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HAUTURU OR LITTLE BARRIER;

ITS HISTORY, GEOLOGY AND BOTANY.

By "Chef"

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F O R E W O R D.

This thesis is a preliminary attempt to draw together the strands of information available regarding the little Barrier island with particular reference to the forest covering of the island. While certain sections such as that dealing with the history of the island may appear to have little reference to the botanical aspect, it was found that the influence of human occupation on the vegetation had been not inconsiderable and it was necessary to collect such information in order to form a clear conception of its possible influence. In the same way the geology, soils and climate of the island were found to have a definite place in the description of the forest covering, the distribution of plant species on the island and their relation to the general distribution of plant forms in the region of the Hauraki Gulf.

The treatment, throughout, aims at being descriptive, rather than interpretive; to be a basis for future work rather than intrinsically valuable or complete in itself. The island has been in the possession of the Crown since 1894 yet up till the present no permanent record has been made of the vegetation on the island. During that time, regeneration has proceeded over a considerable area and excellent opportunities for study in natural regeneration have been lost but more detailed work is still required before the island can be used to study the slow changes occurring in New Zealand forests.

The classification of plant societies is a means to an end and not an end in itself. The present vegetation cannot be regarded as any more than the static representation of a dynamic evolutionary sequence, and it is hoped that the present description may form the basis for future work of a more detailed description of the plant communities and the changes which are occurring in them. Our knowledge of the slow

evolutionary processes leading to the formation of climax associations under New Zealand conditions is, at the present, based almost solely on observation and assumption and it is felt that more detailed work is now warranted to follow up the monumental foundational work of the late Dr.L.Cockayne who was the first to give prominence to, and create interest in the ecological aspects of the vegetation of New Zealand.

Few other reserves are so admirably suited as the Little Barrier for the formation of an ecological research station. The island presents a variety of edaphic and climatic conditions and a range of species and associations which would be difficult to surpass in any other area of similar size, while it has the added advantage of being free from the depredations of grazing mammals. It is to be hoped that in the future, greater use may be made of the unrivalled opportunities which the island presents for ecological research into the primitive forest communities of northern New Zealand.



PLATE I. The Little Barrier viewed from the mainland at Leigh, a distance of 15 miles; Leigh Cove in the foreground; Great Barrier in the distance.

H A U T U R U. (LITTLE BARRIER).

Hauturu or Little Barrier Island lies in latitude 36 degrees 12 minutes South, and 175 degrees 7 minutes East longitude on the northern fringe of the Hauraki Gulf, distant 24 kilometers (15 miles) from Cape Rodney and 17 kilometers (11 miles) from the Great Barrier (Aotea).^(See Fig. I.) Its high and rugged outline is a familiar feature of the northern horizon from Auckland, from which city it is distant 72 kilometers (45 miles) in a N. N. E. direction.

Historical.¹

(See Plate I.)

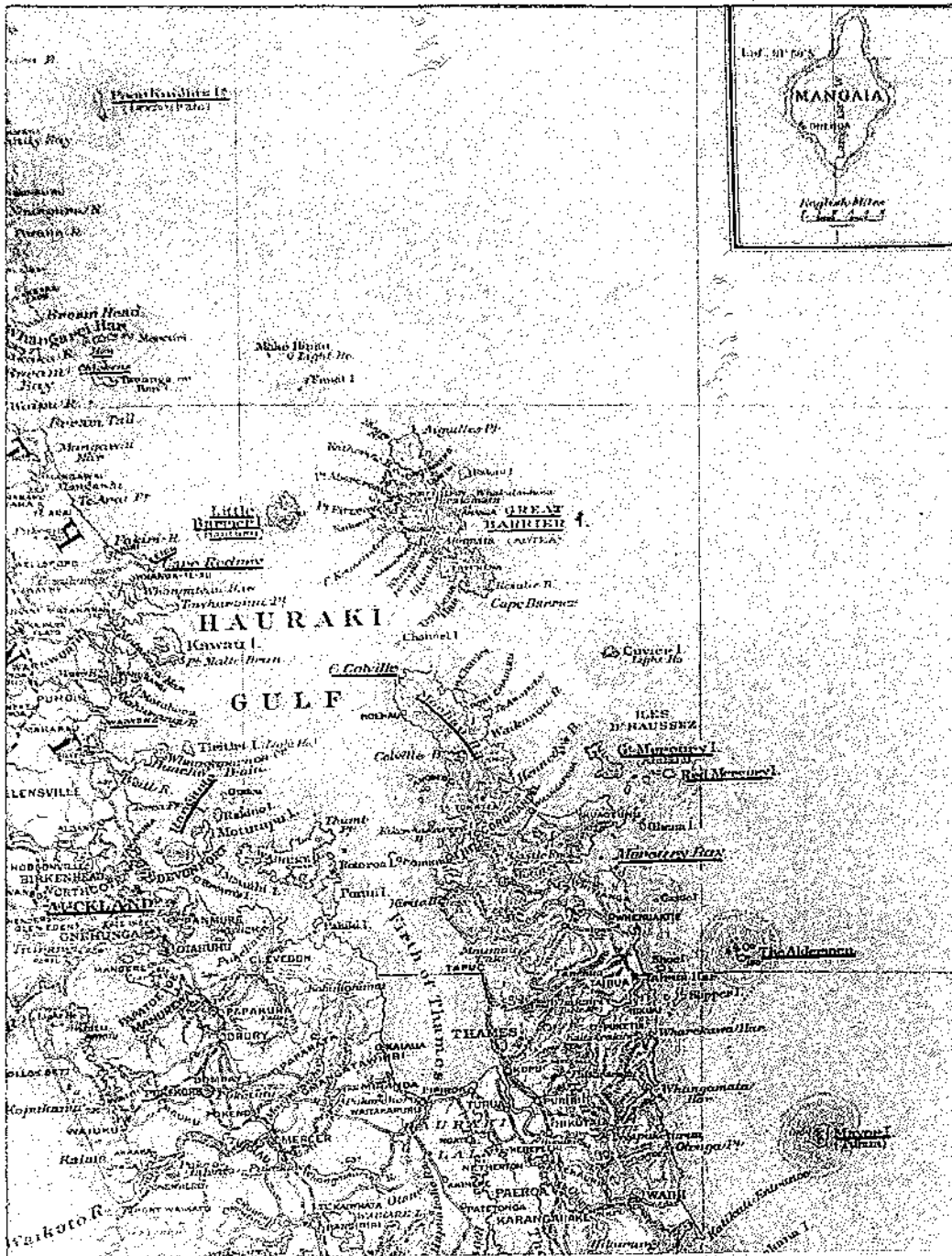
Maori tradition states that the ancient name of Hauturu (The Wind's Resting Post) was bestowed by Toi who arrived in New Zealand from Hawaiki about 1150 A.D. in search of his grandson Whatonga. The Island was uninhabited by "ordinary mankind" but on the misty summits lived the Patu-paiarehe (fairies), visiting the coastline only at night or in misty weather to fish and collect sea foods.

