TE WHANGA LAGOON

WHAREKAURI/CHATHAM ISLAND

A Report on the Nature of
Te Whanga Lagoon,
and the Way in which it has Changed
since 1840

prepared by

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WAITANGI TRIBUNAL

THE NATURE OF

TE WHANGA LAGOON

WHAREKAURI/CHATHAM ISLAND

INTRODUCTION

Purpose

1 This report provides information on the nature of Te Whanga lagoon on Wharekauri/Chatham Island. It has been prepared for the Waitangi Tribunal, in response to a request by Luckie Hain acting for the Ngati Mutunga O Wharekauri Incorporation.

2 The aim of the report is: to firstly give some background information on coastal environments and the nature of lagoons and estuaries, their characteristics and variability; and then to describe Te Whanga lagoon in terms of its natural formation, the changes that have taken place since 1840, and its present condition. The nature of Te Whanga lagoon, compared to other coastal water bodies, has been assessed and described in terms of the relative influences of the various factors or parameters that can be used to describe and categorise coastal water bodies.

3 Comment is provided on the 1938 report on the lagoon, prepared by the then Department of Lands and Survey (L & S), as this report has been used as the base document for determining the nature of the lagoon by that Department. The assessment of the lagoon by the Department of Conservation (DOC) as given in the report attached as Appendix VI to departmental evidence, is also commented on.

Investigations

4 A study of Te Whanga lagoon has been undertaken as part of the investigations carried out for this report. This included field inspections (from 20 to 23 March inclusive), the study of various reports on the lagoon and the Chatham Islands in general, including reports on the geological and climatic conditions on the Islands, and discussions with a number of different professionals about lagoon and estuary systems in New Zealand.

5 The lagoon and its surrounding land was viewed from many places, with a complete tour around the lagoon. The

lagoon outlet at Te Awapatiki was viewed on 21 March, approaching from the north, and on 22 March approaching from the south. During the field inspections discussions were held with local people on the nature of the lagoon, and the changes that had taken place over time. An aerial inspection of the lagoon was carried out on 23 March, and samples were taken of the lagoon water and vegetation. Later, conductivity measurements were taken of water from various places in the lagoon, to estimate salinity.

6 General discussions on Te Whanga lagoon, and investigations on other lagoons and estuaries around New Zealand, were held with people having a range of professional qualifications. This included people with coastal geomorphological experience at the universities of Otago and Canterbury and the Department of Conservation, freshwater and marine biologists or ecologists at the Ministry of Agriculture and Fisheries, National Institute of Water and Atmosphere, Landcare Research, Cawthron Institute and Museum of New Zealand.

7 The reports studied, along with some general reference books, are listed in the References, at the end of the report. This included parts of a draft of a report on Te Waihora (Lake Ellesmere) by the Canterbury Regional Council. A copy of the 1841 report on the Chatham Islands of Dr E Dieffenbach was obtained from the Alexander Turnbull Library, and some relevant files were looked through at the National Archives.

8 A 'Time Line' giving extracts from the L & S file on Te Whanga (file 22/382) was also obtained.

9 All the vertical aerial photography of Te Whanga lagoon held by the Department of Survey and Land Information (DOSLI) was viewed, and parts of the lagoon, especially the outlet, were studied using stereo viewing.

10 A copy of the map that accompanied the 1938 L & S report was obtained from DOSLI (number 4349), as well as old survey plans of Te Whanga lagoon, including those of the 1868 survey of S Percy Smith (triangulation survey - number 4159, outlet area - number 2847).

11 The assessment of Te Whanga lagoon and the way in which it has changed is, then, derived from this research, given my professional engineering experience in the field of water and soil resources.

Qualifications

12 I hold the qualifications of Bachelor of Engineering, Bachelor of Science and Master of Commerce. I am a member of the Institution of Professional Engineers of New Zealand. I have worked for the Water and Soil Division of the Ministry of Works and Development at its Head Office and Napier District Office, and for the

Wairarapa and Hawke's Bay catchment authorities. I have also worked overseas in Mozambique and Papua-New Guinea.

13 Since 1987 I have practiced as a private consultant, working mainly for regional and district councils on catchment and river management, and other water and soil resource investigations, including coastal processes and protection measures.

14 I have been involved in studies and works on many estuaries, through river management, as well as coastal management, and been involved in studies and works on lagoons and wetlands. In Hawke's Bay this included the Hawke Bay coast and Ahuriri Estuary, Whakaki Lagoon and Maungawhio Lagoon. I presented evidence to the Waitangi Tribunal on the nature of Te Whanganui-a-Orotu (WAI 55). More recently I have studied the west coast south of the Manawatu River, with particular reference to the estuaries at the mouths of the Otaki and Waikanae rivers.

15 My engineering experience has been related more to physical factors and physical modifications to coastal and river environments. However, biological factors are not only important in assessing environmental effects, they provide important indicators and guidance in the carrying out of river and coastal management. As an engineer I have often had to draw on the knowledge of many different professionals, and utilise this knowledge in solving practical problems and implementing management strategies.

Findings

16 This study has been constrained by a budget limitation. Some research that was initiated, such as on biological matters, has not been followed up, and some analyses that were intended to be undertaken, have not, because of this limitation.

17 This incompleteness has to some extent compromised the study, and some of the findings are thereby more tentative.

18 The main findings can be summarised as follows:

- The nature of the lagoon has been substantially altered since 1840. The extensive weed beds that used to exist have been destroyed by increased salinity, and the salinity of the lagoon is now much more uniformly high, due to the maintenance of a permanent outlet to the sea.

- The 1938 Lands & Survey Department report is outdated, and is not now an appropriate basis for determining the nature of Te Whanga lagoon. Its findings, which were used to refute Maori claims, are not considered to be correct.

- There is a serious lack of knowledge about the lagoon, and the changes to the lagoon caused by the artificial maintenance of an opening to the sea.

- Te Whanga is an unusual island lagoon, of large size. It is an enclosed coastal water body, with a small catchment. It has a uniform bed shape, without the meandering channels of an estuary, and is not subject to tidal influences.

- Under present conditions, the lagoon has a high salinity, and marine species are present, but this does not mean that the lagoon has a marine environment like that of the open coast.

- Te Whanga could not be called an 'arm of the sea'. It is an island lagoon, similar to large coastal lagoons rather than estuaries, and is properly referred to as a lagoon.

- The modifications to the lagoon due to past and present interventions, in particular the artificial maintenance of the opening, are not irreversible. A change in the opening regime, by means of a controlled outlet, would require a further intervention, but would make the lagoon similar to what it was like in the past when cut off from the sea.

COASTAL ENVIRONMENT

Geological Formation

19 Coasts are dynamic variable environments that have been formed over recent geologic time, since the sea level stabilised at around the present level, about 6,500 years ago.

20 Over the last 2 million years (of the Pleistocene period) the general climate of the Earth has varied greatly, and the sea level has varied in concert, as ice sheets built up and melted. Short warm periods, similar to the present, have been interspersed with longer cold periods, when large ice sheets covered much of the higher latitude areas of the Earth. The climate has varied through the cold glacial periods with relatively warmer and colder times, as well as through the warmer interglacial periods. Recent research suggests that the climate of the present warm interglacial has been unusually uniform, with the sea level correspondingly stable.

21 Thus, prior to about 15,000 years ago, when there were massive ice sheets and glaciers, the sea level was up to about 135 to 150 metres lower than the present level. As the climate of the Earth warmed and the ice melted, the

sea level rose, reaching its present level about 6,500 years ago, with a somewhat higher maximum level about 5,000 years ago.

22 A new shoreline was formed, with a diversity of coasts: of eroding cliffs, drowned river valleys, and, where suitable sand and gravel material was available to reworking processes, long low barrier beaches. These low barriers have formed due to the longshore movement of material supplied by rivers or eroding coastal cliffs, or from the inshore movement of material on shallow sea beds. They separate shallow water bodies from the open sea giving rise to coastal lagoons and more enclosed estuarine river mouths.

23 Although most coastal systems would have developed their primary form soon after the sea level stabilised at its present level, coastal reworking processes of erosion and deposition continue, and many coasts are being actively reworked. Estuary and lagoon systems are most subject to change, being made up of erodible silt, sand and gravel materials, while sediment infilling continues to take place over time.

Coastal Types

24 The terminology used to describe coastal systems is not well defined, and a number of different terms are used. Enclosed or semi-enclosed coastal water bodies may be called estuaries, lagoons, inlets, sounds, fjords, ports or harbours and arms of the sea. The terms are used in different ways, in scientific literature as well as in common usage.

25 Some definitions of commonly used terms are given in Appendix I.

26 A way in which these terms could be used, with a consistent application, is as follows.

27 The drowning of river valleys has given rise to many 'projections' or 'extensions' of the sea into the land, so that the sea is partly enclosed by land (or vice versa, the land projects into the sea, and partly encloses the sea). Any such large 'projections', where the forces and characteristics of the sea prevail, could be called an *arm of the sea*. This could include both the wider projections of relatively open sea or bays, and the narrower and more elongated, but still deep water projections of *sounds* (in river formed valleys) and *fjords* (in glacier formed valleys). The shorelines along these water bodies are similar to open sea shorelines, with the full range of sea forces - of tides, waves and salinity - being felt, and a marine environment existing along the shore, although their morphology is influenced by variations in shelter and hence energy.

28 *Estuaries* form at river mouths, where there is an interplay of river and sea forces, with sediment transport influenced by both, and a mixture of fresh and sea water. The mixed environment gives rise to a more complex ecology of plant and animal species, that have varying salinity tolerances. The exchange of water over the tidal cycle, with sea water flowing in and out, and the variations in freshwater inflow gives rise to a dynamic environment, which the estuarine life must be adapted to. The degree of mixing of sea and fresh water varies - depending on water depths, tidal exchange and freshwater inflow volumes, and the penetration of sea waves or generation of waves within the estuary. Estuaries can have a distinct salt water wedge underneath the fresh water (due to the (slightly) greater density of salt water), be slightly stratified, partially mixed or fully mixed. The constant flow with tidal exchanges - within [bed] materials that can normally be reworked by the flow forces - generally gives rise to tidal channels, that are shifting and meander across the estuary.

29 Large estuaries can form in drowned river valleys that have a narrow opening to the sea and are shallow enough to silt up and form tidal flats at the present sea level. They often have more than one river flowing into them.

30 Coastal *lagoons* are shallow water bodies that are separated from the sea by low barriers or spits, but have a connection to the sea, or are subject to sea water inflows from overtopping of the separating barrier or by seepage through the barrier. They generally have a more constricted connection to the sea than estuaries, are less affected by tides, and seldom if at all influenced by sea waves. While the lagoon environment is normally less changeable than an estuarine one, from lagoon to lagoon there is a wide variation in environmental conditions.

31 There are long complex lagoonal/estuarine systems behind barrier beaches in many places. Along the east coast of North America a string of barrier islands extends from Florida to New York, a distance of about 2500 km. The openings give rise to tidal influences, but the nature of the enclosed water bodies varies depending on their closeness to openings, interconnection flow patterns and the fresh water inflows from rivers and streams.

32 Lagoons can be essentially fresh water when they have a very constricted outlet to the sea, for instance, where there are a series of lagoons, with only one lagoon open to the sea. On the other hand, in arid or semi-arid regions lagoons that are completely cut off from the sea can be hyper-saline, with salinities greater than the sea. This occurs where the water flowing into the lagoon is lost by evaporation (without outflow) and this concentrates the salts in the inflow water. Evaporation can give rise to high salinities in a small water body in much the same way as the sea is made saline at a much larger scale.

33 In New Zealand there are few large lagoons, and many of the smaller lagoons and wetlands that used to exist along the coast have been drained. These lagoons have generally been formed by barrier beach formations. The size and shape of many estuaries has also been influenced by barrier beaches or spits.

34 The position and general shape of a number of lagoons and estuaries around New Zealand is shown on Figures 1 to 4. All these figures are taken from the 1:250000 scale maps of DOSLI, as given in the Heinemann New Zealand Atlas. Comparative comments on these lagoons/estuaries and Te Whanga lagoon will be made later in this report.

Environmental Factors

35 The nature of a lagoon or estuary, and the differences between them, can be described and considered in terms of a number of factors, both physical and biological. An appropriate set of factors could be as follows:

36 [I] Physical

(a) Tide

The presence and influence of tidal exchanges

(b) Waves

The influence of sea waves, and of wind set up and wave generation within the body of water itself

(c) Form

The form of the defining features and bed, their make up and degree of re-working

(d) Salinity

The magnitude and spatial/temporal variations in salinity.

37 [II] Biological

(a) Plants

The species present and the pattern of vegetation around and within the water body

(b) Birds

The presence and use made by different species

(c) Fish/Shellfish/Invertebrates

The presence and relationships between different species, and hence the ecological communities present.

38 This report concentrates on the physical factors, with some mention of biological factors where relevant information had been obtained.

TE WHANGA

Geological Setting

39 The Chatham Rise is part of the continental crust of the New Zealand landmass, and forms a single structural entity, with the older rocks of the rise exposed along the foothills of the Southern Alps as well as on the Chatham Islands. The basement rock of schist is exposed along the north of Chatham Island. Localised basaltic volcanism has occurred on the Rise, and this volcanic material forms much of the Chatham Island, along with limestone accumulations (Hay R F, Mutch A R & Watters W A 1970; and Campbell H J & Others 1993)

40 The area has been relatively stable, geologically, for a long time, but with persistent sporadic volcanism. The Islands were not affected by the tectonic movements of the late Tertiary and Pleistocene periods that affected the rest of New Zealand. Rather, changes in sea levels has been the main cause of modifications, with the development of extensive marine cut surfaces, and extensive sand deposits, such as the Wharekauri Sand layer. Over recent geological times (about the last 50,000 years) a deep peat layer (Moorland Peat) has accumulated over much of Chatham Island.

41 Sea levels in the past (during earlier warm periods) have been greater than the present sea level. Thus less of Chatham Island has been exposed than at present, with marine cutting and deposition at higher levels.

42 Te Whanga lagoon has been formed at the present sea level (of the current 10,000 year interglacial) through a development of barrier beaches, between the volcanic and limestone land that remained above the sea. The barriers have thus connected what would have been separate landmasses, to give an unusually large lagoon (that makes up nearly ¼ of the area of Chatham Island) with major barrier beach features along the northern and eastern sides of the lagoon. To the west and south the lagoon is bounded by old sea cliffs cut into limestone and volcanic tuff deposits, with some minor beach development along the shoreline.

43 Figure 5 shows Te Whanga Lagoon at the same 1:250000 scale as the previous figures.

44 The barriers to the north and east are generally single dune formations, that are relatively high and narrow, having a steep storm face on the sea side. The coastal deposits have, though, been built up through episodes of deposition, followed by long periods of low deposition and soil formation (McFadgen 1994).

45 An old lagoon shoreline is evident between Lake Taia and Long Lake, with sea-rafted pumice from the Taupo eruption (of about 1850 years ago) present at the bottom of this shoreline, and another pumice (of about 590 years ago) on the land above the old shoreline (McFadgen 1994). The shell deposits along this old shoreline are assuredly natural shoreline shell deposits, and not middens as has been claimed. This old shoreline with its pumice and shell deposits was viewed during the field inspections.

46 A generalised cross-section of the lagoon, with a twenty five times vertical exaggeration, is shown on Figure 6.

Historical Conditions

47 A detailed description of the Chatham Islands is given by Dr E Dieffenbach in the journal of the Royal Geographical Society, London, based on his visit in 1840. The map accompanying his article is reproduced as Figure 7.

48 In his account he describes Te Whanga lagoon as a brackish lake. Describing the outlet area and the dewatering of the lagoon, he states:

> "On its eastern side, it is separated from the sea by low sandhills about 100 yards [90 m] broad. At one place, the intervening hills disappear, and between the lake and the sea there is only a low sandy beach; the level of the lake is about 2 feet [0.6m] above high-water mark. According to the natives, the sea never encroaches upon it. Its water is only slightly brackish, probably from infiltration, as it is supplied by two large streams which would otherwise make its water fresh."

and

> "The Wanga lake occasionally empties its waters into the sea, by breaking over its low barriers. This may happen periodically, when it has been sufficiently replenished by its tributaries, or perhaps after particularly wet seasons. In such cases a vast quantity of its waters is discharged. The land at its southern extremity is then left dry to the extent of several miles, and the way from Wai keri, a native settlement on the eastern shore, to Waitangi harbour on the western, is much shortened. The last time that this discharge of the water took place was in 1837."

(Dieffenbach, 1841 p 204)

49 He describes the vast flocks of ducks and other birds, noting that "duck's eggs furnish the natives with a favourite article of food".

50 In an additional note in the Journal the following year, Dieffenbach describes a break out, stating:

> "that a break took place, and the outpouring water formed a broad communication between the sea and the lake, carrying away many thousand tons of sand, and forming a channel that appeared accessible to boats. But a boat which tried to enter this new bar-harbour was upset in the heavy surf and six people were drowned".
>
> (Dieffenbach, 1842 p142)

51 He then described how easterly gales had driven "vast quantities of sea water into the lake: its surface ... now on a level with the sea." He also stated that the "waters partake of the movements of the tide", but does not describe to what extent, and considered "the lake now more properly an 'inlet'".

52 S Percy Smith undertook the first triangulation survey of Chatham Island in 1868. Later, in recalling his time on the Island he stated:

> "A large part (of the Island) is occupied by Te Whanga Lagoon, a brackish water lake containing enormous quantities of eels, ducks and geese ... The Whanga Lagoon teemed with eels in enormous quantities. On some occasions after a strong north east gale, the lagoon breaks out at Te Awapatiki, and the eels seem to become aware of this and take the opportunity of escaping to sea. On one occasion Mr Wilson and I riding along the beach there found that the sea had broken into the lagoon, but the sand bank that forms the bar in ordinary times had closed across the outlet, leaving a narrow channel some three yards wide running towards the sea but not communicating with it. It was about fifty yards [45m] long and three feet [0.9m] deep. Into this channel the eels had gathered in such numbers that our horses refused to cross it while the dry sands beyond were so thickly strewn with dead and dying eels that they might have been gathered by the cart load.

53 At the time of Percy Smith's survey the lagoon outlet was closed, and his survey plans show this, but also indicate where openings occurred.

54 In response to the Petition of George Tuuta and 34 others of 1936, a L & S Memorandum stated:

> "There appears to be some doubt whether the sheet of water referred to is a lake, as there is an opening to the sea about two to three chains wide, and the tide flows in and out. As the opening is so small compared with the large area (about 45,000 acres) [18,200 ha] the rise and fall of the tide does not appreciably affect the level of the contained water.
>
> Mr W H Coulter, Surveyor, who has made various trips to the Chatham Islands, has informed the Chief Surveyor's office that at times the opening to the sea blocks up and retains so until the weight of the accumulated water forces the outlet open again. On occasions when

this natural process does not happen, means are resorted to by the inhabitants to open the outlet, thus reducing the level of the water and allowing the usual fords to be used.

The "lagoon" contains salt water and is deep in places, and flounders abound in it. It is shallow over a large area and Mr Coulter states that the eastern side is the only part where accretion is likely."

55 The 1938 L & S report provides a detailed description of Te Whanga Lagoon at that time, with attached black and white photographs. The report notes the bird, shellfish and fish life of the lagoon, stating:

"Some thousands of acres of the shallow areas of the lagoon are covered with swan nesting grounds. One of these nesting grounds north of the Karewa Peninsula covering an area of approximately 2000 acres [800 ha] is illustrated in Photograph No 25. The water on this ground is approximately 15" to 18" [0.4 to 0.45m] deep, the bed being sandy with a heavy growth of lake grass. (p8)

"Both cockles and mussels can be found along the shores of any part of the lagoon, but are of a very small variety. The pupu (periwinkle) is evident in large quantities in all the shallows along the lagoon shores." (p10-11)

"A perusal of the declarations submitted with this report shows that there are a large variety of sea fish to be found in the waters of the lagoon; .... Summarised, these fish are:- flounder, Kahawai, groper, garfish, gurnard, conger eel, red cod, trevally, herring and eels... The eels are said to inhabit the lagoon in large numbers and have in the past formed a source of food supply for the natives". (p11)

56 The Te Awapatiki outlet site is described, and a study of opening times and their frequency, undertaken by the author of the report, is presented. The report states :

"The last outlet was opened approximately half a mile [0.8 km] north of the present outlet in 1931. During the intervening period of seven years, sandhills up to 30 feet [9m] above sea-level have accumulated." (p7)

and

"This opening has, within the living memory of man, been opened and closed at varying periods. From the declarations which are attached, it will be noted that the opening at Te Awapatiki has been carried out artificially since the '80's. These artificial openings have been necessary because the water accumulating in the lagoon makes the fords impassable and affects the grass land on the Hapupu flats. The last opening cut was made in 1931, at a point more than half-a-mile [0.8km] north of the present outlet. This opening has gradually worked southward and, at some future date, may naturally close when continuous easterly winds are experienced, causing sand bars to be accumulated at the mouth. After a period of three years, it becomes necessary to effect a further opening. Although these opening have been carried out artificially, the general opinion on the Island as borne out in a number of the declarations, is that, if

the outlet to the lagoon was not interfered with, an opening would break out naturally when sufficient water had accumulated and a favourable wind was blowing." (p14)

57 In the New Zealand Geological Survey report on the Chatham Islands of 1970, the following comment on Te Whanga Lagoon is made :

"During the writers' visit (1957) when the outlet was open there were only a few inches of water at the ford that crossed the northern part of the lake, but in times past when the outlet has been blocked the jetty at the flying-boat base at Waikato Bay has been submerged. Under natural conditions, when the level has reached a certain height the restrained water will burst through the sand barrier and the lagoon discharges into the sea. This cycle of opening and closing the outlet under natural conditions takes about 7 years; in practice the channel is sometimes artificially opened to prevent further encroachment of the waters of the lagoon upon marginal grazing land." (p16)

58 Other comments on the lagoon and its outlet have been made in the reports and other documents studied. These comments are generally similar to those given above.

59 Artificial openings of the lagoon have been carried out since last century, first by local farmers, and later by the Ministry of Works and the County Council. This has changed the nature of the lagoon, with the connection to the sea being maintained for long periods, and continually re-instated. Sea water inflows would be correspondingly more continuous, and the large accumulations of fresh water within the lagoon that used to occur would no longer happen.

Present Conditions

60 The present condition of Te Whanga lagoon, and the impact of the artificial maintenance of an outlet to the sea, will now be described, in terms of the influencing factors or parameters that can be used to describe or categorise coastal water bodies.

Tides

61 The tide rise and fall along the Chatham Island coast is relatively small and the variability in tidal range is low. The Hydrographic Survey chart of the Chatham Islands (NZ268) gives the same levels for mean neaps and mean springs at Waitangi, and a range between mean high and low water levels of only 0.6m. This tidal range is compared to other sites on the New Zealand coast in Figure 8.

62 The condition of the opening at the time of the field inspections is shown in the oblique aerial photograph of Plate 1. The outlet during January 1993 is shown in the oblique aerial photograph of Plate 2. An aerial

photograph taken from a similar angle showing the outlet closed off is shown in Plate 3. The date of this photograph is not known, but it was reproduced in a book published in 1989.

63 The flow within the outlet channel and opening to the sea was observed, at low and mid tide, during the inspections of 21 and 22 March. The tidal fluctuations were clearly restricted to the opening itself and the adjacent outlet channels. Even within these channels wind effects due to slight breezes masked the effects of tidal flows. At low tide the only exposed 'tidal flats' were small marginal strips alongside the outlet channel at the opening itself. The height of the cut face and beach here indicated a tidal range of less than 0.5m.

64 A measurement of the tide range given in the 1938 report, at about 400 metres from the opening itself, was of the same order - 18 inches or 0.45m. This report also noted that given "this small range of tide [it] would not be noticeable within the lagoon." The report then considers the declarations of the local residents about tidal fluctuations. These declarations are contradictory, with some claiming that tidal fluctuations could be observed in the lagoon itself.

65 As there is a channel connection between the lagoon and the sea, the flow in and out from the rise and fall of the tide can be modelled by assuming a representative channel. Calculations have been undertaken for a 2 km long channel with a relatively large representative channel section, and a 1 km long channel with a smaller channel section, assuming the lagoon water level is at mean sea level.

66 The tabulated calculations taken directly from the computer spreadsheet programme are attached in Appendix II. The maximum calculated flows are 49 and 22 m^3/s respectively, and the total volume of water flowing into the lagoon is the cumulative volume given in bold in the tables. These volumes would raise the average water level of the 18600 ha lagoon by 4 and 2 mm respectively.

67 A brief shower of rain (of 2 to 4 mm) would raise the lagoon water level by the same amount.

68 Actual in and out flows would vary, according to lagoon water levels, wind speed and direction and sea conditions.

Waves

69 The opening to the sea through the gravel barrier is always narrow, and the lagoon itself is separated from the opening by channels, given the islands situated immediately behind the low length of the barrier beach. Sea waves cannot thus penetrate into the lagoon.

70 Waves in the lagoon are generated directly by the wind, and given the long lengths (or fetch) of open water, substantial wave heights can be generated. There can also be considerable set up, or differences in (wave averaged) water levels from one side of the lagoon to the other, during strong winds.

71 Wind set ups have been recorded on Lake Wairarapa (see Figure 9). Over a period of about 2 years (from 1988 to 1990) the maximum difference in level between two recorders on opposite sides of the lake was over 0.8m, with set ups of over 0.3m occurring on many occasions. In this case the recorders were about 5 km apart, with a down wind fetch for the prevailing winds of 3 km across the lake.

72 The maximum fetch on Te Whanga, for a northerly wind, is over 20 km. The lagoon is, though, split into three basins, and the very shallow areas between the basins, with low islands and channels, would affect wind generated waves and set up. The fetch in the (central) Taihawea basin, for N to NW winds blowing the lagoon water towards the opening, would be about 10 km.

73 The large and rapid changes in water levels that can take place on the old ford route, between Moutapu Point and Hapupu, were described by local people.

74 The lagoon water level at the outlet can, then, vary greatly with changing wind conditions, and increases or decreases in height of from 0.5 to 1 metre could well occur during periods of strong winds. Wave fluctuations would occur on top of these (average) water level differences.

75 Lagoon water can, thus, be essentially blown out of the lagoon, by raising levels substantially at the outlet. The water level in the lagoon in the November 1973 aerial photography (survey number 2413) is clearly well below mean sea level, with large areas of shallow lagoon flats above water level. A look at wind records for 1972 does show strong NW winds prior to the photography. The frequency of such winds, while it could have been assessed, is not known. The assumption would be, though, that wind set up and waves had caused substantial lagoon dewatering.

76 Rainfall records do show a relatively low rainfall in November that year, and net evaporation could have had some (much lesser) effect on lowering the lagoon water level.

77 Given low lagoon levels due to wind effects, larger than normal inflows of sea water would occur, and the lagoon could be largely filled up with salt water, rather than fresh water from rainfall or runoff to the lagoon.

Tsunamis

78 The Chatham Islands are subject to tsunamis, particularly from undersea earthquakes off the coast of Chile. The last large tsunamis occurred in 1868, with three long tidelike waves washing over the eastern and northern dune barriers and travelling across Te Whanga lagoon to the limestone cliffs along the western side.

79 These tsunami waves are not 'walls of water', but are more like short duration tides with much larger fluctuations in level. They thus have analogous effects to tides, with strong rip currents, and leave behind characteristic wash deposits.

80 It is now known that large earthquakes have occurred at the same crustal plate boundary off the coast of Chile at 100 to 150 year intervals, with the 1868 earthquake preceded by large quakes in 1748, 1604 and 1513. (A Barnett, 1995).

81 Coastal landforms, like river systems, are strongly moulded by rare extreme events. In rivers this arises from major landslide blockages and subsequent bursting, on the coast from tsunamis. [Land movement from large earthquakes and major volcanic activity are other strongly influencing happenings, but the Chathams is little affected by such activity.]

82 The form of Te Whanga lagoon, and of the non-cohesive coastal and alluvial materials that surround it, may well have been strongly influenced by tsunamis.

83 When I first studied a map of Te Whanga Lagoon, I thought the lagoon must be tidal. This was because of the shape of the islands and channels behind the opening at Te Awapatiki. They have the characteristic form of what is called a flood tide delta, that forms on the island side of a sea opening, due to the movement and re-working of material by the flood tides into the coastal water body. I quickly disavowed myself of this opinion when I studied the aerial photography - prior to visiting the lagoon. The islands were covered in vegetation, and remained unchanged through all the available aerial photography (from 1963). The only changes were to the barrier split itself, and the margins of the islands immediately adjacent to the opening.

84 Interestingly, a note attached to the 1938 L & S report makes the same point, saying "causal examination of these islands and connecting fords show them to be a reverse delta produced where the currents from an influencing tide fan out and loose velocity on emerging from the channel into the lagoon".

85 They may perhaps be called a 'flood tide delta' of 'tidal waves' or tsunamis. They were probably last re-moulded by the 1868 tsunami. The deposits at the two ford areas, that divide the lagoon into three basins, have probably

been built up by rare but periodic tsunami flows over the barrier beaches and across the lagoon. The scouring and wash effects of tsunami waves may also have contributed to the form of the land between the lagoon and these barrier beaches, with its string of small lakes.

86 It may also be interesting to note that the shell deposits that extend along the top of the barrier beach formations may be natural deposits, formed as wash deposits from tsunami waves.

87 The shell, fish bones and other material would then have come from the adjacent sea shore, and been carried up and on to the beach formation by the waves. There is a lot of shell along the coast, including old shoreline deposits. The shells in the deposits are also broken and smashed up.

88 These shell deposits near the Te Awapatiki opening were viewed during the field inspections, and they have all the characteristics of such natural deposits. The deposits have distinct layers, and there is a continuity along the barrier, even where very few shells are present. They are long shallow deposits, with a varying thickness, like tidal wash beach deposits.

89 In a report to the Tribunal, on the archaeology of the Moriori, D G Sutton notes the many differences between what he calls shallow specialised sites and the much fewer deep complex sites. The later are clearly middens, and all the differences between the two types of sites are suggestive of a natural cause for the long shallow sites - that are the shell deposits along the barrier beaches. If these beach top deposits were due to human activity, then the question would arise as to how they could remain and accumulate over a very long period, in spite of the overflows that occur on [rare] occasions from tsunami waves.

Salinity

90 The salinity of coastal lagoons varies greatly, and is affected by sea storm wave wash inflows over the separating barrier, saltwater infiltration through the barrier, and evaporation, as well as flows through the openings connecting lagoons to the sea.

91 In its natural state the salinity of Te Whanga lagoon would have varied, but generally it would have been brackish, with a high proportion of fresh water. The lagoon water level would have built up from rainfall and runoff inflows until a break out occurred at the opening area, where the periodic openings maintained a relatively low length in the barrier.

92 The coast is a high energy one, and the opening would be closed off by the transport of shore material into the opening. The early survey plans show a pronounced spit

(to the south). Material moving along the beach by longshore currents and waves would then close off the breach, generally pushing the opening to the south before closing it off.

93 Following a break out a substantial inflow of sea water could occur, depending on wind and sea conditions during the time the opening remained. However, over the longer term the main inflow would have been fresh water, from rain and catchment runoff.

94 The height of the barrier beaches around the lagoon is such that storm overflows of the barriers occur only rarely, and any overflows that do occur would be absorbed on the margin of land between the barrier and the lagoon.

95 Storm waves do wash over the low barrier at the opening site, into the outlet channels. Storm overflows can, though, be discounted as a significant source of salt water.

96 On very rare occasions tsunami overflows would give rise to a large salt water inflow, as well as carrying in all sorts of marine life. But, because of the rarity of such events, their impact on lagoon salinity would not be great over the longer term. Salt water is, though, denser than fresh water, and the sea water carried into the lagoon by tsunami overflows could sink to the bottom, and not be that easily flushed out. On the other hand the lagoon water is generally well mixed.

97 The non-cohesive gravel and sand deposits along the east and north sides of the lagoon are clearly of relatively high permeability. The many small lakes between the lagoon and the barrier beaches are generally without outlets, and rainfall and runoff inflows are lost by infiltration as well as evaporation. If fresh water can infiltrate down into the coastal deposits, then sea water can also infiltrate into them.

98 Where there are non-cohesive materials along a coast, there is a salt water intrusion inland, with the denser salt water forming a wedge under the fresh groundwater. Dieffenbach, in his 1841 report, presumed that the slight brackishness of the lagoon at the time of his visit was due to infiltration.

99 The likelihood of infiltration could be determined from a study of the relative heights and distances of the sea with respect to the lagoon bed. This has not been done. However, some infiltration of sea water to the lagoon is considered a likely possibility.

100 Salinity can arise without any sea water inflow, due to evaporation. Sufficient climatic and catchment data was collected to allow a simple water balance model of the lagoon and its catchment to be set up. This would have allowed some calculation of the magnitude of fresh water inflows, the frequency of naturally occurring openings,

and the net effect of evaporation. This analysis, again because of limitations on the study, has not been undertaken.

101 The artificial maintaining of the opening to the sea must clearly affect the salinity of the lagoon. Some comment was made to the effect that the opening has been more permanently maintained since some time after the second World War, than prior to this time. The more the opening is maintained, the greater the sea water inflow and hence affect on lagoon salinity.

102 Sea water entering the lagoon from the outlet channels would spread through the lagoon by density current movements, with the salt water flowing under the fresh water. This probably takes place in the deeper central Taihawea basin. Generally, however, the movement of the lagoon water through wind set up and wind generated waves and currents, would ensure a high degree of mixing.

103 Salinity measurements were undertaken for the 1938 L & S investigations, and the results are recorded on the map that accompanies the 1938 report.

104 Samples were taken from below the surface (up to 2m deep) and the measured salt content is given in terms of grams of salt per cubic centimetre, with the report stating that sea water contains about 2 gm/cc. This is, however, incorrect, the salinity of sea water is around 35 gm/lt or 0.035 gm/cc. Presumably the wrong units have been used [the author would have been unfamiliar with metric units] but the salt content must also have been under-measured.

105 Salinity can be expressed as a percent (of salt by mass) with sea water being around 3.5%. On the presumption that the 1938 measurements were of salts that made up 2% of sea water, and that there is a linear relationship between these salt measurements and true salinity, the measurements may be adjusted to give salinities. The salinity (at depth) of the northern Muriwhenua basin would then have been about 2.4%, and 2.8% for the central Taihawea basin.

106 There is a direct relationship between salinity and conductivity, and as part of the investigations for this report, a field conductivity meter was used to test samples of surface water. This meter was checked against a laboratory meter for two samples, and the field meter was found to be under-reading by about 20%. Applying a correction factor, the conductivity measurements indicated a salinity of around 2.2% for the Muriwhenua basin (by the western shore) and around 2.5% throughout the Taihawea basin.

107 Two samples were also tested for the chloride salt (that makes up about half the salt content of sea water), and there is an empirical relationship between chloride concentration and salinity. Applying this relationship

gave lesser salinities, similar to the uncorrected conductivity readings.

108 The salinity information is then unsatisfactory. It was hoped that a comparison could be drawn between salinities as measured in 1938 and present lagoon salinities. The uncertainties and errors in the data, however, preclude this.

109 The information does, though, show that the lagoon water is highly saline, at those times when the opening to the sea is maintained.

110 During the 1938 testing the lagoon was relatively low, and infilling by sea water inflows through the outlet channel could have been occurring, while evaporative concentration of the lagoon may also have been occurring. The lagoon salinity at this time may then have been higher than usual.

Landform

111 The basins of Te Whanga lagoon are relatively uniform shallow basins, with gentle bed slopes, deepening towards the centre. The bed is generally stable, and there are no meandering tidal channels such as exist in estuaries.

112 The lagoon bottom is generally sandy, with some sandy peat areas and outcrops of limestone rock. Bore holes drilled along the line of the old ford route showed a bed material of sand overlying peat, with 'dry light vegetation' at the top of the peat layer. This suggests an overwhelming of vegetation by rapid sand deposition. The age and nature of this peat is not known.

113 Although there may have been other investigations of the lagoon bed, no further information could be found.

Lagoon Flora and Fauna

114 Extensive inquiries were made to see if information was available on the ecology of Te Whanga lagoon in particular, and on the differing ecologies of coastal lagoons and estuaries around New Zealand. The short answer was that there was virtually no information about Te Whanga lagoon, and while some studies are at present been undertaken on the ecology of lagoons as opposed to estuaries, and of the effects of different salt/fresh water mixes, very little information is presently available. One major study of a lagoon, Te Waihora/Lake Ellesmere in Canterbury, is being written up, and parts of the draft report were provided by the Canterbury Regional Council.

115 A major change in the ecology of Te Whanga lagoon has been the loss of the extensive weed beds that used to

cover large areas of the lagoon, especially in the shallower northern Muriwhenua basin. The extent of these weed beds is commented on in the 1938 report, and their general location indicated on the accompanying map.

116 The same loss of these submergent aquatic plants or macrophytes has occurred on Te Waihora (shown on Figure 1) and the study of this lagoon has provided some information on their environmental determinants and the reasons why they have not regenerated in the lagoon. Their presence is definitely related to salinity levels, and extensive beds have been destroyed by large storm driven inflows of sea water. Unlike Te Whanga, an important source of sea water input to Te Waihora is from flows over the barrier beach.

117 The study showed that high salinity adversely affects the regeneration of aquatic macrophytes, and regeneration from scratch probably requires much more conducive conditions (in terms of low salinity and high clarity and temperature) than regrowth within mature stands.

118 Te Waihora is subject to large changes in salinity, over time, and throughout the lagoon, and salinity and water level variations were found to have the most significant influence on the composition and abundance of the biological communities present in the lagoon (CRC draft report, 1995).

119 In the Gippsland Lakes, that are a series of large lagoons along the east coast of Victoria, Australia, the maintenance of a permanent opening to the sea has resulted in the dieing off of shoreline vegetation. The loss of this vegetation has exposed the shore, and especially fine river delta formations, to erosion (Ian Drummond and Associates 1990).

120 The fauna of coastal environments is very diverse and opportunistic. Along the open coast the varying tidal and wave wash environment supports differing biological communities. The mixed fresh/salt water environment of estuaries and lagoons gives rise to an ecology that is substantially different to the open sea and sea shore. The creatures that inhabit these environments have to cope with major changes in important physical determinants, and as conditions change the make up of the biological communities changes in response.

121 Changes in the coastal environment can then give rise to rapid changes in the biological communities present, with the opportunistic species of these communities rapidly colonising favourable habitats. Cockles, which are a very common shellfish of estuaries and sheltered coastal areas, cannot feed in water with a salinity below 1.8% (SJ Owen 1992), but their life cycle allows them to colonise favourable habitats easily and rapidly.

122 Information on the fauna of Te Whanga is only anecdotal, and is not sufficient to be able to define the character

of the lagoon ecology. Marine fish and shellfish will rapidly enter a lagoon that is opened up to the sea, and becomes sufficiently saline. This does not, though, make it a marine environment. On the other hand, a water body that supports extensive aquatic macrophyte weed beds and a very large eel population, as Te Whanga used to, is most certainly not an open sea marine environment.

1938 REPORT

123 This report gives an assessment of Te Whanga lagoon based on a geological assessment, salinity measurements, a survey of water levels, and observations on tidal effects and the presence of shellfish and fish life in the lagoon.

124 Reference has already been made to descriptions of the lagoon given in the report, and to the tide and salinity measurements undertaken.

