between F and G, this intrusion of the sandy facies may well represent erosion, and later infilling of an old river course. The rapidity of the development of the sandy facies here can be judged by that 100 feet north of section G at Braden Cliff the entire section beneath the coal band at 28 feet is represented by sand. An excellent example of such an infilled river course can be seen in the cliff to the north of Sophia Point.

The upper sandy facies is well exposed at Neilson's Cliff (E), just north of Sophia Point, and at Strahan.

D. Eastern Margin D'Aguilar Range & Mount Sorell (localities J and K)

The Tertiary sediments immediately to the west of Discovery Fault and Long Fault, respectively, are poorly exposed and there has not been an opportunity for the measurement of a section.

Lithologically, the sediments are boulder gravels with particles of Owen Conglomerate up to 3 to 4 feet in size in an unconsolidated matrix of finer particles. Structurally, these friable sediments are faulted against the Owen Conglomerate, a rock noted for its hardness and durability. However, it is interesting to note that the Tertiary sediments at the D'Aguilar Range form a definite cliff 200 to 300 feet high, which overlooks the flat surface of the Henty Peneplain which has been eroded into the western flank of the West Coast Range. This cliff, which is also present at the south end of Mount Sorell, is rapidly being removed by erosion.

c.f. Hills (1916)

E. Birch Inlet (locality L)

The sediments at the south end of Birch Inlet belong to the sandy facies, a series of pebble/small cobble gravels and sand. Particles of

Owen Conglomerate and Precambrian are common but representatives of the Dundas Group are not apparent.

F. Environment of Deposition

From the description given it is obvious that these sediments are not typically marine. When it is considered that the Basin now borders the open ocean it is difficult to visualise what prevented a marine invasion. This is in direct contrast to the Tertiary marine sediments of N.W. and N.E. Tasmania and those of the Furneaux Islands (Banks, 1957). Johnston (1888) and Montgomery (1893) recognised this essential difference and referred to their environment of deposition as lacustrine, in a similar way Twelvetrees (1914), refers to them as a freshwater series which contain no traces of marine life.

G. Basin of Deposition

Plate P25 shows that the borders of the Macquarie Basin are primarily limited by fault planes. Those to the east (Discovery Fault), south (Moore Valley faults) and the north-east (Long, Strahan and King faults) are readily apparent. On the west a fault is considered to exist from Birch Inlet to the region of the Wanderer and recent geological/geophysical work in this zone supports this contention. The S.W. boundary is now covered by the Harbour but some information can be obtained from contouring the soundings[i]. The isobaths show that the bottom of the Harbour is

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[i]It is interesting to note from these isobaths that a relative drop in the water level of 20 feet would isolate the Harbour from the Ocean and deplete its extent by approximately 25% (i.e. Birch Inlet would drain, Phillip and Settlement Islands would be part of the mainland, and it would be possible

(continued on p.10.)

trough shaped with depths of plus 90 feet located in its centre from a point between Farm Cove and Settlement Island and trending N.W. to Sophia Point. The line then swings N.N.W. to Long Bay at Strahan. On this basis it seems reasonable to assume a fault which trends along this linear. Additional support for this is gained from the comparison of levels within the Tertiary sediments, as in the following section, and the lack of correlation between the geological features on either side of the Harbour.

The vertical throw of these boundary faults is not known but it is obvious it must be considerable. The Strahan Fault brings the Dundas Group (Upper and Middle Cambrian) against the Florence Quartzite (Silurian) but an accurate estimate based on stratigraphic thickness is not possible owing to the possible wedging out of sediments (particularly the Owen Conglomerate of Ordovician age) to the west. However, a conservative estimate would be 1,500 feet. It is not necessary to postulate that all of this movement took place in the Tertiary. There is evidence to suggest that some of these boundary faults, and other north-south faults in the area were formed in the Lower Palaeozoic and have been active from at least the Cambrian to the Tertiary eras.

H. Levels within and beyond the Basin

When the basin of deposition is viewed from the Harbour one of the most striking points of interest is the various levels within and beyond the Basin. The levels are very well developed at the south end of Birch Inlet but the most striking is undoubtedly the 900 to 1250 feet level which is eroded into the western flank of the D'Aguilar-Mount Sorell Ranges. The

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i(cont.) to walk from Table Head to Yellow Bluff). A relative drop in levels of 100 feet would divide the Harbour into two small, shallow (20-70 feet deep) lakes with land connecting Liberty and Sophia Points.

heights of these terraces are summarised in Table II.