Toi had a dog, "Moi-pahu-roa" (Moi of the long bark) which he cast overboard to seek a landing for the canoe. A slave (Mokai) was sent ashore on the dog's back, but the sea being rough and the landing rougher, the dog refused to go ashore so the slave killed it with a blow of his weapon and cursed it for not landing. The dog turned to stone and the mark of the weapon is still seen on it. The slave, afraid to return to the wrathful Toi, fled to the forest and in stormy weather is still sometimes heard calling the dog "Moi- pahu- roa- ! -epahu! -epahu! -roa!" This rock, (plate 2) was tapu and was a ceremony stone (uru-whenua) where first-comers laid an offering and where fishermen placed a fish to propitiate the sea spirits.

1. I am indebted to Mr. G. A. Graham for much of the information relative to the early history of the Island; I have also drawn freely on Boscowan's published reports.

FIGURE 1.

LOCALITY MAP OF LITTLE BARRIER.



Places mentioned in the text are underlined in red. Note particularly the Poor Knights Islands, the Hen and Chickens, Moehau R. and the Aldermen Islands.

Land and Survey Dept. map.

Some of Toi's people later lived at Hauturu on "The Flat" there, (Plate 3) called "Marae-roa" (The Long Courtyard) after a place at Hawaike; Toi himself went to Waitemata and later to Whakatane where he settled. His grandson, Whatonga, returned to Hawaike from his wanderings and, finding that Toi had set out for the land of Aotea-roa in search for him, he journeyed thence and found Toi at Whakatane; he later migrated and settled at Waitara

When the "fleet" of canoes "Arawa", "Tainui" and others coming from Hawaike arrived at the East Cape about 1350 A.D. many of them came on to Hauraki and some of the Arawa canoe settled there. Hei, one of the Arawa canoe, lived at Mercury Bay, and hence the Ngati-Hei of that place. His son Waitaka, was the ancestor of the Ngati-Wai who intermarried with Toi's people of the Great and Little Barrier and later were granted title to the Island.

About 1650 A.D. the chief Maki of Taranaki, a descendant of Whatonga's, came on a punitive expedition to Waitemata and Kaipara. He destroyed many of the villages and captured many war canoes in a fleet of which he then attacked the outlying islands. On this occasion the Ngati-Wai of Hauturu were able to repel the attempted landing of Maki's forces, who lost several canoes and their crews in the attempt, owing to heavy weather intervening.

Later, however, Maki's younger brother, Mataahu is reputed to have returned and killed many of the Hauturu Natives at a spot called Te Pua on the south side of the Island and it is from this reputed subjection of the Ngati-Wai that the Ngati-Whatua later claimed ownership of the Island. A burial place at Te Titoki Point is known variously as Ngapumataehu and Pua Mataahu and appears to have some connection with this invasion. (Plate 4).

It was probably subsequent to this date that arose Rangihokaia, (see Geneology; Appendix i.), the chief who was the common

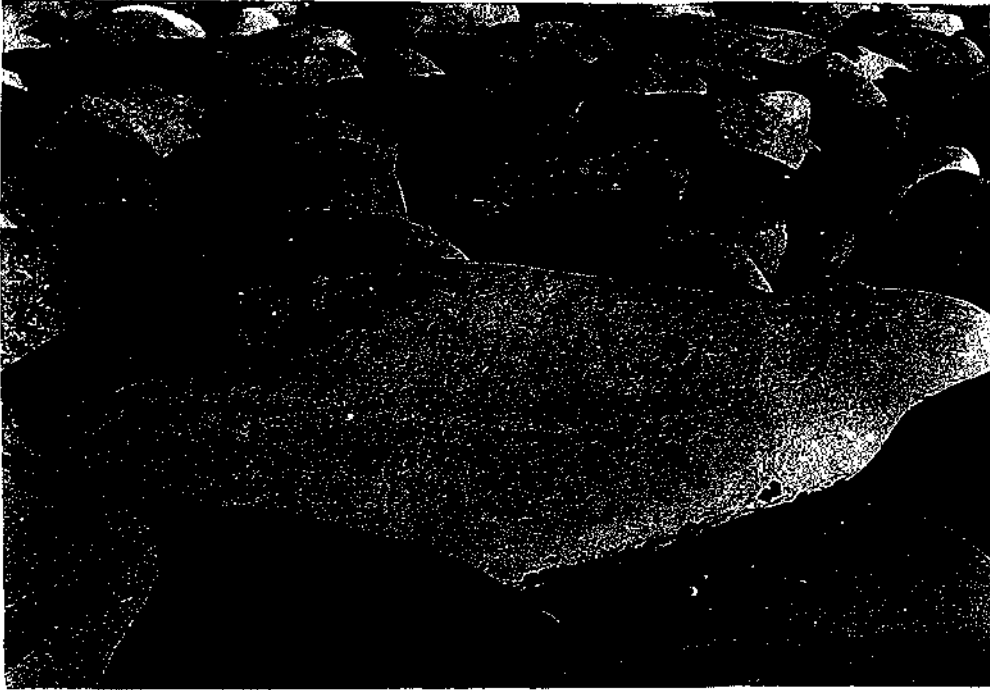


PLATE 2. The Hauturu Stone on the beach at The West Landing. Note the mark on the back of the "dog" where it was struck by the slave. This was a tapu stone or "aru-whenua" of the ancient Maoris where first-comers laid an offering and where fishermen laid an offering to propitiate the sea spirits. The stone is about two metres in length and lies between high and low water mark on the beach.