125 The report also includes a "Determination of Mean High Water Mark". Although the report clearly states that tidal fluctuations would not be noticeable in the lagoon, the mean high water level along the coast (at Kaingaroa) was found to coincide "with the edge of the grass on the Hapupu flats". On this basis the lagoon was considered to have a mean high water level like the open coast.

126 This conclusion is invalid. The grass edge is related to inundation levels, and when an opening is maintained to the sea, rainfall and catchment runoff to the lagoon would not raise water levels much above the mean high water level of the sea. The grass edge may then be at about the mean high water level of the sea, because inundation above this level no longer occurs, or only very infrequently. It is certainly not at this level because it is the mean high water level of a tidally fluctuating water body.

127 The report presents a geological assessment that was reasonable for its time, however, it is now very much outdated. A great deal more is now known about geological processes and the transformations of the Earth's structure in general, and of New Zealand and the Chatham Islands in particular. Climatic variations and associated changes in sea level are now much better understood and documented. In the 1930's plate tectonics was a quaint theory of continental drift that was given no credence by the geological profession.

128 The conclusions drawn in the report about the western limestone sea cliffs and beach formation, and the progressive formation of the lagoon, are thus not now appropriate, nor are they correct.

129 The three low shoreline terrace formations along the western shore of the lagoon, below the limestone cliffs, that are noted in the report, were seen at one place

during the field inspections. The more likely explanation of these formations is that they arose from the three waves of the 1868 tsunami, as they washed up against this shore.

130 The report summary gives seven reasons for considering Te Whanga an arm of the sea. These reasons are given below, followed by comments:

1 The waters of the lagoon, when the outlet is open, are at mean high water level and are subject to the rise and fall of the tide for some miles within the outlet channel.

There is no mean high water level in the lagoon, and tidal fluctuations are restricted to the opening itself and the immediately adjacent outlet channels. The term 'mean high water level' is not applicable to the lagoon.

2 From 70% to 80% of the water of the lagoon is salt sea water.

The salinity of the lagoon is probably normally somewhat less than these percentages. The relative inflows of sea and fresh water are not known. Given the differences in residence time of sea and fresh water in the lagoon, due to the stratification tendency of waters of different density and the complexity of the flow patterns and currents in the lagoon, the relative contributions can not be determined from lagoon salinity.

3 The marine life in the lagoon is similar to that found at the same depth in the open sea.

The presence of marine fish in the lagoon does not mean that the lagoon has a marine environment like that of the open sea, or sea shore.

4 The Te Whanga Lagoon cannot be considered as a still inland water until all access to the open sea has been permanently closed. There is proof enough to show that under natural conditions, the lagoon outlet will periodically close and open.

What is a 'still inland water' body, and what is a 'permanently closed' access? What can the statement possibly mean?

5 The western shores of the lagoon were originally old sea coast and show conclusive evidence of this fact.

The statement, while correct, is irrelevant. Its supposed relevance is based on an incorrect geological assessment.

6 The landlocking of the lagoon has been proceeding slowly through geological ages along the eastern shore, and, until the process is complete, and thus permanently excludes the flowing in of sea water the lagoon must still remain an estuary of the sea.

This statement is incorrect, and based on an incorrect geological assessment.

7 The meaning of 'lagoon' is "a shallow lake connected with the sea or a river". The naming of this sheet of water implies that it was considered not as an inland water, or lake, but an arm of the sea.

This definition of lagoon is reasonable, but the conclusion about an arm of the sea does not follow. The terms used for coastal water bodies have, unfortunately, little consistency, and names can not be reliably used to indicate the nature of different such water bodies.

131 This assessment of the nature of Te Whanga lagoon was used at the time, and has been used since, to refute claims on the lagoon by Maori.

132 The report specifically refers to the claim of George Tuuta and 34 others, and refutes the claim on the basis that Te Whanga was an 'arm of the sea' and not a 'lake'.

133 The extracts from the L & S file on Te Whanga lagoon show that the findings of the 1938 report were referred back to when considering Maori claims. As recently as 1987 the Chief Surveyor, in a communication to the Registrar of the Maori Land Court, stated that Te Whanga Lagoon was an arm of the sea, by reference back to the 1938 report.

134 Even given that the geological interpretation of the time could have been misleading, the 1938 finding that the lagoon was an 'arm of the sea' is not accepted or considered an appropriate finding.

135 Its continued use was, and is, most definitely inappropriate.

DEPARTMENT OF CONSERVATION REPORT

136 This report is principally concerned with coastal lagoons in terms of the Coastal Marine Area of the Resource Management Act (1991). The report does, though, provide an analysis of coastal water bodies, and considers the various factors that can be used to define and categorise them. It provides some definitions, and refers to the Planning Tribunal declaration on the Avon/Heathcote estuary, which gave emphasis to landform rather than salinity or fauna, in determining the limit of the Coastal Marine Area.

137 The report then applies its analysis to six coastal water bodies. I have some familiarity with all these water bodies, except the Wainono Lagoon, through either professional knowledge or personal experience.

138 The only analysis I would disagree with is that of Te Whanga. This may be partly because of its reliance, directly or indirectly, on the 1938 L & S investigation. The so-called mean high water mark of this investigation is referred to, as well as 'observable tidal effect in

lagoon' and 'extensive tidal/lagoon level dependent flats'.

139 The assessment conclusions of the DOC report for Te Whanga are as given below, followed by comments.

* clearly involves extensive foreshore

There is no tidal fluctuation along the lagoon shore, so there can be no coast line 'foreshore'. The tidal fluctuation, and hence 'foreshore', is restricted to the opening itself and adjacent outlet channels.

* clearly extensive 'seawater' albeit with some fresh water, hence "seabed"

The lagoon water is now highly saline, but this salinity does not, by itself, make the bed of the lagoon 'seabed'.

* clearly no riverine connection to sea and a predominant estuarine landform

The lagoon landform, including its bed shape, is quite clearly <u>not</u> estuarine, as it lacks tidal channels and flats.

* clearly extensive marine species

There are marine species present in the lagoon, but again this does not make it a marine environment

* a predominant common recognition as an arm of the sea.

The continual repetition by one party that the lagoon is an arm of the sea, based on a 1930's investigation, can hardly constitute a common recognition.

140 This DOC assessment has been undertaken with reference to the present conditions of the lagoon, as the Department's interest is in the present management of the lagoon - under the Resource Management Act, 1991. The condition of the lagoon in 1840 was substantially different, and the assessment clearly does not apply to the lagoon as it was then.

COMMENT

141 Te Whanga lagoon is unusual in both its size and form. It is a large island lagoon formed by barrier beaches between outcrops of volcanic and limestone land. Relative to the size of the lagoon, its catchment is small, with minor creeks and streams. In this way it is similar to many much smaller coastal lagoons, with relatively low rates of supply of fresh water.

142 The lagoon has a constricted outlet to the sea, with outlet channels linking it to an opening area where the barrier beach becomes a low spit. Once an opening is

formed, either naturally or artificially, longshore movement of beach material (in conjunction with on and off shore movement) progressively moves and then closes off the opening. Although the coast at the opening site is a high energy coast, there is a relatively restricted source of material for longshore movement - as it is a short island coast. Thus openings can remain open for substantial periods, years rather than months. This is in contrast to Te Waihora lagoon, and other lagoons along the New Zealand coast - such as Whakaki Lagoon in Hawke's Bay (shown on Figures 1 and 4).

143 Te Whanga lagoon is divided into three basins by wide shallow areas, and although the lagoon water would generally be well mixed (by wind induced waves and currents) the basins have significant separation. The salinity measurements show clear differences in salinity between the basins. When extensive weed beds were present in the lagoon, these beds would have had a strong moderating influence on water flows within the lagoon, and water exchange between the basins.

144 The information available is adequate enough to show that the nature of the lagoon has changed substantially since 1840. There are clear differences in the lagoon as described in the early reports of around 1840 to 1870, the 1938 report and present day conditions.

145 In its natural state, before an opening was artificially maintained, the lagoon conditions would have been much more variable. Lagoon levels would have risen and fallen over a much greater range, with the accumulation of fresh water inflow, and then an outlet breach and dewatering .

146 Salinity would also have varied greatly, particularly in the central Taihawea basin. Under high lagoon levels salinity would be low, and there would probably have been a definite stratification of salt and fresh water, at least in the Taihawea basin, which is deeper and abuts the outlet. Following a break out, sea water would have flowed back into the lagoon, and definitely flowed down and into the deeper central area of Taihawea. However, the shallows separating the Muriwhenua basin, and its generally shallower depth with extensive weed beds, probably largely protected this basin from sea water intrusion.

147 The separate basins of the lagoon, thus, probably had significantly different biological communities, with the Muriwhenua basin remaining largely, if not completely, fresh water. Even in the Taihawea basin only short stay mobile marine fauna would be able to utilise this water body. Cockles, for instance, would probably not have been able to survive the long periods of closure, but could periodically spread into the lagoon.

148 By the time of the 1938 report the lagoon had been subject to sea inflows through the opening area on a nearly continuous basis for over 50 years (since 1882).

At that time, though, there were still extensive weed beds, especially in Muriwhenua. Cockles shells were present along the shore through out the lagoon, including the Muriwhenua basin. They were, though, all of small size, indicating a poor feed habitat. The actual location of cockle colonies at that time is, however, not known, and some beach deposits of cockle shells could have been wash deposits of shells carried some distance to the beach sites.

149 Some time after the second World War the weed beds disappeared. This has been associated with a change in opening regime in the 1960's, with the lagoon being reopened as soon as the opening closed off. Prior to that time, some closure of the opening was apparently accepted, with an opening cut through only when lagoon levels rose sufficiently to cover the lagoon margin flats and restrict ford access.

150 The weed beds may, however, have slowly been weakened, and once an area was denuded, conditions became such as to prevent regeneration. It may be relevant to note that a significant tsunami resulted from the large 1960 Chile earthquake. A large influx of sea water from this tsunami may have been sufficient to kill off the weed beds (as storm overflows did on Te Waihora in 1968), and prevailing conditions prevented regeneration.

151 At present cockle colonies are present throughout the lagoon, including the Muriwhenua basin. Small cockle and mussel shells lined the beaches along the western shore of this basin, and periwinkles were present.

152 Te Whanga lagoon has, thus, been substantially altered, both in its physical characteristics and in the biological communities present. This has occurred essentially because of the maintenance of a permanent opening to the sea.

153 Although there have been some studies of the physical nature of the lagoon, such as the 1938 L & S report, there has been virtually no studies of the ecology of the lagoon.

154 The changes to the lagoon, through intervention at the lagoon opening, have thus been brought about without any real appreciation of the effects on the lagoon environment or the biological communities within the lagoon.

155 This intervention is continuing. While the overall changes to the lagoon are known to some extent (from documentation and local knowledge), the lack of knowledge about lagoon processes and ecology makes it very difficult to properly assess the effects of the opening activities, or determine appropriate measures to avoid, remedy or mitigate adverse effects.

156 The plant communities of enclosed or semi-enclosed coastal water bodies vary, depending on the salt/fresh water mix. The communities present provide, then, an indication of the overall salinity conditions, and not just the conditions at some point in time, when a measurement may be undertaken. Short term changes in salinity can be accommodated, by a semi-dormancy, thus plant communities can survive short term increases in salinity, such as from temporary changes in opening conditions.

157 In many ways Te Whanga lagoon is similar to Te Waihora, although it has (now) a permanent outlet to the sea, and hence the salinity of the lagoon water remains more uniformly high. Te Whanga, like Te Waihora, does not have a measurable rise and fall of the tide. Thus, even under present conditions, any foreshore would be restricted to the opening and adjacent outlet channels.

158 The 'observations' of tidal fluctuations within the lagoon given in the declarations attached to the 1938 report may have been of tide related increases or decreases in level when the lagoon has been unusually low or high. For instance, with low lagoon levels (and calm conditions) a noticeable rise in water level may occur on each incoming tide due to an inflow 'pulse' of water. This could easily be mistaken for a tidal rise and fall, although the water level changes would <u>not</u> be those of tide levels (along the coast) and would actually be in one direction only.

159 Given a permanent outlet, and the low rate of fresh water supply and evaporative losses, average lagoon water levels would not vary greatly. Localised changes in water level are derived from wind effects - waves and set up. Lagoon levels can be lowered by evaporation in summer, and from additional outflows through the outlet due to wind generated rises in water level at the outlet.

160 The form of Te Whanga is similar to a shallow inland lake. It does not have the meandering tidal channels of large shallow estuaries, such as are clearly shown even on a 1:250000 scale map for the Kawhia, Aotea and Raglan estuaries (see Figure 3). The lack of tidal influences makes Te Whanga also very different to Okarito Lagoon (shown on Figure 2). These coastal water bodies have large tidal exchanges, with salinities very much the same as the open sea, in spite of significant fresh water inflows from rivers. The Okarito Lagoon can, though, be closed off because of the strong longshore currents along the coast, and its natural condition would have been significantly different, and more variable.

161 The main marine aspect of Te Whanga is its high salinity (under present conditions) and because of this many estuarine and marine types of species are present in or use the lagoon. The salinity is not, though, as high as the open sea, and varies throughout the lagoon, both on a

large scale between basins, and on a more localised scale along the lagoon shore.

162 Inquiries about the flora and fauna of Te Whanga and how it could be classified were made, but have not been followed up as intended due to study limitations. From the advice that was received, it would appear that the ecology of the lagoon is probably unusual, but the biological communities present (with existing conditions) have definite similarities to those in say the mid to upper reaches of a relatively well mixed estuary.

163 The lagoon is not, though, because of this an estuary, and it is certainly not an arm of the sea. To be an estuary it would have to be subject to tidal exchanges and fluctuations. The processes of water balancing, the way in which inflow, outflows and losses balance up, are not those of an estuary, but of a more enclosed small catchment coastal lagoon.

164 Large estuaries, with wide openings, could be considered arms of the sea, but there are many small river or stream mouth estuaries that could in no way be called arms of the sea. In fact, on the basis of numbers, the vast majority of estuaries could not be so described. To be an arm of the sea the coastal water body would have to be a part of the sea, as a (semi-enclosed) extension of the sea, where <u>all</u> the various aspects of a sea environment are present.

165 The term an arm of the sea is, therefore, considered to be a more restrictive one than estuary, and would only apply to larger estuaries, and then perhaps only the main body of the estuary.

166 A lagoon is more enclosed and less subject to the forces of the sea than an estuary. As a term for coastal water bodies it, therefore, applies to water bodies that have characteristics differing from estuaries that are in the opposite direction to what would be arms of the sea. To put that another way, the general order in which the terms would be applied, in the order of increasing differences from the sea, would be: arm of the sea, estuary and then lagoon.

167 In form Te Whanga is like a temperate zone (mid latitude) equivalent of an enclosed tropical lagoon. In spite of the very high salinity of their water, even when they are completely surrounded by land, these island lagoons could not be called arms of the sea.

168 In my opinion Te Whanga, as it was formed, and in its present modified condition, can be properly called a lagoon.

169 The 1938 L & S report was probably influenced by a very simple view of water bodies, where any water body had to be either a [fresh water] lake or a [coastal mixed salt/fresh water] estuary. Since then there has

developed a much better appreciation of the complexity and variety of coastal water bodies, with terms such as lagoon being used.

170 The nature of Te Whanga lagoon could be altered back to "a slightly brackish lake" through the construction of a controlled outlet.

171 From the brief inspections undertaken it would appear that there exists the possibility for a simple controlled outlet from the northern basin to Taupeka Point. Here there is a natural break in the beach barriers, and an outlet structure could be fixed to the rock at the shoreline here. A simple channel could then connect this outlet structure to the lagoon.

172 Given that this outlet would only have to pass the net fresh water inflow (less evaporative losses), and because of the vast storage provided by a small rise in the lagoon, only have to pass the longer term average net inflow, its capacity could probably be very small.

173 The effects on the nature and ecology of the lagoon of a permanent opening could then be mitigated by the construction of an alternative controlled opening. The water level within the lagoon could then be controlled, without the salt water intrusion that takes place through the present opening site.

CONCLUSION

173 Te Whanga is an unusual lagoon. It is an island lagoon, of large size, consisting of three partly separated major basins with diverse margins of flats, bays and channel areas.

174 There is sufficient information available to document in general terms the very substantial changes that have taken place in the physical characteristics and ecology of the lagoon, since 1840.

175 There is though a very real lack of knowledge about the lagoon and its ecology. The artificial maintenance of an opening to the sea was clearly a major factor in the changes that have occurred. However, a proper understanding of what has occurred and why can not be gained from presently available information about the lagoon.

176 A reasonable assessment can be made of the present physical character of the lagoon, and hence of its comparative status as an enclosed coastal water body.

177 It is much more difficult to assess the likely nature of the lagoon in 1840.

178 Further studies of the lagoon would undoubtedly be very helpful, for such an assessment. Especially studies of

the lagoon ecology, including a search for evidence about changes that have taken place in the biological communities of the lagoon over the last 100 years or more.

179 The modifications to the lagoon due to past and present interventions, in particular the artificial maintenance of the opening, are not irreversible.

180 Naturally the lagoon was subject to wide variations in conditions, and there would have been continual responses and adaptations. A change in the opening regime, by means of a controlled outlet, would require a further intervention, but by changing lagoon conditions again, would make the lagoon similar to what it was like in the past when cut off from the sea.

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Lagoon -

Penguin Dictionary of Geography

Lagoon. A shallow stretch of water which is partly or completely separated from the sea by a narrow strip of land. In the case of a *Coral Reef*, it is the channel of sea water between the reef and the mainland, or, when an *Atoll* has been formed, the sheet of water enclosed by the latter; a fringing reef, close to the shore, has a relatively narrow and shallow lagoon, while a barrier reef, far from the shore, has a much wider and deeper lagoon. A lagoon may also be formed by a spit of land, composed of mud, sand, or shingle, closing or almost closing the entrance to a bay - eg. off the Nile delta. Again, it may be formed when the sea throws up a bank of shingle at high water mark, and encloses a sheet of water between the bank and the cliff; the lagoon then sometimes disappears at low tide. A lagoon may be formed, too, when an arm of the sea is enclosed by sandhills.

McGraw-Hill Dictionary of Scientific and Technical Terms

Lagoon [GEOGR] 1. A shallow sound, pond, or lake generally near but separated from or communicating with the open sea. 2. A shallow fresh-water pond or lake generally near or communicating with a large body of fresh water.

C L McLay (Reference 5)

A **lagoonal environment** is a semi-enclosed body of water having a free connection with the open sea and where, due to a large volume of fresh water, from one or more rivers, the addition of sea water is intermittent and normally restricted to periods of storm activity or high tidal elevations.

Canterbury Regional Council (Reference 20)

A **lagoon** is a coastal body of brackish water that is periodically in contact with the sea, but does not undergo the regular daily tidal cycles of an estuary.

Lake -

Penguin Dictionary of Geography

Lake. An extensive sheet of water enclosed by land, occupying a hollow in the earth's surface. The name is sometimes loosely applied, too, to the widened part of a river, or to a sheet of water lying along a coast, even when it is connected to the sea; there are many gradations, in fact, between bays and lagoons which are almost enclosed and coastal lakes. Usually the amount of water entering a lake exceeds that lost by evaporation, and there is an outflowing stream; the water

of the lake is thus fresh. In a region of low rainfall and great evaporation, however, the lake has no outlet, and it forms an inland drainage area. All the salts brought down in solution by the rivers accumulate in such a lake, which thus acquires a very high *Salinity*; the Dead Sea and the Great Salt Lake, Utah, U.S.A., are examples of this kind of lake. See *Salt Lake*. When rainfall is seasonal, the level and area of a lake may fluctuate considerably; Lake Chad, in Africa, for instance, decreases greatly in size during the dry season. A lake may also dry up entirely during a drought or in the dry season, leaving only a salt-covered mud flat; Lake Eyre and other lakes of central Australia disappear in this way. A lake remains permanent provided that the amount of water it receives, as rain and as water draining into its hollow, equals the amount lost.

McGraw-Hill Dictionary of Scientific and Technical Terms

Lake[HYD] An inland body of water, small to moderately large, with its surface water exposed to the atmosphere.

Appendix II

TIDAL EXCHANGE CALCULATIONS

The following tables give the spreadsheet calculations of tidal exchange for representative outlet channel conditions.

The tide heights have been calculated for a mean high to mean low tidal range, at quarter hour intervals. Flow grades have been determined assuming the lagoon level is at mean sea level. A channel resistance factor of Manning's of 0.025 has been used. Flow velocity, magnitude and cumulative volumes have then been calculated.

The representative channel dimensions are given on the tables for the two cases considered.

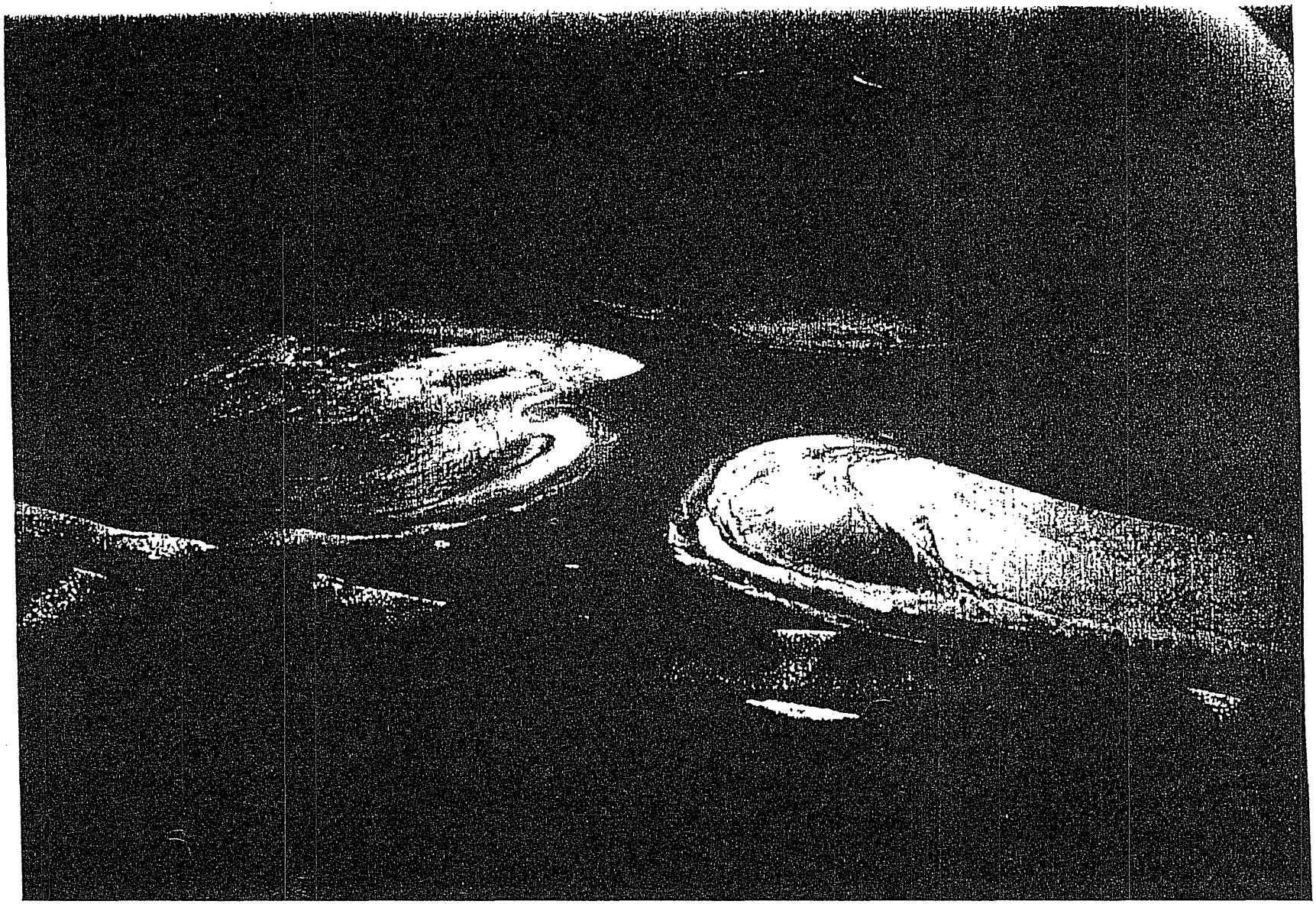
TE WHANGA LAGOON

TIDAL EXCHANGE through OUTLET CHANNEL

CHANNEL 1000m long, 50m wide & 0.5m deep

TIME (hr)	RADIANS	SIN ()	HEIGHT (m)	CHANNEL GRADE	VELOCITY (m/s)	FLOW (m3/s)	VOLUME (m3)	CUMULATIVE VOLUME
0.00	0.00	0.00	0.00	0	0.00	0		
0.25	0.13	0.13	0.04	3.8E-05	0.16	8	3491	3491
0.50	0.25	0.25	0.08	7.5E-05	0.22	11	8407	11898
0.75	0.38	0.37	0.11	0.00011	0.27	13	10898	22796
1.00	0.51	0.49	0.15	0.00015	0.30	15	12823	35619
1.25	0.63	0.59	0.18	0.00018	0.34	17	14397	50016
1.50	0.76	0.69	0.21	0.00021	0.36	18	15707	65723
1.75	0.89	0.78	0.23	0.00023	0.38	19	16797	82520
2.00	1.01	0.85	0.25	0.00025	0.40	20	17693	100213
2.25	1.14	0.91	0.27	0.00027	0.42	21	18409	118622
2.50	1.27	0.95	0.29	0.00029	0.43	21	18954	137576
2.75	1.39	0.98	0.30	0.0003	0.43	22	19336	156912
3.00	1.52	1.00	0.30	0.0003	0.44	22	19558	176470
3.25	1.65	1.00	0.30	0.0003	0.44	22	19621	196091
3.50	1.77	0.98	0.29	0.00029	0.43	22	19526	215617
3.75	1.90	0.95	0.28	0.00028	0.42	21	19273	234890
4.00	2.03	0.90	0.27	0.00027	0.41	21	18859	253749
4.25	2.15	0.83	0.25	0.00025	0.40	20	18279	272028
4.50	2.28	0.76	0.23	0.00023	0.38	19	17528	289556
4.75	2.41	0.67	0.20	0.0002	0.36	18	16595	306152
5.00	2.53	0.57	0.17	0.00017	0.33	16	15464	321616
5.25	2.66	0.46	0.14	0.00014	0.30	15	14105	335721
5.50	2.79	0.35	0.10	0.0001	0.26	13	12470	348191
5.75	2.91	0.23	0.07	6.8E-05	0.21	10	10457	358648
6.00	3.04	0.10	0.03	3E-05	0.14	7	7793	366440
6.25	3.17	-0.03	-0.01	-8E-06	-0.07	-3	1561	368001
6.50	3.29	-0.15	-0.05	-5E-05	-0.17	-8	-5385	362616
6.75	3.42	-0.28	-0.08	-8E-05	-0.23	-11	-8973	353644
7.00	3.55	-0.39	-0.12	-0.0001	-0.27	-14	-11318	342326
7.25	3.67	-0.51	-0.15	-0.0002	-0.31	-16	-13162	329164
7.50	3.80	-0.61	-0.18	-0.0002	-0.34	-17	-14678	314485
7.75	3.93	-0.71	-0.21	-0.0002	-0.37	-18	-15942	298544
8.00	4.05	-0.79	-0.24	-0.0002	-0.39	-19	-16991	281552
8.25	4.18	-0.86	-0.26	-0.0003	-0.41	-20	-17850	263702
8.50	4.31	-0.92	-0.28	-0.0003	-0.42	-21	-18531	245171
8.75	4.43	-0.96	-0.29	-0.0003	-0.43	-21	-19044	226128
9.00	4.56	-0.99	-0.30	-0.0003	-0.43	-22	-19393	206734
9.25	4.69	-1.00	-0.30	-0.0003	-0.44	-22	-19583	187151
9.50	4.81	-0.99	-0.30	-0.0003	-0.44	-22	-19615	167536
9.75	4.94	-0.97	-0.29	-0.0003	-0.43	-22	-19488	148048
10.00	5.07	-0.94	-0.28	-0.0003	-0.42	-21	-19203	128845
10.25	5.19	-0.89	-0.27	-0.0003	-0.41	-21	-18756	110089
10.50	5.32	-0.82	-0.25	-0.0002	-0.40	-20	-18143	91946
10.75	5.45	-0.74	-0.22	-0.0002	-0.38	-19	-17357	74589
11.00	5.57	-0.65	-0.20	-0.0002	-0.35	-18	-16386	58204
11.25	5.70	-0.55	-0.17	-0.0002	-0.32	-16	-15211	42992
11.50	5.83	-0.44	-0.13	-0.0001	-0.29	-14	-13802	29190
11.75	5.95	-0.32	-0.10	-1E-04	-0.25	-12	-12102	17087
12.00	6.08	-0.20	-0.06	-6E-05	-0.20	-10	-9991	7096
12.25	6.21	-0.08	-0.02	-2E-05	-0.12	-6	-7112	-16
12.50	6.33	0.05	0.02	1.5E-05	0.10	5	-496	-512

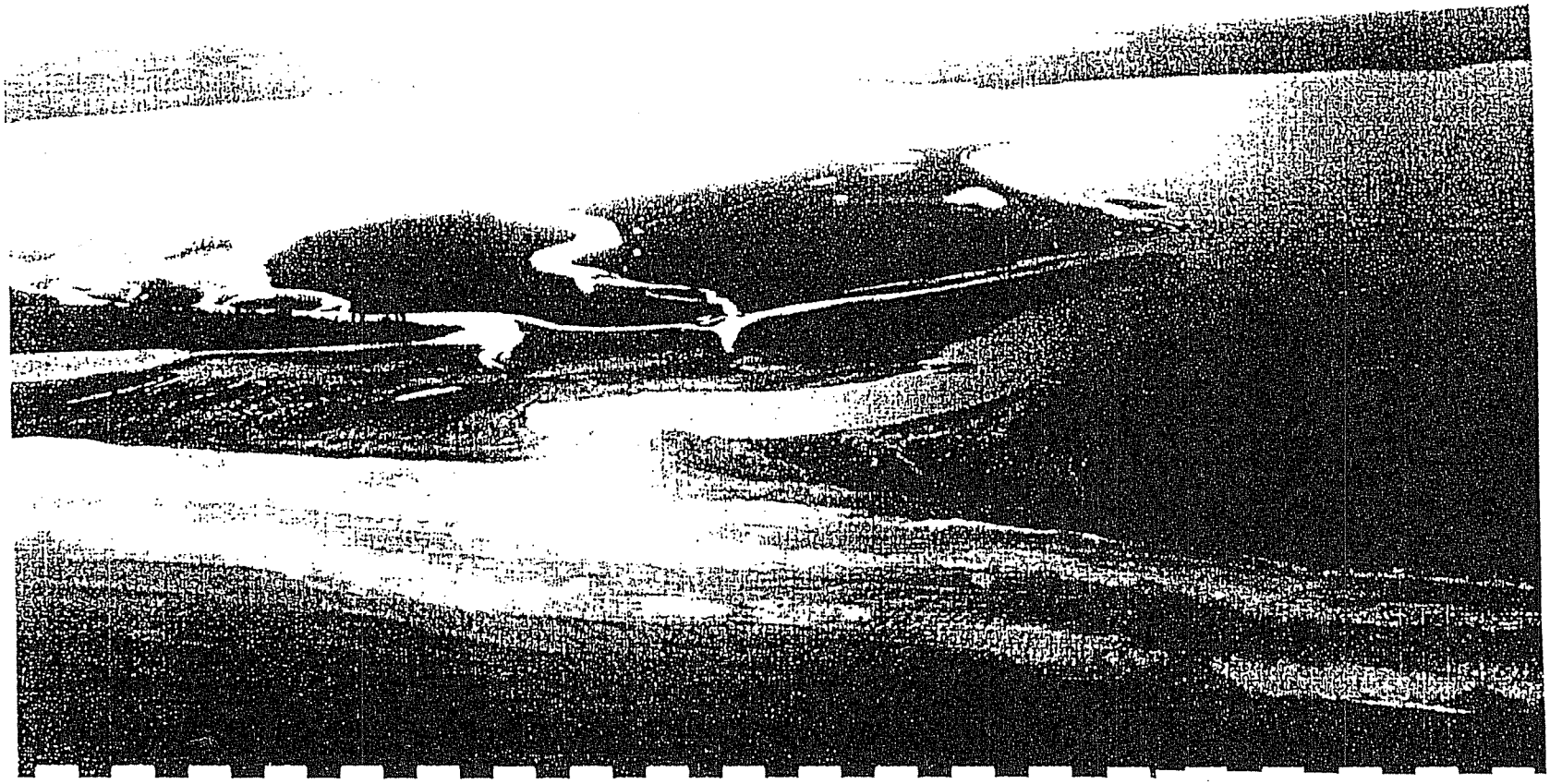
			TE WHANGA LAGOON					
	TIDAL EXCHANGE through OUTLET CHANNEL							
	CHANNEL 2000m long, 100m wide & 1m deep							
TIME	RADIANS	SIN ()	HEIGHT	CHANNEL	VELOCITY	FLOW	VOLUME	CUMULATIVE
(hr)			(m)	GRADE	(m/s)	(m3/s)	(m3)	VOLUME
0.00	0.00	0.00	0.00	0	0.00	0		
0.25	0.13	0.13	0.04	1.9E-05	0.17	17	7836	7836
0.50	0.25	0.25	0.08	3.8E-05	0.25	25	18873	26709
0.75	0.38	0.37	0.11	5.6E-05	0.30	30	24464	51173
1.00	0.51	0.49	0.15	7.3E-05	0.34	34	28785	79957
1.25	0.63	0.59	0.18	8.9E-05	0.38	38	32318	112275
1.50	0.76	0.69	0.21	0.0001	0.41	41	35259	147534
1.75	0.89	0.78	0.23	0.00012	0.43	43	37706	185240
2.00	1.01	0.85	0.25	0.00013	0.45	45	39716	224957
2.25	1.14	0.91	0.27	0.00014	0.47	47	41323	266280
2.50	1.27	0.95	0.29	0.00014	0.48	48	42549	308829
2.75	1.39	0.98	0.30	0.00015	0.49	49	43406	352234
3.00	1.52	1.00	0.30	0.00015	0.49	49	43903	396137
3.25	1.65	1.00	0.30	0.00015	0.49	49	44045	440182
3.50	1.77	0.98	0.29	0.00015	0.48	48	43832	484014
3.75	1.90	0.95	0.28	0.00014	0.48	48	43263	527278
4.00	2.03	0.90	0.27	0.00013	0.46	46	42333	569611
4.25	2.15	0.83	0.25	0.00013	0.45	45	41033	610644
4.50	2.28	0.76	0.23	0.00011	0.43	43	39347	649992
4.75	2.41	0.67	0.20	0.0001	0.40	40	37253	687245
5.00	2.53	0.57	0.17	8.6E-05	0.37	37	34713	721957
5.25	2.66	0.46	0.14	6.9E-05	0.33	33	31663	753620
5.50	2.79	0.35	0.10	5.2E-05	0.29	29	27992	781613
5.75	2.91	0.23	0.07	3.4E-05	0.23	23	23473	805086
6.00	3.04	0.10	0.03	1.5E-05	0.16	16	17493	822579
6.25	3.17	-0.03	-0.01	-4E-06	-0.08	-8	3503	826083
6.50	3.29	-0.15	-0.05	-2E-05	-0.19	-19	-12087	813995
6.75	3.42	-0.28	-0.08	-4E-05	-0.26	-26	-20141	793854
7.00	3.55	-0.39	-0.12	-6E-05	-0.31	-31	-25407	768447
7.25	3.67	-0.51	-0.15	-8E-05	-0.35	-35	-29546	738901
7.50	3.80	-0.61	-0.18	-9E-05	-0.38	-38	-32949	705952
7.75	3.93	-0.71	-0.21	-0.0001	-0.41	-41	-35786	670166
8.00	4.05	-0.79	-0.24	-0.0001	-0.44	-44	-38142	632024
8.25	4.18	-0.86	-0.26	-0.0001	-0.45	-45	-40069	591955
8.50	4.31	-0.92	-0.28	-0.0001	-0.47	-47	-41598	550357
8.75	4.43	-0.96	-0.29	-0.0001	-0.48	-48	-42749	507607
9.00	4.56	-0.99	-0.30	-0.0001	-0.49	-49	-43534	464074
9.25	4.69	-1.00	-0.30	-0.0001	-0.49	-49	-43960	420114
9.50	4.81	-0.99	-0.30	-0.0001	-0.49	-49	-44031	376083
9.75	4.94	-0.97	-0.29	-0.0001	-0.48	-48	-43747	332336
10.00	5.07	-0.94	-0.28	-0.0001	-0.47	-47	-43106	289230
10.25	5.19	-0.89	-0.27	-0.0001	-0.46	-46	-42103	247126
10.50	5.32	-0.82	-0.25	-0.0001	-0.44	-44	-40727	206399
10.75	5.45	-0.74	-0.22	-0.0001	-0.42	-42	-38962	167437
11.00	5.57	-0.65	-0.20	-1E-04	-0.40	-40	-36782	130655
11.25	5.70	-0.55	-0.17	-8E-05	-0.36	-36	-34146	96509
11.50	5.83	-0.44	-0.13	-7E-05	-0.33	-33	-30983	65525
11.75	5.95	-0.32	-0.10	-5E-05	-0.28	-28	-27167	38358
12.00	6.08	-0.20	-0.06	-3E-05	-0.22	-22	-22429	15929
12.25	6.21	-0.08	-0.02	-1E-05	-0.13	-13	-15966	-37
12.50	6.33	0.05	0.02	7.6E-06	0.11	11	-1113	-1150