(a) Levels South of Macquarie Harbour

The level of 800 feet to the south of the Harbour represents the general level of the Henty Peneplain of Gregory (1903) in this area, with the lower levels developed along the river valleys which have cut into this surface. Eastwards, at the D'Aguilar Range, this surface rises to 900 feet whilst westwards it forms a gentle slope to within half a mile of the sea coast. Its grade then steepens and it appears typically at the coast as cliffs up to 150 feet in height (i.e. High Rocky Point). The surface is gently dipping to the south-west and the effect of this is readily apparent in the more hospitable coast line south of the Wanderer River, and especially so south of Elliott Bay, with its wide sandy beaches and absence of high cliffs. South of Elliott Bay it stands at about 200 feet above sea level but rises inland towards the Lawson-De Witt Ranges. This surface continues in the narrow coastal plain between the De Witt Range and the coast and has been recognised at Port Davey by Baker (1956).

The surface of the plain is gently undulating with low monadnocks of Precambrian (Elliott Hill, Moore's Lookout, Isolated Hill), Owen Conglomerate (Mount Osmund) and of the Dundas Group (Wart Hill). On a broader scale the West Coast, D'Aguilar and Lewis Ranges appear as monadnocks which rise to 3,800 feet, 2,700 feet and 2,600 feet respectively.

It is interesting to note that whilst the D'Aguilar Range is the direct southerly continuation of the West Coast Range, south of the Wanderer River this feature has been eroded to peneplain level, the only remnant of what must have been its former ruggedness and grandeur in this area is the monadnock of Mount Osmund, a low, rounded hill rising to 1,210 feet.

Within the Basin there are two marked discrepancies in the elevation of the peneplain. From Birch Inlet the top, 300 feet level can be traced continuously southwards to the 800 feet surface of the Wanderer River. Secondly, on the western flank of the D'Aguilar Range there is a localised surface existing as a strip at 1200 feet (see also page 8) which appears to be directly related to the Discovery Fault. This surface can be traced northwards to the Gordon River (at 1200 feet) and remnants of it can be seen farther to the north on the western flank of Mount Sorell where it is at plus 1300 feet.

(b) North of the Harbour

The peneplain north of the Harbour has been adequately described elsewhere, Gregory (1903), Twelvetrees (1910), Ward (1911), Loftus Hills (1914), Waterhouse (1916) and recently by Bradley (1956). In the Queenstown area, the plain is at 1000 feet, rising to 1200 feet to the west on the West Coast Range, and falling to 5-600 feet above sea level to the coast near Strahan. It is equivalent to the Little Henty Peneplain described by Waterhouse (1916) near Heemskirk which is at 700 feet, and to the surface described by Ward (1911) near Balfour which is at 800 feet above sea level. The level of the plain at 1000 feet in the Queenstown area, and the three lower levels measured in the Tertiary sediments, do not correlate at all well with those measured to the south (800 feet and lower), this is shown on Table II. This discrepancy is also shown in the difference of the maximum heights of the plain as measured on the west flanks of the West Coast Range where that on the D'Aguilar Range (south of the Harbour) is at 900 feet, whilst that on Mount Sorell is at 1200 feet.

Summarising these variation in the elevation of the peneplain,

it appears that the entire plain south of Macquarie Harbour has been tilted to the south-west. In this tilting may lie the origin of Elliott Bay. The plain immediately to the north of the Harbour does not appear to have undergone such a movement and this, with the difference in elevation of the plain on both sides of the Harbour and lack of correlation of the geology is the basis for the fault which is postulated as running north-west through the Harbour (see page 10). This fault appears to have served as the hinge on which the tilting of the plain south of the Harbour occurred. Within the Basin itself the 1250 level on its eastern edge can be accounted for by post depositional movement on the Discovery/Long Fault.

In the Central Plateau of Tasmania the St. Clair surface at 2500 feet has been correlated with the Miocene surface of the mainland (David 1950). The relationship of the Henty surface to this peneplain is not clear: it can be regarded either as a surface younger than or eroded out of the St. Clair plain, or as being essentially continuous. Recent work by Baker (1956) in the Port Davey area correlates a 1500 feet surface with that of the St. Clair, with the Henty Plain at a lower level. The present work is in agreement with Baker and I would place the Henty surface as being younger and eroded out of the St. Clair level. In the Macquarie Harbour area, owing to the vigorous erosion, the higher plain has not been definitely recognised unless the 2000 feet level at Mount Jukes and Mount Darwin (Solomon, 1956) is part of this surface.