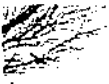


PLATE 3. "The Flat", "Marae-roa", on the south-western side of the island viewed from the ramparts of Parihakoakoa pa. The "West Landing" is in the immediate foreground while the position of the Hauturu Stone is marked by a cross. Te Titoki Point stands out clearly to the right.

ancestor of the grantees to the title of Hauturu. His descendants, it was, who built the pas at Te Hue and Haowhenua^a. These pas were on the cliff-tops being well defended by deep trenches on the narrow spurs leading up to them. The old kumara pits and the trenches surrounding the pas are still plainly visible while away back in the bush on the Flagstaff range are more pits presumably used as reserves in case of prolonged attack.

Te Kar^u is said to have lived in Parihakoakoa pa at Waipawa; Boscawen (4) records (1893) that "the walls are still standing, made from large boulders from the beach; but the old carved posts, which tradition states were there, must have rotted away very many years ago, as an old ngaio tree is now growing in their place and it shows signs of great age. The natives only lived in this pa in rough weather, when their enemies from the mainland could not cross in their canoes; in fine weather they lived at the Te Hue and Haowhenua pas".

There are many traces of old occupation on "The Flat"; long ridges of stone, probably collected off land the natives proposed to cultivate, are still standing though now almost covered from sight by soil and vegetation. There is also, near Te Waikohare, a large passage through the boulders (Plate 5), evidently where the natives must have hauled up their canoes, or have launched those built up the gullies.

Wars between the Ngapuhi and other northern people and those of Waitemata, Kaipara and Hauraki continued till after the arrival of the "Pakeha"; several times Hauturu was attacked by fleets coming and going in these expeditions and though the Ngati-Wai had sometimes to seek refuge in the precipitous interior of The Island they were never dispossessed. The last record of cannibalism on the Island is when, after the defeat of such a party by the Ngati-Wai under the leadership of Te Heru, Te Waihoripu was killed and eaten at Te Waikohare near the present care-



PLATE 4. Looking from Kapuamataahu, an ancient burial place and the supposed scene of a massacre of many of the Hauturu natives by Maki's younger brother, Mataahu. Shews the "South Landing" in the curve of the bay and in the distance Awaroa Point with Mt. Haurua through the trees.



PLATE 5. The passageway through the boulder bank at the south landing thrown out by the Maoris in order to permit them to haul up their canoes from the beach or to launch those built up the gullies. Now used as a pathway from the caretaker's house to the South Landing. Mt. Herekohu in the distance.

taker's residence, probably between 1820 and 1830.¹

The Island was used by the celebrated Hongi as a calling place when on his punitive expeditions to Hauraki and Bay of Plenty; Sir James Cowan records (10) that Paratene te Manu, then a young man, accompanied Hongi on eight excursions between 1822 and 1830. In later years, (1862) Paratene te Manu visited England and was given an audience by Her Majesty, Queen Victoria.

In more recent times the Maori occupation was sporadic, few residing constantly at Hauturu but visiting frequently from Aotea (Great Barrier) and Pakiri for fishing and bird-snaring. In the late sixties and up till the time of the purchase of the Island by the Crown, much firewood was removed by the Maoris from the lower slopes of the southern, western and northern parts of the Island and altogether nearly one third of the Island must have been cut or burnt over prior to its acquisition by the Crown. Gum-diggers were also active and added to the destruction of the native flora.

"In 1844 the Island was offered for sale to a Mr. Hughes, a grocer in Shortland Street, Auckland, by Pomare, of the Bay of Islands; but the Ngatiwai hearing of it turned up and objected to the sale just as a bargain was completed. A small schooner was to have been given Pomare for it." (4)

With the gradual spread of colonisation, with its resultant destruction of the native flora and fauna, attention began to be directed to the establishment of sanctuaries. So at a meeting of the Auckland Institute and Museum (2) held in 1875 Mr. F. D. Fenton suggested that the Island should be set aside

¹ Mr. R. Shakespear, son of the first caretaker of the Little Barrier, informs me, however, that at a later date a fugitive from Orakei landing on the Island met a similar fate near the entrance of Awaroa Stream on the south coast - hence the name "Cannibal Gully" by which the stream is sometimes known.

for this purpose, in pursuance of which object the Council urged Sir R. Stout, then Premier of the Colony, to purchase the Island from the Native owners without delay. Public opinion was expressed in favour of the proposal and it was also warmly supported in later years by Lord Onslow and Sir W. L. Buller.

ESTABLISHMENT OF TITLE.¹

The ownership of the Island was claimed by two tribes, the Ngati-Whatua and the Ngati-Wai. TeHemara Tauhia first made formal claim of ownership on June 1876 and this was followed by a series of claims by other tribal members of the Ngati-Whatua and the Ngati-Wai. The Native Land Court held its first meeting to adjudicate on the establishment of title to Hauturu, at Helensville at a sitting presided over by Judge Rogan. A decision was arrived at in favour of Ngati-Whatua but the absence of the Ngati-Wai from this hearing led ~~to~~ the Governor in Council to set aside the judgment and order a rehearing.

"A procuring by way of such hearing was opened at a sitting presided over by Chief Judge Fenton, who personally decided in favour of Ngati-Wai, but his assessor not concurring the procuring lapsed, but effect was afterwards given to the Order in Council, when, at a sitting presided over by Judges Munro and O'Brien the Court found in favour of Ngati-Wai".

"Here the legislature interposed and, by a clause in the Special Powers and Contract Act 1883, enacted that Hauturu should be redeemed to be again native land and its ownership be again inquired into by the Court. In 1884 a sitting was duly held when

¹ I am indebted to Mr. Earle of the Native Lands Court, Auckland, who permitted me to peruse the files and minutes of the Court dealing with the procuring of title for the Island.

the Court found Ngati-Whatua to be the owners instead of the Ngati-Wai. But the legislature being no more satisfied with this one of the only two possible decisions than it had been with the other again interposed and by enactment in 1884 prescribed another hearing which was held before Judge Puckey when the Court again declared in favour of Ngati-Wai."

The Ngati-Whatua claimed ownership by right of conquest by their ancestor Maki and his younger brother Mataahu who they claimed subdued the people of Hauturu. They admitted that the land had not been occupied by their tribe, but claimed that the Ngati-Wai paid toll for the use of the land and that the Ngati-Kawerau had in their possession a tiki given as part payment for the right to occupy the land.