TE AWAPATIKI OUTLET SITE

MARCH 1995

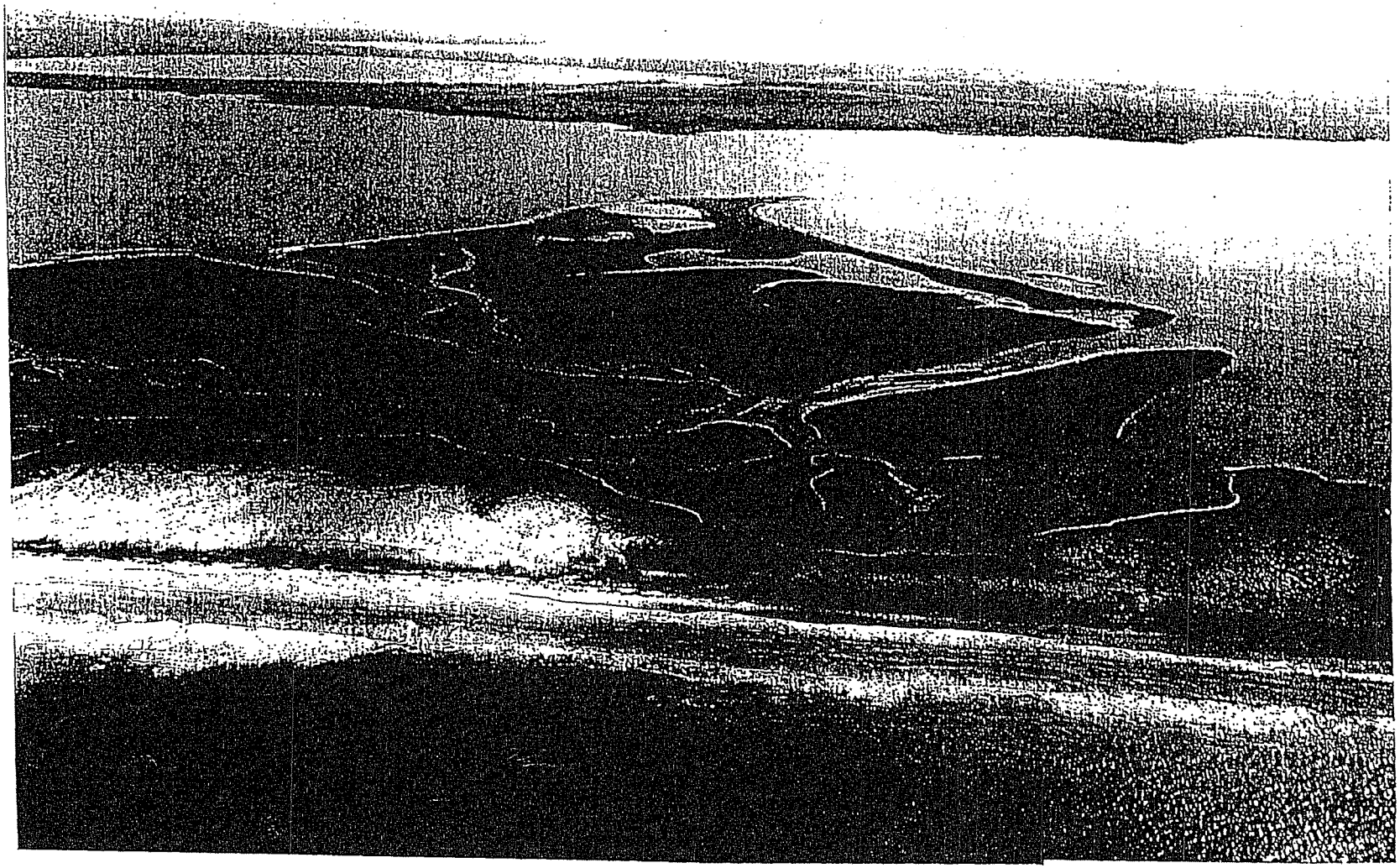
PLATE



TE AWAPATIKI OUTLET SITE

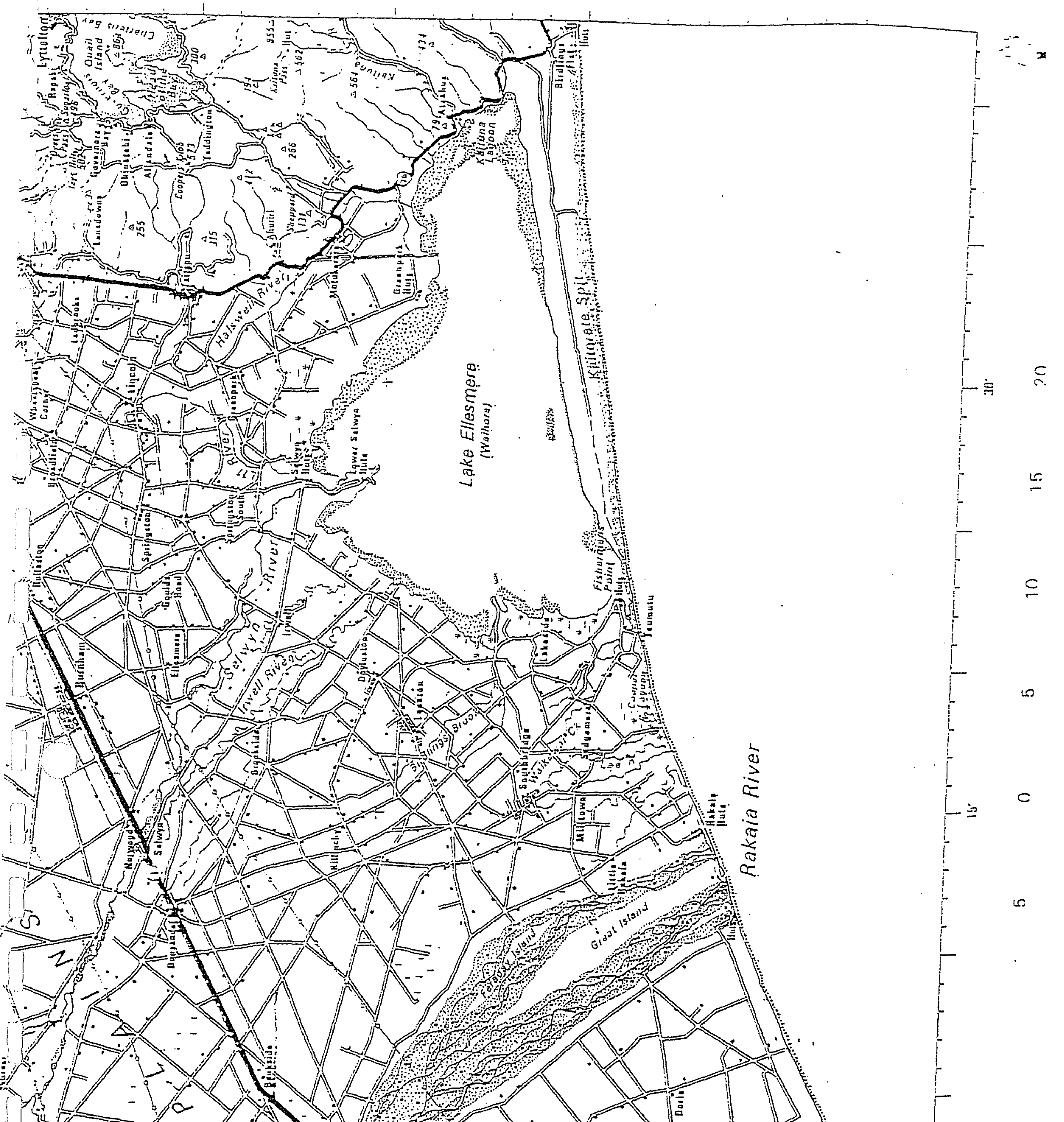
JANUARY 1993

PLATE 2



TE AWAPATIKI OUTLET SITE

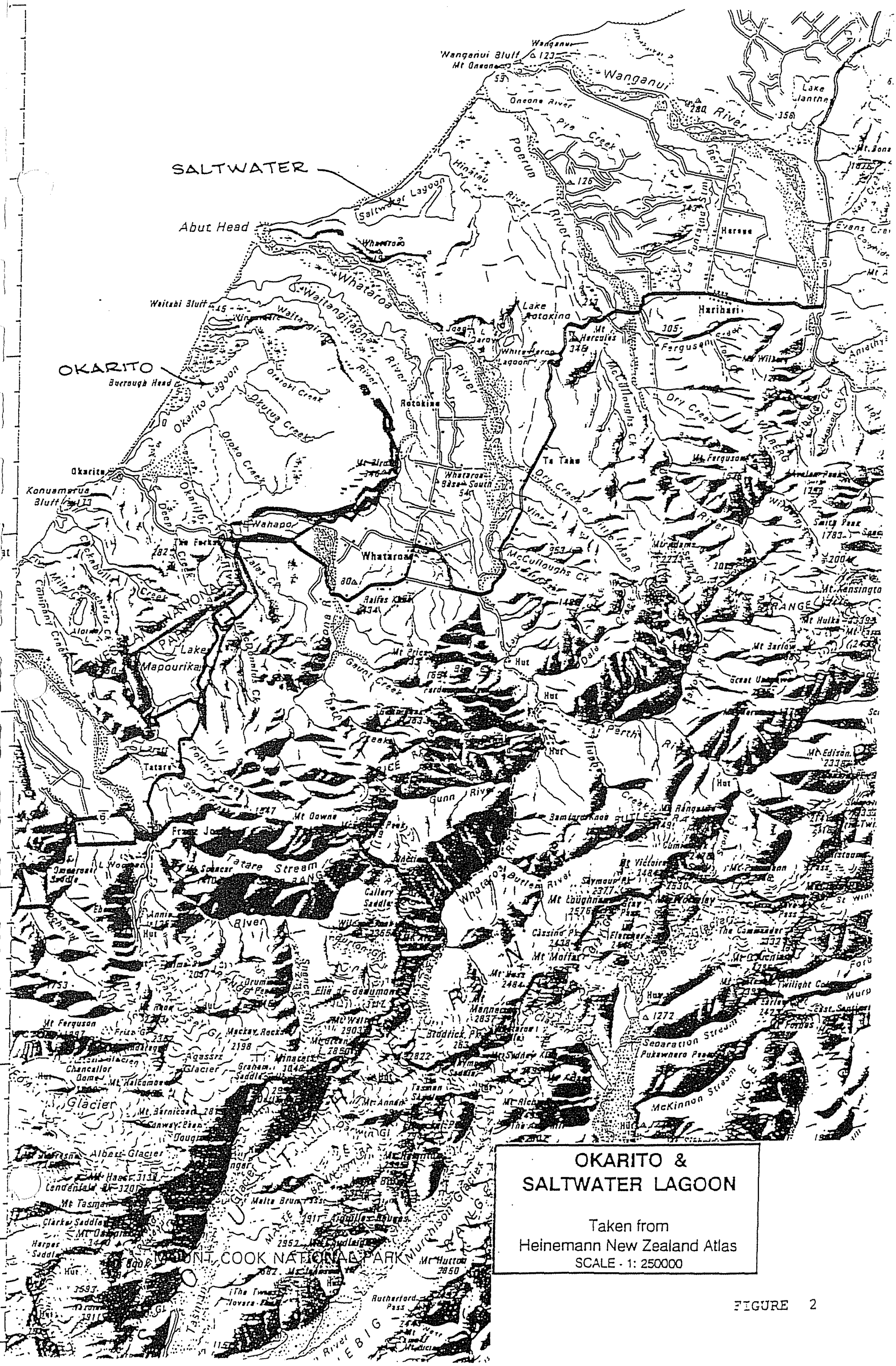
PRIOR to 1989



TE WAIHORA LAGOON

Taken from
Heinemann New Zealand Atlas
SCALE - 1: 250000

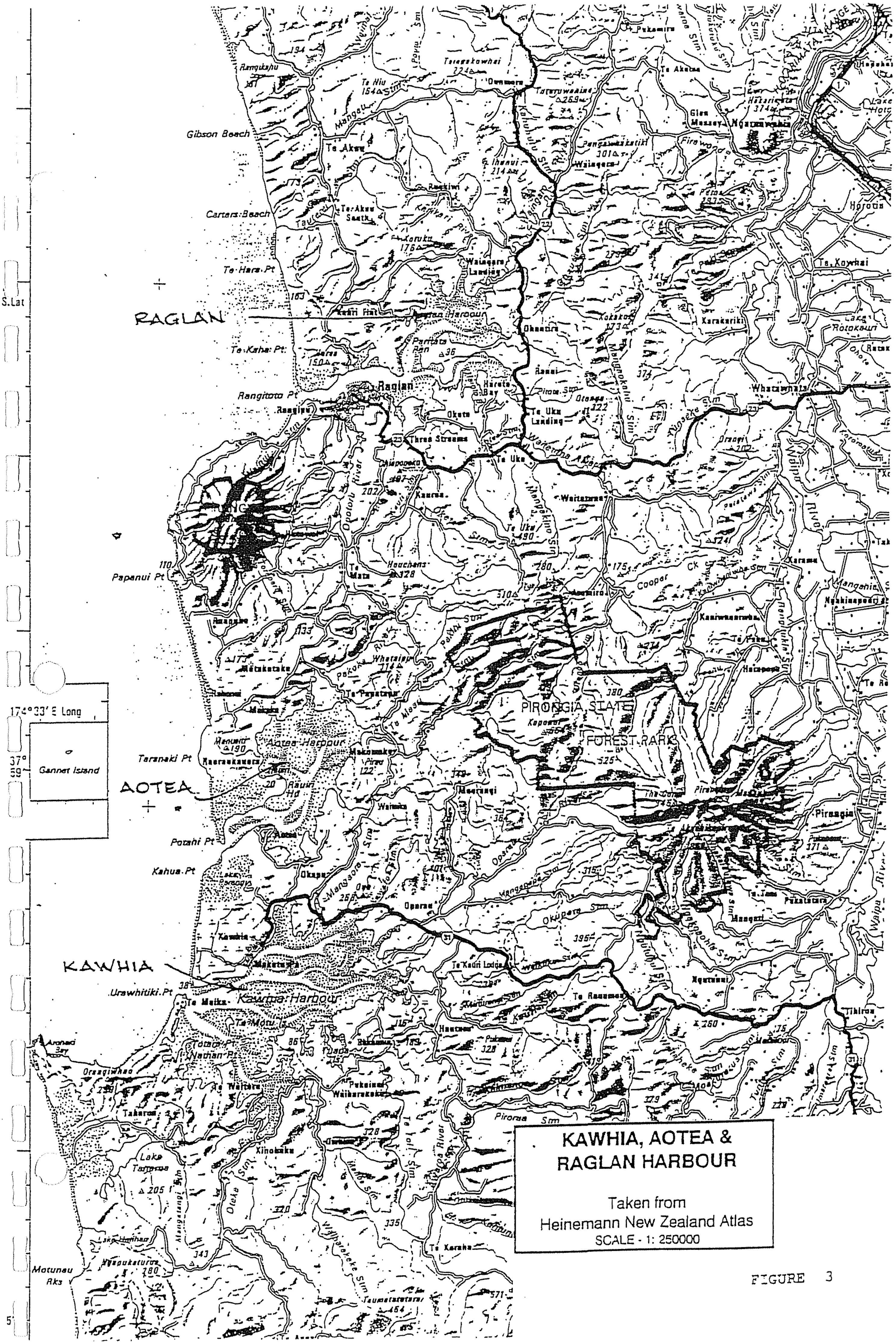
FIGURE 1



OKARITO & SALTWATER LAGOON

Taken from
Heinemann New Zealand Atlas
SCALE - 1: 250000

FIGURE 2



KAWHIA, AOTEA & RAGLAN HARBOUR

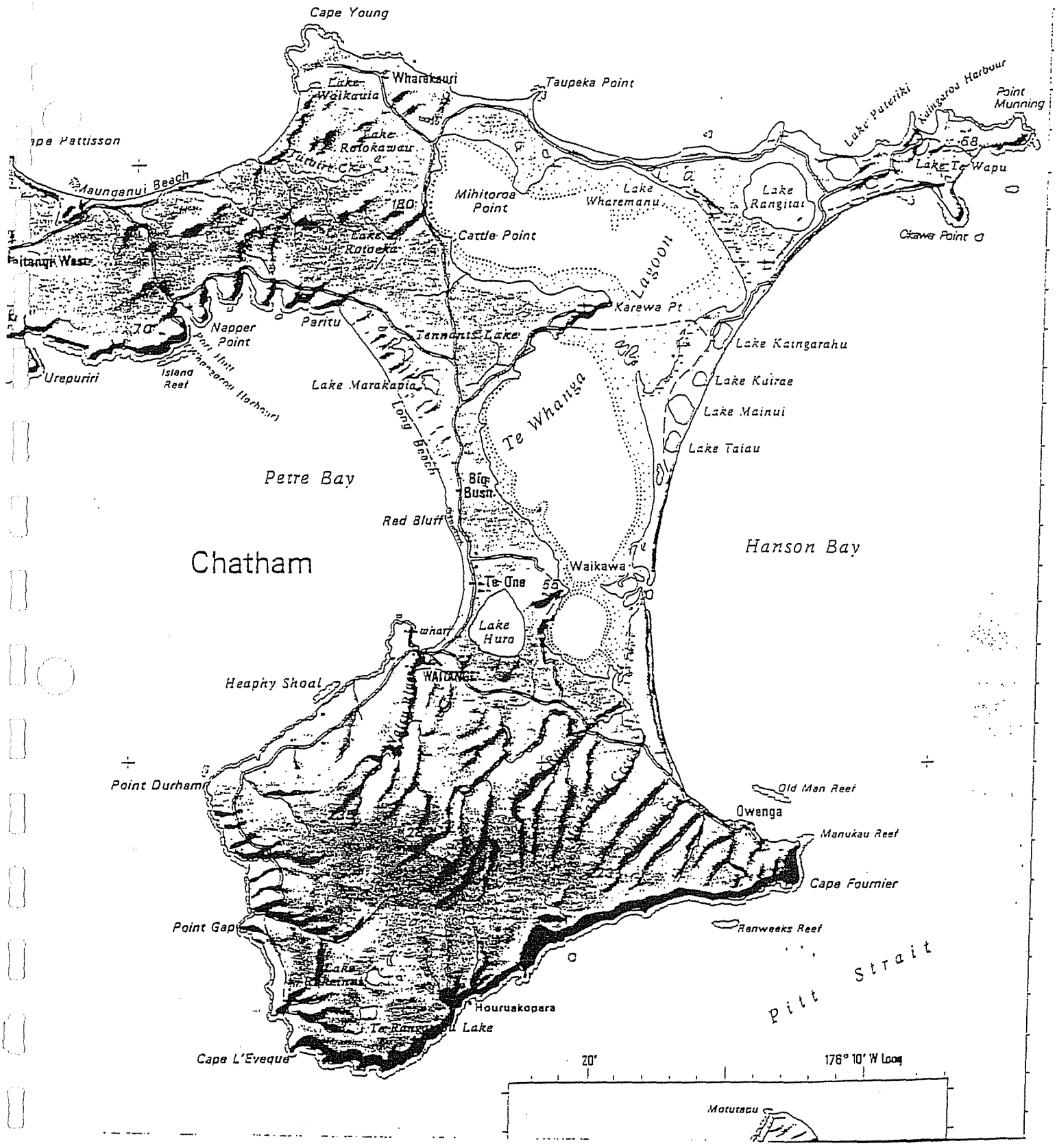
Taken from
Heinemann New Zealand Atlas
SCALE - 1: 250000

FIGURE 3

WHAKAKI &
MAUNGAWHIO LAGOON

Taken from
Heinemann New Zealand Atlas
SCALE - 1: 250000

FIGURE 4



TE WHANGA LAGOON

Taken from
Heinemann New Zealand Atlas
SCALE - 1: 250000

FIGURE 5

WHAREKAURI
CHATHAM ISLAND

1840

Taken from
The Report of Dr Dieffenbach

FIGURE 7

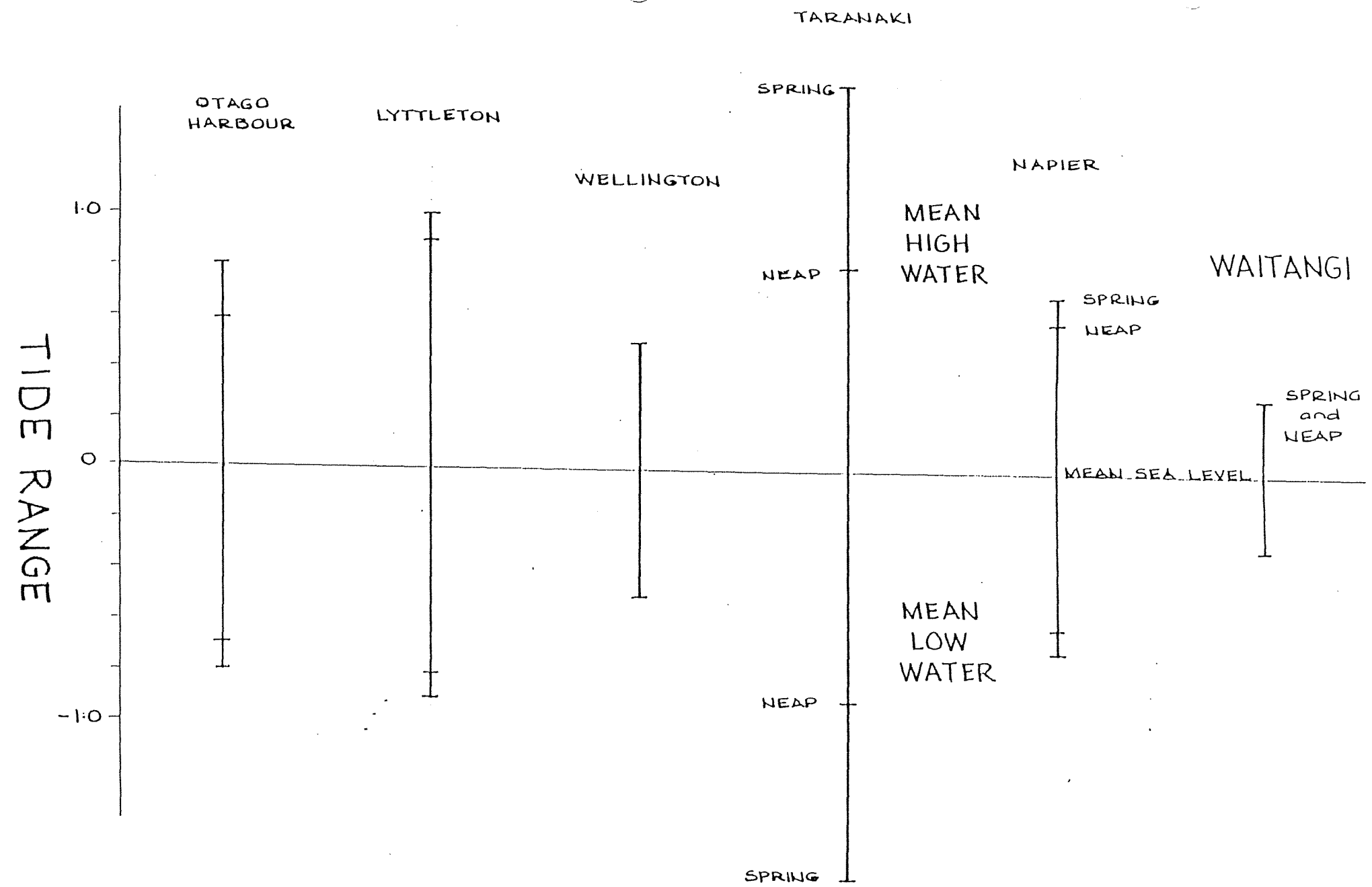
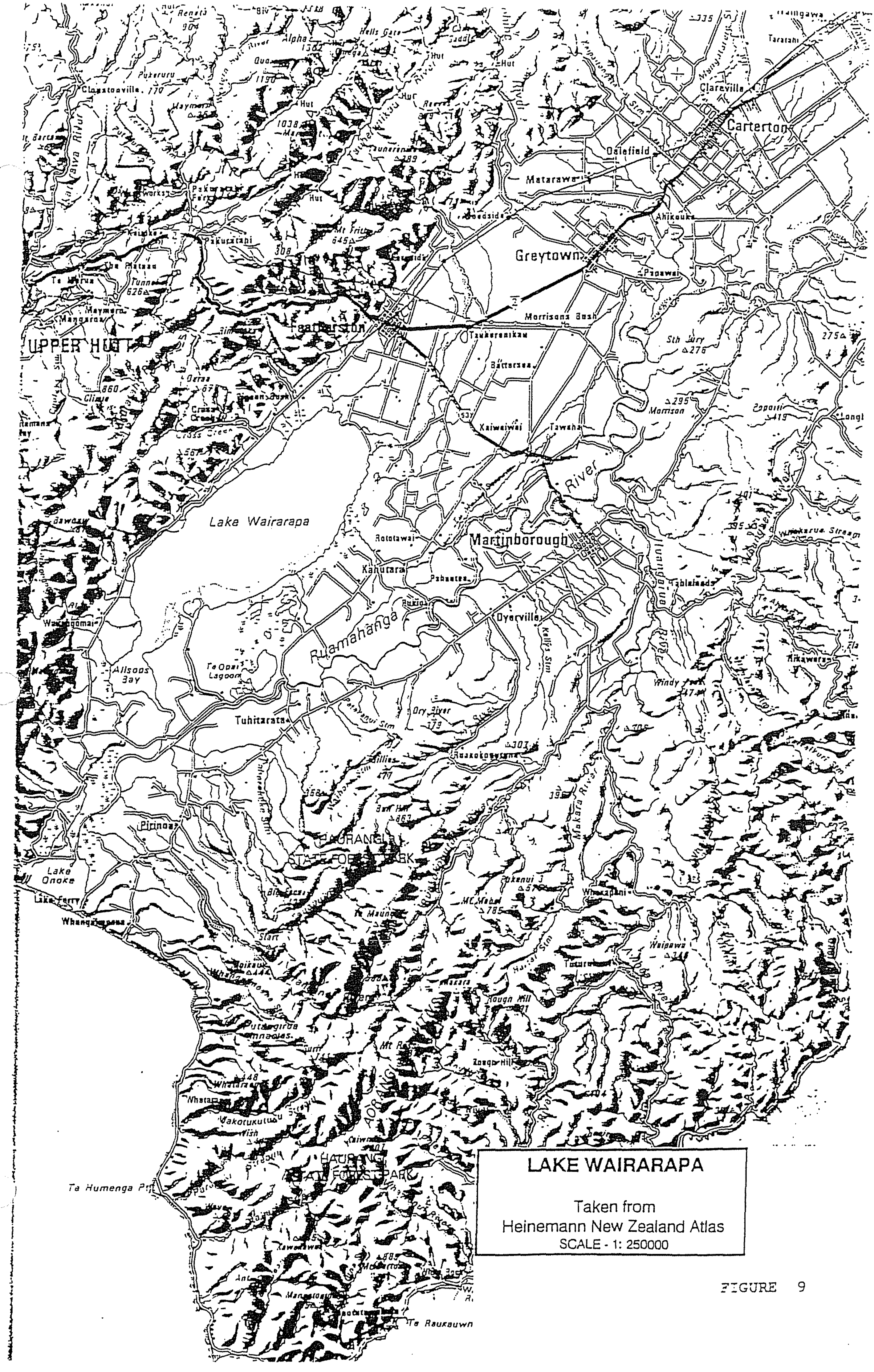

TARANAKI
OTAGO HARBOUR
LYTTLETON
WELLINGTON
NAPIER
WAITANGI
SPRING
NEAP
MEAN HIGH WATER
SPRING
NEAP
SPRING and NEAP
MEAN SEA LEVEL
MEAN LOW WATER
NEAP
SPRING
TIDE RANGE
1·0
0
-1·0

FIGURE 8



LAKE WAIRARAPA

Taken from
Heinemann New Zealand Atlas
SCALE - 1: 250000

FIGURE 9

BEFORE THE WAITANGI TRIBUNAL

WAI 65

CONCERNING the Treaty of Waitangi Act 1975

A N D the **CHATHAM ISLANDS** claims

TE WHAANGA LAGOON
WHAREKAURI/CHATHAM ISLANDS

DOCUMENT BANK—INDEX

FILE: COA 055

14 December 1994

Mr Albert Tuuta
Chairman
Te Runanga O Wharekuri/Rekohu
P O Box 102
Waitangi
CHATHAM ISLANDS

Dear Albert

RE: TE WHANGA LAGOON

I understand that the Runanga has concerns regarding Te Whanga Lagoon and what you may see as an attempt by the Department to seek its control. Here in the Department we have concerns regarding misconceptions and misinformation on the Chathams at present regarding the Department's actions with respect to the Lagoon.

I wish to say clearly right at the beginning that the Department is not seeking control of Te Whanga. In fact with repeal of the Harbours Act 1950 functions the Department has less legislative responsibility for Te Whanga under the Resource Management Act than it had prior to that Act's 1 October 1991 introduction date.

The issue the Department is seeking to clarify with the Chatham Islands County Council is the Lagoon's status with respect to the "coastal marine area" boundary, which is not precisely defined in the Resource Management Act with respect to coastal lagoons. On consideration of the lagoon's characteristics the Department currently believes that the lagoon is within the coastal marine area and thus should be managed in the same manner as the open coastal waters, bays, harbours, estuaries and rivermouths, i.e. via a Regional Coastal Plan by the Chatham Islands County Council. If outside the coastal marine area then the Resource Management Act management would be by the County Council via its other Regional and/or District Plans, and the bed of Te Whanga would be Crown land administered by the Department of Survey and Land Information.

In both cases, but more so if within the coastal marine area, the Act requires consultation with Iwi and potentially the transfer of management functions to Iwi authorities.

The Department's concern with Te Whanga is that, like all the coastal environment, it is managed in accordance with the sustainable management requirements of the Resource Management Act, the provisions of the resultant New Zealand Coastal Policy Statement, and any relevant part of the Council's yet to be prepared Regional Coastal

Canterbury Conservancy
Private Bag, 155 Victoria Street, Christchurch New Zealand
Telephone 03-379 9758 Fax 03-371 3779

Plan. The Minister of Conservation does have an important function in the final approval of Regional Coastal Plans but has a relatively limited role beyond that.

There is other legislation that covers management of aspects of the lagoon (e.g. the Fisheries, Conservation and Wildlife Acts) and these apply irrespective of the coastal marine or non coastal marine area status. Please note that the Department's Conservation Act management responsibilities for the lagoon are very limited and relate only to freshwater fish species (e.g. Inanga) and to concern for their habitat as they move between freshwater rivers and streams and the open sea.

The Resource Management Act and the Conservation Act management processes are quite separate and any Department involvement with the lagoon in respect of the Resource Management Act does not mean the lagoon becomes a conservation area or a reserve. The Department's Conservation Management Strategy (CMS) will have only a minor influence on management of the lagoon, by stating our freshwater fisheries and Wildlife responsibilities and by explaining the respective roles of various parties under the Resource Management Act.

Additional to the Chatham Islands County Council and Department exchange of views on coastal marine area status there is the extra element of the Ngati Mutunga application to the Maori Land Court regarding Maori Customary Land status. The issue of whether Te Whanga is foreshore and/or seabed below mean high water springs (and hence part of the coastal marine area) may have implications in respect of the Maori Land Court and/or the Crown's ability or willingness to grant such application. I am not aware of any Crown policy with respect to seabed/foreshore grants but I note that non Crown ownership of seabed/foreshore is a reality in parts of New Zealand's coastal marine area.

In all these matters I want to stress again that the Department is not seeking to control the Lagoon and all its attendant attributes. I do think there is a need for all agencies and groups with an interest in the Lagoon, and this definitely includes yourselves, to:

1. Clarify the range of legislative controls that do exist now.

2. Agree on the factual matters that could influence the Lagoon's status with respect to the coastal marine area.

3. Identify the management outcomes that are desired for the Lagoon (i.e. what we all want to see the Lagoon managed for - not who should manage it).

4. Try to identify a 'package' from the existing legislation that provides for the desired management and is legal with respect to the Resource Management Act's coastal marine area definitions and other legislative definitions.

In recent correspondence by the Department with the Chatham Islands County Council point 2. above was stressed and a Mr R.B. Buxton (a Council Consultant Solicitor) in reply agreed.

From the point of view of the CMS, resolution of the Te Whanga Lagoon debate is not a major issue as the CMS will have only minor influence on the management of the Lagoon. The issue will, however, become more relevant in respect of the Ngati Mutunga application, the Chatham Islands County Council development of its Resource Management Act plans (1995-96??), and any Resource Management Act consent application (e.g. for marine farming) that may affect the Lagoon.

I trust this letter helps explain the Department's position and you feel encouraged to be part of some future process to assist with clarifying the Lagoon's management.

Should you wish to involve your legal advisors I would welcome this, especially as Geoffrey Palmer was a leading influence in the Resource Management Act development and can be expected to provide good advice on the Act's coastal environment management implications.

You will see below that I have copied this letter to other interested parties.

Yours sincerely

Mike Cuddihy
Regional Conservator

c.c. Ngati Mutunga O Wharekauri, c/o Sue Thomas, Te One, Chatham Islands.

General Manager, Chatham Islands County Council, P O Box 24, Waitangi, Chatham Islands.

M.B. Webb of Mai Chen and Geoffrey Palmer, P O Box 2160, Wellington.

Chairman, Chatham Islands Conservation Board, c/o Department of Conservation, Private Bag, Christchurch.

Moriori Tehakat Henu Association of Rekohu Inc., P O Box 125, Waitangi, Chatham Islands.

Te Iwi Moriori Trust Board, 74 Kahu Road, Paramata, Wellington.

North Canterbury Catchment Board & Regional Water Board

Cnr. Latimer Square and Worcester Street
CHRISTCHURCH

Address all Correspondence to
Secretary
P.O. Box 738

Telephone: 792-060

In reply please Quote 9/44/19623

If calling ask for Mr Cathcart

19 April 1983

The Commissioner of Crown Lands,
Department of Lands and Survey,
P.O. Box 5014,
WELLINGTON.

Attention: R.L. Still

Dear Sir,

Please find enclosed a copy of the report on "Water and Soil Functions on the Chatham Islands" as requested.

The Board was asked by the National Water and Soil Conservation Authority to consider servicing the Chathams for water and soil functions. You will note from a copy of the Board's letter to N.W.A.S.C.A. that it is prepared to service the Chathams on an agency, fees for services, basis only and does not wish to have the area added to the North Canterbury Catchment District. The reluctance to include the Chathams within the catchment district is to avoid subsidising the service from Canterbury ratepayers' funds.

The exercise your department is undertaking is certainly necessary as a first step in any form of development on the Chatham Islands, whether it be for agriculture or peat mining.

Please do not hesitate to contact the undersigned should any points raised in the report require clarification.

Yours faithfully,

R.W. Cathcart,
MANAGER - RESOURCE PLANNING.

Encl.
:RP

Te Whanga
pgs. 2, 8, 13, 15,

Return to
Planning Office

9/4/1/0104

Mr Cathcart

15 February 1983

The Director,
Water & Soil Conservation,
Ministry of Works & Development,
P.O. Box 12-041,
WELLINGTON NORTH.

Dear Sir,

WATER & SOIL FUNCTIONS ON THE CHATHAM ISLANDS

The Board at its meeting of 4 February resolved to:-

"Offer in principle to service the Chatham Islands for full catchment and water board functions on an agency, fee for services, basis on behalf of the National Water and Soil Conservation Authority."

The Board reached this decision following discussions with representatives of the Chathams County Council, a visit by the Board Chairman and a MWASCO party to the Chathams, and after studying the enclosed report prepared by the Board's Manager - Resource Planning. The Board came to the conclusion that full catchment services were necessary and could be of benefit to the islands at this stage of development and that the need would be more urgent should either the peat or phosphate mining proposals eventuate.

The Board did not however believe that the addition of the Chatham Islands to the North Canterbury Catchment District would be a satisfactory way to accomplish this because the normal financial arrangements would be quite inadequate. Hence the resolution to offer services on an agency basis in an endeavour to suggest a practical solution.

We await further advice on this matter.

Yours faithfully,

E.R. Wood,
CHIEF EXECUTIVE OFFICER.

RWC:SAN

NORTH CANTERBURY CATCHMENT BOARD
AND REGIONAL WATER BOARD

The Chief Executive Officer,
NORTH CANTERBURY CATCHMENT BOARD.

Sir,

The following is my report and recommendations on the question of the North Canterbury Catchment Board providing full catchment and regional water board services for the Chatham Islands.

The report was written following a visit to the Chatham Island during the week of 11 to 15 October 1982 and is according to the following brief:

1. Reconnaissance of the Chatham Islands to determine what catchment board and regional water board services may be required.

2. To determine the possible costs involved in providing these services and possible sources of revenue to finance the services.

3. To recommend to the Board whether or not I consider the Board should offer to service the Chatham Islands and subject to what conditions.

R.W. Cathcart,
MANAGER - RESOURCE PLANNING.

PROVIDING CATCHMENT AND REGIONAL WATER BOARD SERVICES FOR THE CHATHAM ISLANDS

SUMMARY

INTRODUCTION

The Chatham Islands group consists of ten islands approximately 860 km east of Lyttelton. The two main islands in the group are Chatham Island (96,400 ha) and Pitt Island (6200 ha). The remaining islands are all considerably smaller, some little more than rock pinnacles and with no permanent population.

POPULATION

The population of the islands today is about 600 people. The two main settlements are Waitangi and Owenga on Chatham Island, with approximately 250 and 75 residents respectively. There are about 60 people living in the Kaingaroa area and 60 in the Te One locality. The remaining residents live on a number of farms scattered throughout Chatham Island. There are seven farms on Pitt Island.

TOPOGRAPHY

Chatham Island is generally of low relief with the highes point on the island, Oropuke, only 290 m above sea level. Apart from some very steep cliffs at the southern end of the island, gentle slopes predominate with the majority of the topography classified as gentle to rolling. Stable land comprises about 72% of the island's area. The remainder being occupied by either lakes and lagoons, or unstable beach and sand dunes.

Pitt Island is dominated by high cliffs on the western side of the island with gentle to rolling land generally sloping down to sandy beaches on the east coast. The highest point on the island is near the west coast and is 241 m above sea level.

CLIMATE

The climate of the Chathams has been summarised by the Meteorological Office as generally windy, damp and cool. South-west winds predominate and bring the majority of the rainfall to the islands.

The annual rainfall varies between 500 and 1000 mm over much of Chatham Island, although there are indications that rainfall is greater on the higher land at the southern end of the island. On average there are 135 rain days a year, with rainfall well distributed throughout the year.

Hail is not uncommon but snow is rare and of very brief duration. Frosts occur on an average of one day per year and are usually very light.

Pitt Island has a very similar climate.

GEOLOGY

On Chatham Island the rocks of the northern part of the island consist of schist and limburgitic basalt, the central low-lying area consists of tuff and limestone and the southern area of normal basalt and tuff. Peat covers much of the island.

SOILS

Soils on the Chathams reflect the complex interaction of peat forming vegetation and climate on basalt, sand, schist, limestone, volcanic tuff and large peat deposits. Peat and soils derived from peat occupy 59% of the land surface of Chatham Island. Soils derived from other soil types show levels of weathering and podsolisation more characteristic of soils of the northern half of the North Island of New Zealand.

VEGETATION

Many of the plants found on the Chathams are endemic and there is an absence of some of the more common New Zealand plants such as manuka, the Podocarp family, Dacrydiaceae which includes rimu and tussocks. One species, Dracophyllum aborsum, appears to have dominated the vegetation of the island and been responsible for most of the peat accumulation.

Most of the vegetation on the island has been extensively modified by burning, and grazing, and then by wind. Frequent burning has resulted in some areas becoming bracken fern dominant.

Despite the high cost of land development, productive pastures have been established on several parts of the island.

AGRICULTURE, LAND USE AND THE ECONOMY

The island has suffered a 'boom and bust' type economy with boom periods when local gardens supplied shipping, and the goldfields during the whaling and gold mining era of the 1840's to 1860's, followed by depressed periods when the only income was from wool. The more recent crayfish boom in the late 1960's continued this trend.

Agricultural land development has been hampered by high development costs, uncertain shipping (for products), land ownership, and difficult soil types. More recent attempts to establish farm woodlots have faced difficulties from soil conditions, exposure, and the condition of tree stocks.

HYDROLOGY

The extent to which the peat blanket covering most of the upland areas of the island influences stream flows and groundwater is not well understood. The largest river systems on the island are the Nairn, with a catchment area of 6,500 ha, and Te Awainanga, catchment area 7,770 ha, both drain the southern uplands.

Te Whanga Lagoon occupies about 20% of Chatham Island. There are numerous smaller lakes, some of which have no apparent outlet to the sea.

PEAT RESOURCE

Estimates of the peat reserves on Chatham Island are in the vicinity of 1000 to 2000 million tonnes. Prospecting is planned to further evaluate this resource with a view to exploitation for liquid fuel or peat wax production.

PHOSPHATE

Prospecting for phosphate in the lagoon and larger lakes is also being considered. It is suspected that phosphate resources similar to those on the Chatham Rise may have been uplifted with the island and may be present on the bed of the lagoon.