J. General Summary

The conclusions are best summarised in the general development of the Macquarie Basin.

I. Formation of the Macquarie Basin

The Basin was formed by block faulting along N.W.-S.E. and north to south lines, as on Plate 25. This movement is considered to have been largely along pre-existing faults. At its maximum development the Basin would have been represented by a lake of 330 square miles, this is roughly five times the size of the present Great Lake in N. Tasmania. In this basin several hundred feet of sands and gravels were deposited, with a development of a shaley facies in the northern part of the basin. The stratigraphy demonstrates that the movement on the boundary faults continued during deposition. The upper part of the sandy facies on the northern part of the basin at Strahan have been dated as post Pliocene (Upper Tertiary) by Gill.

II. Peneplanation

The period of erosion which followed the deposition of the sediments resulted in the present surface of the Henty Peneplain which can be traced from Heemskirk south to Port Davey. This Henty surface is considered to be younger than the St. Clair surface of the Central Plateau region.

III. Rejuvenation of the West Coast

The West Coast has been relatively uplifted some 700-1100 feet within recent geological history (Post Pliocene) and this can be correlated with the Kosciusko epoch of the mainland. The Henty Peneplain is still being actively eroded with most of the rivers in a youthful stage of development, showing rapids, waterfalls, and river capture. The relative uplift has not been uniform on the Coast and this is expressed in the different elevations of the peneplain. The presence of the localised 1200 feet surface on the Discovery and Long Faults would indicate a very recent

vertical movement of 200-300 feet on these faults.

It is interesting to note that elsewhere in south west Tasmania a fault system which is associated with the Tertiary (?) sediment of Lake Pedder was responsible for the New Years Day tremor of 1958 (Carey,1958)[i].

IV. The flooding of Macquarie Harbour presumably took place on the melting of the Pleistocene Ice sheet. Slight eustatic emergence has since taken place.

(B. SCOTT)

Geologist-in-Charge.

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[i]Letter to B. Scott, January, 1958.

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TABLE I

FARM COVE BORE

Commenced 11th November, 1902. Completed 23rd January, 1903. Total Depth 571 feet

0' - 33'10"	Alternating bands of lignite and clay none of the bands of lignite over twelve inches. No bands of lignite below 18'1".	Shaley Facies
33'10" - 88' 3"	Alternating bands of grey, dark and light shales/sandy shales.	
88' 3" - 180'10"	Sandstone, light and dark, very soft and friable.	Sandy Facies
180'10" - 571' 0"	Alternating sandstones (soft and friable) with occasional lignite bands up to 5" thick.	

Reference: Report Sec. Mines, Tasmania, 1902-1903, p.lvii.

TABLE II

Summary of Levels[i] within Macquarie Harbour Tertiary Sediments

Birch Inlet	Spero River	Urquhart River	Moores Valley	Mount Discovery	S. West Coast[ii]	Mount Sorell	Strahan	Generally north of Harbour
	Top not msd.	800'	800'	900'		1100'		
								1000'
	510'							600'
	460'							400'
	420'							380'
	310'							
300'							230'	
210'								
110'					150'		130'	
60'					70'		50'	
30'					35'			
15'							20'	

Heights underlined indicate the top surface for that area.

[i]All heights measured by aneroid barometer.