The Ngati-Wai claimed from their ancestor Rangihokaiia who it was alleged occupied from a period "when men were stones" and whose descendants had continued to exercise rights of ownership without having been dispossessed. As one witness¹ said, "The Ngati-Wai may claim both by ancestry and by occupation; they have cultivated there; their dead are buried there; and there are none but Ngati-Wai on the land. The hearthstones of the Ngati-Wai on Hauturu had never grown cold." Occupation giving the premier claim to ownership the Ngati-Wai were finally adjudged owners, the title being made out at a sitting of the Native Land Court of New Zealand held at Auckland before Edward Walter Puckey, Esquire, Judge, and Benjamin F. J. Edwards, Assessor, on the 18th October 1886. (Fig. 2.)

¹ Mr. J. A. Tole; Crown Solicitor attached to the Auckland District.



FIGURE 2. The Title map of the Little Barrier lodged in the Lands and Survey Office, Auckland. The map was made by enlargement from the Admiralty Chart and bears the signatures of the various Judges of the native Land Court of New Zealand before whom the map was produced in the securing of title to the island. Note the signatures of Judges Macdonald, Puckey, Fenton, O'Brien, Munro and von Sturmer.

The shares of the various owners were determined at a sitting of the Native Land Court on the 28th May, 1892, as follows :-

Rahui te Kiri	One-thirtieth
Ngapeka	One-thirtieth
Wi Taiawa	One-thirtieth
Tenetahi	One-tenth
Miria Taukokopu	One-tenth
Paratene te Manu	One-tenth
Ngapera Taiwa	One-twentieth
Hone Paama	One-tenth
Kino Rewiti	One-twentieth
Pita Kino	One-twentieth
Rapata Ngatiwai	One-tenth
Te Nupere Ngawaka	One-tenth
¹ Miria te Moananui	One-fortieth
¹ Mata Kuru	One-fortieth
¹ Paratene te Manu	One-twentieth
Ngawhare Taiawa	One-twentieth

THE PURCHASE BY THE CROWN. ²

The Island was first proclaimed as under negotiation for purchase by the Crown in a Gazette notice in 1881 but further negotiations were delayed pending the completion of the procuring of a title to the Island in the Native Land Court.

¹ Shared the estate of Henare te Moananui who died in September 1891.

² My thanks are due to the Under Secretary for Lands for the assistance given me in obtaining information relative to the purchase of Hauturu by the Crown and for permission to peruse the files in the Auckland Lands and Survey Office.

Following the issue of a title to the Ngatiwai, negotiations were entered into by the Government in October 1891 for the purchase of the Island.

"We Native Owners of Hauturu, hereby agree that the Island shall be sold to the Government for the sum of three thousand pounds (£3,000) which is the price fixed by the Hon. Mr. Cadman, Native Minister.

We also agree that the purchase price shall be divided amongst us according to the relative interests recently defined by the Native Land Court, that is to say :- "

And follows a list of the Native Owners and their respective shares as set out on page eight.

"And we severally agree to sell our respective shares to the Government and to accept our respective shares of the purchase money according to the relative interests defined by the Court".

However, in the establishment of title the cost of the proceedings on behalf of the Ngatiwai had been borne by Tenetahi on the understanding that on the successful establishment of title and sale to the Government, Tenetahi was to be reimbursed by the grantees to the title. The following agreement between Tenetahi and Mr. Edger, on behalf of the Crown, was drawn up in October 1891 :-

"It is hereby understood that in signing the deed transferring Hauturu to the Queen, no money (consideration) is to be paid to any of the owners until all of them sign the said transfer and if all the other said owners consent to Tenetahi receiving the whole of the said money (£3,000) the same shall be paid to him for distribution amongst all the owners according to their respective shares." At the same time Mr. Edger obtained a deed of transfer of the shares of Wai Taiawa, Tenetahi and Kino Rewiti.

About this time the natives received tempting offers for the kauri timber upon the Island and began to regret the agreement they had entered into with the Crown. However, as by

no means all the grantees to the title had signed the agreement to sell a notice was inserted in the "New Zealand Herald" for January 7th, 1892 stating that as Mr. J. A. Tole had failed to complete negotiations for the purchase of the Island it was no longer for sale, but inviting applications for the lease of the Island or independently for the sale of the timber.

Following this notice Simon Welton Brown, the son of Mr. Brown, then Chairman of the Rodney County Council, entered into an agreement with Tenetahi on March 12th 1892 to purchase all the kauri on the Island for the sum of £1,000, all the timber to be removed within five years. The conveying of the timber from the water's edge at Hauturu to Auckland was under taken by Tenetahi.

"Mr. Gerhard Mueller (Chief Surveyor, Auckland), in reporting to the Surveyor General in July 1892 says 'the kauri is small and hardly worth the risk and trouble of obtaining, as it is cut and then thrown over the cliffs to take its chance of falling on the beach below without being shattered. I saw several logs on the beach with splinters twelve and sixteen feet long broken off them'.

In a report dated October 1892 Mr. Henry Wright observes that "the felling and hauling of kauri had already made great havoc with the bush (in Awaroa Stream) - - - every kauri tree of sufficient size having been removed. Eight white men are up Wai-pawa (Stream) felling kauri and drawing out with bullocks".

"In consideration of Tenetahi bearing the whole cost of carrying the title through the Land Court it has been agreed that the timber is to be his own property. He has arranged with Mr. Brown to fell all the kauri as speedily as possible, the object being to realize on it before the sale of the Island can be completed"

Brown estimated the kauri on the Island at eight million superficial feet and proceeded energetically to arrange for its

felling and conveying to Auckland. A weatherboard house was erected on "the Flat" near Waipawa, bullocks were brought over from the mainland and the work of destruction began in earnest.

Removal of the ~~first~~^{first} covering would have destroyed the value of the Island as a bird sanctuary and hence its value to the Crown who were negotiating for its purchase. Backed by public opinion, the Land and Survey Department did all in its power to prevent further felling of kauri on the Island by notice appearing in the press, and by posters placed in conspicuous places round the coast of the Island, warning that all persons other than the owners or occupiers of the Island, who cut timber or trespassed, would be proceeded against by the Crown - dated June 1892.