WATER AND SOIL PROBLEMS

Sand Dune Control:

The most obvious problem on Chatham Island is the spread of sand dunes onto productive farmlands. Heavy stocking of the marram covered dunes, overgrazing of the adjacent fertile, sand derived soils appears to have extended the area of unstable dune and bare sand well beyond the limits recorded in a D.S.I.R. Soil Bureau survey in 1959.

Fencing and planting marram grass on this dune sand is estimated to involve a job cost in excess of $400,000.

Sand Country Management:

The adjacent fertile sandy soils once supported extensive market gardens amongst broadleaf bush. This same sheltered land then became the most valuable grazing country on the island, but as the shelter has been lost so has the productivity. There is scope for re-establishment of shelter on this sand country, both to control erosion and to increase productivity.

Fire Control:

Burning of peat upsets the natural drainage pattern causing swampy depressions or even lakes to form, and has converted once grazable heathlands to less productive plant species such as bracken fern. The County Council recognises the need to control burning and is taking steps to implement a 'fire plan' and appropriate controls under the Forest and Rural Fires Act 1977.

Shelter and Timber:

The whole island suffers from exposure to desiccating salt laden winds. Considerable benefit, both shelter and wood production, would result from extensive shelter and woodlot planting. Fencing and building costs are very high on the island because almost all roundwood and sawn timber has to be imported. Firewood is also becoming more difficult to find as the remaining stands of Chathams akeake are cut or die out. While difficulties exist in woodlot establishment, the problems could be overcome by careful attention to tree stocks, handling and planting techniques, and to woodlot management. There is a case for establishing a nursery on the island to provide at least some of the tree stocks required.

Land Development:

The capital requirements for successful land development appear to be beyond most farmers, particularly where on the more difficult soils it is some time before any return can be expected. The islands would benefit from the type of development and resettlement programmes conducted so successfully in New Zealand by the Department of Lands and Survey.

Drainage:

While not involving major expenditure, the opening of the lagoon has been a significant water and soil management work on Chatham Island. With theopening of a new airport beyond the influence of the lagoon, the opening will now only benefit surrounding farmland and fish passage to the sea.

There is a need for reconstruction of Mangape Creek between Lake Huro and the Nairn River near Waitangi. Because of the flat grades in this creek, continuing maintenance will be required.

Peat or Phosphate Mining:

If peat or phosphate mining do proceed, there will be a need for close supervision of the mining and processing operations to protect water and soil values.

RESOURCE INVENTORY

There is an urgent need for a detailed inventory of the land and water resources of the island and a study of the interaction of these resources. Until such work has been completed it is difficult to assess the implications of land development or mining operations.

An inventory must include a study of the buffering effect of the peat blanket and associated vegetation on both the surface and groundwater resource.

SERVICING THE CHATHAMS

To provide the level of service considered necessary would cost approximately $12,000 per annum.

An initial survey of resources as recommended would cost approximately $60,000 plus equipment.

Water Board costs would be light initially, but would increase if a major mining and processing venture was to be developed.

Some concern has been expressed at the possible difficulty in getting work (soil conservation and drainage) done on the islands. I consider such difficulties could be overcome by a positive and practical approach to the situation.

Because of the existing workload and work allocation within the Board staff, I estimate that to provice a service to the Chathams the Board may have to consider the appointment of an extra two or three staff.

RECOVERIES

At the Board's existing level of rating the Chathams would have yielded about $4370 to administration in 1982/83.

Once the possible works reached their peak annual expenditure, after possibly 10 to 15 years, a recovery in services charges of about $10,500 per annum could be expected.

Recoveries on water right application fees may only meet the cost of advertising water right applications, but would certainly not fund Water Board functions on the island. So few water right applications can be expected that this source of revenue can be ignored.

Should the Board be required to supervise any matters relating to mining or disturbance of the land, such a cost would have to be carried by the administration rate as there is no mechanism for recovering such costs.

RECOVERIES - SUMMARY

If the N.C.C.B. were to service the Chathams on the same basis as it services the North Canterbury Catchment District, it could expect to recoup the following revenue:

Admin Rate (1982 figures)	$4,370
Service Charge on works (max.)	$10,500
	$14,870

COSTS - SUMMARY

Following the initial establishment costs estimated to be about $60,000 in the first year with a continuing cost of about $5000 per year for a further four years (Total $80,000 establishment cost plus the cost of equipment), the Chathams would cost approximately $12,000 per year.

The Chatham Islands may just pay their own way as far as administration costs are concerned once the level of work had built up sufficiently, perhaps after 20 years Should however additional catchment authority involvement be required as a result of mining for either peat or phosphate, there would be insufficient revenue to cover the cost of these 'non-recoverable' services.

Recommendations:

(1) That the Board advise the N.M.A.S.C.A. that there is a need for water and soil services on the Chathams.

(2) That the Board offer to service the Chatham Islands for full catchment and water board functions on an agency, fee for services, basis.

THE CHATHAM ISLANDS

The Chatham Islands comprise Chatham and Pitt Islands and numerous smaller uninhabited islands. Waitangi, the main settlement and port on Chatham Island, is some 850 km due east of Christchurch. With a total area of 964 km^2 the Chathams is the largest of New Zealand's outlying groups and is similar in size to Banks Peninsula.

Chatham Island (Rekohu or Wharekauri), the largest in the group, has an area of 90,000 ha of which lagoons and lakes occupy about 20,000 ha or 22%. It is 56 km across at the widest point and 48 km long, north to south.

Pitt Island (Rangiauria) is situated 19 km south-east of Chatham Island, is some 6200 ha in area, 14.5 km long (north to south) and 6-8 km wide.

The principal smaller islands of the group are South East Island (Rangatira, 260 ha), Mangere (260 ha), Little Mangere (The Fort or Tapuaenuku), The Castle (Rangiwheau), The Pyramid (Te Rekokoe), Star Keys (Motunope), all in the vicinity of Pitt Island. In addition there are The Sisters (Rangitatahi), 20 km north-east of Chatham Island and the Fortyfours (Motuhara), about 40 km east of Chatham Island. There are also numerous reefs and rocky islets within the group.

PHYSICAL GEOGRAPHY

Main Chatham Island can be divided into three distinct physiographic regions. The northern zone consists of schist, consolidated sand and limburgitic basalt, the central of consolidated sand and limestone, and the southern of basalt and tuff. Throughout the island gentle slopes predominate: 94 percent of the topography is flat to rolling and less than 2 percent consists of steepland.

The Northern Zone:

This zone, which lies to the north of a line drawn from Te Roto in the west to Hapupu in the east and which extends across the widest part of the island, consists of rolling schist country capped with sand and peat up to a height of 60-75 metres a.s.l., the low relief of which is broken in the north and west by a double rank of isolated volcanic hills up to 191 metres. Several of these have eroded to symmetrical cones. Generally the schist is exposed only in the vicinity of the coast which is highly indented with off-shore islands, reefs and channels. The bay head beaches are of sand. Inland the schist and sand are mainly peat-covered, with swamps and lakes, and crossed by short, indefinitely meandering creeks.

At Kaingaroa in the north-east, the schist block carries no volcanics and represents a once separate island now joined to the north-west by a long sandspit enclosing the northern end of the great Te Whanga Lagoon.

The Southern Zone:

This region extends south of a line drawn between Waitangi in the west and Owenga in the south-east. It is basically a tilted tableland of volcanic rocks dipping gently towards the north from a height of over 280 metres close to the southern coast, which forms a forbidding line of high cliffs up to 220 metres in height overlooking Pitt Strait. With the exception of five deeply entrenched streams in the south-west all the major rivers on the island flow generally north-eastwards across the sloping plateau. Much of the south-west part of the plateau is heavily bushed. A conspicuous feature on the eastern part of the plateau is the monotonous 'clears' country, with a deep peat soil largely covered by stunted heath vevetation and numerous ponds and swamps. On the west of this region there is a coastal belt of low, undulating country with prominent boulder beaches, generally referred to as the Ngaio coast.

The Central Zone:

Between the contrasting northern and southern regions is a more diversified area of gentle, undulating country bounded in the west by Petrie Bay and in the east by Hanson Bay, and enclosing the central and southern basins of Te Whanga Lagoon. The central region comprises mainly grassland on consolidated sand and peat covering red tuff, hard crystalline limestone and soft friable limestone. However, some of country is still in fern and some in attractive patches of "lowland" bush, of ...ch the kopi or karaka, akeake, karamu and matipo are the outstanding trees, with kowhai along parts of the lagoon shore. Around the western shore of the lagoon the limestone forms prominently cliffed headlands with bush-backed sandy bays between.

Coastal Sandhills and Dunes:

Sandhills occur extensively along portions of the northern coast, in places forming a narrow belt where sand and peat are mingled. Along the eastern coast there is a 43 km long unbroken stretch of sandhills from Okawa Point to Owenga. On the western coast they occur extensively between Lake Rotopuraoa and Waitangi. Generally the hills are narrow, of the order of about 100 metres in width, but along the western coast near Lake Marakapia they reach a maximum width of 2 km. Burning and the introduction of stock destroyed the native plants by which the sands were largely fixed and allowed sand to advance eastwards. The dunes have since been extensively planted with marram grass and lupin but there are several serious blows north of Te One.

Te Whanga Lagoon:

Occupying as it does about 20 percent of the total area of Chatham Island, Te Whanga Lagoon is perhaps the most important single feature of the island. The lagoon is 24 km from north to south and is of varying widths up to 16 km. It covers a total area of 18,600 ha, divided into three basins each separated by fordable shallows. The northern basin is generally not more than 2-3 metres deep, the central basin 5-6 metres and the southern basin 3-4 metres. To the west and south the lagoon is bounded by old sea cliffs cut in limestone and tuffs, while to the north and east it is contained mainly by dune sands and was clearly once part of the open sea. The lagoon is artificially opened at the south end of the central basin, at Te Awapatiki on the eastern coast.

...iodically in the past the outlet channel has silted up through the building up of ...shore sand bars at the mouth by north-easterly winds. The level of the lagoon would rise several feet as a result of the closure until there was sufficient pressure to burst through the sand barrier and scour out the opening to normal again. Records indicate that this cycle of opening and closing the outlet takes about seven years under natural conditions, but in practice in recent years the channel has been artificially opened by bulldozer to facilitate use of the ford to the old Te Matupu airstrip and to prevent further encroachment of lagoon waters on marginal grazing land around the perimeter.

The lagoon is fed at the south end by the Te Awainanga and Makara Rivers draining the southern zone tableland. This catchment area is comprised mainly of peat land which causes brown to black discolouration of the stream waters. Along the western shore there are many small streams draining mainly limestone and consolidated sand and peat country. There are no significant streams entering the lagoon along the northern and eastern shores, the country being sandy and any rainfall is quickly absorbed.

The level of the lagoon is affected considerably by the wind. If a north-westerly wind blows for any length of time, the water level in the northern basin may fall by up to 0.6 metres. Similarly winds from a southerly quarter may cause the lagoon water to be driven northwards and result in an appreciable deepening of the northern basin. A detailed investigation by a surveyor in 1938 showed the lagoon to be tidal for quite some distance from the outlet channel, but the small range of tide coupled with the effect of wind would make any daily rise and fall of level imperceptible over most of the lagoon area. Salinity tests were also carried out in 1938. These showed the northern basin to be approximately 70 percent seawater, the southern basin approximately 75 percent, and the central basin 80 percent increasing to almost 100 percent seawater at the outlet channel.

The lagoon is the home of large numbers of swans and ducks and also supports a wide variety of marine life. Flounders and eel abound, while kahawai, herring, trevally, gurnard, garfish, groper, red cod and conger eel have all been taken or sighted within the confines of the lagoon. Cockles and mussels can be found almost anywhere along the shores, but are generally small. The pupu (periwinkle) is evident in large quantities in all the shallows along the lagoon shores.

Other Lakes and Lagoons:

A number of smaller lakes and lagoons have become separated from the sea by the formation of low sandbars. These include Rangitai and Pateriki in the north-east and Huro near Waitangi. To the north-west of Te Kairakau there is a group of beautiful, clear, fresh-water lakes which are probably infilled limestone sink-holes, the two largest being Tennants and Marakapia. In the northern region there are many small discoloured lakes which are infilled depressions caused by giant peat fires.

Although it is the next largest area of water after Te Whanga Lagoon, Lake Rangitai does not support eels or other marine life, probably because it has no direct outlet but is drained by seepage through surrounding sandy areas. Next in size is Lake Huro which supports a large eel population. There are no trout or other introduced fresh-water fish in the Chathams.

CLIMATE

The climate of the Chathams is strongly influenced by the convergence around the group of warm saline subtropical waters with cold,less saline sub-antarctic waters. These two currents flow eastward across the north and south Tasman respectively and around the Chathams.

The mean sea temperature is summer is 16°C and in winter 10°C, with a mean over the year of 13°C. The weather in the Chathams tends to be more unstable and cloudy than in most parts of New Zealand. Changes are rapid but temperature extremes are rare, and in general the weather is very similar to that in Rangitikei County in the south of the North Island.

Since 1878 the highest temperature recorded at Waitangi is 24°C and the lowest -2°C. The mean annual temperature is 11.25°C, about the same as Timaru, the July average 7.8°C and January average 14.7°C. The mean daily range is only 5.6°C while the mean annual range is 6.9°C. Frosts occur on an average of only one day a year and are usually light[1].

There is an average 80% cloud cover with small variations from month to month, May being the cloudiest and January the least cloudy month. Clear skies (less than 30% cloud cover) occur on average about 64 days per year and the annual sunshine hours average only 1470.

The average annual rainfall at Waitangi is only 914 mm, about the same as Nelson, with just under half the days of the year being recorded as 'raindays' (>0.25 mm). The rainfall is well spread with May and August being the wettest months, but dry spells are common.

Most rain comes with the south-west wind, usually as a quick succession of ice-cold showers of short duration followed by an interval of strong winds without rain. Much of this rain would be lost to evaporation and would not promote pasture growth as effectively as the warmer north-east and north winds.

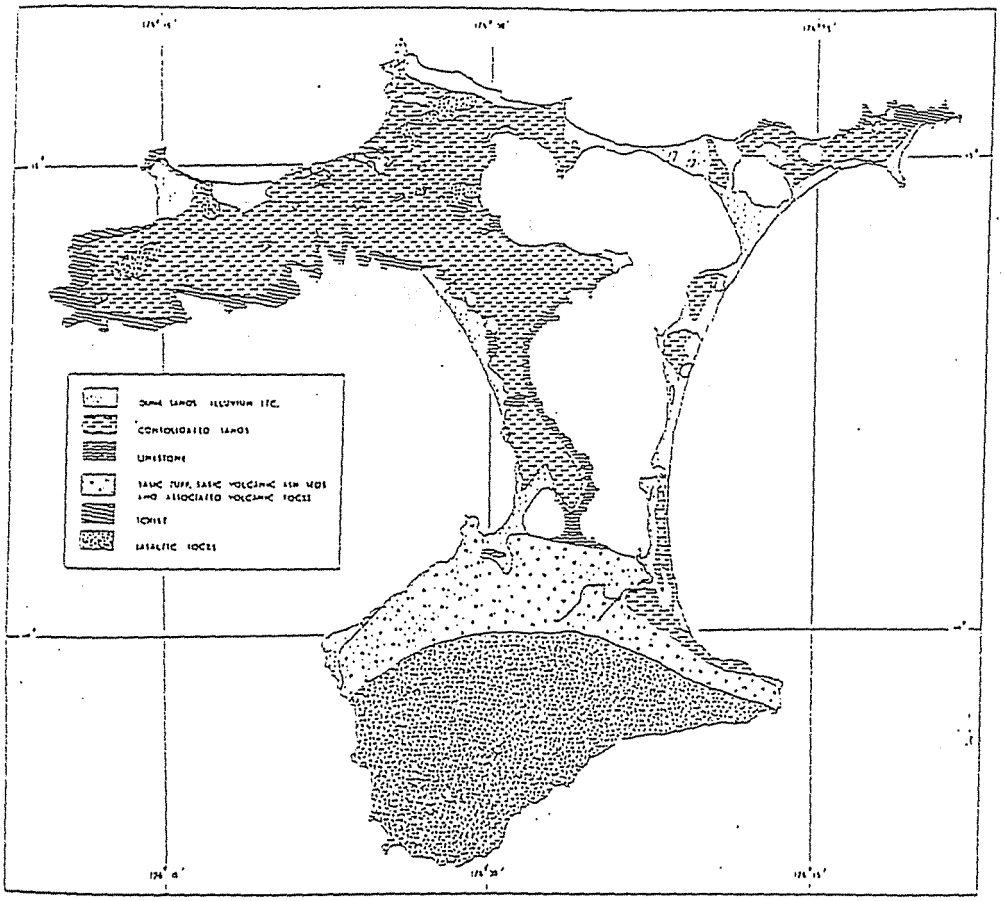
Although no raingauges have been sited on the higher southern tableland of the main island, it is probable this area receives more rain than the lower country.

South-westerly winds are the most common throughout the year, blowing for about 30% of the time. Next in order of frequency are southerlies in winter and westerlies or north-westerlies in the remaining seasons.

Because no place in the Chathams is more than 8 km from the sea and winds are generally moisture-laden, a high humidity is maintained. Proximity to the sea and the frequency of strong winds result in appreciable deposition of salt on both land and the vegetation it supports.

Generally the Chathams has a climate well suited to pastoral agriculture.

GEOLOGY AND SOILS



Generalised geological map of Chatham Island

(DSIR SOIL BUREAU BULLETIN 19)

Volcanic Rocks and Soils[2]:

The southern uplands comprise basaltic rocks overlain by deep deposits of peat with, in places, deposits of ash and andesitic tuff between. North of these harder rocks, extending from Waitangi to Owenga, are tuff and ash beds with some outcrops of harder basalt.

The ash and tuff beds vary in composition and under the influence of more or less peat give rise to local variations in soil type. In general however the soils resemble the older volcanic ash soils of the Waikato with some of the more strongly leached sites resembling the more mature 'gumland' soils of Northland.

The basaltic rocks of the northern zone have intruded through beds of loosely consolidated tuffs and the resulting conical hills protruding through the peat-covered plain are a local landscape feature. Small areas of 'volcanic' soils similar to those in the southern zone surround the rock outcrops on these hills.

Skeletal soils from harder basaltic rocks are found around the southern coast and on some of the northern cones, but are extremely limited in extent and are of little agricultural sugnificance.

Schist and Schist Soils:

The oldest rocks on Chatham Island are schists of similar lithology to the schists of Central Otago. These rocks contribute little to the landscape for they are always of low relief; outcropping mainly along the northern coastline and nearly always partly covered with peat or windblown sand. The highest outcrops are little over 40 metres a.s.l. near Port Hutt and Kaingaroa.

The rock is a quartzo-feldspathic schist which produces a large amount of quartz sand on weathering. The schists of the northern coastline are probably the chief source of the quartz sand that sustains the beaches and dune areas.

Complexes including podsolised soils from schist are found mainly along the north-western edge of the island. Topsoils tend to be pale grey to pinkish white in colour and the subsoil is usually strongly cemented.

Limestone and Rendzinas:

Overlying the schist across the central waist of the island are various sedimentary beds including limestones and calcareous tuffs. The limestone varies from fairly soft and pure rock to extremely hard crystalline outcrops containing volcanic ash and in other places quartz sand.

The limestone soils, because of their limited extent, are of little agricultural significance but the soft and remarkably pure lime deposits (98% to 99% Ca) are of great importance on an isolated island where most soils are acidic and would respond to liming.

The rendzina soils are typically dark grey to black but are usually associated with podsolised soils containing peat and sand.

Peat Soils:

Peat and soils derived from peat occupy 59% of the land surface of Chatham Islands. In places the peat is over 10 metres thick but is firm enough for passage of stock or at times machines because of bands of volcanic ash and buried mineralised peat soils. These are not peat marshes as found in the Marshlands area, but gently undulating to rolling downs. Typical slopes measured were from $1\frac{1}{2}^{0}$. Bogs of this type form a more or less continuous blanket over the gently undulating landscape of the southern uplands and a large proportion of the northern zone.

On the lowlands, peat has developed in basins where runoff has collected.

The peculiar vegetation/climatic influences of the Chathams have also caused accumulation of mor litter, which forms peat or organic deposits over other soil parent materials, particularly sand and schist but also volcanic material.

t of the peat areas have been modified from their natural state, but have not yet reached a high level of development for agricultural or horticultural purposes. The soil pattern is extremely complex ranging from areas of peat where no soil has yet developed over the parent peat to areas where the underlying mineral soils have been exposed by burning of the peat or oxidation and compaction around the periphery of the larger peat mass. Exposed underlying layers may comprise highly modified former mineral soils, podsolised sands, or soils modified by the advancing peat blanket.

Wright[2] describes the extent of the peat and soils derived from peat as being so widespread "that mineral soils often have the appearance of clinging precariously to the fringe of a blanket of peat or occur only on protuberances that break through the peat blanket".

Sands:

There is an abundance of quartz sand around the northern shores of Chatham Island, and accumulations of dune sand occur at intervals along the north coast and along both the eastern and western sides of the waist of the island. Deposits of older sand, perhaps marine beds, occur around Te Whanga Lagoon and at various other locations.

Soils on these sands reflect both the age of the deposit and the vegetation they support. They range from dune sand adjacent to the beach to sand podsols immediately adjoining the peat deposits. Such a sequence of increasing soil maturity from a common parent material is referred to as a soil suite. Vegetation follows a similar sequence from marram grass on the dunes, karaka and akeake dominant broadleaf forest on the Te One soils, increasing proportions of Dracophyllum and tree-ferns and decreasing broadleaf trees as a mantle of mor litter and peat develops until a heathland Dracophyllum-Gleichenia-Sooradanthus-Cyathodes-Sphagnum cover is reached on the sand podsol-peat complexes.

e younger soils of this suite, those under broadleaf forest, were used extensively or gardening during Maori occupation of the island and produce from the gardens was sold as far afield as the Australian and Otago Goldfields, Christchurch, and the ships sailing the South Pacific. These same soils now support relatively intensive sheep grazing.

Sedimentary Deposits, Gley and Saline Soils:

Soils derived from alluvium are of minor importance on Chatham Island. Alluvial material is accumulated fast enough to keep ahead of peat development and sand encroachment only over a total area of some 2000 ha, mainly in the vicinity of Lake Huro where almost half the gley soils are located. Here the soils have a high water table and impeded drainage.

Also included in these gley or meadow soils are the estuarine deposits of Te Awainganga River and around the shores of Te Whanga Lagoon. Here the water table is brackish and the soils have been classed as salty meadow or saline soils.

General Soils Pattern:

From the foregoing account, it can be seen that the broad pattern of soils on Chatham Island is relatively simple. The landscape is more than half occupied by organic soils and, where the land is not blanketed by peat, it has been to a considerable extent covered by windblown sand. Thus, between the pincers movement operating through the growth of peat and spread of sand, relatively little is seen of the soils derived from country rock. Although not of great extent, these soils derived from the country rock are of great agricultural importance and an understanding of the geology of the island is of considerable importance to agricultural development.

VEGETATION[2]

Many of the plants found on the Chathams are endemic and in comparison with New Zealand there is an absence of Podocarpaceae (e.g. totara), Dacrydiaceae (e.g. rimu) and such common mainland communities as manuka, scrub and tussock grassland. It would appear, one species, Dracophyllum arboreum, became the dominant plant of habitats that, in New Zealand, would have been occupied by podocarp-broadleaved forest, manuka scrubland or tussock grassland. The widespread occurrence of Dracophyllum roots thorughout the peat suggest these deposits may have been formed mainly from Dracophyllum rather than the usual moss residues.

Both the wood and litter of Dracophyllum is easily ignited and burns with a quick hot fire which spreads rapidly through the forest. Only remnants of these former extensive forests remain.

Cockayne[3] described the "Tableland Forest" as containing Dracophyllum arboreum, tree ferns (Dicksonia squarrosa and D. fibrosa), Senecio huntii, Coprosma chathamica, Hebe gigantea, Olearia semidentata, Corokia macrocarpa, and Pseudopanax chathamicum, most of which are peat builders but not as outstanding as D. arboreum.

Frequent burning has changed some of these upland areas to Cyathodes robusta dominant heathland.

Other plant communities that have been largely destroyed by burning and by grazing include:

> Coastal Broadleaved Forest - The forest found on the younger stabilised sands included karaka or kopi (Corynocarpus laevigatus), akeake (Olearia traversii), matipo (Myrsine chathamica), manoe (Hymenanthera chathamica), and karamu (Coprosma chathamica) and supplejack (Rhipogonum scandens).
>
> Of these species the Chathams akeake is the most resistant to the effects of fire, followed by grazing, and of wind. Even this species is having great difficulty surviving on exposed and grazed land.
>
> Coastal Broadleaved Forest with Tree Ferns plus Dracophyllum - As described in the description of soils on sand, the broadleaved forest tends towards a greater proportion of tree ferns on the more mature soils. The broadleaved species are replaced by D. aboreum on the podsolised soils.
>
> Heathland Vegetation - The heathland communities found on the lower peat country comprised Dracophyllum paludosum, Sooradanthus traversii, Gleichenia circinata (umbrella fern), Cyathodes robusta, Leucopogon richei, with Sphagnum Spp and Carex Spp in marshy hollows. Frequent burning has modified this community with a general loss of Sooradanthus and Gleichenia and an increase in bracken fern (Pteridium aquiluium var esculentum)on the drier mounds.

AGRICULTURE, LAND USE AND THE ECONOMY[1]

Prior to the arrival of the Maori in 1835, the original Moriori inhabitants relied on available food and apart from possibly some bracken fern culture did not practice any form of agriculture. The early whalers and sealers introduced pigs to the island and began to cultivate crops. The Maoris established extensive gardens in the sheltered micro-climate of clearings in the broadleaved forests and supplied ships with considerable quantities of potatoes, wheat, taro, swede, maize and pumpkins.

Sheep and cattle arrived in 1841 but European farming was commenced in earnest by the Lutherans who, in 1848, built a flour mill. Under missionary guidance the Chathams became one of the most important agricultural areas of New Zealand, if not the whole South Pacific. The Maori and European settlers developed a thriving trade with passing whalers, New Zealand settlements, and the goldfields of California, Australia and Otago.

During this period public revenue in New Zealand was derived almost solely from Customs duties, but goods landed in the Chathams generally escaped such charges and a lucrative smuggling trade with the mainland developed. As the smuggling was brought under control and with a decline in whaling, the number of ships calling at the Chathams dropped and much produce rotted for want of transport. Under these depressed conditions, grazing became more profitable than cultivating and ...icultural supremacy passed into the hands of the European settlers.

The resulting depression, a tidal wave, and a measles epidemic contributed to a decision by most Maori settlers to lease their land to European sheepmen and return to New Zealand.

The extensive gardens were invaded by exotic and native pasture grasses and much of the original vegetation was destroyed or damaged by wild pigs, untended cattle and horses and generally lowered to a size more suited to sheep.

Profiting by the Maoris' dissatisfaction and desire to return to the mainland, a number of large-scale Canterbury graziers obtained from them in the mid-sixties extensive sheep grazing leases at reasonable rentals. By 1870 almost the whole island was taken up by six large pastoral leased. Wool soon became the principal, but not the only, export from the Chathams.

The graziers burnt the vegetation and grazed their sheep on the regenerating plants and herbs. The 1880's and 1890's were disastrous decades for the Chathams, which not only had to compete with developing agricultural regions in New Zealand, but also suffered a number of setbacks. Excessive use of fire in pasture management and stock trampling led to unpalatable vegetation invading the natural pastures; the weather gave its worst; parasites struck the sheep; Maori-European relations degenerated; market prices slumped and New Zealand's economic depression hit the Chathams with full force.

Stagnation, both agricultural and social, characterised the first 50 years of the present century in the Chathams. While this was due in part to the region's physical isolation from the rest of New Zealand, there were other factors which contributed to the lack of progress. These included the extreme conservatism of the runholders, an unsatisfactory subdivision of Maori land, farm labour being drawn off to the on ...in-off again fishing industry, poor internal roading and the irregular and costly ...hipping service.

Following World War II, many islanders who had spent the war years away from home returned home with new ideas and with increased Government support encouraged more progressive ideas. Roads were built, the shipping service improved and a passenger air service established. The record wool prices of the early 1950's and greater Government financial assistance lead to improved social amenities and greater prosperity.

The islands experienced a "crayfish boom" in the late 1960's but, as islanders are quick to point out, the industry 'mined' the resources of the islands, putting little back into the local community. This perhaps sums up the local feeling to the possible peat and phosphate mining ventures - will they provide long-term stability to the islands' economy and to social life or will they be another 'boom period' with all the profits being shipped out?

HYDROLOGY:

The largest river on the island is Te Awainanga which, with a total catchment area of some 7770 ha, drains the north-eastern slopes of the southern uplands into the southern end of Te Whanga lagoon.

The upper catchment is a peat covered plateau in Dracophyllum bush and Cyathodes heathland association. Catchment boundaries are somewhat indefinite because of the flat swampy nature of the plateau.

The numerous strongly dendritic tributaries descend the gentle northern slopes of the uplands in channels entrenched some 30 metres into the peat and weathered volcanic substratum. The streams flow over a series of 2 to 3 metre high waterfalls with ponds and slack stretches between.

The Tauraroa Stream becomes the Te Awainanga River and is joined by its other major tributary, the Makara River, immediately upstream of the Waitangi-Owenga Road. The river reaches lagoon level a few hundred metres downstream of this road and is joined by the Mangahau Creek a further 3 km downstream, flowing a further 3 km before entering the lagoon.

Te Awainanga River has a catchment area of some 5900 ha upstream of the Waitangi-Owenga Road Bridge and has a calculated mean annual flow at the bridge of 1,070 m^3.[4] This resource is being investigated by the Central Canterbury Electric Power Board as a possible site for hydro-electricity generation.

Flow was estimated at between 1.8 m^3s^{-1} and 2.4 m^3s^{-1} by the author on 12 October 1982, following a dry spell broken by light rain and showers.

The other river of any size is the Nairn, which discharges to Waitangi Bay near the Waitangi settlement. The Nairn River, like Te Awainanga, drains the peat covered southern uplands via an entrenched channel and, for the last 1-2 km of its course, is tidal. The Nairn is joined by Wairarapa Creek, and Mangape Creek which drains Lake Huro, about 1 km from Waitangi Bay. The total catchment area of the Nairn at Waitangi is over 6500 ha, comprising 3050 ha of upland catchment, 1075 ha Lake Huro with an additional catchment area of 1480 ha, mainly on easy volcanic, sand and limestone country, and a little over 900 ha draining into the lower Nairn River between the upper catchment and Mangape Creek.

The upper Nairn catchment of some 3050 ha is also being investigated for hydro-electricity generation.

Calculated[4] mean annual flow in the Nairn at the possible power generating site is 0.56 m^3s^{-1}.

A flow of 0.8 m^3s^{-1} was assessed on 12 October 1982, downstream of the confluence of the Mautere Stream and the Mangatukarewa River, the two major upland tributaries (the site being investigated for power generation).

Numerous other streams drain the southern uplands directly to the coast. Typical of this size and type of stream is that draining the western edge of the plateau from near a high point called Whakamarino (±235 m a.s.l.) to the coast approx. 1.5 km north of the Point Durham lighthouse. Flow was estimated at approx. 160 litres per second and according to local residents the flow observed was typical and does not vary greatly.

Although these streams flow over a bouldery basalt bed, the water is peat stained and only suitable for stockwater.

Streams draining the lower northern peatlands are smaller and tend to be swampy. Some drain small lakes to the coast and some drain into lakes with no apparent outlet.

The whole island, in addition to the larger lakes and lagoons, is dotted with small lakes, many of which are trapped behind coastal sand dunes. Some of these act as local water supplies, for example, Lake Rangitai which provides water for the fish processing plant at Kaingaroa. Many are however peat stained or of inadequate quality to be used for other than stockwater.

GROUNDWATER

Reliable supplies of groundwater can be obtained from bores and in some places from springs in the volcanic tuff areas. Waitangi welldriller, Peter Black[5], advises that bores in the Waitangi area strike water lying on the volcanic rock at 24 to 36 metres. Yields of 0.9-1.8 litres per second of rather hard but otherwise good quality water are obtained from this source. Even better quality water is obtained from 55 metre deep bores at Wharekauri which yield 1.6 litres per second.

While these are not high yielding bores, they meet the stock and domestic needs of the island and the needs of the Meatworks some 8 km east of Waitangi on the Waitangi-Owenga Road. This latter user draws from a well field on a ridge some 100 metres a.s.l. and uses reservoir storage.

The settlement of Waitangi draws its supply of up to 90 m^3 per day from a spring above the town. The spring also supplies stockwater for the landowner at up to 2.3 m^3 per day.

The role that the peat blanket and associated vegetation play in regulating the flow of water in streams and to groundwater is not well understood.

RAINGAUGE NETWORK

Discussions with Met. Service staff[6] at Waitangi indicated there is a limited network of raingauges on the Chathams with a weekly recording gauge at the new airport and other gauges at the Met. Station at Waitangi, Wharekauri, Owenga, Kaingaroa, Hapupu and Pitt Island. This distribution suggests gaps in the north-west, the central waist of the island, and the whole of the southern uplands and south coast where higher rainfall can be expected.

Rainwater:

Many houses rely on rainwater for domestic supplies and periods of low rainfall can lead to costly 'topping-up' of tanks from more reliable sources.

OTHER RESOURCES

Peat:

As described, peat and soils derived from peat occupy 69% of the land surface of Chatham Island or over 41,000 ha. In places this peat deposit is up to 10 metres thick. McKenzie[7] refers to an estimated 28,925 hectares of peatlands on the main island with an average depth of between 8 and 10 metres and to estimated reserves of between 1000 and 2000 million tonnes.

The upland or high moor deposits vary considerably in age with the oldest deposits having the highest calorific value as they are further along the coalification process. Products that can be derived from peat include crude oil, peat wax (which includes resin, true wax and asphatline) with asphalt being a major by-product of crude synthetic oil refining.

Currently prospecting licence applications covering some 20,000 ha on various parts of the island are under consideration by the Ministry of Energy, Mines Division.

Possible peat mining methods include draining and cutting a quarry face and scraping the peat off in layers. It is the problems of disposal of drainage water and the risk of fire during mining, the problems of rehabilitation of mined areas, the possible effect on stream flow of removing the peat blanket, and the impact of peat processing on water quality that, amongst other matters, causes some concern amongst the people of the Chatham Islands.

Phosphate:

In addition to the submarine phosphate deposits of the Chatham Rise, there is a possibility of economic deposits in the lagoons of the island[8]. These deposits have been explained as having been concentrated as the result of changes in sea level and of submarine and volcanic activity during recent geological times. Applications for licences to enable prospecting in the lagoons of Chatham Island are, I understand, currently being processed by the Mines Division, Ministry of Energy.

WATER AND SOIL PROBLEMS

Existing:

The most obvious water and soil problem on Chatham Island is the spread of the sand dunes along Petrie Bay onto the (potentially) highly productive soils immediately adjacent and to the east. Wright[2] estimated that in 1959 there were some 5250 ha of beach and dune sands that he considered unstable. Heavy stocking of the marram covered dunes, overgrazing of the adjacent fertile, sand derived Te One sandy loam appears to have extended the area of unstable dune and bare sand beyond the limits recorded by Wright.

From a brief inspection I estimate an area in excess of 1700 ha should be fenced and stock totally excluded. Some of this land may be suited to forestry, but in general it is too exposed to have any productive value.

The greatest proportion of this sand country is along Petrie Bay between Waitangi and north of Rotoparaoa. Over 20 km of fencing would be required to fence out this area at a cost of approximately $5000 per km. (Fencing costs are extremely high on the island due to a lack of timber and very high transport costs. Salt spray and sandblasting would rule out the use of 2.5 mm wire and any steel posts.)

Active sand drifts in excess of 100 ha in total area were observed. The cost of stabilising these drifts with marram grass, based on my own experience in Northland, with updated costs, would be in excess of $750 per hectare.

The cost of fencing, and planting where required, this block of sand country would involve a job cost in excess of $175,000.

Further areas where eroding dunes are spreading onto productive land occur at Waitangi West, between Wharekauri and Kaingaroa, and along the east coast (Hanson Bay) from Kaingaroa to south of Mainui Lake. Up to 45 km of fencing with limited marram planting would be required to exclude stock from these areas. This would involve a job cost in excess of $225,000.

Total investment in sand dune stabilisation could involve a job cost in excess of $400,000. County Councillors and Council staff considered the sand drifts the most immediate problem and considered a high proportion of landowners would be prepared to co-operate in a stabilisation scheme.

Overgrazing on Sandy Soils:

Immediately behind the sand dunes are some of the potentially most productive soils on the island. The younger Te One soils of the Kekerione suite are found mainly on the western side of the centre of the island, with smaller strips along the northern and eastern coasts. Soils formed from shallower sand deposits over rock (volcanic, limestone, or schist) formerly carried broadleaf bush and clearings in the bush were used extensively for gardening during early Maori occupation of the island. With a swing to grazing the bush was burnt and stock and wind completed its destruction.

Loss of shelter and overgrazing has caused these shallow soils to dry out, open up and to erode with sand drifts forming in some places. Greater control over grazing, mobstocking, shelter planting and generally better management is required to return the 4800 ha of this land to its former levels of production. More detailed land resource surveys are required to determine the extent of the problems on this class of soils and to determine appropriate management techniques.

Podsolic Soils:

Across the northern part of the island are soils that resemble in appearance and have similar problems to the 'gumland' soils of Northland. These soils are strongly leached but once the initial nutrient deficiencies have been overcome they can be used for relatively intensive grazing.

The thin peaty topsoil can be easily lost by overgrazing or burning and the underlying leached silica sand exposed by wind erosion - "blow-outs" are common. Experience in Northland suggests this class of country is much less prone to erosion when developed to grass than if left in frequently burnt scrub.

There are some 2760 ha of these podsolised soils, largely undeveloped.

Peat Lands:

The major problem associated with the peatlands is burning. Three smouldering fires were noted during the inspection, one of which had resulted in a crater 3 to 5 metres deep (the surface intact with a cover of vegetation except where flooded), 750 metres long and 200 metres wide. Fires in peat are extremely difficult to extinguish and unless buildings, roads or developed land are endangered, they are usually left to burn.

To assist the County Council to recover costs when firefighting is involved, a 'fire plan' is being formulated and a permit system is under consideration[3].

Frequent burning has converted large areas of peatland upon which relatively palatable shrubs once grew to largely unproductive bracken fern country.

Control of burning is required, in addition to protecting capital assets, to prevent further reversion to unproductive plants. As well as the bulk of the peat being lost by burning, the potential agricultural productivity is also being threatened. There is a danger that basins will be created in the land surface causing ponding of water rather than shedding downslope or absorption into the peat.

Volcanic Soils:

Only very limited and localised erosion problems exist on the volcanic soils and few problems can be expected if land use intensity increases. Areas bared by earthworks revegetate very quickly according to Council staff.

Lack of Shelter:

The whole island is windswept and strongly indluenced by salt spray. Most farmhouses are protected by a hedge of macrocarpa, pine, flax and on sandy soils, by boxthorn. Because of the non-availability or cost of tree stocks of suitable shelter species, very little effective shelter has been established apart from this farmhouse shelter.