iiRaised beach levels on Ocean Coast between Cape Sorell and Elliott Bay

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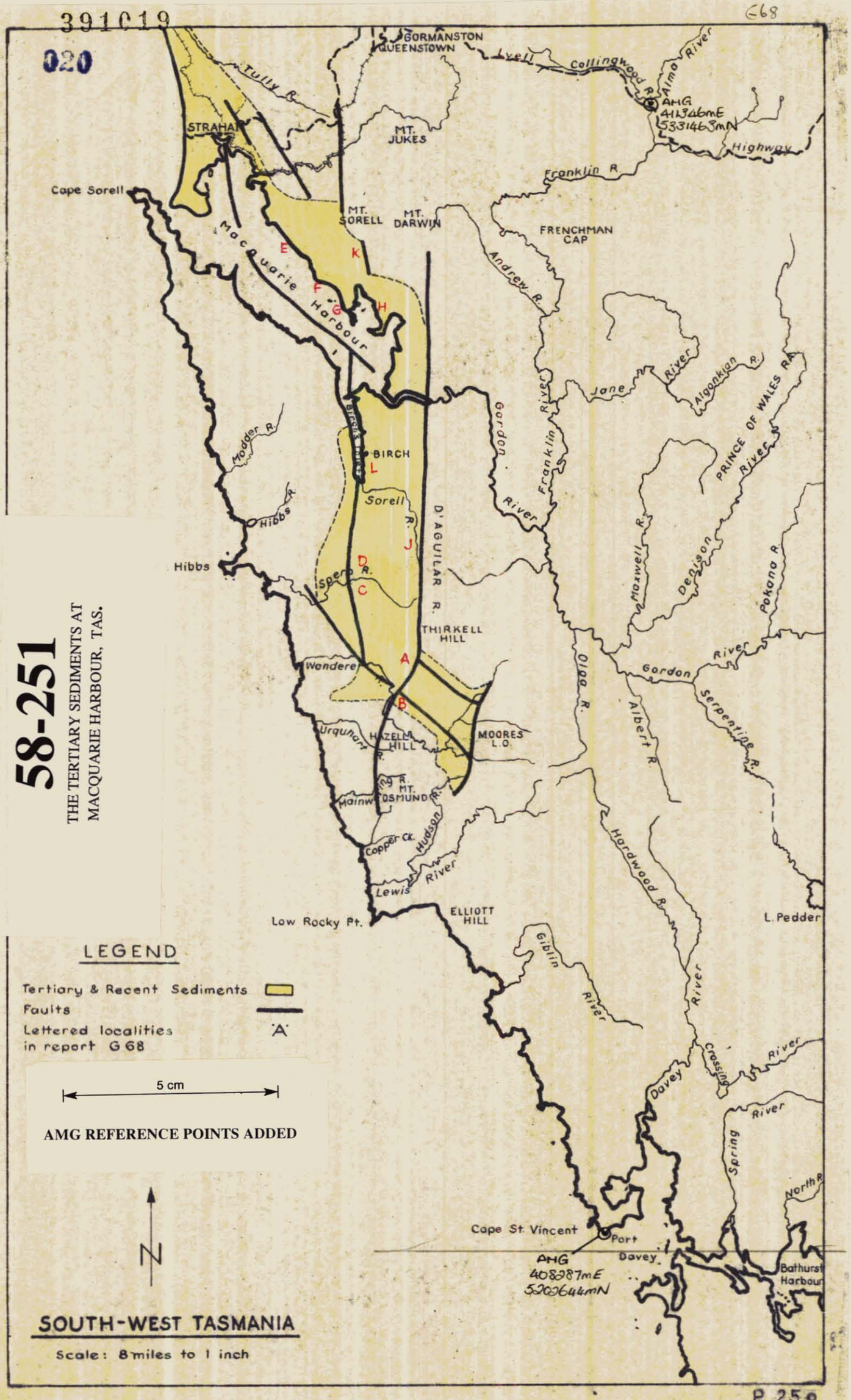