However, not to be discouraged by this setback, the native owners, proceeded to fell and log the timber on the Island and by the late spring of 1892 logs from the Island were arriving weekly at the sawmills at Auckland, conveyed thence in the scow "Irene".

In September of that year Mr. Bishop R.M., visited the Island, acquiring and paying for the interests of Hiria Taukokopu, Paratene te Manu, Miria te Moananui and Mata Kuru, being three-tenths of the shares in the Island. As the Crown has now paid one-third (almost) the value of the Island they had power to claim one-third of the value of anything exported therefrom, and further timber arriving in Auckland was marked with the Government brand.

At the same time ~~an~~^{an} injunction was issued restraining Brown or Tenetahi from further timber cutting (December 1892) while Mr. Henry Wright was appointed temporary ranger to see that the injunction was obeyed. He was succeeded in that capacity by Mr. Chas. Robinson of the Agriculture Department in February 1893.

Unavailing efforts were made by the Crown to complete the purchase but without success. The two chief grievances of the natives appear to have been :-

1. Tenetahi's agreement with the Government by which he was to have reimbursed himself for the cost of the Native Land Court proceedings had been broken, by the Government treating individually with other native owners. Tenetahi naturally objected to selling his land when the purchase price by the Government (for his share) would scarcely recoup for him the cost of establishment of the title; a benefit which had been enjoyed equally by the other owners.
2. There was a definite feeling on the part of the Native Owners that Brown had been ^{harshly} dealt with by the Crown. Brown had paid a deposit on signing the contract with Tenetahi; he had been ^{ou}put to considerable expense in erecting a house on the Island and in conveying bullocks, men and gear from the mainland, while such timber as had been conveyed to Auckland had been seized by the Crown; the remainder lay either at the water's edge or alongside the bullock tracks on the Island. Whether or not Brown's contract was legal following the Gazette Notice 1881 of the Government's intention to purchase the Island, and the agreement by the Native Owners to sell it, the Native Owners felt that Brown should have been compensated for his losses and refused to treat further with the Government.

How far this attitude on the part of the Natives was prompted by a genuine regard for what they believed to be a gross injustice done to Brown, and in what degree it was merely a veneer covering their own sense of frustration at being deprived, by the intervention of the government, of the value of the contract, it is now difficult to say, but probably the latter added considerably to the force of their protests on Brown's behalf.

Matters continued in this unsatisfactory state for some time, the remaining Native Owners refusing to treat with the Government for the final disposal of the Island to the Crown. At

the Annual Meeting of the Auckland Institute, February 1894, a resolution was passed requesting the Council to urge the Government to complete the purchase as speedily as possible since, "by degrees, the Island is being rendered less suitable for the purposes of a preserve". (2) "In response to this, a deputation of the whole Council waited on the Premier fully explaining the position of affairs and the necessity for immediate action. He expressed himself as being anxious and willing to expedite the purchase; and engaged that if the Native Owners continued to refuse reasonable terms a Bill would be introduced into Parliament providing for the compulsory purchase of the Island at a fair valuation."

This was later done under the provisions of "The Little Barrier Island Purchase Act 1894" which provided that the Island should be deemed Crown Land and the respective shares of the purchase price (£3,000) of those Native Owners who had not signed the Deed of Transfer should be paid to the Public Trustee on their behalf. (12) "This gave the Crown legal, but not quiet possession, as Tenetahi and his family obstinately declined to remove their cattle and other belongings. Briefly to recapitulate events, it will suffice to say that as soon as legal possession had been given to the Crown the European and Native residents upon the Island were given notice to quit, and a steamer was sent down by which they had the opportunity given them of being removed with all their belongings to any place they chose. Shortly after this Tenetahi appealed to the Stipendiary Magistrate for an extension of time to remove his stock and crops, alleging as a reason that his scow was being repaired, and to this the Magistrate agreed. The six weeks expired in the middle of May and during that time (the caretaker's services having been dispensed with) two of the permanent Force were stationed upon the Island as representatives of the law, and are still in residence. To show how little Tenetahi intended from the first to keep faith, he has not, up to this date, attempted to remove any of his belongings, though

his vessel is long since repaired - - -". Finally the Natives still resident upon the Island were removed with the help of the Permanent Force and a specially chartered vessel removed all the live stock on the Island claimed by the Maoris.

There remains little room for doubt that Tenetahi had a genuine grievance in his claim for reimbursement for the costs of establishment of title to the Island and the action of the Crown in compulsorily purchasing the Island at a fair valuation may be hard to justify as a standard of policy for dealing with the Native Owners of land, who believed their titles sacrosan^ct under the Treaty of Waitangi. Be that as it may, it still remains, that, viewed in perspective, the purchase of the Island has created for the flora and fauna of New Zealand a preserve, unequalled elsewhere, and the value of which, as such, might have been seriously diminished had its purchase not been effected ^{when} ~~as~~ it was.

(13) "Having thus obtained possession, the next consideration was how best to carry out the object for which the Island was purchased. This it was felt could best be done by the Auckland Institute, and it was agreed that the Government should grant £200 to cover the expenses of management for one year; that the Institute should appoint a resident curator and that the Government steamer when making her periodical visitations to the northern lighthouses, should, when convenient, call at the Island and land stores for the use of the curator. A sum of £250 was also granted for the erection of a house for the curator upon the Island." (Plate 6).

Mr. R. H. Shakespear was appointed curator by the Auckland Institute and left for the Island early in January 1897 since which date a caretaker has been constantly in residence upon the Island to prevent unauthorized persons from landing.

¹On April 1st 1905 control of the Island was assumed by the Tourist Department in whose hands it still remains. The services of Mr. R. H. Shakespear were retained until, owing to ill-health he resigned on February 28th 1910 but died two days later and was interred at Leigh. His son, Mr. R. Shakespear now of Whangaparoa, remained on the Island till the appointment on May 4th of the same year of Robert Hunter-Blair, the third son of Sir Edward Hunter-Blair, baronet, of Ayrshire, Scotland. Mr. Blair had been in indifferent health for some time previous to his transfer to the Little Barrier and in September 1910 he took seriously ill and expired the following morning, the 22nd September. His widow the only other person on the Island, interred the body in a grave not far from the house and having no means of communication with the mainland waited patiently for a boat to call at the Island. Five days later, the Government steamer "Hinemoa" called and Mrs. Blair was brought to Auckland. The grave remains as a mute reminder of one of the minor tragedies of the Gulf.