As the broadleaf bush has died out, due to grazing, burning and wind, the shelter this bush formerly provided and the microclimate effect on soil productivity has become readily apparent. There is a need for both traditional farm shelter systems, incorporating windbreaks and woodlots, and for the closer shelter provided in an agro-forestry system.

Forestry:

Attempts have been made to establish woodlots at various places on the island, but a combination of poor tree stocks, poor handling, poor planting techniques, difficult soil conditions and desiccating salt laden winds has resulted in few productive woodlots. Older trees scattered around the island near settlements or abandoned settlements and a few successful woodlots indicate that, with care, productive woodlots could be established.

There is a great need for woodlot production on the island to help reduce the impact, on building and fencing costs, of importing timber. Careful design of woodlots and shelter systems with suitable species could provide a proportion of the wood needs of the island. One of these needs, becoming more apparent as the broadleaf bush dies out, is wood for domestic fuel. Carefully managed woodlots on selected sites could meet the demand for firewood, roundwood and sawn timber.

Plant Materials for Soil Conservation and Forestry:

County Council staff expressed concern at the cost and condition of tree stocks after being transported from New Zealand. Pinus radiata and Cupressus macrocarpa have both been planted on the island and grow well on sheltered sites. If these species are to be planted on more exposed or more difficult sites, it is important that tree stocks are in the very best condition or heavy losses can be expected.

Several indigenous species appear to be suitable for shelter planting on more exposed sites, particularly Chathams akeake (Olearia traversii) and flax (Phormium tenax). Both these species have been planted for shelter and can be used for primary or windward shelter enabling other species to be established in their lee.

While P. radiata and C. macrocarpa may be more successfully propagated in larger mechanised nurseries in Canterbury and transported to the island, there certainly appears to be scope for propagating other species on the island, particularly indigenous species.

Marram grass for sand dune stabilisation is plentiful on the island and there would be no difficulty in selecting more stable sites for management as nursery areas.

Land Development:

Although land tenure has been cited as a limitation to land development on Chatham Island, the impression gained from this brief inspection is that development capital is one of the major limitations. Development of the difficult soils on the island, a process which will take time and careful management, may well be beyond the resources of the individual farmer.

The whole area has many similarities to the 'gumlands' of Northland where the State was the only agency able to withstand the long period of development and fertility buildup. An individual has great difficulties in surviving this period when investment exceeds returns, particularly when he is starting from scratch rather than extending an already developed block onto undeveloped land. There does not appear to be enough developed land to support this latter type of development.

As with the 'gumlands' of Northland, problems such as burning, overgrazing of the under-developed land, and erosion of the more susceptible soil types tend to diminish as the land is converted to farmland or where appropriate to forest.

The island needs more developed land with greater stock production to support the meatworks, provide stable employment, and to justify and pay for transport links, both internal roading and external shipping and air services.

Drainage:

The major drainage exercise in the past has been the opening of Te Whanga Lagoon to the sea on average every 3 years. This involves a cut some 150 metres long through a sandspit when the water level in the lagoon is high enough and the wind direction favourable (north-west) to achieve a successful opening.

Unlike the Lake Ellesmere opening, the cut in Te Whanga Lagoon is through a sand dune and there is ample evidence of sand movement on the dune being influenced by both wind and by the sea overtopping into the lagoon. The opening point is not the shortest route through the dune/spit, but is sheltered from the prevailing south-westerly wind and is through a section with an easier seaward beach slope. On the day of inspection there was evidence of a sand bar some 70-100 metres from the beach providing some protection from waves.

... inspected at midday on 14 October, the crest of the dune was estimated (using an abney level) to be approximately 2.6 metres above the water level in the lagoon. The seaward slope of the dune was 30 metres long and the lagoon side 80 metres to the water's edge. The remains of the old cut extended some 30 metres into this backface of the dune. A check with tide tables and rough measurements with the abney level indicate that the lagoon water level was approximately 1.5 metres above low tide level for that day. There was only a light south-westerly wind blowing at the time.

When the lagoon level rises it affects farmland around the shores and used to cause the old Hapupu Airstrip to become boggy. The new airfield is well above the influence of the lagoon.

The lagoon water is brackish enough to support flounder and presumably eels migrate over the dune or wait for the infrequent but lasting openings.

Discussions with Mr B. Pease of Royds Sutherland & McLeay, engineering consultants to the Council, indicate the opening costs are about $5000 job cost and involves about 24 hours work with a D6 size bulldozer.

The work has attracted a grant from N.M.A.S.C.O. with the local share coming from the Council's general funds, formerly collected by way of a freight levy on the wharf at Waitangi but now from a combination of freight levy and a capital value rate.

Drainage in the Waitangi Area:

Lake Huro, east of Waitangi, drains via Mangape Creek into the Nairn River and out into Waitangi Bay. Mangape Creek is joined by Wairarapa Creek in a swampy area sitting astride the only access route to Owenga, the meatworks and a high proportion of the developed farmland in the area. Lack of co-ordinated maintenance on this drainage ... not only effects the road but also the productivity of surrounding farmland ...ding those around Lake Huro, houses near the Nairn River and the Waitangi Racecourse and sports complex.

...here is an obvious need for an upgrading of Mangape Creek and for regular maintenance ...rough this very shallow graded system. In places the channel is almost non-existent and would need to be totally reconstructed for most of its 3 km length.

...ssibility of Peat Mining:

The role that the peat blanket plays in both the surface and groundwater hydrology of the island has not been studied and is not well understood. There is a need for a thorough investigation into this complex hydrological system before the exploitation of the peat resource is too far advanced.

Such a study would require a much more extensive distribution of raingauges and a programme of stream gauging spanning several seasons to understand any buffering effect the peat and associated vegetation may have on stream flow. Because groundwater is a limited but extremely important resource, a study of the extent and the method of recharge of this system is also a matter of priority.

The effect of draining the peat to enable mining is also not well understood but overseas experience may be of assistance. The impact of drainage water on the streams, lakes and lagoons, and on the surrounding sea has also not been investigated. A study of this impact would also include the impact of chemicals used in peat processing on the water resources of the island.

Techniques of revegetation following mining in Europe may well have application on Chatham Island, but again these techniques will have to be modified to cater for the salt spray and exposure effects on the island.

Phosphate Mining:

It is far too early to consider the impact of phosphate mining from the bed of the lagoon and lakes on the waters of these bodies and on the fish and wildlife they support. This however is a field in which investigations will be required.

Water Supplies:

As described earlier, there are problems of water shortage on the island, particularly the northern end. With land development and increased stock numbers, there will be a need for greater supplies of quality stock and domestic water. Again there is a need for a study of both the quantity and quality of ground and surface water resources.

Land Resource Inventory:

While Soil Bureau Bulletin 19 is a valuable reconnaissance survey of the soil resources on the island and their potential for farming use, there is a need for resource data in similar form to both the N.Z. Land Resource Inventory Worksheets (M.W.D.) and the additional data contained in the National Land Inventory being undertaken in parts of New Zealand by the Department of Lands and Survey.

Survey work to record or to update existing data on lithology, soils, slope, erosion or soil limitations, vegetation and land use, as recorded on the worksheets and land tenure, farming types, stock numbers, etc, would be a necessary first step before providing water and soil services to the island.

Servicing the Chathams:

One of the main problems in servicing the Chathams would be the cost of travel and accommodation for staff. There does not appear to be sufficient work to have an officer stationed on the island, but two or three trips a year, of up to one month duration each, would be required to stimulate works and maintain progress.

The return airfair to Christchurch is $412 and accommodation at the Waitangi Hotel is approximately $35 per day (dinner, bed, breakfast and lunch). A vehicle (landrover) can be hired on the island for approximately $40 per day, including fuel. To send one member of the staff to the Chathams for a total stay of two months in three visits (not necessarily the same officer) would cost -

Airfares	$1,250
Accommodation 60 days @ $35/day	2,100
Vehicle hire 60 days @ $40/day (average) $28/day hire and $12 petrol)	2,400
Salary (2 months @ $24,000 per annum)	4,000
	$9,750

In addition there would need to be administrative and support services in the office which, if assumed to be 20% of the field officer's costs, would amount to a further $1,950, giving a total cost of some $11,700 per annum. Staff time would also be involved in servicing the island between visits.

Initial Survey:

An initial resource survey and detailed survey of works requirements would require a team of three to four staff to be stationed on the island for two to three months plus the continuing costs associated with servicing a raingauge and stream gauging network. Based on the costs estimated above, the cost of staff alone on such a survey would amount to -

Airfares - 4 return tickets	$1,650
Accommodation - 4 men x 90 days	12,600
Vehicle hire - 2 landrovers for 90 days	7,200
Salaries - 3 mths @ $24,000 p.a. x 4	24,000
Drafting & administrative support 30%	13,650
	$59,100

Added to this sum would be the cost of equipment required, and the cost of transport, installation, monitoring and maintenance of such equipment.

The Scientist in Charge of the Land Resource Survey, Aokautere Science Centre, Ministry of Works and Development, has offered assistance in carrying out the Land Resource Inventory of the Chathams.

Water Board Functions:

Until there is some progress in the peat or phosphate mining ventures, there is not likely to be any great demand for the water right provisions of the Water and Soil Conservation Act 1967. Given adequate data from a resource survey, particularly ground and surface water, it should be possible to frame a management plan for these resources and to introduce a broad general authorisation for water use, within suitable guidelines.

Such an authorisation would preferably involve a notification procedure, perhaps initially to the County Council, to enable a record to be kept of the various uses of the water resource.

Mining:

Should a peat mining venture get off the ground on the scale being discussed, there may well be a need to station an officer - a general purpose 'catchment board officer' - permanently on the island to monitor such an operation and to provide the usual catchment authority-regional water board services.

As well as having this resident officer on Chatham Island, there would still be a need for regular visits by specialist staff.

Work Progress:

There is reference in some reports on the Chathams[1] to difficulties in promoting and sustaining progress on projects on the island. One may well question the likelihood of soil conservation and land development works being implemented. Discussions with Council staff and members suggest that there is some enthusiasm for this type of work but a careful and sustained extension programme with suitable incentives would be necessary to make any progress.

I personally do not share the expressed pessimism having seen similar problems, both physical, economic and social, successfully solved. These problems can be overcome by an understanding of the situation and in particular a practical demonstration of methods, hence my suggestion that Department of Lands and Survey have a role to play in land development.

I would expect the annual expenditure (job cost) on the sand stabilisation work to be in the vicinity of $50,000 per year.

Staff Requirements:

Should a catchment authority service the Chathams, a workload equivalent to one officer spread across the whole of the authority's functions would be created following the initial survey period. Should the mining proposals proceed, then additional work would be required depending on the scale of the project and its impact on the island.

For the North Canterbury Catchment Board to service the Chathams, two to three extra staff may be required as the workload would fall in areas where the Board is understaffed or where existing staff are fully committed on priority work, i.e. soil conservation, resource investigations and resource planning. Staff to service the above-mentioned staff may also be required in typing and drafting sections of the N.C.C.B. staff.

RECOVERIES

Rates:

The Chathams County Council has only recently introduced capital value rating as a source of revenue, having relied until this year on an import-export levy and on Government grants. A proportion of the Council's revenue still comes from this levy system.

In a generally undeveloped area where owning land has tended to be more important than farming land[1], capital value rating would appear to be a disincentive to land development.

Should a catchment authority rate the Chathams for administrative purposes to the maximum allowed under the Soil Conservation and Rivers Control Act 1941, it could collect approximately $7800, assuming a 100% collection (capital value $15,550,000 in 1981). The N.C.C.B. could collect $4370 at its 1982/83 level of rating.

Works:

Assuming 10% of the estimated $400,000 worth of sand stabilisation work is completed each year, or soil conservation work is carried out on the adjacent grazing land, a recovery of $10,000 to administration is possible. With the lagoon being opened every three years and possible work on Mangape Creek, an annual expenditure of $2000 on this type of drainage work is possible giving a recovery of another $400.

Total recovery to administration from a service charge is unlikely to rise much above $10,500 per annum. It could take up to 20 years to reach this level of works expenditure.

Water Right Application Fees:

With little likelihood of many water right applications being made, this source of revenue can be ignored.

Mining Supervision:

There is as yet no mechanism for catchment authorities to collect a supervision fee for monitoring and advising on matters relating to the Mining Act.

Recoveries - Summary:

If the N.C.C.B. were to service the Chathams on the same basis as it services the North Canterbury Catchment District, it could expect to recoup the following revenue:

Admin Rate (1982 figures)	4,370
Service charge on works (max.)	10,500
	$14,870

Costs - Summary:

Following the initial establishment costs, estimated to cost about $60,000 in the first year, with a continuing cost of about $5000 per year for a further four years (total $80,000 establishment cost and equipment, etc.) the Chathams would cost approximately $12,000 per year.

The Chatham Islands could therefore just pay their own way as far as administration costs are concerned once the level of work had built up sufficiently, perhaps after 20 years. Should however additional catchment authority involvement be required as a result of mining for either peat or phosphate, there would be insufficient revenue to cover the cost of these 'non-recoverable' services.

ACKNOWLEDGEMENTS

I wish to record my appreciation to Dick Schofield and Ian Tuanui of the Chatham Islands County staff and to Council Chairman Mr Bunty Preece and Councillor Joe Tuanui for their advice and assistance. Thanks also to Mr Russell Fellows, Government Representative for the Internal Affairs Department, Waitangi.

In preparing this report I have relied to a large extent on information contained in the Industries and Commerce Department report kindly loaned by Mr Stephen Barker of Hawarden and Kaingaroa (Chatham Island). Mr Barker's assistance is appreciated.

The assistance provided by Dr B.P.J. Molloy and staff of the Botany Division, Department of Scientific and Industrial Research, Lincoln, in identifying plants found on Chatham Island is also appreciated.

R.W. Cathcart,
MANAGER - RESOURCE PLANNING AND MANAGEMENT DIVISION,
NORTH CANTERBURY CATCHMENT BOARD.

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TIME LINE OF TE WHANGA LAGOON

18[illegible]. 30 Dec	Conveyance of the three Islands in Te Whanga Lagoon opposite Te Awapatiki to Thomas and Robert Ritchie by Rakatau, Karaka, Roretama, Heremaia, Hapurona Pawa and Hoeta for the sum of thirty pounds. (p.279)
1900. 20 Mar	Extract from Chatham Island Minute Book Application by Heta Namu to the three Islands in Te Whanga Lagoon. The case was dismissed because the land had not been surveyed. (p.258)
1913. 15 Oct	Chief Surveyor to Surveyor-General Stating he is unable to find the trigangulation maps of the Chatham Island even though they were recorded in Smiths field book. (p.175)
1916	S Percy Smith records his memoirs. They include a chapter on Chatham Islands. He states re Te Whanga Lagoon "A large part [of the Island] is occupied by Te Whanga Lagoon, a brakish water lake containing enormous quantities of eels, ducks and geese...The Whanga Lagoon teemed with eels in enormous quantities. On some occasions after a strong north east gale, the lagoon breaks out at Te Awapatiki, and the eels seem to become aware of this and take the opportunity of escaping to sea. On one occasion Mr Wilson and I riding along the beach there found that the sea had broken into the lagoon, but the sand bank that forms the bar in ordinary times had closed across the outlet, leaving a narrow channel some three yards wide running towards the sea but not communicating with it. It was about fifty yards long and three feet deep. Into this channel the eels had gathered in such numbers that our horses refused to cross it while the dry sands beyond were so thickly strewn with dead and dying eels that they might have been gathered by the cart load...On the 12th Feby we all hands started for the Awa-patiki, where the lagoon breaks out, to form a camp while we are measuring the base line which we had selected along the level shore of the lagoon north

of the outlet, (though there is only an outlet occasionally.)"
However Percy Smith's account may need to be read with some caution, as he admitted "I am sorry that I did not do so [write his recollections] soon after my return from there in 1869 when the whole detail of the geography and geology was fresh in my mind, but now I have to trust to a fading recollection and notes scattered through my diaries." [Reminiscences of a Pioneer Surveyor from 1840 to 1916 by S Percy Smith, p.86-91]

1930, 10 Feb — Statement of claim from John Mathias Barker of Waihi in the Province of Canterbury to the Islands in Te Whanga Lagoon. The land was conveyed by Rakatau and "his Moriori slaves" to Thomas and Robert Ritchie in 1875 although the Ritchies had occupied it since 1868 when Rakatau returned to Taranaki. In 1894 Barker obtained the land from the mortgagees of Thomas and Robert Ritchie. The title to the land had never been investigated and thus was customary land. (p.283-284)

1930, 18 Sept — Evidence of Mr Ritchie re title to three Islands in Te Whanga Lagoon]
"The spaces between the mainland and each Island could be forded or were dry at low tide. Whanga Lagoon had an outlet to the sea on the Eastern side of these three Islands and was consequently affected to some extent by the tide...my brother and myself were in undisturbed possession of the three islands until about the year 1894, when the Mortgagees exercised their power of sale. The Mortgagees sold the Ritchie Bros. station to Hon Mathias Barker of Canterbury New Zealand...There were no fences on the islands, the lagoon being a sufficient barrier. I used to take my sheep backwards and forwards at low tide... I never knew any of my cattle or horses to go across the lake to Matarae from Waikawa, or from Matarae to Waikawa." (p.270)

1930, 19 Nov	Evidence of Mr Barker [re title to three Islands in Te Whanga Lagoon] "I know the Owhanga Lagoon in the Chatham Islands - I own it- I purchased those Islands from the National Mortgage and Agency Company of New Zealand Limited - I bought it in 1894 - ...Immediately after the conveyance was signed and after I had paid the purchase money I took possession of the islands - I have remained in undisturbed possession of them ever since - I am still in possession of them I understand -...At low tide it is possible to drive stock from those Islands to the mainland - that was at the lowest water - I do not think there was much fencing on the Islands to keep the stock there - not much was needed - they may have been an odd bit." (p.274)
No date	"Islands in Te Whanga Lagoon Chatham Islands Conveyance 23207 appears to me to be attested in the manner required by Section 85 of the Native Land Act, 1873, but as the land was dealt with before it became vested in the freehold tenure by Order of the Court the Conveyance appears void by Section 87 of the Act. By the Native Land Purchase Ordinance 1846 it was made an offence for a European to purchase customary land, and this prohibition is repeated in Section 73 of the Constitution Act, 1852, Section 75 of the Native Land Act, 1865, section 87 of the Native Land Act, 1873, and Section 117 of the Native Land Act, 1894." (p.269)
1930, 9 Dec	Crown Solicitor to Under Secretary, Department of Lands. [re Mr Barkers application for title to islands in Te Whanga Lagoon] "As the Conveyance No. 23207 was not attested in the manner required by the Act I

think it was void under Section 87 of the Native Land Act 1873. From the evidence it appears that claimant bases his claim on possession since 1865 or thereabouts, that is to say for over 60 years. This raises a difficult legal question whether the Statute of limitations - in the case of the Crown the Nullum Tempuis Act - applies to Customary Native Land. In Wi Neera v. Wallis (1902) 21 N.Z.L.R p.668, the Chief Justice said that the ordinary Statute of Limitations did not apply to inalienable Native Land." (p.291)

1931, 4 Feb — Under Secretary to the Commissioner of Crown Lands
"...I pointed out that it was probable that the land [three islands in Te Whanga Lagoon] involved would prove to be Native customary land which would eventually go to the Natives, and in view of the circumstances that it was only fair the Crown should be reimbursed for the survey and other expenses.(p.264)

1931, 9 Feb — Chief Surveyor to Under Secretary for Lands
"In 1907 such a plan [sketch map of Te Whanga Lagoon] was prepared and registered as W.D. 1943 for the purpose of investigating the Title on behalf of one, Heta Namu, and can be forwarded to the Court at any time.

Before forwarding my previous memorandum I had enquiries made at the Native Land Court office with regard to Heta Namu's application, but could trace nothing in connection with it, and save for the plan there is no record in this office."(p.263)

1931, 17 Feb — Crown Solicitor to the Under Secretary Department of Lands
"For example, efforts should be made to trace Heta Namu, or his descendants, to find out the basis of the claim suggested in 1907. There was a

Native Agent named Walker who acted for Chatham Islands Native a few years back." (p.262)

1931, 29 Apr — Memorandum from L V Fordham Registrar to the Commissioner of Crown Lands.
Records that applications for investigation of Waikawa Island in Te Whanga Lagoon were lodged by Inia Tuhata on 28/3/07 and by Heta Namu on 27/3/07 and 1/2/1900. (p.257)

1931, 28 May — Sgd J H Damon to The Commissioner of Crown Lands
Stating that papers of the late Heta Namu were taken to Taranaki by a relative who travelled from Taranaki to the Chatham Islands to care for him before he died. Among these papers was a tracing of the Islands in Te Whanga Lagoon labelled D.F.M 15 4. (p.256)

1931, 29 Jun — Sgd A Gregor to the Commissioner of Crown Lands
Mr Walker was located but he was 88 years old, blind, very deaf and had practically lost his memory. Therefore he would be little help in the tracing of Heta Namu. (p.252)

1932, 9 Jan — Sgd R Holmes to the Commissioner of Crown Lands
[re Islands in Te Whanga Lagoon]
"The Islands have always been looked upon here as belonging to Mr JM Barker. Mr Barker brought the Kaingaroa property as you are aware about forty years ago from the Mortgagees of Thomas Ritchie...The value of the Islands for grazing varies. At times they are of no value as when the outlet of the lagoon becomes blocked or closed with sand, the water in the lagoon rises and covers much of the islands besides it deepens the channel between the Islands and the mainland making it difficult or impossible for stock to cross over...A new outlet of the Lagoon was made over a year ago and it is considered not likely

to close up in future which would improve the value of the Islands." (p.243)

1932, 4 Mar — Commissioner of Crown Lands to the Under Secretary for Lands
"From his [Mr Holmes] report it would appear that the islands have very little value and I am of opinion that no good purpose can be served by further prosecuting the Crown's claim thereto." (p.242)

1936, 23 Apr — Petition of George Tuuta & 34 others
The petitioners stated that ownership of Te Whanga Lagoon was not decided in 1870 therefore it was deemed to be Maori property and freely used at all convenient times and seasons. The petitioners claimed that since 1870 the water in the Lagoon has greatly receded and those owners whose land abuts the lagoon use the accreted land however the petitioners claim this land belongs to them. (p.240)

1936, 14 May — Memo from Commissioner of Crown Lands to the Under Secretary for Lands
"2nd. There is some doubt whether it [Te Whanga Lagoon] is a lake as there is an opening to the sea about two or three chains wide, and the tide flows in and out. As the opening is so small compared to the vast area of the lagoon (about 45,000 acres) the rise and fall of the tide does not appreciably affect the level of the contained water."

"3rd. Mr W.H Coulter. Surveyor, who has made various trips to the Chatham Islands, has informed this office that at times the opening to the sea blocks up and remains so until the weight of the accumulated water in the lagoon forces it open again. On occasions when this natural consequence does not happen, means are resorted to by the inhabitants to open the outlet, thus reducing

the level of the water in the lagoon and allowing the usual fords to be used."

"4th. The lagoon contains salt water, and is deep in places, flounders abound in it - it is shallow over a large area - and Mr. Coulter says the eastern side is the only part where accretion is likely."

"5th. The justice of the Native's petition seems to depend entirely upon whether this vast area of water can be determined as a lake. If it is, then the legislation &c. applicable to still waters would appear to apply, to the exclusion of any suggestion of accreting rights by adjoining owners. This would leave the area open for investigation by the Court, for determination of ownership in accordance with the petition. If on the other hand the fact that the sea water flows into the lagoon (or lake?) determines the area as moving waters, the contiguous owners would appear to have accreting rights, and the Natives' petition apparently would be of no avail." (p.238)

1936, 5 June — Crown Solicitor to the Under Secretary of Lands and Survey
[re Petition of George Tuuta and 34 others]
"It is a question of fact whether the Te Whanga Lagoon is a lake or an enclosed arm of the sea. Upon the statements submitted and from the term "lagoon" it would appear to be sea even though the entrance is very narrow and is sometimes blocked. If it is sea then the ordinary law as to accretion and erosion would apply in respect of riparian lands. I do not follow the reference of the Commissioner to legislation as to still water".

"If it is a lake then the question is one that comes within the general issue still undecided as to the ownership of lakes in New Zealand." (p.234)

No date	Application of investigation of title to land not yet named but appearing in the survey maps of Te Whanga Lagoon by Te Oti te Koea, Kume Hoani, Te Haina Hoani (Mrs Stewart), Te Araroa Kapinga, Neri Kaa, Wi Poriana. (p.213)
1937, 17 Dec	Chief Surveyor to the Under Secretary for Lands "Actually there is not a complete survey of the lagoon as required by Rule 19, but there is a triangulation map (W.D. 4159) showing the outline of the lagoon (apparently approximate), which should comply with Rule 20. It is signed by S Percy Smith in the year 1868. A map could be prepared from the many individual surveys surrounding the lagoon, but if an accurate definition of the boundaries of it is required, as it is today, a ground survey would be necessary." (p.208)
1938, 4 Jan	Crown Solicitor to the Under Secretary Department of Lands & Survey "If the application now on the panui is to develop into a claim to the bed of the lagoon, it will be necessary to decide first whether the lagoon is really an arm of the sea that has gradually been almost entirely enclosed and that it is still salt water and tidal, and secondly the policy of the Department in respect of the claim." (p.206)
1938, 25 Jan	Statement of H.R. Clough States water in lagoon is brackish but that fresh water springs rise in the bed of the lagoon on the western shore. (p.161)
1938, 25 Jan	Statement of A.F. Bauche Recalls outlet was more open than closed and when it did close it was opened artificially. The water was affected by the ebb and flow of the tide and was brackish. (p.159)
1938, 4 Feb	Statement of H Grinnell

Agrees that outlet to lagoon was closed on occasions and was opened artificially. Has seen red cod and groper in the southern end of the lagoon and flounder, garfish, herrings and kahawai in the northern end. (p.163)

1938, 4 Feb — Statement of R E Paynter
Lagoon continued to close into the 20th Century and opened artificially although would open naturally when sufficient water accumulated. Lagoon affected by rise and fall of tide. Water is brackish and different fish found in different location in the lagoon. (p.162)

1938, 14 Feb — Statement of William Jacobs
States lagoon outlet closes periodically but never for long because it is opened artificially, believes it would open naturally if left longer. Has observed sea fish in the lagoon although when the lagoon has been closed for a period fresh water accumulates.(p.160)

1938, 18 Feb — Statement of Te Rua Herata
States the lagoon closed in 1881 for seven years during which time it was not possible to cross the lagoon at the usual fords. Believes lagoon would open naturally if left. The water is brackish and houses grouper, conger eel, kahawai, gurnard, garfish, terakihi, herring, flounder, tuna. (p.164)

1938, 18 Feb — Statement of William Davis
States lagoon outlet closed periodically but was not allowed to remain so because it effected the fords and was therefore opened artificially. When the lagoon is open sea fish enter. When the outlet is open the water is brackish but is less so when the outlet has been closed for some time. The rise and fall of the water is affected by the tide and wind. (p.157)

1938. 18 Feb — Statement of Sgd A. D. Carsen

States water in Te Whanga Lagoon is salty. The water level is influenced by the tide and the wind. Is of the opinion that if there was no salt water running into the lagoon that the present area would be restricted to a very small lake at the south-western end. (p.156)

1938. 1 Mar — Statement of Charles Symour
Records that in 1866 the outlet of Te Whanga lagoon was open. It closed in 1866 and was closed until 1872 when it broke naturally. The outlet was closed between 1873-1876 when it broke naturally. The outlet closed again in 1878 and remained so until it was opened artificially in 1882. The outlet was closed periodically but has subsequently been opened artificially. Believes lagoon would open naturally if left. The water in the lagoon rises and falls in accordance to the tide. The water is brackish to sustain sea fish. (p.166)

1938 Feb — Report on Investigation of the Te Whanga Lagoon [Extracts from Report]
"Chatham Island has an area of approximately 180,000 acres excluding Te Whanga Lagoon which is actually an estuary of the sea. (p.133)

"This large lagoon is almost certainly a cut-off arm of the sea, the inner coast being clearly old sea cliff." [Mr R.S.Allan in Transactions and Proceedings of the New Zealand Institute. Vol 59, p.829] (p.136)

"The periodic opening and closing of the lagoon outlet has no doubt been going on for centuries and the permanent closing will not occur for a geological age when a sufficient barrier has been formed to confine the accumulation of water within the lagoon when closed." (p.139)

[Discussion re small number of lakes on northern and eastern lands adjoining Te

Whanga Lagoon which were at one time part of the sea bed but are now lakes] "Te Whanga Lagoon is no doubt passing through some such process, but owing to the huge area of water, it is essential that an opening to the sea be maintained." (p.142)

[Records that Te Awapakiti Outlet been opened and closed are varying times. Has been opened artificially in recent years and was necessary to do this so the fords remain passable. If the outlet was left it would open naturally.] "The Whanga Lake occasionally empties its waters into the sea, by breaking overs its low barriers. This may happen periodically, when it has been sufficiently replenished by its tributaries, or perhaps after particularly wet seasons. In such cases a vast quantity of its waters is discharged. The land at its southern extremity is then left dry to the extent of several miles, and the way from Wai keri, a native settlement on the eastern shore, to Waitangi Harbour on the western, is much shortened. The last time that this discharge of the water took place was in 1837." [Dieffenbach in Royal Geographic Journal 1841, Vol 11, p.197] (p.146)

Seed also noted his observations on Te Whanga Lagoon. "In the centre of the main island, which is nearly all low and undulating, there is a large salt water or brackish lake occupying fully one-third of its area. This lake has a hard sandy bottom and is easily fordable over about half of its extent, when the mouth is open at the point where its waters flow into the sea; at times, however, after heavy gales of wind, I believe, this is closed up, and then it is too deep to be crossed except in boats; a large portion of it is always very deep." (p.147)

Smith makes some conflicting observations about Te Whanga Lagoon. His field notes indicate that the lagoon was closed but his survey plans show a connection between the lagoon and the open sea. (p.149)

"I consider that there was no reason for an investigation by the Native Land Court in 1870, as to the ownership of the Te Whanga Lagoon, as, from the investigations carried out, I am satisfied that this lagoon is not a lake but an estuary of the sea." (p.150)

The report dismissed the petition of George Tuuta and others by stating as the lagoon was an arm of the sea any accreted land belongs to adjoining owners.

In conclusion the report stated the the lagoon was an arm of the sea and gave the following reasons:
"(1) The waters of the lagoon, when the outlet is open, are at mean high water level and are subject to the rise and fall of the tide from some miles within the outlet channel.
(2) From 70% to 80% of the water of the lagoon is salt sea water.
(3) The marine life in the lagoon is similar to that found at the same depth in the open sea.
(4) The Te Whanga Lagoon cannot be considered as a still inland water until all access to the open sea has been permanently closed. There is proof enough to show that under natural condition, the lagoon outlet will periodically close and open
(5) The western shores of the lagoon were originally old sea coast and show conclusive evidence of this fact.
(6) The landlocking of the lagoon has been proceeding slowly through geological ages, along the eastern shore, and, until the process is complete, and thus permanently excludes the flowing in of sea water, the lagoon must still remain an estuary of the sea.
(7) The meaning of "lagoon" is "a shallow lake connected with the sea or a river". The naming of this sheet of water implies that it was considered not as an inland water, or lake, but an arm of the sea." (p.152)

1938. 19 Apr	Chief Surveyor to Asst. Surveyor-General [Re field books of Chatham Islands] "There is also a copy of an Admiralty Chart prepared in 1840 which shows a break in the shore of the salt water lagoon in the vicinity of the outlet at Awapatiki." (p.174)
1938. 21 Apr	Asst. Surveyor General to Native Draughtsman, Lands and Survey Department "I had an impression that the outlet at the date of Smith's survey was open, but on following the matter up there appears to be very definite evidence that the outlet channel was closed at the date of survey which will largely complicate the question of accretion along part of the foreshore of the lake." (p.177)
1939, 8 Aug	Application by Arthur Tipene, G Tuuta, P Kamo, E Hough, Wm Hough, Reta Raumoa, Kaweau Tamihana for investigation of title to parts of Te Whanga Lagoon. (p.82)
1948. 24 Aug	Crown Solicitor to the Under-Secretary Department of Lands and Survey Gives history of claims to Islands in Te Whanga Lagoon. (p.72)
1949, 22 Aug	Crown Solicitor to Director General Department of Lands and Survey Agrees to application of Barker Bros to be granted title to islands in Te Whanga Lagoon. (p.48)
1951, 4 Apr	Islands in Te Whanga Lagoon awarded to Barker Bros under Land Transfer Act 1915. (p.21)
1963, 30 Sep	V P McGlone, Commissioner of Crown Lands to the District Commissioner of Works "The Te Whanga Lagoon was investigated by the Assistant Surveyor General Mr R G Dick in 1938. No statutory authority could be found declaring the lagoon to be an arm of the sea but Mr Dick concluded from an extensive

consideration that the lagoon is an arm of the sea." (p.16)

1966, 19 Apr — V P McGlone Commissioner of Crown Lands to the District Commissioner
Recently visited Chathams and walked over land the Barker Bros wish to acquire. The land is covered by two inches of water or nine inches during a southerly. Considers that the reclamation of the land in question would have little effect on the water levels in the rest of the lagoon. (p.15)

1966, 3 Aug — Application of Barker Bros to reclaim 1000 acres of Te Whanga Lagoon by erecting a stop bank granted. The stop bank was agreed to by the District Commissioner of Work Christchurch. (p.21)

1967, 16 Feb — Application of Barker Bros to reclaim @1150 acres of harbour granted by the Commissioner of Crown Lands. The land in question was affected by salt water and therefore only suitable for hoggets although the erection of a stopbank would eventually make the land suitable for ewes. (p.8)

1968, 4 Jul — Application of Sunday Wharetutahi Hough of Waitangi to reclaim @1000 acres from Te Whanga Lagoon granted by the Marine Department and Ministry of Works. (p.5)

1984, 13 Mar — The Water Resources Council as Regional Waterboard Chatham Islands granted the right to discharge 570 litres per day of water into Te Whanga Lagoon to the Minerals Exploration company subject to special conditions. (p.3)

1987, 11 Aug — Chief Surveyor to the Registrar Maori Land Court States Te Whanga Lagoon is an arm of the sea and list reasons as per 1938 Report. (Moriori Document Bank 2.1)

Extracts form Article by David Holmes entitled 'Te Whanga Lagoon or Big Lake'.

"When the Lake is running out there is a large area of flats which gives grazing to a considerable number of sheep, mostly on the East side - from Te Awaingnga River to Taupeka, East boundary in the North. The West side is not effected very much. To make the flats available for sheep grazing, the owners of Kaingaroa Station and Owenga Station agreed to open the Channel and let the Lake out at more frequent intervals than the 4 years that it was closed. It was generally opened after 2 years closed, if sufficient water had built up. Opening mostly took place in the Spring."

"The water is salt or brackish, more so in the Patiki or south area. The centre area is the deepest; up to 25 feet in places. There is a wide shallow, 4 miles long west to east from Moutapu to Kaingaroa which was used always as a crossing ford for horse traffic, when the lake was low."

"For the last 70 years or so the Lake has been opened by various farmers when the water level is high enough to force a flow. Of latter years the Council and Ministry of Works have been involved in the opening also. The sand bar now has marram grass growing on it which makes opening more difficult."

"The Lake, being tidal allow some kinds of sea fish to live and thrive in its waters, especially in the southern portion where the outlet is. At times there are great quantities of Flounders which are caught."

"Around the Patiki area there are beds of cockles, which are gathered at times by people. There are often shoals of Garfish and sometimes other species of fish. Inanga and whitebait are found mainly on the west side. Eels are very plentiful in the Lake also in the many stream which flow into the Lake, living mostly in the weed which grows out from the shore. The small Eels evidently go up Patiki Channel when it is open and remain in the Lake till fully grown when they return again to the sea. When the Lake is closed for any length of time the mature Eels cannot get to the sea, because of the sandy bar. They evidently knew where they should go to the sea, as the waters in the Lake at Patiki at times are full of Eels of great size, many having white patches on the skin which I have been told is a colour pattern on old Eels. At times they try to cross the bar and are found in large quantities stranded." (Moriori Document Bank 4.39)

EXTRACTS FROM THE DIARY OF S PERCY SMITH

25 January 1868
The view from the house is very pretty. We catch a distant view of the large salt water lagoon which occupies such a large extent of the land.

13 February 1868
There are great lots of duck and pukeko out here and Rowan saw about 50 wild geese on the lake. It is said there are sea fish in the lake.

14 February 1868
Rowan and Harry have been employed all day in building a raft with which we hope to cross the Lagoon to put up station on the other side - the distance round to opposite this point being = to a days journey...We are encamped amongst the trees near a Moriori settlement at the outlet of the lagoon which however is closed now and is likely to be for a considerable period, until the water rises to a sufficient height to break through.

28 March 1868
Some Morioris mentioned to me today that there were three migrations to this island (which they call Rangikohua). The first was headed by Kobu. The second by Rangitata. he brought the karaka tree with him. He threw some ashore at Cape Franier which grew. He dragged his canoe part of the way into Te Whanga and Te Awapatiki when the lake is said to have opened and let him in. He crossed to Moriroa where he planted a karaka tree and his canoe is to be seen at present day turned into stone together with the occupants. The third migration was headed by Mohe or Moe probably.

30 April 1868
Blowing heavily last night and this morning packed up and started northwards. Found that the sea was breaking over into the Lagoon and that there were thousands of eels trying to get out to the sea. The number of eels dead, dying and living was something incredible some of them of very large size. averaging about 2 feet 6 by 2 inches thick.

1 May 1868
The sea has ceased to run into the Lagoon and the number of stranded eels is greater than before. There is a great congregation of seagulls and pigs to the feast.

8 May 1868
There are still a great number of eels here but the sea has constantly been rising into the lake and has swept large numbers away.

These journal entries were used as a prompt when writing his reminiscences some 46 years later. There is no substantial difference between his diary entries and 'Reminiscences of a Pioneer Surveyor'.

EXTRACTS FROM REMINSCENCES OF A PIONEER SURVEYOR

A large part [of the Island] is occupied by Te Whanga Lagoon, a brackish water lake containing enormous quantities of eels, ducks and geese...The Whanga Lagoon teemed with eels in enormous quantities. On some occasions after a strong north east gale, the lagoon breaks out at Te Awapatiki, and the eels seem to become aware of this and take the opportunity of escaping to sea. On one occasion Mr Wilson and I riding along the beach there found that the sea had broken into the lagoon, but the sand bank that forms the bar in ordinary times had closed across the outlet, leaving a narrow channel some three yards wide running towards the sea but not communicating with it. It was about fifty yards long and three feet deep. Into this channel the eels had gathered in such numbers that our horses refused to cross it while the dry sands beyond were so thickly strewn with dead and dying eels that they might have been gathered by the cart load...On the 12th Feby we all hands started for the Awa-patiki, where the lagoon breaks out, to form a camp while we are measuring the base line which we had selected along the level shore of the lagoon north of the outlet. (though there is only an outlet occasionally.)"

However Percy Smith's account may need to be read with some caution, as he admitted "I am sorry that I did not do so [write his recollections] soon after my return from there in 1869 when the whole detail of the geography and geology was fresh in my mind, but now I have to trust to a fading recollection and notes scattered

through my diaries." [Reminiscences of a Pioneer Surveyor from 1840 to 1916 by S Percy Smith. p.86-91]

ning eastwards, near which place it is joined by a small stream, which they called the Kinghorn.