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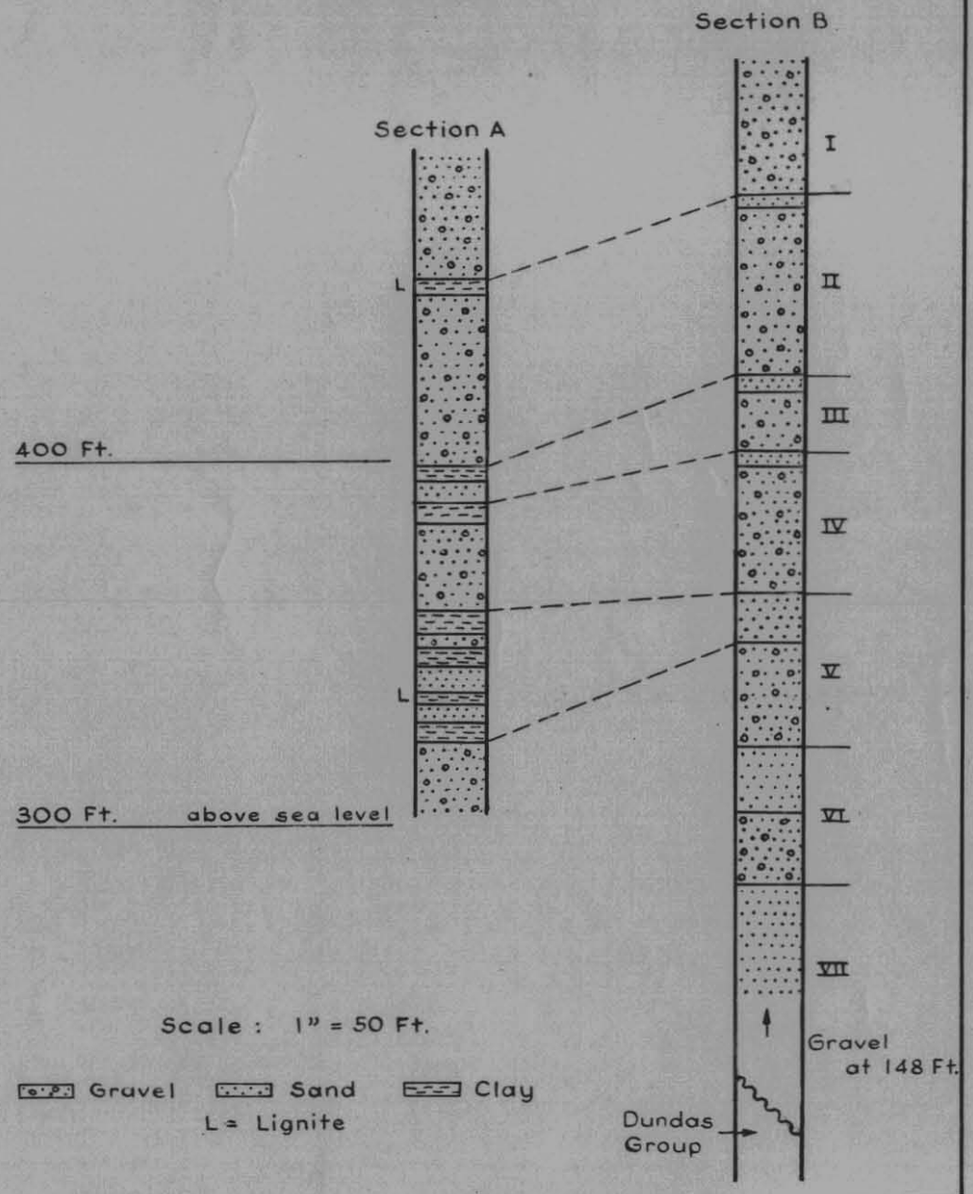
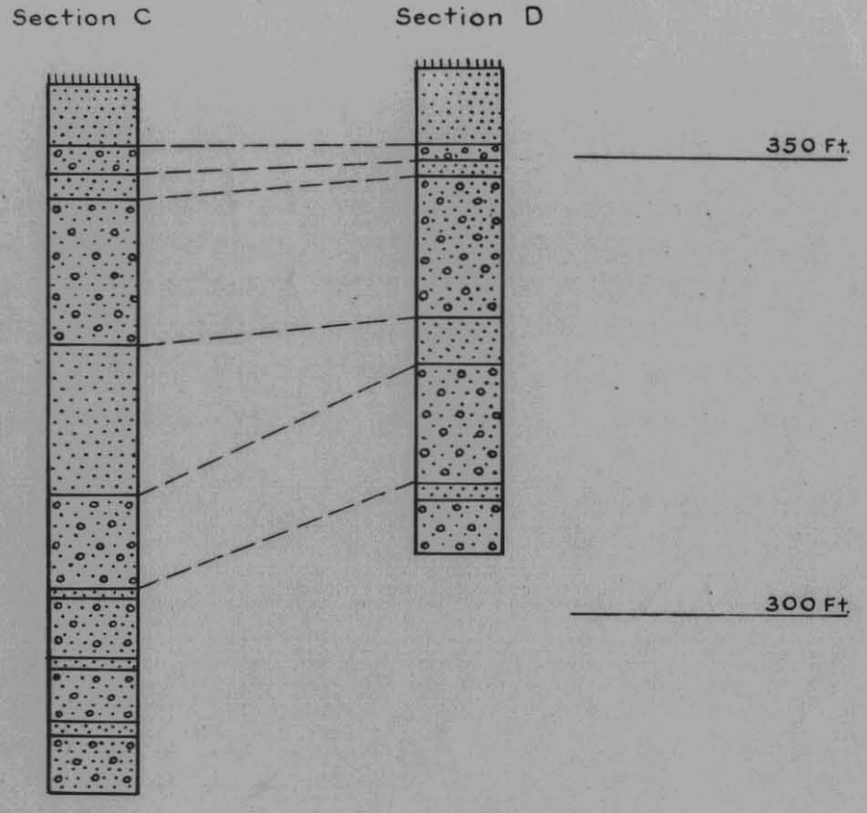
WANDERER RIVER