Mr. Hunter-Blair was replaced by the temporary appointment of Mr. T. P. Firman who was caretaker from the 17th November 1910 until the 12th May 1911 when he was succeeded by Mr. Robert Nelson who was appointed on the 29th May 1911 and remained until the 4th May 1922 when he retired on superannuation.

His successor was William Cleaver who remained until the 29th August 1923. During Mr. Cleaver's caretakership an unauthorized visitor to the Island met his death under tragic circumstances. Mr. H. G. Weidman, one time first mate of the ill-fated schooner "Cecilia Sudden", was apprehended by the caretaker, gum digging on the Island and was taken to the caretaker's residence. However, during the night he made his exit and rowed away in Cleaver's dinghy. It was not till eleven days later (June 27th 1923) that the body of the man was found on the beach at the foot of high cliffs and interred on the Island. The manner in which Weidman met his death remains a mystery.

¹ Much of the information relative to the recent history of the Island was kindly supplied by Mr. G. W. Clinkard of the Tourist Dept



PLATE 6. The Caretaker's residence upon the island erected in the year 1898 from a grant of £250 made by the Government for the purpose. The Te Waikohare stream flows immediately to the right of the house. Mt. Herakohu shews through the trees on the left. Photo by T.W. Collins.



PLATE 7. The arrival of the fortnightly mail on the island. Landing is impossible except in the calmest weather and the mail service while ostensibly running once a fortnight is strictly subject to "weather permitting."

A suitable caretaker not being available, Robert Nelson agreed to return to the Island (September 1923) where he remained until the 15th November 1932, when he again retired on superannuation.

William Henry Hardgrave, the present caretaker was appointed on the 15th November, 1932.

Communication with the Island is maintained by a fortnightly launch service run from Leigh (Little Omaha) by the Post and Telegraph Department, the present holder of the tender being Mr. D. Mathieson. (Plate 7).

Permission to visit the Island must be obtained from the Tourist Department. As a sanctuary some restriction is necessary on visitors to the Island; it is no place for picnics nor have the merely curious any right there, but with proper supervision by the caretaker every facility is, and should be given to those genuinely desirous of studying, under natural conditions, our fast disappearing bird and plant life.

Only so, can we justify in some small measure our inroads into the domain of Maoridom. This attempt to draw together such information as was available regarding the history of the Little Barrier might well have been from abler hands, but I trust it may serve as a foundation for further research into the stories and legends of Hauturu before such are forgotten together with the people who, at one time, called Hauturu "Home".

T O P O G R A P H Y.

The Little Barrier is roughly circular in outline being 7.5 km., (4.5 miles) from north to south and 6 km., (3.8 miles) from east to west and having an area of approximately 2,832 hectares (7,000 acres). (Fig. 3.)

The Island consists of a much dissected volcanic cone of Tertiary age, with deep and precipitous ravines radiating from the central group of peaks, which rise to a height of over 700 metres (2,300 feet) above sea-level.

Hauturu was doubtless formerly of much greater extent but incessant marine erosion has, in the course of time, reduced the Island to its present size and flanked it on all sides, save at "The Flat" on the south-west, with high and forbidding cliffs. Owing to the eastern side being exposed to the full fury of Pacific gales, that coast has tended to recede more rapidly than the comparatively sheltered western side and the cliffs there are higher and the northern side of the Island also is, generally, more precipitous than the western.

The constant erosional recession of the eastern coastline has resulted in the streams flowing to that side of the Island, constantly cutting down their beds, so that many of them flow through narrow steep-walled gorges. Many not having the volume of water to erode their beds to grade, or having their courses leading over resistant rocks, have failed to grade their outfalls to sea-level and discharge from the gorge-mouth as a waterfall onto the beach below. (Plates 8, 9 & 11). The process of degradation must be comparatively slow, since, during the greater part of the year, the streams carry little or no flow of water. Waterfalls, with graded reaches between them, are common in the ravines and render the negotiation of such streams a matter of extreme difficulty. (Plate 10). That the rate of recession of the coastline is not invari-

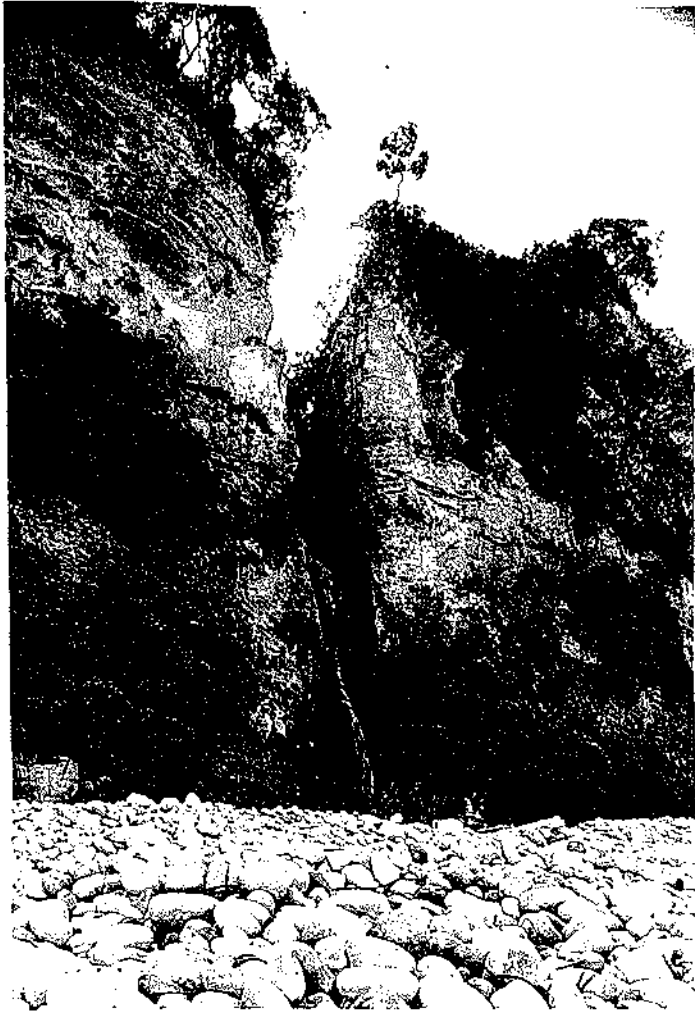


PLATE 8.