On the 3rd, they crossed the La Trobe, and proceeded N.W. by W. for about 6 miles, when they crossed another river called Kirsopp.

The remainder of the journey was pursued with much difficulty; the party was obliged to cut a road for more than 30 miles through dense brushwood, and reached Mr. Turnbull's Station on the 11th, very much fatigued, about 35 miles from Melbourne, near Western Port.

The country thus explored is generally well watered. The banks of its rivers are lined with every kind of the finest timber usually found in this colony; and the intervening land is either gently undulating or quite level, having a rich alluvial soil, supposed to be formed by the deposits of the numerous rivers which descend from the Snowy Mountains. Throughout the whole of Gipps's Land scarcely a rock was to be seen.

I have the honour to be, Sir, &c.,

JOHN ORR.

XVI.—*An Account of the Chatham Islands.* Communicated by Dr. ERNEST DIEFFENBACH, M.D., Naturalist to the New Zealand Company, and printed with its concurrence.

The group, in the Southern Pacific Ocean, called the Chatham Islands, was discovered by Lieutenant William Robert Broughton, of His Majesty's brig "Chatham," who hoisted the union-flag on the largest of the islands, and took possession of it, in the name of His Britannic Majesty, on the 29th of November, 1791. He anchored in Waitangi, or, as he calls it, Skirmish Bay, and had some intercourse with the natives; but a misunderstanding having arisen between the latter and the Europeans, one of the natives was killed, and thus terminated abruptly the discoverer's short visit. The natives did not appear ever to have seen a ship. Lieutenant Broughton ascertained Cape Young to be in latitude 43° 48′ S., and longitude 176° 58′ W.; two small rocky isles, called the "Two Sisters," to the N.W., being in latitude 43° 41′ S., and longitude 177° 11′ W.*

I visited the largest island of this group in the year 1840, in the barque "Cuba." The purchases of land in New Zealand by the New Zealand Company having suddenly terminated in consequence of a proclamation of His Excellency the Governor, the "Cuba" was despatched to this group of islands, in order to purchase them, as they were not included within the limits specified in the proclamation; and I was attached to that expedition as naturalist. Twelve days after we sailed from Port Nicholson

* Vancouver's Voyage to the North Pacific Ocean, vol. i.

we anchored in Waitangi Bay, in the middle of May, 1840, and remained constantly on the coast till the 26th of July.

The following is an abstract of what I have been able to ascertain with respect to the islands, partly from our own observations, partly from the reports of whalers and sealers, who had frequented and become well acquainted with all the islands and reefs which compose this small archipelago.

In my chart I have retained the native names, and I do so in my narrative likewise: were that method universally followed, much confusion would be prevented.

The whole group consists of three islands: a large one called Ware-kauri by the natives, and Chatham Island by its first discoverer; a smaller one, named Rangi-haute, or Pitt's Island; and a third, called Rangatira, or South-east Island. In some charts or rather sketches, an island is laid down, called Cornwallis's Island,* but I have been repeatedly assured that no such island exists; and that a rock, called, from its shape, "The Pyramid," must have been mistaken for it. There are also, to the N.W., Rangitutahi, or the Two Sisters; to the E., the Forty-fourth Degree Isles; and some reefs, which will be described hereafter.

Ware-kauri has nearly the form of a horse-shoe, or rather that of an indented square, the four sides of which are directed towards the four points of the compass. On its west side, where ships coming from New Zealand will generally first make the land, it stretches in a semicircle from S.W. to N.W., so as to form a deep bight. The land has there an undulating surface of small elevation, and is overreached to the N. and N.W. by higher insulated hills, which have either regular pyramidical forms or are irregular and massive in shape. With the exception of two hillocks at the S.W. point of the island, which the natives name Wakaiwa, no hills are visible in that direction; but the land rises gradually from the shore, which is rocky, and clothed with verdure to the water's edge, and at the top of the slope spreads out into a level or undulating surface. On advancing towards the inner part of the bight, a red cliff, or rather bluff, becomes visible, which forms the southern headland of a smaller inlet into the larger bight, the northern head of which is a bluff of the same description. The distance between these two bluffs is by measurement 3 miles; the beach between them is sandy, and bordered by low hills. This inlet has a very regular, semicircular form; and under the southern bluff is the principal harbour, called Waitangi. From the northern bluff the beach becomes again sandy for some miles, and afterwards rocky, which it continues to be to the N.W. point of the island: being indented by

* Cornwallis's Islands are marked as three rocks or islets in Mr. J. Arrowsmith's chart of the Pacific Ocean (1832), and appear to correspond nearly with the Starkey Reef in the author's chart.—Ed.

four small bays, three of which are close together, the fourth being near to the N.W. point. These bays open to the S.E. by E., and two of them, though small, are good harbours.

The direct distance, in a straight line, from the S.W. to the N.W. point of the island is 25 miles; measured along the beach the distance is about 40 miles; whence it appears that the bight forms a deep curve.

The northern side of the island runs nearly from W. to E., and forms several wide, open bays: to the westward the shore is flat, and the headlands of the bays run out in long, wooded tongues of land. About 10 miles from the N.W. point there is a group of irregular hills, which terminates in a rocky precipice towards the sea, from the foot of which runs out a spit with a level beach. These hills are called Maunga-nui (the high mountain), although they are of very inconsiderable elevation. This spit forms one termination of an open bay, stretching about 10 miles along the coast. Its eastern boundary is a headland terminating in a hilly promontory, the sides of which are steep or perpendicular. The shore between them consists generally of sand-hills, which are wooded to a short distance inland, and are either shelving or cut down into cliffs by the action of the waves, so as so show their geological structure. In the middle of this bight, four needle-shaped rocks lie off the shore, from which they are distant about a cable's length. The beach itself consists of a fine sand. On the other side of the headland, the shore retreats again, and runs for about 15 miles to the eastward with a broad beach and low wooded hills. Although the beach is sandy, rocks spread along the shore are left uncovered by the sea at low water: this beach is terminated by a long point, behind which, very near to the N.E. end of the island, there is a small bay, Kaïnga roa, with an entrance partly obstructed by rocks. Its N.E. end is extremely rocky; and its outermost point is formed by an island, or rather a peninsula, called Wakuru, as the channel which separates it from the main island is dry at low water.

The length of this northern shore is about 48 miles; but of course more when reckoned along the beach, on account of its many curves and indentations.

The coast continues to be rocky on the E. side of the island, when it again forms a bay nearly 2 miles long, enclosed by a broad sandy beach and low wooded hills. Rocks, most of them only visible at low water, are everywhere scattered along the shore; and, with easterly winds, a heavy surf and high breakers roll over them for several miles from the land. The southern head of this beach is perfectly rocky, and from thence a long, deep bay extends to the S.E. point of the island. Sand-hills are thrown up along the coast, and stunted shrubs cover them on the weather-side. The S.E. point is formed by a hilly promontory covered with wood.

The distance from the N.E. to the S.E. point of the island is 25 miles in a straight line, and 35 miles along the shore.

The southern shore is abrupt and precipitous; the land on the summit of the cliffs is level, and covered with trees. Small streamlets trickle down the cliffs, and clothe their face with herbage.

In this general description of the coasts, I have mentioned several larger or smaller bays; and, as they form the harbours of the island, I shall now attempt to give a more detailed description of them.

The first is Waitangi Bay: it is situate in 43° 58′ S., and 176° 38′ W. Though exposed to the N.W. winds, the force of the swell is broken by the N.W. end of the island, and also by a short reef, which runs off from the southern bluff, and may be doubled by ships of any size to half a cable's length. From the south-westerly winds which prevail during a great part of the year, this harbour is completely sheltered. Its general depth of water is from 7 to 12 fathoms, and the best anchorage is in 5 fathoms, off the southern bluff, where the bottom is a firm sand. If a ship anchors farther to the northward, she is more exposed to the swell occasioned by long north-westerly gales; and the danger increases if she anchors too near the shore.

The tide in this place comes from the southward, but is very irregular, generally recurring only once in twenty-four hours; and at changes, it rises to about 6 feet. If easterly and southerly winds have long prevailed, the tide cannot be perceived at all, and its force is hardly ever perceptible at any time.

The land in the neighbourhood of this harbour is the richest in the island, being a black loam. For some years past this harbour has been much visited by ships for laying in fuel, provisions, and water, which can easily be procured there. During my stay, there were never less than five vessels lying in this harbour; and, in the whole whaling-season of 1840, thirty vessels came hither for refreshments.

For ship-timber, the wood of the island is not fit: it can only be used for inconsiderable repairs.

A cargo can be landed at all times at a place where there is no surf at all, and the water is constantly smooth.

The next harbour which the "Cuba" entered is Wanga roa, to the northward of Waitangi. This bay is an oval, nearly a mile deep, its extreme points being half a mile distant from each other. The best anchorage is about two-thirds up the bay, somewhat nearer to the western than to the eastern shore, in 6 fathoms water, with a soft sandy bottom. The anchorage is protected from N.W. winds by the land, and from S.W. winds by the lee of the western side of the harbour. The tides are here also irregular. The harbour of Waitangi is, however, preferable.

as the country is here bare of wood, and uninviting, being merely an undulating boggy moor. Provisions also must be brought by the natives from a distance, for there are few cultivated spots near the bay: but, as two Europeans have already settled here, this harbour will doubtless be hereafter of some importance, as the best of the four in this neighbourhood.

The two others to the eastward of Wanga roa, called Wanga moe and Wangatehe, are nearly similar to Wanga roa, and perhaps offer the same advantages; but they have not yet been tried, and there is nothing particular to recommend them.

The bay to the westward of Wanga roa, Pohaute, has nearly the same shape, but is more sheltered. The land around it is also richer and more cultivated. It was formerly the principal resort of vessels in quest of seals; and, as a large French whaler was captured there by the natives, it evidently has a good anchorage.

The northern shore of the island is much exposed, and could only serve as a roadstead. It has, however, one sheltered bay, 6 miles from the north-eastern extremity, which, when surveyed, may prove a secure harbour; and if such, will be valuable, from its proximity to fine and fertile districts: its name is Kaïnga roa. I have been told that it has an anchorage from 10 to 12 fathoms. The eastern and western extremity of this bay are rocky promontories, each terminated by a spit of reefs, over which breakers are continually seen. The outermost rock of the eastern point is below the surface, but is occasionally covered with breakers. The rocks above water, off the western point, extend to the middle of the entrance of the bay, and are also terminated by a sunken rock 500 yards distant. A ship can enter with a northerly wind between the two sunken rocks, and would be sheltered from all winds by the western point, where there seems to be the best anchorage. On approaching Kaïnga roa from the land, an oval, smooth basin of water, bordered by gently sloping and wooded hills, opens to the view. This water has, however, no connexion with the sea, as I first supposed, but is merely a lagoon of brackish water. A low sandy beach, about 48 yards broad, intervenes between it and the sea, while the latter is hidden from sight by the hills surrounding the lagoon. This lagoon is of little depth, and its reeds and rushes are tenanted by vast flocks of ducks.

The channel by which this port is entered has not yet been surveyed, nor is there any native settlement in its immediate neighbourhood, but there are two on the eastern coast, only 3 miles distant.

The eastern shore has been frequented by whalers and trading vessels. The best anchorages are about 6 miles from the north-east extremity, where a boat can land at all times, and at Oinga, where the hilly foreland offers some protection. But easterly winds often set in suddenly, which happened while the "Cuba"

was lying there, in consequence of which she was driven out, and left an anchor and her long-boat behind.

The irregularity of the coast-line makes it difficult to form a correct estimate of the whole number of square miles contained in the island. At its north-western extremity its breadth does not exceed 4 or 5 miles; from Waitangi harbour to the beach on the eastern side, its breadth is 12 miles; the south-east and southern part of it is the broadest, being about 15 miles. A rough computation gives for the whole surface 477 square nautical miles, or 305,280 acres. Of this, however, 57,600 acres, at least, are water, being lakes, lagoons, &c.: the land therefore cannot amount to more than 247,680 acres. Of these, 100,000 acres may be considered as productive: the rest, for the most part, affording good pasturage.

I shall now speak of the geology of the island, that being the best foundation for an account of its soil, as far as agriculture is concerned. I have already observed that, at its north-western extremity, a chain of hills succeeds to the low undulating surface near the coast. Their form alone is sufficient to point out their structure. Some of them are regular pyramids, with their longest base running from W. to E.; and above, it forms a kind of oblate cone, from which the pyramid rises. Others have a more irregular shape, and consist of rounded stony masses piled on the top of a mound of earth. All these hills have had a volcanic origin, and are formed of either dense and firm, or cellular and amygdaloidal basalt—the cells of which are either empty or filled with white, decomposed carbonate of lime. This rock will furnish an excellent material for roads and buildings.

None of these hills are more than 800 feet in height. The westernmost of them is called Mata Ketaki, or Mount Paterson. Two or three miles distant from it there is a small group of hills, separated from each other by ravines, called Maunga-nui. The extremity of this group, nearest the shore, forms a perpendicular cliff 100 feet high; but it is separated from the sea by a flat beach, a mile and a ½ or 2 miles in breadth.

Three miles distant from Maunga-nui, near the head of Wanga roa bay, there is another hill of small elevation, called Emo kawa. Three miles from which, near the head of Wanga tehe bay, is Maunga wakai pai, the most regular pyramid, and apparently the highest of all. Only a few miles from it, is Wai papa, likewise pyramidical. The last in the series, and that from which the original name of the island is derived, is Ware Kauri. It is situate about 2 miles from the northern shore, and 15 miles from the north-west end of the island. It consists of several steep declivities, and is wooded. I had no opportunity of ascending it; but it is not higher than the others, and is apparently of the same structure. These are the only hills on the island, excepting two

hillocks at its S.W. end, called Waka kaiwa, which are an excellent sea-mark.

On the northern coast, the receding tide shows the same volcanic rock, and it is found in large fragments from the southern red Bluff to the S.W. end of the island; dykes of it traverse the clayey conglomerate of that Bluff, with an E. or E.N.E. direction, and a depth of a foot or a foot and a ½ broad. In the interior of the island, this rock is also found in large boulders, covering basin-shaped depressions of the surface, and here by its decomposition small masses of milk-white chalcedony are often laid bare.

Notwithstanding these manifest traces of volcanic action, this island does not appear to be subject to earthquakes, and none are remembered by its present inhabitants.

Another series of rocks, which is the most common, and by its occurrence in a stratified state, shows that it had an aqueous origin, is a green slate of a very firm texture, containing much quartz. Its layers have generally a direction from W. by S. to E. by N., and a dip of about 45° southwards. This formation appears principally at the N.W. end of the island, in Wanga tehe, Wanga moe, and Wanga roa bays. In Kaïnga roa Bay, on the northern coast, and on the adjoining part of the eastern, the direction of the strata, which are almost perpendicular, is W. by S. This rock contains frequent laminæ and veins of white quartz, which often swell into compact grey masses, the largest of which I observed near Waï keri, on the eastern coast: it was about 300 cubic feet in thickness, the surrounding softer slate having fallen away by decomposition. When this slate has been decomposed by the action of the water and of the atmosphere, its lighter and softer ingredients are washed away, but the quartz remains, and forms the white sand found on some parts of the beach. This slate breaks into slabs, and can be used in laying the foundations of houses and walls.

This rock, apparently the undermost and oldest in the island, has been traversed by volcanic cones, the rocks of which often contain fragments of the slate altered by the action of volcanic fire.

The next rock in succession is that of which the southern and northern red Bluffs are composed. This is a soft conglomerate of sharp-edged, solid, sharply-angular particles of a brick-coloured clay, cemented together by white carbonate of lime. Sometimes the argillaceous, and at others the calcareous constituents prevail; and if the component parts are coarse, the rock assumes the appearance of a pudding-stone. This rock may be easily examined at the Bluff which forms the southern headland of Waitangi harbour. There it forms either unstratified masses, or a stratification which can be distinguished striking from N.E. to S.E.,

and dipping to the N.W. with an angle of 45°. The redness of this rock is produced by its containing much iron, which often appears in thin slices or in dark shining nodules as brown iron ore, imbedded in the conglomerate.

I have already observed that dykes of basaltic lava traverse the latter: the conglomerate itself contains fragments of volcanic rock, around which it appears to have undergone more or less alteration by fire; and the whole shows manifestly that its present form has been in a great measure occasioned by the agency of heat. In Waitangi a creek empties itself into the sea, the left bank of which is formed by a range of low hills, which are of the same construction as the Bluff, and from the decomposition of this stone mixed with the vegetable mould derived from trees which cover it, a rich, reddish, and very fertile loam has been formed.

On the northern coast, I found a fourth series of rocks, laid bare to the view by the continual fall of the cliffs. Near the beach, the lowermost of the horizontal strata is, for about a mile, a dark green friable sand. Over this, about 3 feet above the level of the sea, there is a horizontal bed, from ½ a foot to a foot thick, of broken decomposed shells of the nautilus and oyster tribe. They are cemented together by a very soft, pepper-coloured sandstone. A calcareous breccia, 1 or 2 feet thick, follows next in order, and consists of comminuted fragments of shells: then comes the pepper-coloured stone above mentioned, alternating with layers of shells; and upon it, to the summit of the cliff, which is about 40 feet high, is a black, loamy, sometimes boggy earth, which, in the latter case, contains the remains of trees or plants. Both the calcareous beds of this formation, and the shelly sand on the beach of this part of the coast, would furnish lime in abundance. In some parts of the island, the rocks consist almost entirely of trunks of trees in the state of lignite, which I observed particularly near Kaïnga roa Bay, but in other places it assumed rather the character of peat. It is difficult to say to what kind of tree this lignite belongs; but impressions of monocotyledonous plants can be easily distinguished.

Geologically speaking, the island of Ware kauri belongs to New Zealand; and this is still further confirmed by its plants and animals. The whalers say that soundings can be obtained between New Zealand and Chatham Island—a remarkable phenomenon, upon which, however, I shall not enlarge here.

Having thus described the structure of the rocks, which may be considered as the skeleton of the island, I shall describe its uppermost coat, which by many will be deemed far more interesting.

This, in the northern half of the island, is generally undulating, deep and boggy. In the hollows, it is often marshy; but, from

its height above the sea, it can everywhere be easily drained. This promises to be highly productive, and equally fit for grain or pasturage. Wherever the superfluous water has been carried off by a natural outlet, a rich vegetation of fern and flax* (phormium tenax) has sprung up, giving additional firmness to the soil by decayed leaves, and yielding a rich harvest to the native planter. This is particularly the case on the low hills above the sea-shore, which are well wooded, and encircle the island with a verdant zone. Where these hills are sandy, the decayed leaves cast by the trees have formed a light, black soil, which the natives prefer for agriculture. The conical hills, which rest on a volcanic rock, have a very rich soil in their neighbourhood, which is generally covered with a vegetation of fern and trees, agreeably mixed together, and these fertile spots are like so many oases rising from the surrounding bog. On the west side of Wanga roa Bay, and at other places between Maunga nui and Emo kawa, the soil has been set on fire by some cause or other, and is burning slowly beneath the surface: the temperature, also, although neither flames nor fire are visible, is much raised. "Te ahi kai kai te one one" (the fire consumes the earth), say the natives; and in consequence of this slow combustion, which had begun before the New Zealand colonists settled here, six years ago, and may, indeed, be traced to a much earlier period, the soil in the neighbourhood, is gradually sinking. The vegetation at these places is extremely vigorous, though the soil is perfectly dry. A phenomenon like this, of a burning soil, is not unparalleled, as in several places beds of coal, accidentally ignited, have continued to burn slowly for a long series of years: this is therefore explicable, without any reference to volcanic agency. What has been already said applies almost exclusively to the northern part of the island, which presents another remarkable feature; viz., several lakes, usually surrounded by gently sloping hills. These lakes are, for the most part, at the back of the low hills which run parallel with the coast, for there is generally an outlet for the water into the sea. They are most frequent near the northern coast, and are usually one or two miles in circumference. There are some also not far from the beach near the western coast; the largest of which is at the head of Waitangi Bay, and about 6 miles in circumference. A river, named Te Manga pe, from 6 to 8 yards broad, drains this lake, and is tributary to another river, which enters Waitangi harbour. The hills surrounding these lakes are slightly wooded, and form a beautiful feature in the Ware kauri landscape. The shores of the Manga pe river are low, and, at some places, its water is stagnant.

* A large, rushy plant, very different from common flax.—Ed.

This lake is separated by a range of low fertile hills from Te Wanga, the largest lake in the island, which is, however, brackish. It is about 25 miles long, and 6 or 7 broad, and therefore occupies a very large portion of the whole island. It is surrounded by hills either wooded or boggy. On its eastern side, it is separated from the sea by low sandhills about 100 yards broad. At one place, the intervening hills disappear, and between the lake and the sea there is only a low sandy beach: the level of the lake is about 2 feet above high-water mark. According to the natives, the sea never encroaches upon it. Its water is only slightly brackish, probably from infiltration, as it is supplied by two large streams which would otherwise make its water fresh. They descend in a serpentine course from a range of low hills which run from N. to S. to the southern extremity of the island. Although only a few yards broad, these streams are deep and rapid, discharging their waters into a long branch of the lake. Both these rivers would be very useful for turning mills. The Wanga lake occasionally empties its waters into the sea, by breaking over its low barriers. This may happen periodically, when it has been sufficiently replenished by its tributaries, or perhaps after particularly wet seasons. In such cases a vast quantity of its waters is discharged. The land at its southern extremity is then left dry to the extent of several miles, and the way from Wai keri, a native settlement on the eastern shore, to Waitangi harbour on the western, is much shortened. The last time that this discharge of the water took place was in 1837. This fact shows that a large part of the lake could easily be drained.

The larger and better part of the island is that to the southward of Waitangi harbour. It has an undulating surface, is not so boggy as the rest, and is either covered with an open forest of moderate sized trees, or with high fern, in which case the land can be brought into cultivation with very little labour. In general the soil is extremely fertile and preferred by the natives, to that of New Zealand, where the soil is often covered with almost impenetrable forests. The winds which sweep over these islands are not sufficiently violent to injure vegetation, and it is only in a few peculiarly exposed places on the coast that the shrubs appear stunted.

It is worthy of remark that some of the streams and rivulets are black, and of a light brown tint even in transmitted light; but this may be easily explained, as they ooze from boggy land. Notwithstanding this, however, the water is excellent, and fit for all purposes. The Mangatu, the principal stream which flows into Waitangi Bay, has a bar at its mouth, which is passable by a boat only at high water; but beyond the bar, the river is navigable for about 3 miles, even at low water, as its depth is

often 12 feet, though its channel is narrow. It then becomes a mere rivulet, which winds its way through a deep valley from E. to W. It rises from a range of hills in the southern part of the island, near the two rivers which discharge themselves into the lake Wanga. The length of the Mangatu is about 12 miles; at its mouth, the left shore is higher than the right, which forms a low land: both are wooded or covered with fern. That strange plant, the karaka tree,* with its glossy leaves, and fruit of a golden yellow, a very handsome dracophyllum, and many other trees and shrubs enlivened by singing birds and the splendid parroquet, together with the unshorn honours of the native forest, form a beautiful and impressive scene. The clear, tranquil and transparent though black, water of these streams reflects every object with a very distinct outline, like a darkened landscape-glass.

On a careful examination of the structure of this island, it is manifest that the sea has left many places bare which were once covered by its waters.

During my stay there, in the months of May, June and July, I always found the climate extremely mild and agreeable. After 8 o'clock in the morning, the thermometer was never below 45°, or above 60° of Fahrenheit's scale, though it was then the winter season. I was often obliged to sleep in the open air, covered only by a light cloak; and though it was sometimes wet with dew in the morning, I never experienced any inconvenience. Being surrounded by the sea, the air is always moist and cool, but never misty, the vapour being carried off by the constant breezes. Even during the winter, the sky is generally cloudless and of the deepest blue. The changes of temperature are neither so sudden nor so frequent as in New Zealand, where they are occasioned by the neighbourhood of high mountains, capped with snow. Chatham Island being far in the ocean, at a distance from any neighbouring land, its heat and cold are both moderated by the sea breeze: but there is no want of rain; and we had showers for a few hours, every week. The prevailing winds are N.E. and S.W. The climate appears very favourable to European constitutions.

This character of the climate is especially evidenced by the state of vegetation, which, though not remarkable either for diversity of species, the beauty of its flowers, or the magnificence of its trees, possesses that freshness which is so peculiar to moist, insular climates, especially to New Zealand, and, in the northern hemisphere, to England. The whole flora is similar to that of New Zealand, though in point of variety it is far inferior. Thus the beautiful pine tribe, of which about a dozen different species are found in New Zealand, has only one representative in Chatham

* Corynocarpus lævigatus (polished club-fruit-tree).—ED.

Island, a low yew (taxus), with purple berries, growing like our juniper. There are about twelve sorts of fern, all of them found also in New Zealand. Among these a tree-fern is remarkable. I have been assured by the natives that the korau (Cyathea medullaris) also grows here, but I never found it myself.

Rushes, bulrushes, several kinds of grasses and the New Zealand flax (phormium tenax), mixed with a plant of the compositæ (or syngenesious) family, and the eatable fern (pteris esculenta), cover large districts.

Among the trees, the karaka tree (Corynacarpus lævigatus) forms the largest part of the forest. It grows to a greater size here than I have ever seen it in New Zealand, rising to 60 feet in height, with a diameter of from 1 to 3 feet. Its wood is light and spongy, but it furnishes planks, and may be used for several purposes. On the eastern and northern sides of the island, this tree attains its greatest thickness: it is the only tree which the natives can use for making canoes, some of which I have seen nearly 3 feet broad.

Another tree, which, however, is rather scarce, and is of an irregular growth, has a yellow, fragrant wood, like sandel-wood, to which family it probably belongs. It is called kalamu. or karamu.

The tupa kihi (Coriaria sarmentosa) is found among the shrubs: it gives a very beautiful and durable black, and is used by the natives for dyeing the strings of their mats. In New Zealand the natives use, for that purpose, the bark of the hinau tree (Elæocarpus hinau); but, as they did not find that tree on their arrival in Ware kauri, they soon fixed upon another to supply its place.

The esculents planted by the natives are potatoes, different kinds of turnips, cabbages, taro (esculent Arum), and some tobacco, which thrives well, even in winter; and on Pitt's Island, wheat, formerly sown there by sealers, now grows wild. The natives have no maize. A small parroquet, very common in the island, is said to devour the seeds. They have in abundance different sorts of pumpkins, which form a great part of their food.

With regard to the capabilities of the island, it may be affirmed that whatever thrives in England would thrive there also; plantations of forest-trees would improve both the soil and climate, as affording more shelter, and furnishing timber for building. Of fuel there is no want, as lignite and turf are found in sufficient quantity. For the vine, the fruit of which will not ripen without long and considerable summer-heat, this climate is not well suited.

The animal, like the vegetable world is here poor in species, and all the animals, with the exception, perhaps, of one or two birds, are common both to it and New Zealand. Except the Norway rat, there are no quadrupeds; birds and fishes constituting all the remaining portion of the animal tribes, particularly the latter, which are numerous and important. Both the spermaceti and

black whales are seen in abundance off the shore, and visit the east coast, especially in June and the following months. The first whaling station on this coast was established at Oïnga in 1840, by a Captain Richard; another was afterwards formed farther northwards. The southern sealers used formerly to visit Ware kauri and the neighbouring islets and reefs, in considerable numbers. Captain Broughton says that most of the natives whom he saw had seal-skin cloaks. At present that is no longer the case, as the seal has nearly disappeared. About twelve years ago, seal-hunting was very profitable, and yielded many thousand skins: the last sealer whom I saw at Ware kauri had got only fifty in two years, and did not expect to get any more.

The birds are more numerous. Vast flocks of the common dark grey duck, snipes, plovers, curlews and redbills inhabit the lakes and sea-shores, and a sand-lark which builds its nest on the ground, abounds in the bushes of phormium and fern. In summer the ducks' eggs furnish the natives with a favourite article of food. The forest is enlivened by numerous tuïs or mocking-birds; a little green parroquet flocks in hundreds to the potato-fields, and proves a great nuisance to the farmer by picking up the seed as soon as it is sown. This bird is generally a little larger than the New Zealand parroquet, and is perhaps a different species. The mako-mako, the finest songster in New Zealand, is also found here, and is larger than it is there, which raises a suspicion of its being another species of the honey-eater. The large New Zealand pigeon, called "kúkupa," finds plentiful food here in the fruit of the karaka-tree and the berries of a smilax. There are also three or four small, insectivorous birds. A new kind of rail was formerly very common; but, since cats and dogs have been introduced, it has become very scarce. The natives call this bird meriki, and catch it with nooses. I often heard its short, shrill voice in the bush, and, after much trouble, obtained a living specimen.

Crawfish, lobsters, cockles and other fish abound on the shores, and the fresh-water eel grows to a large size.

The natives of these islands, with an account of whom I conclude my remarks, were found by Captain Broughton to be a cheerful race, full of mirth and laughter, dressed in seal-skins or mats, and courageous enough to resist his landing. The sealers who first visited the island,—and I met with some who had been there ten years ago,—found the natives numerous and healthy, in number at least 1200, and they were received by them with a hearty welcome. What a wretched change has taken place in the short interval which has since elapsed!—a change occasioned by the importation of a large number of New Zealanders brought thither by an European ship. *Not ninety* of the original natives now survive in the whole group; a few years of slavery and degradation

have reduced their numbers, and in a short time every trace of them will be lost, as even the New Zealanders have disdained to intermarry with them!

These original inhabitants call themselves Tuïti; but this name is now scarcely ever heard, as they themselves have adopted the name of Blafello (black fellow), which was kindly bestowed upon them by Europeans, and readily adopted by the New Zealanders. In comparison with the latter, they have indeed a darker shade of the skin, which is, however, by no means universal, as individuals may be found who are of as light a complexion as the former; and the deeper hue of the Chatham Islanders may be in great measure attributed to their greater exposure and still greater uncleanliness. They are neither so tall, muscular nor well proportioned as their western neighbours, especially the women and the younger men. They have often short necks, thick heads, and, when young, prominent paunches; the forehead is often low and sloping, the cheekbones prominent, the eyes narrower, the nose flat and clumsy. Whether straight or curled, all have black, glossy hair; their eyes are of the same colour, and their teeth white and regular, but they have generally a downcast look. Some of the men have well-proportioned forms, and are handsome. They are Polynesians, and not Papuas, and their present state of degradation may be ascribed to the miseries which they suffer from the oppressive sway of the New Zealanders, and from want of sufficient nourishment. These unhappy islanders were in a far different state some years ago; but now they are reduced to the greatest misery: they are the labourers and porters of their masters, who have no notion of anything like moderation in the labour they exact; so that ulcerated backs bent almost double, and emaciated, paralytic limbs with diseased lungs, are the ordinary lot of these ill-fated wretches, to whom death must be a blessing. This is no exaggeration. Almost all whom I saw were living in miserable huts in the open fields; their disposition is morose and taciturn, and it was with difficulty that I could gain their confidence; but, after I had succeeded in doing so, I found them not at all deficient in intellect, and naturally cheerful. To an European, by birth a Dane, who was living with the last surviving daughter of their former chief, and treated them with kindness, having restored some of them to a happier condition, they were much attached, and for him they worked cheerfully. Not only have their numbers been thinned by slavery, but the skulls which are seen lying on the beach, pierced by musket-balls or battered by clubs, show that many of the natives, who were perfectly inoffensive, have been murdered by the New Zealanders; and, when questioned about it, the latter acknowledge the fact; but one tribe always lays it at the door of another. An excess of toes, so as to have six or more on each

foot, is not very uncommon, as is the case also among other savage nations. Sometimes it is difficult to distinguish their sex; and a sealer who had formerly lived among them, told me that they often emasculate their male children by compressing their testicles between stones. This is highly probable, as the island is too deficient in natural resources to provide food for a large population, and no method of preventing an over-population can be more obvious or effectual. On the first arrival of the European sealers, the condition of this people, miserable as it might be, was far superior to what it is now. The fruit of the karaka-tree supplied them with food, which, though acrid and poisonous when fresh, is rendered nutritious by boiling and soaking in running water; fern-roots, sea-eggs (echini) found in the hollows of the rocks, orange-coloured ascidiæ (sea-pears) thrown up by the sea, various kinds of shell-fish, especially haliotis, patella, periwinkles and mussels, eaten either raw or roasted; crabs, lobsters and freshwater fish, especially eels; birds, snared or speared, were all formerly the principal articles of their diet; but they have all now given way to potatoes and pumpkins, and the above-named delicacies are now procured only for the sick. Formerly they were either naked, or wore a thin covering of the fresh leaves of the Phormium tenax, sometimes also a seal-skin. They had no ornaments or decorations, and were not tatooed. Dispersed over the island in small families, they lived without any shelter, or in mere huts near the lakes, and in the thickets. Their government seems to have been patriarchal; their only instruments were knives made of sharp pieces of quartz for cutting; their canoes, called korari, and described by Broughton, are still seen in the island, and were very remarkable; they are like a large sledge made of a wickerwork formed from tough creepers, principally a smilax; their double bottom of wickerwork is bound together by split strips of that creeper, or by pieces of New Zealand flax (phormium); the space between these bottoms is filled up with the buoyant kelp, and these canoes, which are propelled by coarse paddles, go well over the surf. The natives ventured in them even as far as Rangi haute or Rangi tutahi, a distance of nearly 20 miles. Their only articles of furniture were a vessel in the form of a sugar-loaf, for holding water, made of the leaves of the New Zealand flax, and their only weapons, rarely used by them, were clubs.

When the New Zealanders first visited this people, they did not understand their language; but, as it is merely a dialect of that of New Zealand, the natives soon learnt the language of their oppressors, or rather formed an intermediate dialect, differing less in words and construction than in pronunciation. They now seldom use their own dialect, not even among themselves. As far as I could judge, it does not bear so close a relation to that of

New Zealand as to that of Tahiti. The same words are differently accented; the last syllables of a word are often drawled out; *o* is used for *a*, *e* for *aï*, &c., for instance:—

The New Zealand word Waï, water, is We.
,, A'rero, tongue, is O'rero.
,, Moe, sleep, is Mo.
,, Motu, island, is Wutu.

Their songs also differ from those of New Zealand. I never heard one of them sing, but a New Zealander once imitated them, and I was struck with the soft and plaintive character of the tune. They therefore do not belong to the same branch of the Polynesian race as the New Zealanders.

No tradition seems to exist among them respecting their origin: they only say that the two from whom they all are descended lived at first in Pitt's Island.

Their ignorance of the use of the phormium, and their inability to work it up as the New Zealanders do, is a remarkable trait of the difference between them; and the mats seen among them by Broughton were no longer found when the sealers first arrived there. It seems to be a sure proof that the natives of Ware kauri are not descended from the New Zealanders, that they possess none of those arts in which the latter are skilled.

The peculiar form of their canoes, noticed above, and their funeral rites, are other indications of a different origin from that of the New Zealanders: the latter deposit their dead in a sitting posture in wooden boxes; the former burnt them. The "Tapu," or Prohibitive Law with respect to sacred or dreaded objects, was common to them with the rest of the great Polynesian race.

But the event which has had so fatal an influence on the condition of the natives of these islands was the importation of various tribes of New Zealanders about 10 years ago (in 1830 or 1831). Mate oro, a chief of the Nga te Awa branch of the Nga te Motunga tribe, and Te Puahi, a chief of the Nga te Toma tribe then living in Port Nicholson, whither they had been driven by the Waï kato tribe from the Mokau, Oneïro, and Komimi rivers, on the western coast of the northern island of New Zealand, were brought to Ware kauri, by two sealers, the latter soon after the former. A pot belonging to the first of these sealers having been placed on sacred ground, was broken by the natives; in consequence of which the crew of the sealer assisted Mate oro, and a pack of bull-dogs was sent in pursuit of the offenders. When found in the interior of the island, Mate oro shot their leader. The Europeans caught twelve of them and hanged them from the trees with their heads downwards, leaving them in that state till they were nearly dead. This refined piece of cruelty, which exceeds the ingenuity of the New Zealanders, is not unhappily

without its parallel in the history of the intercourse of Europeans with the Polynesians. The New Zealand chiefs, however, saw immediately how easy a conquest such a defenceless race would prove to their countrymen who possessed fire-arms. They both returned to Port Nicholson, proposed to their tribes an emigration to the Chatham Islands, and their scheme was willingly adopted, as it put them at once beyond the reach of the Nga te Kahohunu, the proprietors of Port Nicholson, and made them masters of a fine and fertile island, with plenty of slaves to cultivate it. A brig, named the "Lord Rodney," which soon afterwards arrived at Port Nicholson, was hired by them for pigs, flax, mats and potatoes, amounting in value to a considerable sum. The mate remained at Port Nicholson to salt the pork; and in two trips, the whole of the tribes of the Nga te Motunga and Nga te Toma, with a few of the Kékeri waï and Taranaki tribes, reached Chatham Island. The aborigines were reduced to slavery without opposition, and divided among the different tribes, as was also the land. The tribes of the Nga te Motunga, whose chiefs were E. Mare, Ko teriko and Mate oro, received, as their shares the N.W. end of the island and the greater part of the western coast; Waitangi Bay, the northern and eastern coast and the S.W. part of the island fell to the share of the chiefs of the Nga te Toma, Ahi Totara and his brother E tuna, and to the chiefs of the Kékeri waï, Rau moa, and Erau. The number of the New Zealanders was about 300; and by means of the labour of their slaves the land was soon brought into cultivation, so that they could furnish supplies for the thirty or more vessels which annually resort to the island. The aborigines possessed neither dogs nor pigs: the New Zealanders brought the latter, together with potatoes and different kinds of seeds.

The feuds and jealousies which constantly prevail among such rival and independent chieftains as the heads of the New Zealand tribes could not fail to interrupt the harmony of the invaders as soon as they had firmly established themselves in the island; and only four months before our arrival, E Mare with his tribe, envying the position of the Nga te Toma, and invited, as was said, by the captain of a vessel from Sydney, who had promised to buy the land from him as soon as it was conquered, came to Waitangi, and laid siege to the strongholds of the Nga te Toma for the purpose of starving them out, and then exterminating them, and making himself sole possessor of the island. The Nga te Toma were not, however, unprepared, for, having long foreseen what was about to take place, they had laid in provisions, on which they had already subsisted for four months.

On our arrival in Waitangi, the captain of an American whaler informed us of the existing hostilities; and we soon witnessed the firing of muskets from the stoccades of the opposite parties.

E Mare, whose party was established in newly-constructed houses on the left bank of the river, received us with a hearty welcome, and ferried us across to see his fortifications. An armed party of the Nga te Motunga, his followers, was stationed there in trenches thrown up behind high pallisadoes, in which they had constructed temporary houses: they occasionally fired into the Pa of the Nga te Toma, which was only about 60 yards distant. The firing, however, ceased on our arrival, and we passed, without any flag of truce, into the Pa of the Nga te Toma. This Pa occupied a large extent of ground: in front was the sea and a broad sandy beach; at the back a low swamp; the besieged had done everything with great skill to secure their position: deep trenches were hollowed out, under the shelter of which they followed their daily occupations: double and triple pallisadoes, often 30 feet high, made of the stems of trees, enclosed the Pa, and were pierced by loopholes, while trenches well covered for the outposts stretched down the sandhills towards the seashore. Te Ahi Totara (burning grass), the principal chief and his people, received us cheerfully, and did not appear to have suffered much from the siege they had sustained. They even offered to furnish us with a stock of potatoes. This, however, as I afterwards learned, was a mere rodomontade, for they had been, for some time, put upon an allowance. To the northward there was a high tower built of logs, in which watch was constantly kept. They were plentifully provided with muskets and ammunition. Some people in this Pa had been dangerously wounded; among them were a young woman and a boy who had been sent to fetch water from the swamp behind them, which was the only place whence they could obtain that indispensable article.