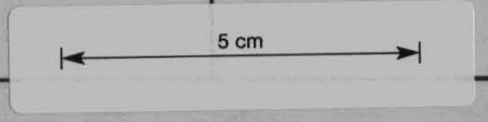
COLUMNS I



SPERO RIVER

COLUMNS II





MACQUARIE HARBOUR

COLUMNS III

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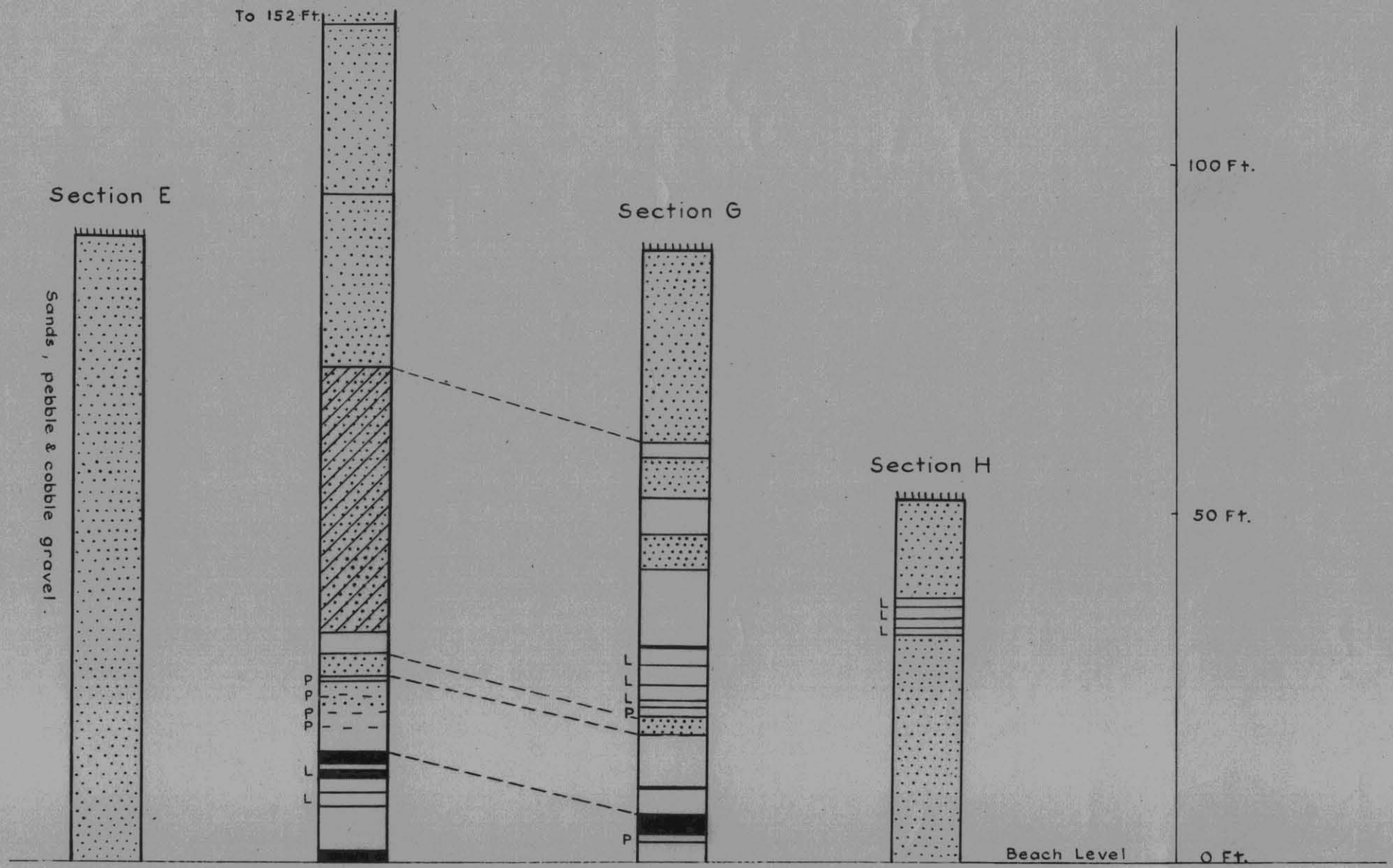

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