On the left; the outfall of
Haurua Stream on the East coast
showing the hanging valleys
characteristic of many of the
streams discharging onto the
eastern coast. The fall is
approximately 50ft. in height.

PLATE 9.

On the right. A view taken in
the Crau Gorge showing the nar-
-row steep-walled formation cut
through breccia and a wind
erosion cavity cut high up on
the gorge wall. The bare stem
in the mid-foreground is that of
a dead mamuku (Cyathea medullaris)





PLATE 10.

On left; Waterfalls with graded reaches between them are common in the ravines. This picture shows a party in process of negotiating a fall in the Orau Gorge with the aid of a rope which was always carried as part of the equipment.

PLATE 11.

On right. The entrance of Orau Gorge. Looking seaward from the top of the fall onto the beach below.



ably the cause of waterfalls near the outfall of streams is shewn by the fact that several of the streams (e.g. Whekau and Waitoki) have graded their beds for a short distance back from the sea (50-100 metres) before the first fall is encountered.

On the southern coast and on the western coast, as far north as Haowhenua, the streams have graded their outlets to beach level and the country which they drain is of a more gently sloping and maturer topography than the northern and eastern side of the Island, while waterfalls in the streams are infrequent.

Except after heavy rains, many of the streams carry little or no run of water during the drier seasons of the year. The stream beds are almost entirely covered with large andesitic boulders and such water as may be present easily escapes from view, except where the creek-bed becomes visible. Much of the water also percolates away through the jointed lava-flows of the eastern side of the Island, while the breccia of the western side also appears to be very porous, allowing the ready escape of all but excessive precipitation. At Awaroa Point a strong underground stream issues from under the breccia cliff and, in the summer months at least, carries a considerably greater volume of water than Awaroa stream, and similar streams issue at other points along the coast.

The position of the vent or focus of eruption is not now apparent owing to the extensive denudation which has occurred since the period of eruptive activity. Instead, occupying the centre of the Island is a group of high peaks, connected by knife-edged ridges the slopes of which drop precipitously 400 metres or more into ravines which diverge in all directions from the centre of the Island to the coast. (Plates 12, 13 & 14).

The ridge system may be considered in two sections. The main ridge of the eastern section commences at Ngatamahine Point and, from a relatively flat-topped plateau, gradually increases in elevation until it rises abruptly to the table-topped



PLATE 12. The summit of the island, Mt. Hauturu (704m.) viewed from Kiriraukawa, 695m. (2,280 ft.) and showing on the right the windswept ridge separating Crau Gorge from Awaroa Stream. Dracophyllum recurvatum in the foreground.



PLATE 13. Looking down the Crau Gorge from the summit of Kiriraukawa Mt. Crau 646m. (2122 ft.) towering 400m. above the gorge on the right-hand side illustrates the precipitous nature of the island.



PLATE 14. Looking north-east from the summit of Mt. Ohakiri showing flat-topped Mt. Crau in the distance and to the left Ngatamahine Point, the Waitoki Gorge in the foreground. Note also the cluster of kauri on the ridge in the middle distance and the bare rock faces showing in several places.

peak of Orau, 646 metres (2,122 feet) high. The ridge then continues southwards at a high elevation to Orotere, 667 metres (2,190 feet) and Kiriraukawa 695 metres (2,280 feet) which latter is only slightly lower than the peak of Mt. Hauturu 704 metres (2,314 feet). The ridge then drops to a low saddle before rising to Whekauwhekau 640 metres (2,104 feet) after which it falls away steeply one hundred metres or so to a flat-topped ridge out of which rises Hauruia (Bald Rock), an enormous mass of columnar jointed andesitic lava having its long axis parallel with the ridge and having a bare rock-face 110 metres in height on the western side. The ridge then drops rather sharply to flatten out into a plateau sloping gently seawards and intersected by a number of shallow streams.

From Kiriraukawa northwards the ridge is flanked on its western side by the Orau Gorge and southwards of that peak by the Awaroa Stream; these are the two largest gullies on the Island, being separated only by a narrow, tortuous, knife-edge ridge leading from Kiriraukawa to Mt. Hauturu (Mt. Archeria). Eastward, a series of high ridges run towards the coast gradually losing elevation to end abruptly in lofty cliffs and precipices at the coast. Connecting with the main ridge between Orau and Orotere by a low saddle, is Kauri Ridge, a long flat-topped divide approximately 450 metres (1,400 feet) in elevation running in a north-easterly direction. At its seaward end this terminates abruptly in a precipice 430 metres (1,433 feet) high where at some time a large landslide has occurred. The billowing surface of this old land-slide covers an area of approximately 23 hectares (60 acres) known as "Hingaia" or "Pohutukawa Flat". The highest part of the slide now rests at an elevation of approximately 60 metres (200 feet) above sea level, a tumbled mass of lava blocks. In its downward course the landslide swept outward along the coast to the south and, at the southern end of "Hingaia", 80 metres from the present coastline, half-buried the entrance of a former marine cave.

(See Plate 15).



PLATE 15. The entrance of the old marine cave, its entrance half-buried by the debris of the landslip of "Hingaia" as it swept out along the coast to the south.

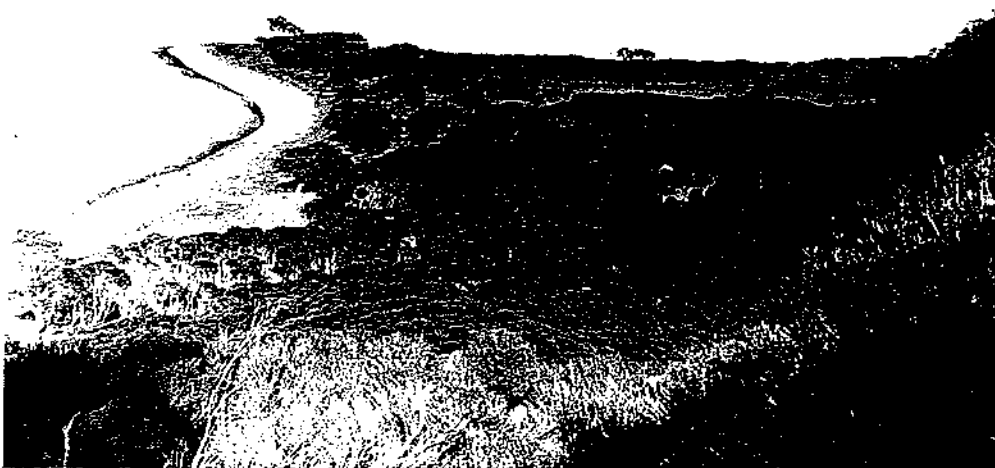


PLATE 16. "The Flat" from the east showing the boulder bank curving out to Te Titoki Pt. and the area of grass in the middle distance covering what was once an old lagoon. The Caretaker's residence is in the mid-foreground, just beyond the small clearing. The line of ancient sea cliffs shews plainly to the right of the photograph.