I passed without hindrance into the stoccade of the Nga te Motunga, the opposite party, where I saw a six-pounder and a swivel mounted, but they were not used.

The number of people in the Pa of the Nga te Toma was about 180; in the stoccade of the Nga te Motunga the numbers were more considerable; and there were more able-bodied men. The war had not been taken up by all the families of these tribes: two large parties of the Nga te Toma, living on the eastern coast, had only fortified their villages and laid up a store of provisions, as E Mare had threatened them with extermination after his conquest of the Pa at Waitangi. Many individuals were neutral, and allowed to carry news from one party to the other.

The aborigines were serving their respective masters on each side; but, as slaves, took no part in the contest.

We communicated to both parties the cause of our coming to their island: they were eager to embrace the opportunity of selling their land and of having white colonists established among

them. The existing warfare, however, made our negociation difficult: the agent of the Company considered it as his duty not only to satisfy the claims of both parties, but to save, if possible, the weaker from destruction.

E Mare, who himself did not engage in the war, but was merely an adviser, and Mate oro, his Commander-in-Chief, were from that time our daily guests. Mate oro was the brother of Tipahi, a chief in Queen Charlotte's Sound, who had written introductory letters for us. All the people in the island were at that time suffering from a malignant influenza; and I had a great deal to do in providing them with medicine. Both the New Zealanders and the aborigines universally believed that an European woman, who came to the island a short time before, brought the disease with her, but they made no attempt to stone her on that account, as was done by the populace in a more civilized part of the globe in the time of the cholera, with regard to some physicians whom they supposed to have poisoned the wells.

E Mare proved, on every occasion, a very intelligent and reasonable man. He had been for some time at Sydney, and had visited nearly the whole coast of New Zealand. He drew for me a chart of the Chatham Island, which exceeds in accuracy all the previous sketches made by Europeans. He was remarkably polished in his behaviour, and took the greatest interest in all my inquiries. Our European notions of this people, whom we call the most ferocious savages, are strangely incorrect. There is not, even in their exterior appearance, the slightest ground for this prejudice; and, when provoked, they are not more ferocious than Europeans similarly circumstanced.

All our efforts to bring about peace between E Mare and the Nga te Toma, however, failed. At the beginning of the siege, a boy, son of the former, was killed, and two more persons afterwards: this unhappily made reconciliation impossible. The agent of the company, therefore, concluded an agreement with E Mare for the purchase of all the land claimed by the Nga te Motunga; but that chief would not hear of a tenth part of the land reserved for himself, choosing in preference to reserve a fertile district for himself and his tribe. It was, however, finally settled that, should he afterwards alter his opinion, and prefer mixing with Europeans, he might have leave to do so, and obtain the land reserved for him.

We took E Mare and some of the principal men of his tribe on board, and sailed for Wanga roa, which district he claimed with more reason as his property; the purchase of it also was, therefore, concluded to his satisfaction. The ship then took him back to Waitangi; but I set off with Mr. Hanson, the agent, for the eastern coast, for the purpose of exploring it, and consulting with the natives of the Nga te Toma tribe, who lived there in several small villages,

how they could best save their relations at Waitangi from destruction. It was at last determined that the latter should be removed from Waitangi to Waï keri, on the E. coast. Accordingly on our return to Waitangi we informed our besieged friends that we had made an arrangement for their liberation, and it was determined that their removal should take place on the 17th of June.

E Mare was soon aware of our intention, and seemed to be rather inclined to think it right that the Nga te Toma should be removed. On the morning of the day appointed, an American whaler voluntarily gave up the loan of two whale-boats, which, with the Cuba's boats, were willingly manned by her crew. The old men, women, and children, were removed first, and last came the fighting men, in their war dress, duly armed and accoutered, with feathers stuck in their hair, and their naked bodies stained with ochre. The Nga te Motunga regarded all these proceedings with the greatest displeasure, and fired towards the boats, without, however, doing any damage, till our interpreter, who had married into the besieged tribe, and had formerly lived many years among them, encouraged the men in his boat to cheer and discharge their muskets. At this moment their exasperated adversaries fired into the boats. One ball struck the stern, and another an oar, but did no farther damage, and the boats were soon out of their reach.

E Mare, during the whole of these transactions conducted himself in a manner worthy of a civilised man. He at first remonstrated with Mr. Hanson, who was with him, about his right to remove his enemies, and interfere at all, threatening that he would follow the Nga te Toma wherever they went; but he afterwards ordered his men to desist from firing. Self-command is a virtue which the savage possesses in a by far higher degree than the European: it is too often ascribed to fear of our arms, but that is seldom its real cause, as the savage is remarkable for his contempt of death, and in this case fear could not be the passion by which E Mare was moved, as our force was too weak, and as he well knew that any aggression on our part, even in self-defence, would not be countenanced by the government at Sydney.

It was only when the European boats' crew set his people at defiance, and their cheering roused the passions of E Mare's men to the highest degree, that they fired into our boats. The last men quitting the besieged Pa had set fire to all their houses, and the flames spread rapidly among these combustible huts. On seeing this, the Nga te Motunga rushed into the Pa, and then to the beach, whence they fired off their muskets towards the ship, danced their war-dance, uttering the usual yells, and making the customary contortions of the face, which, together with the smoke and flames of the burning village behind them, formed a most striking and fearful picture.

Having now 180 natives aboard, we weighed anchor without delay, and made sail for Waï keri, on the E. coast, not more than 80 miles distant, which, however, on account of easterly winds, we could not reach before the 26th of June. During these nine days, though it may be imagined that we were not very comfortably circumstanced, the natives behaved in a most exemplary manner, and were contented with the very small allowance of provisions which we could afford to give them. The chiefs and aged priests, who were generally on deck during the night, with their arms uplifted to heaven, prayed for better weather. We landed eighty of the party on the 23d in Kaïnga roa, and the rest at Waï keri in the morning of the 26th. At this place, the agent purchased from the whole tribes of the Nga te Tuna and the Kékeri waï their right to the possession of the islands, and thus concluded the business for which he was sent.

The other islands which complete the group may be described in a very few words. Rangi haute is about 12 miles long and 8 broad. It consists principally of a mountain of moderate height with a flat summit, and four sides which extend nearly to the coast. It has no harbour. There is a safe passage between it and Ware kauri; and the same, I understand, is the case between Rangi haute and Ranga tira, which latter is a mere rock. On Rangi haute there are twelve of the aboriginal natives. The "Western Reef" is a range of rocks lying off the north-west end of the island, once a favourite resort of seals. The "Cuba" passed between this reef and the main, and found a clear channel.

Rangi tutahi, or "the Sisters," are two pyramidical rocks about 100 feet high, covered with scanty bushes, and frequented by countless numbers of sea-birds. There is a long line of breakers running westwards from these islets, which forms the "North-West Reef."

The rocks which form the "Forty-fourth Degree Islands" were also seen by us; and the "Star Keys," marked by high breakers, were visible from the mast-head. All these rocks were formerly much visited by sealers.

XVII.—*Observations on the Indigenous Tribes of the N.W. Coast of America.* By JOHN SCOULER, M.D., F.L.S., &c.

SINCE the period of the important voyage of Vancouver, the admirable surveys of that navigator have rendered the numerous islands and complicated inlets of the N.W. coast of America familiar to the geographers of Europe. The expeditions by land of Sir A. M'Kenzie, Lewis and Clarke, and the subsequent enterprises of the fur-traders, have explored the countries which extend

III.—*Letter from Dr. Dieffenbach, describing the present state of Te Wanga Lake in Chatham Island.*

[In Dr. Dieffenbach's paper on the Chatham Islands (Jour. Roy. Geo. Soc., vol. xi. p. 204) he mentions that the Te Wanga lake, which was completely isolated from the sea at the time of his visit, at other times discharged its waters into it. It appears, by the following letter from that gentleman to the Secretary, that the communication between the waters of the lake and the sea is now permanently established.]

DEAR SIR,—A fact has just come under my notice regarding the geography of Chatham Island which is of some interest, as showing one of the many ways in which the configuration of countries may be modified.

The large lake of Te Wanga, which, as I stated in my communication to the Royal Geographical Society, occupies an extensive portion of the island; and which at the time of my visit in 1840 was separated from the sea by low sandhills, and about two feet above high-water mark; had filled again during the last year (1841) to such an extent, that a break took place, and the outpouring water formed a broad communication between the sea and the lake, carrying away many thousand tons of sand, and forming a channel that appeared accessible to boats. But a boat which tried to enter this new bar-harbour was upset in the heavy surf, and six people were drowned.

By this outbreak the size of the lake was at first remarkably diminished. Easterly gales, however, which subsequently set in and continued for some time, drove a vast quantity of water from the sea into the lake: its surface is now on a level with the sea, its water partakes in all the movements of the tide, and yet the surface of the basin is actually much larger than it was before.

At the time when the agent of the New Zealand Company, who was living in Chatham Island, left that place for Wellington (I think, in September last), this state of the lake, now more properly an "inlet," remained unaltered.

I am indebted for this communication to Mr. Heaphy, the draughtsman of the New Zealand Company, who has lately returned from New Zealand.

January 13, 1842.

VN.

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Department of Lands and Survey.

Wellington, C.1. 2nd May, 1938.

MEMORANDUM for

The Under-Secretary for Lands,
WELLINGTON.

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Te Whanga Lagoon, Chatham Islands.

In accordance with your instructions of the 14th January last, I wish to submit herewith my report on the investigations of the Te Whanga Lagoon, Chatham Islands. Special reports on possible aerodrome sites, Owenga Settlement, and a general outline of the Chatham Islands will be submitted in due course.

I left Wellington on Saturday, 15th January, but was delayed in Christchurch until Saturday, 22nd January, the Chatham Island steamer, the S.S."Tees", being under negotiation for sale. I reached Waitangi on Tuesday morning, 25th January. On the 26th, 27th and 28th, accompanied by a guide, I made a complete itinerary of the lake, visiting Owenga and Kaingaroa en route. I was able from this preliminary investigation to determine my course of operations for the purpose of investigation.

A level traverse was run from Kaingaroa to the N.E. edge of the lagoon transferring the M.H.W.M. determined at Kaingaroa to the lagoon shores. This traverse was completed on 4th February. Between 7th and 10th February, twenty-one soundings of the lagoon were made and samples of the lagoon waters obtained for future analysis. A rowing boat was requisitioned for this purpose, a distance of over thirty miles being travelled.

Between 10th February and the date of the sailing of the next boat on 17th February, I obtained declarations from old residents, both European and Native, as follows:-

Mr. A.D. Carson. (European) Manager, Kaingaroa Station. Resident on the island since 1927, and responsible for the opening of the outlet in 1931.

Mr. W. Davis. (Native) Farmer, Chatham Islands. Resident on the island since 1890, and very familiar with the lagoon and its various features. He impressed me as a very reliable declarant.

Mr. A.F. Bauche. (European) Westland.
Mr. Bauche was born on the island in 1851, leaving in 1881. He paid a short holiday visit to the island during the summer months, 1937-38. I was able to obtain a declaration from him on the day of my arrival prior to his return to New Zealand by the boat returning the same day.

(Mr. W. Jacobs)...

Mr. W. Jacobs. (European) Farmer, Chatham Islands. Resident on the island continuously since 1866. I found some difficulty in obtaining accurate dates from Mr. Jacobs but otherwise his memory was good.

Mr. H.R. Clough. (European) Fisherman, Waitangi. Born on the island in 1901 and resident continuously since. Mr. Clough was very familiar with the lagoon, having taken part in many fishing and swan and duck shoots.

Mr. R.F. Painter, (European) Fisherman, Kaingaroa. Born on the island in 1879, and resident continuously since 1911. Mr. Painter's evidence is valuable in that it is an expert's statement on the fish that he has seen in the lagoon at various times.

Mrs. H. Grinnell. (Quarter Native) Born on the island in 1879, and resident continuously since. Mrs. Grinnell's evidence, although not as full as other evidence, serves to bear out the statements of others.

Mr. Rua Herata. (Native) Te Roto. Resident continuously on the island since 1880. This native gives reliable statements and I am satisfied that his evidence is valuable as it bears out facts stated by others.

Mr. C. Seymour. (European) Christchurch. Resident continuously between 1866 and 1900, 1906, and 1918 to 1931. I took the opportunity of calling on Mr. Seymour on my return to Christchurch. His mind is active and his testimony is most reliable.

Except for a few natives, these are the only living individuals who have an intimate knowledge of the lagoon and its various features. Many of the old residents have died in recent years but it is doubtful whether any further information could have been obtained.

I was fortunate in experiencing good weather during the investigation. Wind conditions during the second week prevented me from carrying out further soundings on the lagoon, the lagoon being very turbulent during windy weather.

Material assistance was given to me by many of the local residents who did all in their power to assist me with advice and hospitality. I wish to particularly refer to the kind assistance given to me by the local magistrate, Mr. R. Holmes, who accompanied me on some of my journeys.

I returned by the S.S."Tees" from Waitangi on the 17th February, reaching Lyttelton on Monday, 21st February.

I forward herewith copies of the report illustrating maps, declarations and illustrating photographs.

Asst. Surveyor-General.

REPORT ON INVESTIGATION OF THE TE WHANGA LAGOON.

(FEBRUARY, 1938.)

HISTORY:

The Chatham Islands are a group approximately 500 miles due east of Lyttelton. The main island of the group correctly called Wharekauri, but commonly known as Chatham Island, has an area of approximately 180,000 acres excluding Te Whanga Lagoon which is actually an estuary of the sea. This island has a population of 700 souls, of which 300 are classed as Maori. The main port of the island, Waitangi, is located at the head of Petre Bay and is the administrative centre of the group. Kaingaroa and Owenga are the centres of the blue cod fishing industry at which are stationed shore freezers where cod and groper are packed and retained in cool storage for shipment to Wellington. Kaingaroa Harbour, on which Kaingaroa is situated, is a deep bay sheltered to some extent by reefs at the eastern and western ends of the bay. Owenga on a stream of the same name gives poor shelter for shipping. The freezer at Owenga has recently closed down owing to the high cost of operating the obsolete machinery. Cod fishing is also operated from Port Hutt, (Whangaroa) on the north shore of Petre Bay, which is the base from which the fishing trawler, "South Seas" operates.

The whole island is comprised of easy, undulating country rising at the southern end in easy slopes to a height of 800-900 feet above sea-level. The southern coast is bounded by cliffs of 600-700 feet in height. Except for an area of approximately 40,000 acres, which is under pasture, the island is covered mainly with low scrub and fern with patches of kopi (karaka species) and ake-ake bush mostly located at the southern end of the island. The soils and geological formation vary considerably. Some rich limestone land between Petre Bay and Te Whanga Lagoon is farmed chiefly by Maoris.

Four large sheep stations are located at Mangonui, Wharekauri, (Kaingaroa)...

Kaingaroa and Owenga on land of varying quality, comprising peat land, sandhills, basalt or volcanic soils. South of Waitangi along the coastal shores, on basalt or volcanic soils, a few settlers are engaged in sheep farming.

Except for a rough cart or bullock track between Waitangi and Te Roto, a distance of approximately 10 miles, there are no roads on the island, and during the winter, many of the tracks which traverse peat land become almost impassable.

Sheep farming and cod fishing are now the only two industries on the island. Up until recently a proprietary cheese factory was operating but owing to lack of sufficient suppliers, was closed down.

SETTLEMENT AND OCCUPATION OF CHATHAM ISLAND:

Maori tradition states that the island was populated by the original inhabitants of New Zealand, the Moriori, who were driven from New Zealand by the conquering Polynesians, or Maoris. Apparently, the Moriori were not warlike and lived peaceably together. After a long residence on the island, Moriori tradition states that they were visited by four canoes from New Zealand, the occupants of three of which settled peaceably among the Moriori. The occupants of the fourth canoe introduced cannibalism and, on that account, were one night burnt to death by the Moriori while sleeping.

In 1791, the H.M.S. "Chatham", commanded by Capt. Broughton, a small convoy ship, separated by storm from its parent ship, on a voyage between Dusky Sound, New Zealand, and Tahiti, sighted Chatham Island. Capt. Broughton sailed along the north coast, the feature Cape Young being named by him. He landed at Kaingaroa and took possession of the land in the name of His Majesty, King George III.

At this date, the island was apparently thickly populated, for at the arrival of Maoris from New Zealand in 1836, the Moriori numbered a thousand or more. The Chatham Islands were visited by whalers between 1791 and 1836, which visits extended well into the 1860's.

(In)...

In 1836, a brig called the "Rodney" conveyed boatloads of Taranaki and Port Nicholson Maoris from Wellington and landed them at Whangaroa. They quickly spread over the island, taking possession of all the Moriori land, without receiving resistance from the inhabitants. The Moriori were enslaved by the conquering Maoris and the stories of cannibal feasts and cruel atrocities perpetrated on the Moriori make sordid reading. In the intervening years, the Maori population increased and that, together with the arrival of settlers in the 50's and 60's, caused the ownership of the land to be a constant source of dispute. By 1867, the native population of the island, exclusing Hauhau prisoners numbering 300, was 467, of which only 115 were Moriori.

In 1868, a complete survey of the island was made by Mr. S. Percy Smith, when the various land ownerships were pointed out and pegged. In 1870, the Native Land Court sat at Waitangi to investigate the title of the Chatham Islands, and, after considering the evidence given by Maori and Moriori inhabitants, awarded title to the Maoris. It was considered that the Maoris had proved title by right of conquest, Chatham Islands being part of the Colony of New Zealand, and therefore subject to the Treaty of Waitangi. The island was partitioned, the Moriori receiving five small reserves. The bed of the Te Whanga Lagoon was not included in the area investigated, the boundaries of the partitioned areas adjoining the Te Whanga Lagoon being defined by the edge of the lagoon in accordance with the survey carried out by Mr. S. Percy Smith in 1868.

PHYSICAL FEATURES:

The Te Whanga Lagoon, which covers an area of approximately 46,000 acres, being 15 miles in length north and south and of varying widths up to 10 miles, occupies the northern and eastern portion of the main Chatham Island. It is divided into three basins:- a ~~northern basin called Kuriwhenua, a central basin called Tainuwe~~ (and)...

and a southern basin; which basins are separated by fords across shallow areas.

The attached map illustrates the lagoon and its various features, which can be determined by reference to the legend thereon.

The lagoon is fed at the southern end by the Te Awainanga and Makara rivers, rising approximately eight miles inland in the high country at the southern end of the island and draining an area of approximately 20,000 acres. This drainage area is mainly comprised of peat land and a large proportion of the drainage disappears by saturation. The waters of this stream are of a brown to black colour due to discolouration by the peat land traversed.

Along the western shore, there are many small streams up to two miles in length, draining mainly limestone country with a drainage area of approximately 15,000 acres. There are no streams along the northern and eastern shores of the lagoon, the country being sandy, and any rainfall is quickly absorbed.

Mr. R.G. Allan, M.Sc., in the 'Transactions and Proceedings of the New Zealand Institute' Volume 59, page 829, states that--

> "This large lagoon is almost certainly a cut-off arm of the sea, the inner coast being clearly old sea cliff. This old shore line probably commenced in the northern end near Tuapeka Point, followed the present western margin of the lagoon to Te Matarae and thence by way of Lake Huro to Petre Bay."

Huro Lake is approximately six feet above sea-level and drains by the Mangape stream into Waitangi Bay. There is certainly a low area of sandhills between Te Whanga Lagoon and Lake Huro just south of Waiuru. The northern end of this lake is illustrated on Photograph No. 24.

DESCRIPTION OF LAGOON:

(1) Western Shore:

The western shore of the lagoon from Waiuru, near Huro Lake, to Te Rahui on the northern shore, is comprised of low limestone cliffs and small sandy bays with outcrops of schist and basalt at

various spots along the shores of the Muriwhenua basin. These shores are suitably illustrated in the following photographs:-

Photograph No.1:

A small bay north of the Ohuru Trig. The foreshore, as will be noted, is covered with an extensive area of white shell, which were deposited there by the sea when this coast was exposed to the action of the open sea. Although not very well illustrated in the photograph, there are three series of low terraces between the present water's edge and the kopi bush. It is stated that these terraces were formed by successive changes in level of the Te Whanga Lagoon, caused, according to Moriori tradition, by the periodic opening and closing of the outlet channel at Te Awapatiki. I, however, doubt this statement, as these terraces are more typical of an old open sea coast, the terraces being formed by the building of successive banks as sand accumulated and the sea edge receded.

Photograph No.2:

A view at Pamarama, looking south towards the lagoon outlet, illustrating the limestone outcrops in evidence along this shore. Note the old sea shells along the beach.

Photograph No.3:

A view looking along the lagoon shores to the north of Pamarama, with kopi bush reaching to the shore edge. The deep bays are covered with sand and shell.

Photograph No.4:

This illustrates a small bay between Te Hiti and Moutapu, which is also extensively covered with old shells. The mud flats are covered with cockles, and pupu (periwinkle) with a small mussel on the rock outcrops.

Photograph No.5:

Moutapu Point looking south across Tai Hawea basin, the water one chain offshore being approximately 14 feet deep. Note the evidence of old sea shells and rocks eroded by the action of the open sea.

Photograph No.6:

Illustrates the land end of a ford at Korowaipuna. This ford crosses the lagoon between the Muriwhenua and the Tai Hawea basins, being approximately 4½ miles in length. It is marked by high poles, one of which can be seen at the landward end of the ford.

Photograph No.7:

A panoramic view from Te Ranga, from east to south-east, illustrating the shallow area between the Muriwhenua and the Tai Hawea basins, with the eastern shore of the lagoon

The character of the lagoon shore between Te Ranga and Te Rahui changes in feature. The bays are longer and deeper with shallows extending up to half a mile off shore, along which can be found extensive evidence of cockles and pupu (periwinkle). Karewa peninsula is low and undulating as is the whole of the country around the shores as far as Te Rahui, with occasional low cliff points extending into the lagoon clothed with low kopi bush.

Photograph No.8:

The section of the lagoon illustrated in this photograph was taken approximately half a mile off shore from Karewa in the Muriwhenua basin. The headland on the left is Te Kinto Point, while the conical hill is Korako at the western end of the basin.

(2) Northern Shore:

The northern shore between Te Rahui Point and Te Ahua is comprised of low sandhills and flats which are illustrated in the following photographs:-

Photograph No.9:

A view from the centre of the Muriwhenua basin looking northwest, showing Mihitoroa Point, which is covered with a growth of kopi bush.

Photograph No.10:

From Waikoko looking south-westward across Mihitoroa Point towards Korako in the background. The foreground is dry sandy lake bed, the water's edge being approximately 20 chains distant from the grass edge in the foreground.

Photograph No.11:

A panoramic view from a point about one mile south of Te Ahua looking westward towards Korako, and southwards along the eastern edge of the lagoon at the Hapupu flats. The flag in the fence at the left marks the limit of the grass, while the present water level is approximately 10 chains beyond the end of this fence, shown in the centre of the photograph. These lake flats and shallows are suitably illustrated in the accompanying plans, claims to which have influenced the natives to lodge a claim to the bed of the Te Whanga Lagoon.

(3) Eastern Shore:

The eastern shore is bounded by low sandhills built up through the ages by the action of sea-blown sand, covered with scattered areas of kopi bush. Large areas of peat land are located on the

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narrow isthmus between the lagoon and the sea along the eastern shore. Four or five small fresh water lakes on this isthmus are the homes of numerous swans and ducks and are also used by the sea gulls to educate their young, bred on the adjoining peat lands. The following photographs illustrate portions of these shores and the lagoon outlet at Te Awapatiki.

Photograph No.12:

A panoramic view of the eastern lagoon shore and outlet channel from Hikurangi. The Te Awapatiki outlet is located at the right end of the picture. Growths of maram grass can be seen on the white sand at the outlet to the lagoon, which grass grows prolifically along this coast.

Photograph No.13:

This photograph was taken approximately 10 chains south of Hikurangi looking eastward directly across the lagoon outlet. It will be noted that the outlet channel has a S-shape. The bars at present forming will probably eventually cause the outlet to close.

These last two photographs illustrate excellently the action of the sea in the building of sandhills along the eastern shores. The last outlet was opened approximately half a mile north of the present outlet in 1931. During the intervening period of seven years, sandhills up to 30 feet above sea-level have accumulated. This definitely proves that the whole east coast from Mapupu south has been built up through geological ages in this manner. The periodic opening and closing of the lagoon outlet has no doubt been going on for centuries and the permanent closing will not occur for a geological age when a sufficient barrier has been formed to confine the accumulation of water within the lagoon when closed.

Photograph No.14:

Looking across the outlet channel from the sandhills opposite Hikurangi Point. The stake on the channel edge was placed for the purpose of observing the rise and fall of the tide within the channel mouth.

Photograph No.15:

A view from Hikurangi looking westward across the islands at the mouth of the outlet.

My dear:- (Over page)

Your recent information indicates that part, at least of the western flat consist of a layer of sand only six inches deep, and founded upon peat.

I have not stopped to examine this peat closely as I was in a considerable hurry to catch a plane on the only occasion I have crossed the flat, and at that time I had no particular interest in this feature.

My impression of what peat I saw suggests that it was fairly compacted, suggesting that at some time it had been subjected to the weight of an overlying dune. Therefore at some time the northern & middle basins would have been desert & exposed. I imagine this sand has been spread mainly northwards and this accounts for the rather shallower Abumbumma Basin.

I would not commit myself beyond this hypothesis at present until I had a chance to investigate thoroughly. You may care to revise your note slightly.

It also appears that the sands forming the Karaka peninsula and the sands ~~from Koo to the southern point~~ will extend from that point southwards to Hautapu point are the Western remnants of this dune area.

My opinion!!

Islands:- opposite outlet. General examination of these islands and connecting fords show them to be a minor delta produced where the current from an inflowing tide fan out and loses velocity on emerging from the channel into the lagoon. As velocity is lost the current must first drop its bed load. They are drift sediments of no long continued connection between the ocean and the Inn Tidal rise body connected to the ocean by a sandy channel; not an outlet alone, but an inlet

Yours sincerely,

Allan Williams

Photograph No.16:

From the Te Ranga Trig (A) on the western shores looking across the shallows between the Tai Hawea and southern basins towards the islands at the outlet.

Photograph No.17:

From a point marked Poukore on the attached map showing the low islands at the mouth of the outlet. As will be noted, these islands are covered with low scrub and patches of kopi bush, and are approximately two to three feet above mean high water mark.

Photograph No.18:

This photograph shows the location of a tern nesting ground on a small island just north of Waikawa Island, the black dots in the photograph being the terns disturbed while passing.

(b) Southern Shore:

The southern shore from Poukore to Waiuru is mainly composed of low flats and peat hills, the country southward being heavy peat land, traversed by the Awananga and its tributaries.

Some thousands of acres of the shallow areas of the lagoon are covered with swan nesting grounds. One of these nesting grounds north of the Karewa Peninsula covering an area of approximately 2,000 acres, is illustrated in Photograph No.25. The water on this ground is approximately 15" to 18" deep, the bed being sandy with a heavy growth of lake grass. Reference to the photograph indicates small black features, which are the nests built up by the swans. Photographs Nos.26 and 27 show the process of the building of these nests. Other swan nesting grounds of extensive area are located along the eastern shore of the Tai Hawea Basin.

FORDS:

(a) Northern Ford:

This ford, in regular use by riders and conveyances between Kaingaroa and Waitangi, crosses the lagoon between Hariwhenua and Te Hawea basins. The bottom of this ford is hard and sandy, from which it is assumed that below is a ledge of limestone rock, an extension of the limestone at Moutapu Point. This ford is marked

by poles from end to end between Korowaipuna and Korommoana. The landward end at the former point is illustrated on Photograph No.6. At the date of investigation, this ford, for approximately two-thirds of the distance, was dry. Two channels cross this ford, both of which were, at the date of investigation, from 15" to 18" deep. These channels drain the northern Kuriwhenua basin.

I understand that it is unusual for this ford to be in such a dry state, it being at most times wholly covered with water. The depth of water on the shallows in the lagoon is greatly affected by the winds, particularly during the prevailing S.W. winds during the winter months. The northerly winds generally prevailing during the summer months tend to keep the ford free of water but never completely dry.

A further ford branches from the latter at a point about midway across and traverses a few low-lying islands to Kahupiri Pt., used by travellers between the northern end of the lagoon and Owenga.

The southern ford between Matarai and Waikawa Island on the south end of the Tai Hawea basin, although not used as regularly and frequently as the northern ford, provides good access from Waitangi to Te Awapatiki. It is never dry, and at the time of investigation, reached a maximum depth of approximately 2 feet. There are small fords from Waikawa Island to the adjoining mainland, the locations of which alter a little from time to time, due to the change in location of the outlet channel.

LAKES:

There are a number of small lakes along the northern and eastern lands adjoining the Te Whanga lagoon, namely, Wharo, Waiongongo, Koomutu, Kaipakau, Kaimoumi, Tapapa, Rangitai, Pateriki, Rotorua, Te Wapu, Kaingarahu, Koromatuaiti, Kairae, Mainui and Hapuaro: all fresh water lakes except Te Wapu and Pateriki, which are slightly brackish. The bottom of these lakes is comprised of [illegible] waters being discoloured by the peat soil. Lake (Pateriki)...

Pateriki and Lake Te Wapu have low sand bars on the seaward end. Their brackishness is no doubt caused by the proximity of the sea, which occasionally breaks over and through the sand bars. It is very evident that these lakes were all, at one time, part of the sea bed, the accumulation of sand or subterranean disturbances having caused them to become wholly landlocked. Te Whanga lagoon is no doubt passing through some such process, but owing to the huge area of water, it is essential that an opening to the sea be maintained.

A few of these lakes are illustrated in the following photographs:-

Photograph No.19:

A view from a point about half a mile northwest of Lake Waiongongo illustrates extensive areas of flats covered with rush and bracken fern. The sandy formation of this land can be noted by reference to the low sandhill on the left end of the photograph.

Photograph No.20:

Lake Koomutu looking north-east.

Photograph No.21:

Lake Kaipakau from the south-western corner.

Photograph No.22:

Lake Te Wapu from the beach at Kaingaroa Harbour. The outlet channel, at present closed, is illustrated in the foreground.

Photograph No.23:

A view taken from the north-western end of Lake Kairae. This lake is used by the sea birds during the nesting season.

Photograph No.24:

Looking west across Lake Huro, which is approximately 6 feet above sea-level and is drained by the Mangape Stream into Waitangi Bay.

MARINE LIFE:

(a) Shell Fish:

Both cockles and mussels can be found along the shores of a[illegible] are of a very small variety. The pupu

(continued)

(periwinkle) is evident in large quantities in all the shallows along the lagoon shores.

(b) Fish:

A perusal of the declarations submitted with this report shows that there are a large variety of sea fish to be found in the waters of the lagoon; in fact, it can almost be said that every kind of sea fish found in the open sea at a similar depth of water can at times be seen in the lagoon. Summarised, these fish are:- flounder, Kahawai, groper, garfish, gurnard, conger eel, red cod, trevally, herring and eels. Flounder, kahawai, garfish and eels can be seen almost at any time in the lagoon waters. The eels are said to inhabit the lagoon in large numbers and have in the past formed a source of food supply for the natives. There are said to be four types of eels, the two common types being kokupu, (3'-4'long) and whakahu, (a small black eel about 2'-3' long). While carrying out soundings on the Muriwhenua basin, I noted large schools of jelly fish, and during the late afternoon, while carrying out soundings, observed kahawai jumping.

TECHNICAL INVESTIGATION:

(a) Determination of Mean High Water Mark:

While crossing the outlet on 27th January, opportunity was taken to observe the rise and fall of the tide, about a quarter-mile from the confluence of the outlet channel with the sea. In Photograph No.14, a stake will be noted at the edge of the channel. The high tide on the 27th was marked on this stake and again on Thursday, the 10th February; the rise and fall was observed at two distinct high and low tides. This rise and fall was about 18" and from general observations, this is apparently about the mean range of tide within the outlet. No attempt was made to observe any rise and fall of tide in any other part of the lagoon, as this small range of tide would not be noticeable within the lagoon. Some residents

(observed)

observed at times, and there is no doubt that under very calm and quiet conditions, a difference in tides could be observed, but during my stay on the Island, the light winds blowing would counteract the effect of tides to a large extent. Mr. H.R. Clough, one of the declarants, who is very familiar with the outlet and eastern shore of the lagoon, states that he has observed a rise and fall in the tide for a distance of six miles north of the outlet channel.

Arrangements were made to observe mean high water mark in a sheltered part of the Kaingaroa harbour. Between 29th January and 14th February, twenty-two high tides were observed, and from these records, a reduced level for mean high water mark was determined. Observations were carried out during fairly mild weather with slight winds, mostly from the north-east.

The reduced M.H.W.M. level was carried from Kaingaroa to the lagoon at Hapupu by a traverse of seven miles checked and referenced to suitable bench marks at intervals of one mile. The mean error over this seven miles of levels was .17 of a foot, an average of error of .025 feet per mile. This mean high water mark level, as determined, coincided with the edge of the grass on the Hapupu flats; that is, at the flag indicated on Photograph No.11, and is shown approximately by the blue line on the plan herewith submitted. At the date of the survey, the water level was approximately 6' inches below mean high water mark.

The distance from the edge of the grass to the water's edge was approximately 1,500 feet, and this approximate water edge is shown dotted on the plan submitted. I estimated that the approximate area of dry lagoon bed is as illustrated on the plan coloured yellow. The areas coloured red are grass land between mean high water level and the boundary as defined by S. Percy Smith in 1868. I found that the water level on Lake Rotuma was 11.9" above mean high water mark, the water level on Lake Rangitai was 7' above M.H.W.M., and that on Lake [illegible] was 10" above M.H.W.M.

(the)...

The waters of the lagoon were thus proved to be at M.H.W.M. level subject to the horizontal influence of the tide. The existence of large areas of dry bed are due to the fact of evaporation during the summer months, and the prevailing northerly winds, the inhabitants on the Island stating that it was unusual to have such large areas of the bed of the lagoon in its then dry state.

(b) Soundings:

Following the determination of mean high water mark, over a period of three days, I obtained soundings at twenty-one points in the three basins of the lagoon, (indicated on the attached plan). These, generally summarised, show that the maximum depth in the Huriwhenua basin was 8'9"; in Tai Hawea basin, 18ft, and in the southern basin, 11ft. The bottom of the lagoon is covered with a sandy deposit and lake grass with an even floor.

The late Dr. Cockayne states in the Transactions and Proceedings of the New Zealand Institute, 1901, page 272:

> "The floor of the lagoon consists of sand or of sandy, peaty mud formed from the decay of many generations of plants".

The Marine Department state that a mile offshore in Hanson Bay there is a depth of 5 fathoms. It is interesting to note that the lake bed along the western shores of the Tai Hawea basin falls at approximately the same gradient for the first half-mile offshore, bearing out other evidence in proof of the fact that this shore once formed part of open sea coast.

(c) Salt Content:

At each of the soundings a sample of the water was taken at a depth of 7 feet below the surface where soundings permitted, and afterwards analysed by the Scientific and Industrial Research Department (indicated in red figures on plan attached). Sea water from the Tasman Sea contains 2.07 grammes of salt per cubic centimetre. The analysis carried out by the Scientific and Industrial Research Department showed that the waters in the

Kuriwhenua basin ranged from 1.38 to 1.46 grammes per c.c., approximately 70% sea water. In the Tai Hawea basin the salt content ranged from 1.63 to 1.67 grammes 80% per c.c., sea water. In the Southern basin the salt content ranged from 1.42 to 1.77 grammes per c.c.; approximately 75% salt water. It was noted that the salt content of the water increased towards the outlet of the lagoon where a sample just within the outlet showed 2.02 grammes per c.c.

(d) Te Awapatiki Outlet:

This opening has, within the living memory of man, been opened and closed at varying periods. From the declarations which are attached, it will be noted that the opening at Te Awapatiki has been carried out artificially since the '80's. These artificial openings have been necessary because the water accumulating in the lagoon makes the fords impassable and affects the grass land on the Hapupu flats. The last opening cut was made in 1931, at a point more than half-a-mile north of the present outlet. This opening has gradually worked southward and, at some future date, may naturally close when continuous easterly winds are experienced, causing sand bars to be accumulated at the mouth. After a period of generally three years, it becomes necessary to effect a further opening. Although these openings have been carried out artificially, the general opinion on the Island as borne out in a number of the declarations, is that, if the outlet to the lagoon was not interfered with, an opening would break out naturally when sufficient water had accumulated and a favourable wind was blowing.

The first evidence of reference to this lagoon outlet is made by Dr. Dieffenbach in his report to the Royal Geographic Journal, 1841, Volume 11, page 197:

> "The Whanga Lake occasionally empties its waters into the sea, by breaking over its low barriers. This may happen periodically, when it has been sufficiently replenished by its tributaries, or perhaps after particularly wet [illegible]

(then)...

> then left dry to the extent of several miles, and the way from Wai keri, a native settlement on the eastern shore, to Waitangi Harbour on the western, is much shortened. The last time that this discharge of the water took place was in 1837."

I wish to particularly draw attention to the fact that, according to Dieffenbach, the last discharge of water took place in 1837. At that date, I assume that the opening was natural. Dieffenbach makes reference to the dry land at the southern extremity of the lagoon. This, no doubt, refers to the low islands at the mouth of the outlet, which are from two to three feet above sea level. A further reference to the opening at this outlet is made in the New Zealand Gazette report of the landing of Surveyor William Seed, Wellington, on the Chatham Islands, in 1861:

> "In the centre of the main island, which is nearly all low and undulating, there is a large salt water or brackish lake occupying fully one-third of its area. This lake has a hard sandy bottom and is easily fordable over about half of its extent, when the mouth is open at the point where its waters flow into the sea; at times, however, after heavy gales of wind, I believe, this is closed up, and then it is too deep to be crossed except in boats; a large portion of it is always very deep."

From this, it may be inferred that in 1861, the lagoon was open.

The next authentic evidence of the opening can be found on the file 22/1382/1, in the declaration by Thomas Ritchie, when the question of the ownership of the islands at the outlet was under consideration. He stated,-

> "that in 1864, Te Whanga lagoon had an outlet to the sea on the eastern side of these three islands and was consequently, to some extent, affected by the tide."

It can be assumed from this statement that the outlet in 1864 was open. He states further that after 1868,

> "I occasionally saw the Moriori from Owenga going to Waikawa for eeling".

This implies that the outlet was closed after 1868, for eels only collected at the outlet sufficient to attract Moriori for eel fishing.

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In describing the Te Whanga Lagoon in the Transactions and Proceedings of the New Zealand Institute Volume 1, 1868, page 124, Dr. J. Hector states:-

> "It almost intersects the island, the space between the north bank and the sea shore being little more than three or four miles, whilst at the south end it is only separated from the sea by a sand-bank a hundred or a hundred and fifty yards wide. This sand-bank is periodically broken through by the accumulated waters of the lagoon; the beach, after the lagoon has sunk to high water mark, being repaired by the wash of the sea from the south-east. The lagoon is in some places bordered by extensive spongy tracts, in others by grasses, sedges and rushes, and in others by bush similar to that which occurs on the sea shore."

The following information extracted from various reports and the declarations, submitted herewith, summarises the dates of the natural opening and closing of the outlet:-

OUTLET OPEN	OUTLET CLOSED
1837 (Dieffenbach's report)	
	1841 (Dieffenbach's report)
1861 (Seed's report) 1864 (Ritchie's report)	
	* 1866-1872 (C. Seymour's declaration)
1872-1873 (C. Seymour's declaration)	
	1873-1876 (C. Seymour's declaration)
1876-1878 (C. Seymour's declaration)	
	1879-1882 (C. Seymour's declaration).

It is not possible to obtain evidence of the opening and closing of the outlet between the years 1841-1861, but from the latter year to 1882, the evidence is fairly complete. Mr. Seymour's statements I consider are strictly reliable as the old man had a most active memory and his dates are to some extent borne out by the evidence of Mr. W. Jacob's, whose memory was failing.

In 1882, the first artificial opening was effect and, since that date, the outlet has not been permitted to remain closed for too long a period, as, after a period of two years, the grass flats at the eastern end of the Muriwhenua basin become submerged. I

understand every artificial opening has been undertaken by the owners of Kaingaroa Station, who have purchased scoops for this purpose.

There is some doubt as to the exact date of the closing of the outlet between 1866 and 1872. Mr. S. Percy Smith carried out a complete survey of the Chatham Islands for investigation purposes in 1868. His survey work at the outlet was made early in 1868, and, from an examination of his field notes of the survey, there is a presumption that the outlet was closed at the date of survey, although his plan shows evidence of a connection between the lagoon and the open sea. At the most the accumulation of water had extended over a period of two years, and consequently the change in water level would not seriously affect the grass flats. This is borne out by the relative position of Smith's definition of the lagoon boundary and the present M.H.W.M. which is coincident with the present edge of the grass. The area affected by these definitions is shown coloured red on the attached plan.

(e) Native Title to Chatham Islands and Te Whanga Lagoon:

In June, 1870, the Native Land Court investigated the title of the Chatham Islands and awarded the islands to the Maoris by right of conquest, the remaining Moriori being awarded small unalienable reserves in various parts of the islands. The plans used for the purpose of investigation were those compiled by the late Mr. S. Percy Smith from the surveys carried out by him in 1868. The Whanga Lagoon was excluded from this investigation, the lagoon boundary being shown by the heavy black line as indicated on the attached plan. Except at the eastern and north-eastern end of the Muriwhenua basin, this boundary is coincident with the present M.H.W.M. along the lagoon shores.

PETITION OF GEORGE TUUTA AND THIRTYFOUR OTHERS:

The petitioners stated:

(1) [illegible] the Chatham Islands [illegible] were

investigated...

investigated by the Native Land Court in 1870, nothing was said or done as to the ownership of a large stretch of inland water known as Te Whanga Lagoon.

I consider that there was no reason for an investigation by the Native Land Court in 1870, as to the ownership of the Te Whanga Lagoon, as, from the investigations carried out, I am satisfied that this lagoon is not a lake but an estuary of the sea. In reference to this, the Encyclopaedia of the Laws of England, volume 14, page 622, describes inland waters under the first sub-section as--

> "all estuaries of the sea and rivers up to the point at which the tide ceases to ebb and flow in which the property in the soil covered by the water is prima facie vested in the Crown and in which the public have, at common law, a right of navigation and a right of fishing."

(2) The titles to the surrounding blocks of land were in every case bounded on the side towards the said lagoon by the margin of the lagoon.

Mr. S. Percy Smith in 1868, defined the boundaries of the lagoon which are reproduced on the plan attached, indicated by a heavy black line. Except at the north eastern shores of the lagoon, these defined boundaries are coincident with the present mean high water mark. The only difference is that illustrated along the north eastern shores, the land coloured red being that between Smith's survey and the present mean high water mark. This appears to be, in no case of greater width than 20 chains, and the apparent accretion at this point has been caused, as already described, by the growth of salt grass and the action of wind on the bed of the lagoon when dry and exposed to south-west winds.

(3) The said lagoon was thus an uninvestigated title and as such was always deemed by the Maoris to be their property, and was freely used by them at all convenient times and seasons.

The lagoon has been used by all inhabitants of the Chatham Islands at all convenient times and seasons. It is submitted that native custom did not permit of any separate ownership of this lagoon but the rights of all inhabitants of the Chatham Islands were (recognised)...

recognised. This right has been the right of the public, particularly the European public, since first settled by Europeans. Declarations attached will show that Europeans have made use of the rights of fishing and the right of crossing this lagoon at the recognised fords, which rights have never been disputed by the natives. The public have also had rights over the swan nesting grounds and both European and Maori have, in the past, made extensive use of the swans' eggs for food.

(4) Since the date of the titles of 1870, the waters of the said lagoon have greatly receded, leaving a considerable area of fertile land. This uncovered area is now used by the persons who have titles to the adjoining lands, and is claimed by them as being an accretion to their original holding although their titles expressly defined the boundaries as being the then margin of the lagoon.

I do not consider that the level of the lagoon has at all changed since 1870. Any change in level has only been due to the periodic closing of the outlet when the water rise is due to the accumulation of natural drainage from the surrounding watersheds. This rise has thus only been of a temporary nature, and, as soon as the outlet is open, the water recedes and resumes its natural level at mean high water mark. Apparently the natives are assuming that there is a very considerable area of fertile land existing between the natural level of the lagoon and the boundary defined by Smith in 1868. This area, as already stated, is comparatively small as shown in red on the attached plan.

(5) Your petitioners are advised and believe that laws of accretion and decretion in the case of lands abutting on running waters do not apply to a large inland lake such as Te Whanga Lagoon, and that any area uncovered by the receding of the water belongs to the original owners of the territory.

In reply to this statement, it is only necessary to point out that it is not considered that the Te Whanga lagoon is an inland lake. As stated before, it comes under the terms of inland waters as an estuary, thus being an arm of the sea. Any area uncovered by the receding of water belongs, under the laws of accretion, to

(H. Your)...

(6) Your petitioners are firmly convinced that it is not right that the uncovered areas should pass into the possession of European who have not paid for them, to the loss and injury of the Maoris who had the original ownership of both the land and the Lagoon.

This statement has received answer under the other five headings, the possession of "uncovered areas" being vested in the ownership of adjoining land. This is a right which operates by common law and as the lagoon is an estuary, the owners who possess land bordered by the lagoon are the only persons who have any claim on the accretion along the shores of the lagoon.

SUMMARY.

The Te Whanga Lagoon is an arm of the sea for the following reasons:-

(1) The waters of the lagoon, when the outlet is open, are at mean high water level and are subject to the rise and fall of the tide for some miles within the outlet channel.

(2) From 70% to 80% of the water of the lagoon is salt sea water.

(3) The marine life in the lagoon is similar to that found at the same depth in the open sea.

(4) The Te Whanga Lagoon cannot be considered as a still inland water until all access to the open sea has been permanently closed. There is proof enough to show that under natural conditions, the lagoon outlet will periodically close and open.

(5) The western shores of the lagoon were originally old sea coast and show conclusive evidence of this fact.

(6) The landlocking of the lagoon has been proceeding slowly through geological ages, along the eastern shore, and, until the process is complete, and thus permanently excludes the flowing in of sea water, the lagoon must still remain an estuary of the sea.

(7) The meaning of "lagoon" is "a shallow lake connected with the sea or a river". The naming of this sheet of water implies that it was considered not as an inland water, or lake, but an arm of the sea.

In respect to the claim made by the Maoris to the bed of the lagoon, I question their rights to this claim for the following reasons:-

(1) The bed of the Te Whanga Lagoon was excluded from the investigation of title at the Native Land Court in 1870, it no doubt being considered an arm of the sea.

(2) I consider that Moriori rights to the fishing in the lagoon were always paramount to the Maori rights. From the time of the arrival of the Maori in 1836, when their conquest was hardly in accordance with native custom, being assisted by a European vessel, the rights of fishing were exercised more by Moriori than Maori. The latter supplemented their food supply with European diet and had not the necessity to gather and store their food in accordance with their customs. The Moriori exercised this customary right continuously until 1870.

CONCLUSION.

In conclusion, I wish to state that the petitioners are influenced in their claim to the bed of the lagoon on account of a supposed right to some of the rich grass flats at present part of the Kaingaroa Station, commonly called the Hapupu Flats. They have neither a moral nor a legal right to this land.

The land was conveyed by the Maoris to Ritchie Brothers in 1865, and the Hapupu flats have been in undisputed occupation by them and their successors in title ever since. So that assuming there is a strip of land between Mr. S. Percy Smith's original survey and the present mean high water mark, which may have been land that was excluded from the original investigation in 1870, this uninvestigated land belongs by prescriptive right to the owner in undisputed possession. Then again, the owners of Kaingaroa Station are bounded by the edge of the lagoon and surely cannot be deprived of their riparian rights which means that their land is bounded by the lagoon, wherever it may be, limited only by mean high water mark. However, this is a matter for the Registrar-General of Lands to decide.

1921, and
IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

096

I, A. D. Carron of Waingaroa, Chatham Islands

do solemnly and sincerely declare:

1. My full name is Arthur Dudley Carron.
2. I am ~~Manager of Sheepfarm~~ and reside at Waingaroa
3. I have been eleven years at Chatham Islands eight and a half of which I have occupied my present position
4. I am familiar with the Te Whanga Lagoon which includes about four and a half miles of its east & South East shore in the property I am Manager of.
5. The water is salty
6. I have noticed the depth of water at the ford, or crossing through having at times to drive sheep across the lagoon
7. The water on a calm day is generally about six inches deep on eastern side of crossing & becomes deep about half a mile from Eastern side & is deep until about a mile from Western shore when it gradually gets deeper until it reaches a depth of from a foot to eighteen inches. influenced by the wind, and the southern end by the rise & fall to the tide.
8. The water is at all times very much
9. During the time I have been at the Islands the ~~water~~ to the lagoon has been only once closed, for about nine months and I had it opened this was eight years ago last month.
10. I am of opinion that if there was no sea water running into the lagoon that the present area of water would be restricted to a very small lake at the South Western end.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitangi Chatham Islands
this 15th day of January 1938,
before me

A. D. Carron.

L. Holmes

Justice of the Peace in and for the Dominion of New Zealand.

IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

097

I, William Davis of Hawaruwaru, Chatham Island do solemnly and sincerely declare:

1. My full name is William Davis
2. I am 58 years of age and reside at Chatham Island. N.I. 79
3. I was born in 1880 and came to reside on the island in 1890 at the age of 11 years. N.I.
4. I have resided on the western shores of the lagoon, except for periodic visits to the mainland and a period in the Great War, ever since.
5. I am very familiar with various features of the lagoon having visited and fished at various places on & in the lagoon.
6. During my residence the outlet to the lagoon has closed at various times but on each occasion has been opened artificially. The residents have not permitted it to remain closed longer than 2 years as the fish cannot be negotiated with safety after that time owing to the deepening water. The outlet was open in 1890 but closed towards the end of 1890 & remained closed until 1892.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitangi this eighteenth day of February 1938, before me

W. Davis

D.McMahon
Postmaster, Waitangi
~~A Justice of the Peace in and for the Dominion of New Zealand.~~

I, [illegible] the witness of the signature of William Davis [illegible] Waitangi [illegible] 1938 [illegible]

1931; and
IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

098

I, William Davis of Hanaruwaru, Chatham Islands do solemnly and sincerely declare:

1. My full name is William Davis
2. I am 58 years of age and reside at Chatham Islands.
3. The outlet to the lagoon was opened artificially in 1892. The outlet closed again before the Boer War and was again opened after being closed for a short period.
4. While the lagoon is open fish from the sea enter at the outlet and I have observed many varieties in the lagoon. They are:- flounder, inanga, porure, red cod, kahawai, garfish (piki) and three or four types of tuna, the two common types being tuna roa (large up 3'-4' long) and whakahu (small black up 2ft long)
5. When the outlet is closed eels collect at the outlet and became stranded as the outlet attempting to obtain access to the salt from the open sea.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitangi
this eighteenth day of
February 1938,
before me

W. Davis

H. C. Mason
Postmaster, Notary Public

A Justice of the Peace in and for the Dominion of New Zealand.

I, [illegible] Davis, the attesting witness of the signature of William [illegible] hereto, solemnly declare that the said William Davis [illegible] day of [illegible] 1938, [illegible]

Taking Declaration

1951; and

IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

099

I, William Davis of Hawaruwaru, Chatham Islands do solemnly and sincerely declare:

1. My full name is William Davis
2. I am 58 years of age and reside at Chatham Islands.
3. When the outlet is open the water in the lagoon is distinctly brackish but is less so after the outlet has remained closed for some time.
4. The bed of the lagoon is mainly covered with lake grass (kohukohu). Where this grass is thick the swans make extensive nesting grounds. This grass has a flower and the pollen from this flower floats on the surface of the lake.
5. Small mussels, cockles & pupu are found in the lagoon. There are no crabs.
6. Swans and ducks (grey) live on the lagoon. Various sea birds, gulls, terns live and rest on the lagoon shore and small rocks & islands in the lagoon.
7. The fords at Moutapu and Wharawara are constantly used by the islanders.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitangi
this Eighteenth day of
February 1958,
before me

William Davis

J.M. Graham
Postmaster, Waitangi
A Justice of the Peace in and for

I, Daniel Nicholson, the attesting witness of the signature of William Davis original native hereby certify that the said William Davis has stated to me that he understands and is perfectly conversant with the English language.

IN THE MATTER of an Application for
Investigation of Title to the bed of
Te Whanga Lagoon, Chatham Islands:

100

I, William Davis of Hawaruwaru, Chatham Islands

do solemnly and sincerely declare:

1. My full name is William Davis

2. I am 58 yrs. of age and reside at Chatham Islands

3. The outlet at Pikiki is opened artificially to limit the ability to use the lands and the land adjoining the lake shore which became covered with water.

4. I have observed a rise and fall of water at and near the outlet due and corresponding to the rise and fall of the tide. The level of water in the lake is greatly affected by a change in direction of the wind.

5. I consider that, under present conditions, the opening at the outlet (Pikiki) would break in opening naturally, W.H. Davis when the lake had been closed for a number of years, after sufficient water had accumulated.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitangi
this eighteenth day of
February 1938,
before me

W. H. Davis

D. McMahon
Postmaster, Waitangi

A Justice of the Peace for the Dominion of New Zealand.
Officer authorised to receive Statutory Declarations.

I, Daniel McMahon, the witnessing witness of the signature of William Davis the original native hereby certify that the said William Davis is client knowledge of the English language to me and that he doth understand the full nature and purport of the declare

Dated this 18th day of February 1938

IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

101

I, A. F. Bauchop of Kaniere, Westland

do solemnly and sincerely declare:

1. My full name is Augustus Francis Bauchop
2. I am 87 years of age and reside at Kaniere
3. I was born on Chatham Island in 1851 and was resident on the island from that date until 1881.
4. I was familiar with Te Whanga Lagoon from my early boyhood until 1881.
5. I made and use of the fords, at present in use across the lagoon.
6. The outlet to the lagoon, at Awapatiki, was more often open than closed during my residence. The outlet would remain open for years until blocked with sand by the prevailing winds. The opening was never permitted to stay closed for too long a period as the rising level of the lake detrimentally affected the fords and land bordering on the lagoon.
7. The water in the lagoon was brackish.
8. There was an ebb and flow at the outlet corresponding to the rise and fall of the tide.
9. Flounder and eels were plentiful in the lagoon. Cockles could be obtained in and around the outlet.
10. Mucks ~~[illegible]~~ were more plentiful than they are at present.
11. I visited the lagoon in January 1938 during a visit to the island.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Christchurch
this 25th day of January 1938,
before me

A. F. Bauchop

[illegible] Holmes

[illegible] the Peace and [illegible] the Dominion of New Zealand.

Investigation of Title to the bed of
Te Whanga Lagoon, Chatham Islands: 102

I, William Jacobs of Chatham Islands
do solemnly and sincerely declare:

1. My full name is William Jacobs
2. I am 72 years of age and reside at Ruku Tohoku (Rock Lomond)
3. I was born at Lyttelton in 1866 and was brought as an infant to Kangaroa, Chatham Islands, the same year.
4. I came to live at Rangiauria, near Te Awe, on the western shore of the Te Whanga Lagoon in 1874 and lived there as a boy & young man until 1888. I have resided at various places on the island since that date.
5. I am familiar with the Te Whanga Lagoon and its various features
6. The lagoon outlet at Paiki has been opened and closed on various occasions ~~since~~ during my residence on the island. Except on one occasion the opening at the outlet has been assisted artificially. The lagoon would remain open for varying periods depending on the winds and weather conditions prevailing.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Chatham Islands
this 11th day of
[illegible] 1938,
before me

W. Jacobs

R. Nelson

A Justice of the Peace in and for
the Dominion of New Zealand

IN THE MATTER of the Native Land Act, 1931; and
IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

103

I, William Jacobs of Chatham Islands

do solemnly and sincerely declare:

1. My full name is William Jacobs
2. I am 72 years of age and reside at Puke Tahuhu (Lock Lomond)
3. My first recollection of the opening of the lagoon by artificial means was in about 1878 when Mr Tom Ritchie opened the outlet with horses & scoops. The lake was again closed in 1881 and remained closed for some years. I remember crossing the lagoon at Waikawa in 1887 at which date the outlet at Paikiri was open. Since that date the outlet has been closed on various occasions but has not been permitted to remain closed for a long period. The outlet would be artificially opened to permit of the crossing of the fords and the drainage of the lands along the Hapupu flats for farming purposes.

I am definitely of the opinion that the waters of the lake would naturally break an opening at the outlet if left to accumulate sufficient water. I recollect that in the early '70's a natural break of the outlet occurred.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Chatham Islands
this 11th day of
January 1938,
before me

W. Jacobs.

A Justice of the Peace in and for

1951; and
IN THE MATTER of an application for Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands: 104

I, William Jacobs of Chatham Islands

do solemnly and sincerely declare:

1. My full name is William Jacobs
2. I am 72 years of age and reside at Puke Tokulu (Loch Lomond)

3 I have observed many types of sea fish in the lagoon among them being flounder, conger eel, red cod, kahawai, mullet, ~~sprat~~ fish (pipi) I once caught a seahorse at Waitaua.

When the outlet has been closed for a time and fresh water accumulates I have found fish stranded at ~~Emp~~ Moutapu. This occurred in 1921.

4. In 1881, when the lagoon was closed I observed the water of the lake within a few chains of the beach at Hapupu.

5. The winds affect the level of the water in the lake over very large areas of flat that at normal times are dry land.

6. The swans which at present live on the lake were liberated on the lake in the 80's. The grey ducks, spoon bill ducks (now extinct) and teal were always found on the lake in the early days.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitaua
this 11th day of February 1938,
before me

W. Jacobs

A Justice of the Peace for the Dominion of New Zealand

IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

105

I, H. R. Clough of Waitangi, Chatham Island.

do solemnly and sincerely declare:

1. My full name is Herbert Richard Clough
2. I am 37 years of age and reside at Waitangi
3. I was born on Chatham Island and have been resident here ever since, except for a few years spent in N.Z.
4. I am familiar with the Te Whanga Lagoon.
5. I know all of the fishing fords and make frequent use of them
6. I have fished for flounder and eels and shot ducks and swans in the lagoon
7. The lake is of brackish water although there are fresh water springs rising in the bed of the lagoon on the western shore near the main ford.
8. I am familiar with the outlet of the lagoon at Awapatiki and have observed that there is a strong ebb and flow at the outlet corresponding to the rise and fall of the tide. I have frequently noticed horses across this outlet.
9. I have noted that the lagoon is afflicted by the ebb and flow from the outlet in a direction north along the eastern shore of the lagoon for a distance of approximately six miles to Kahupeka Point.
10. I know of fords at the southern corner of the lagoon between Te Whakaruru Hos 1 & 3 & the Wharf frequently used by the public
11. The outlet at Awapatiki is more often open than closed

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitangi
this 25th day of
January 1938,
before me

H R Clough

S. Henderson.

A Justice of the Peace for the Dominion of New Zealand.

IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

106.

Painter of Kaingaroa, Chatham Island

y and sincerely declare:

l name is Robert Edward Painter

54 years of age. and reside at Kaingaroa, Chatham Is.

so born on Chatham Island in 1879 and have been
ently resident on this island since 1911.
m familiar with the Te Whanga Lagoon and first
d the lagoon in 1893
lagoon has only remained dried for very short
so since my residence in the Chatham Islands. Since
residence the lagoon was dried up in 1912 and was dry
for 2 or three years, in 1922 it was dried for
years and in 1931 after was dried for nine months.
opening of the outlet was artificially assisted as
so in the interests of the fishing industry as lake is known to have
low levels. I am certain that the lake would naturally
be in opening at the outlet when a sufficient body
water had accumulated and a favourable northerly
d was blowing.
I have observed that the southern end of the lagoon
ufficiently by the rise and fall of the tide. This is
ecially noticeable at the head where the natural and
ficially mixed waters flow between Te Matarae and
Weavers Island.
The depth of the water in the lake, when full is
ut 20 feet, so ample to charge by wind.
Northerly winds drive the water well up the
ern end and practically on the main road when southerly
ds ~~up~~ deepen the lake.
Some years ago I drove short across the flood
ween Motutapu & Kaingaroa points, the flood at
s time being dry & dusty after northerly winds. Further
so after on my return journey the whole length of
flood was covered with water after a strong S.W.
.al.

ake this solemn declaration conscientiously believing the
be true and by virtue of the Justices of the Peace Act, 1927.

ed at Kaingaroa Chatham Is.
this 4th day of
February 1938,
me

R. E. Painter

A Justice of the Peace in and for
the Dominion of New Zealand.

1931; and
IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

107.

I, R.E. Painter of Kaingaroa, Chatham Is.

do solemnly and sincerely declare:

1. My full name is Robert Edward Painter
2. I am 54 years of age and reside at Kaingaroa, Chatham Is.
3. The water in Te Whanga Lagoon is brackish. I have seen a anger eel and a yarnaw landed at the Rootapu end of the main food after a northerly wind. I have seen kahawai at Wiupapa at the weaker end of the northern half of the lagoon. I saw it at Hawaiki, a food reserve that has been handed on the island just south of the main food.

I have frequently seen yarfish in the lagoon. Flounder and eels are abundant. I have seen schools of kahawai coming into the lagoon at the outlet.

4. Swans and ducks have always been found in the lagoon.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Kaingaroa Chatham Islands
this 24 day of February 1938,
before me

R.E. Painter

R. Holmes

A Justice of the Peace in and for the Dominion of New Zealand.

1951; and
IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

108

I, (Mrs) A Grinnell of ~~Hall~~ Matarakau

do solemnly and sincerely declare:

1. My name is Nelly Grinnell

2. I am 59 years of age and reside at Matarakau, Chatham Is

(3.) I have resided in the Chatham Islands all my life and was resident at Matarakau for 37 years and have resided at Waitangi for 22 years.

(4.) I am familiar with the Te Whanga Lagoon.

(5.) The lagoon has been closed at the outlet on occasions since my residence. I have been told that on one occasion the outlet opened naturally by the accumulation of water. On other occasions the outlet has been opened artificially.

(6) I have seen groper and red cod in the southern end of the lagoon. I have also seen flounder, parore, kanga, kahawai, ~~eels~~ in the northern end of the lagoon.

(7) The winds affect a change in level of the water particularly at the northern end of the lagoon

(8) The main food of Mutton is generally dry during the summer months. I have seen the food covered with water during the summer when there is a strong southerly wind.

(9) I have seen fresh water springs at and near the Mutton fowl.

(10) I have been told that during my lifetime the outlet to the lagoon was closed for seven years.

And I make this Solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Waitangi, Chatham Is
this 14th day of February 1951,
before me

N. Grinnell

R. Holmes

A Justice of the Peace in and for the Dominion of New Zealand.

1931; and
IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

110

-109

Herata of Te Roto, Chatham Islands

nd sincerely declare:

me is Te Rua Herata.

years of age and reside at Te Roto

1888 the lagoon has been closed at the
on various occasions but has only remained
for comparatively short periods, being
y opened. This was done so that the
the lagoon could be used and land
n the shores free of water to permit
grazing of sheep and cattle.
water in the lagoon is distinctly brackish
have observed the following fish in the
e many being stranded on the shores
ake by changes of wind. The fish are
ffe (kapuka), Conger eel, Kahawai, Jumard,
ffe), Terakihi, Herring, Flounder, Inanga (whi
and cockles shells are found in various
e lake.
he Morioris traditions there was a
the lake where sea fish were caught.
also state that when the lake was
artificially opened the outlet to obtain
the eels it was made.
n declaration conscientiously believing the same
ue of the Justices of the Peace Act, 1927.

day of

Te Rua Herata

A Justice of the Peace in and for
the Dominion of New Zealand.

In the Matter of the Native Land Act 1931; and

In the Matter of an application for Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands.

111

I, Te Rua Herata of Te Roto, Chatham Islands

do solemnly and sincerely declare:

1. My full name is Te Rua Herata.
2. I am 66 years of age and reside at Te Roto.
3. The fords at Moutapu & Waikawa have been ordinarily used by the islanders. The ford at Waikawa can be crossed by a man.
4. I have observed the rise and fall of the sea at the outlet (Putiki) for a distance of about one mile to one and a half miles north of the outlet.
5. I consider that after the outlet to the lagoon has been closed for a period of year, the water would break an opening to the sea naturally and without artificial assistance when sufficient water had accumulated to force an opening and wind conditions were favourable.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the provisions of the Oaths Act, 1957.

Declared at Te Roto this 15th day of February 1973 before me:

Te Rua Herata

A Justice of the Peace

IN THE MATTER of the Native Land Act, 1931; and
IN THE MATTER of an application for an Investigation of Title to the bed of Te Whanga Lagoon, Chatham Islands:

112

I, Charles Seymour, of Christchurch,

do solemnly and sincerely declare:

1. My full name is Charles Seymour.

2. I am 79 years of age and reside at Christchurch.

3. I came to reside on the Chatham Islands in 1866, as a boy of 7 years.

4. I was constantly resident on the island from 1866 to 1900, for a few months in 1906, and then from 1918 to 1931. Since the latter date, I have resided in Christchurch.

5. I am thoroughly familiar with the Te Whanga Lagoon and have observed its various changes and features during my residence on the island.

6. In 1866, I rode with a Maori lad to the outlet of the Te Whanga Lagoon at Awapatiki. The outlet at that date was open. I also observed at that date that the Hapupu flats at the North-Eastern corner of the lagoon was covered with rushes and flax 7ft. or 8ft. high.

The outlet closed between the years 1866 and 1872, at which latter date the opening at Awapatiki broke out naturally.

The outlet was again closed between the years 1873 and 1876, at which latter date the lagoon broke out naturally.

The outlet again closed in 1878 or 1879, and remained closed until September, 1882, when it was artificially opened for the first time. In July, 1882, two boys were drowned not far from Karewa.

The lagoon remained open until 1888; when it again closed. The lagoon has closed on occasions since that date until the present time, but each opening has been effected by artificial means. When artificially opened, the outlet at Awapatiki remained open for a longer period than when a natural opening was effected.

7. The Moriori stated that the lagoon remained open or closed for approximately equal periods of from three to four years.

8. I am of the opinion that the outlet would break a natural opening when the lagoon had been closed for a period sufficient to permit water to accumulate and force an opening, particularly when a favourable North-West wind was blowing.

(8)...

9. There is a noticeable rise and fall in the waters of the lagoon, around the islands at the outlet and on the ford between Waikawa Island and Matarae, corresponding to the rise and fall in the tide. I have noticed a rise and fall in the waters of the lagoon on the eastern side of the lagoon towards Kahupiri Point.

10. The winds greatly affect the level of the water in the lagoon and I have seen all of the flats at Hapupu (North-East end of lagoon) covered with water during a South-Westerly gale.

11. I have observed many types of sea fish in the lagoon, similar to those in the sea. I have seen groper stranded at the northern end of the lagoon. The water is distinctly brackish and would sustain the life of sea fish.

12. The fords between Matarae and Waikawa Island and the ford to Kaingaroa are and always have been constantly used by the public.

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Justices of the Peace Act, 1927.

Declared at Christchurch
this 1st day of
March 1938,
before me
J. S. Fairweather
A Justice of the Peace in and for
the Dominion of New Zealand.

C. Seymour

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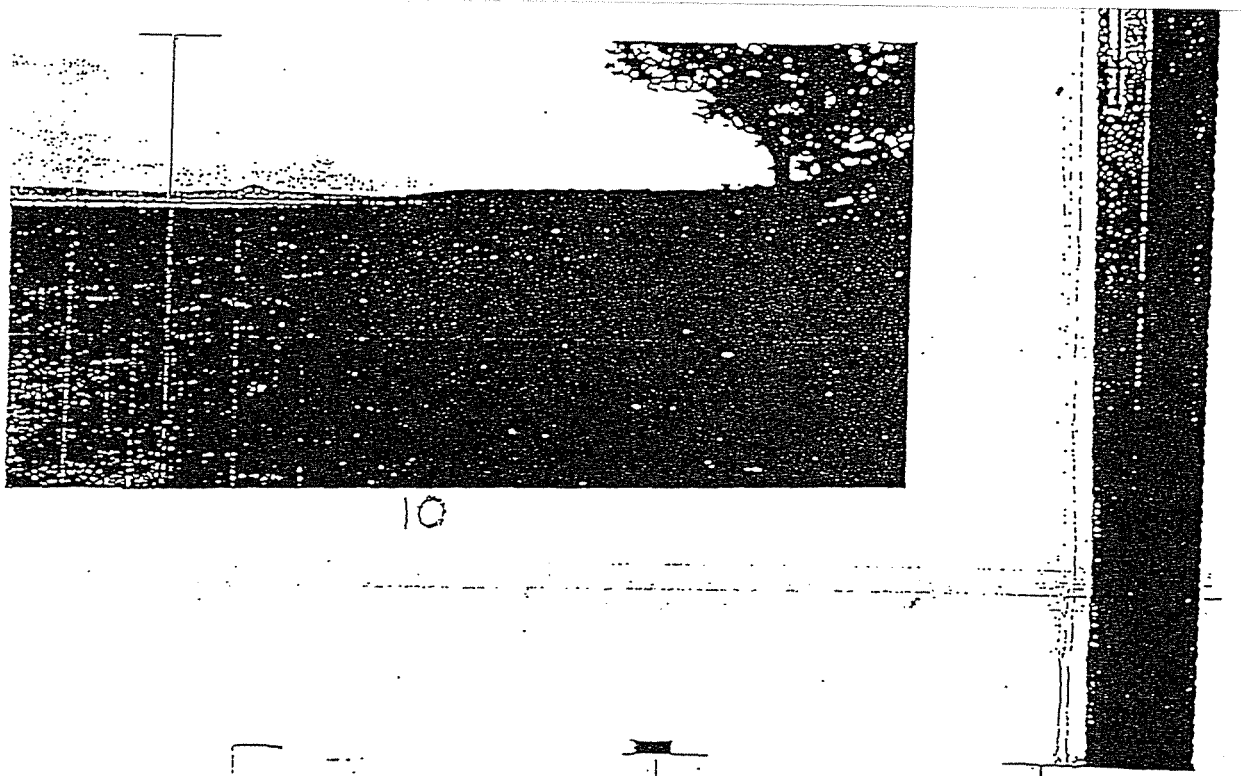

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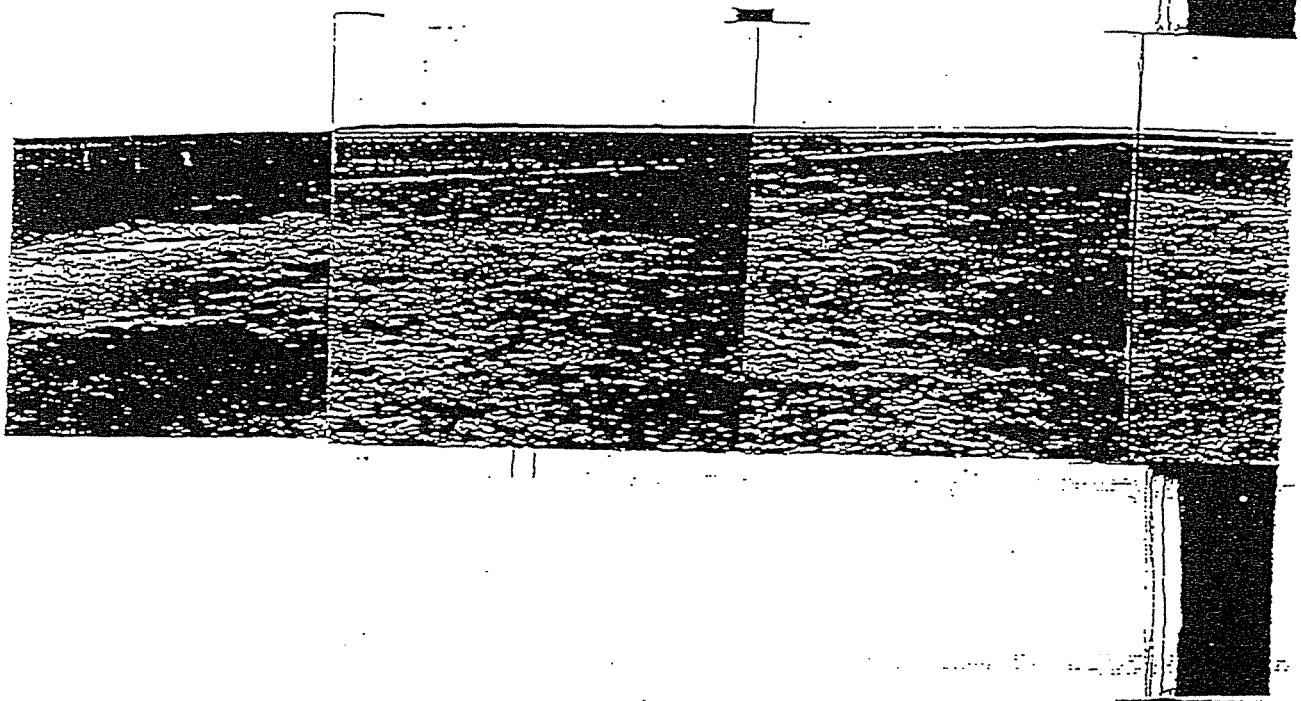

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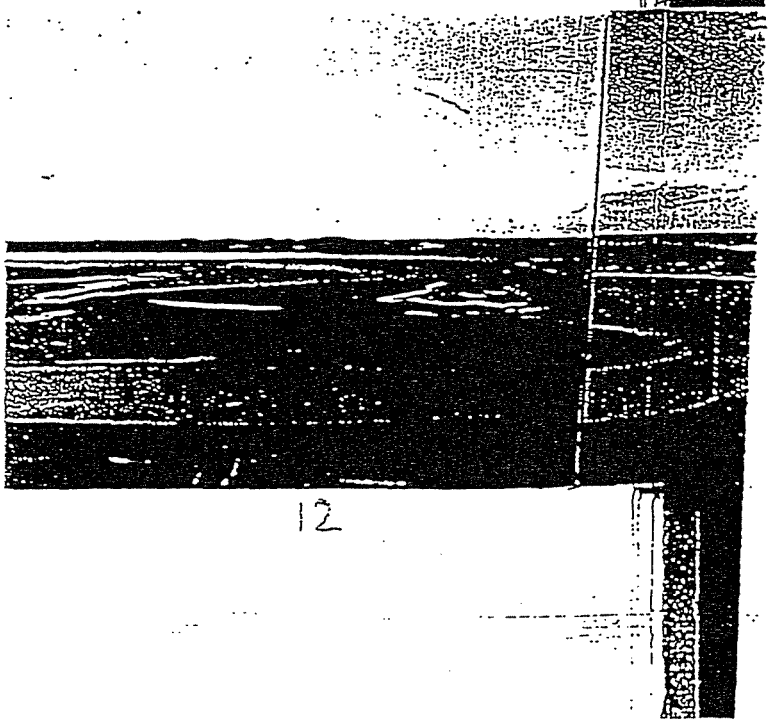

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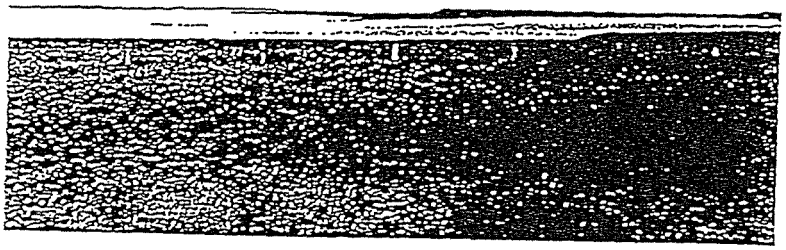

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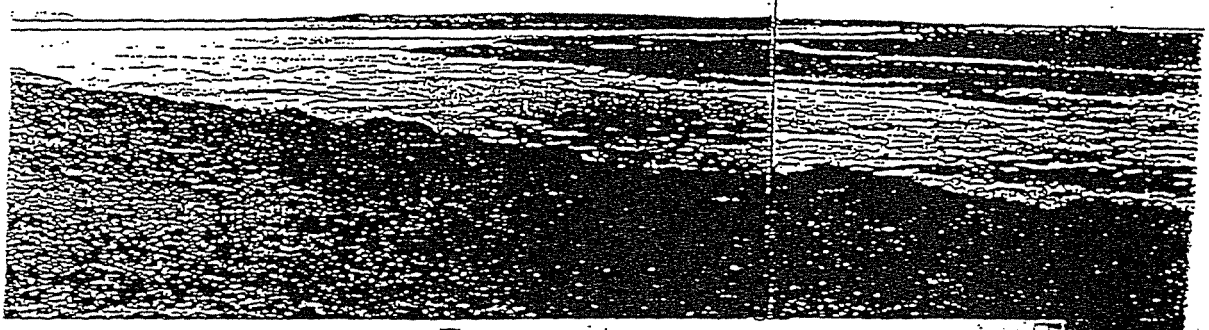

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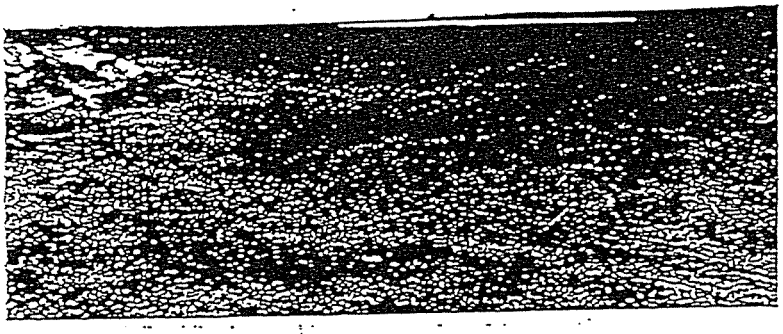

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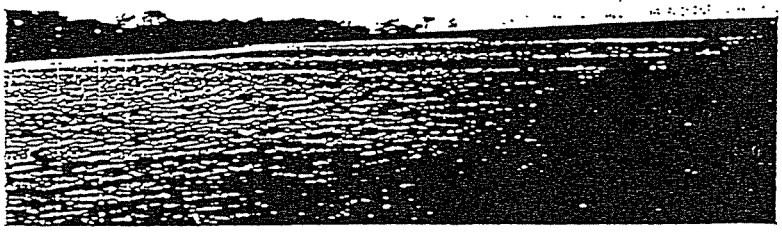

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