The western ridge system commences in a high rounded spur, 396 metres (1,300 feet) high, at the south point of Te Anau^u Bay. It trends inland in a south-easterly direction and drops slightly before rising steeply to Ohakiri 676 metres (2,200 feet) and Mt. Hauturu 740 metres (2,314 feet) the summit of the Island. It then runs south-west to Mt. Herekohu (The Thumb), a scrub-clad rock remaining on the ridge, from where it divides into a number of diverging ridges which at first rapidly lose elevation but gradually flatten out towards the coast.

On the south-western side of the Island, storm currents have built out two converging boulder banks which at their outer ends join, to form Te Titoki Point ("The Spit")^(Plates 3 & 16.). Three streams have their outfall into the triangular area enclosed by the boulder banks and the detrital material carried by these has been deposited in what was doubtless once a lagoon. The delta fans slope gently towards the boulder banks while between the fans are slightly lower areas which, in times of heavy rain, are submerged forming transitory remnants of the old lagoon. The alluvium deposited forms an area of level land 25.7 hectares (63.5 acres) in extent and relatively depressed in relation to the boulder banks except at the landward end of these where the banks are lower. The Te Waikohare, being a larger stream than the other two draining into the area, has built up a larger delta fan; it has then, at some time, cut its way through the boulder bank and excavated a steep-walled channel through its own fan of detritus.

Behind "The Flat" stills shews plainly the sea-cliffs of the ancient coast-line, now somewhat rounded and weathered in outline by subaerial erosion^{(Plate 17).}. The boulder banks are storm beaches built of material carried by opposing currents which sweep round the Island and meet at this point.



PLATE 17. The seacliffs of the ancient coastline still shew plainly behind The Flat, though now somewhat rounded in outline by sub-aerial erosion. Note the windswept manuka (*Leptospermum* spp.) in the foreground.

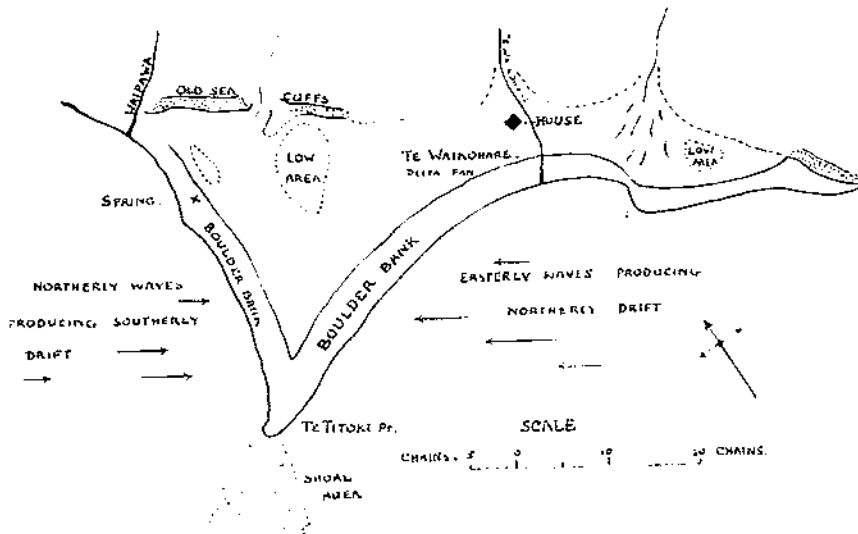


FIGURE 4. SHEWS THE POSITION OF THE BOULDER BANKS AND THE ENCLOSED DELTA FANS. Drawn by J.J.C. Suckling.

FIGURE 4.

During an easterly or north-easterly gale one wave system comes in via the Colville passage and striking the south end of the Island the waves, retarded in the shallower water near the shore, curve round the Island and sweep up the south-west coast; a second wave system coming round the northern end of the Great Barrier and striking the northern end of the Little Barrier, in like manner sweeps down the western coast, the two opposing wave systems meeting at the point now occupied by "The Flat" and producing an area of "dead water". The opposing drifts produced by the two wave systems have resulted in the deposition of a line of debris on each side of this "dead water" the two lines converging to enclose a lagoon. The drift from the south being somewhat the stronger of the two, the point of convergence has been forced northwards so that "The Flat" is assymetrical.

The storm beach is fully 6 metres (20 feet) above normal high tide level and composed entirely of rounded andesitic boulders perched precariously at the angle of rest. The drift from the south sweeps the entrance of Te Waikohare Stream north-westward and gives a slight hook to the end of the boulder bank.

The fact that the sea, previous to building the boulder banks as described, cut back a line of cliffs at this point may be explained on the assumption that the initial coastline fell steeply into deep water and it was not until continued erosion had built up a coastal shelf of accumulated debris that beaches were built at the base of the cliffs; previous to that, detritus was removed by wave action as rapidly as it was formed. Once beaches were formed the transport of material along the shore was possible and the boulder banks were built out, so protecting the cliffs previously subjected to marine erosion, (see Figure 5. .)

Except at promontories, the cliffs have at their base a wide boulder beach which makes landing by boat an extremely hazardous undertaking except in calm weather. The boulders vary considerably in size at different places along the coast but the sandy material formed by corrasion is carried seaward and

FIGURE 5.

Shows how the condition for the formation of the boulder banks was delayed until cliffs had been cut and a coastal shelf formed, partly by erosion in the basement rock and partly built up from debris formed by the erosion of the cliffs by the sea.

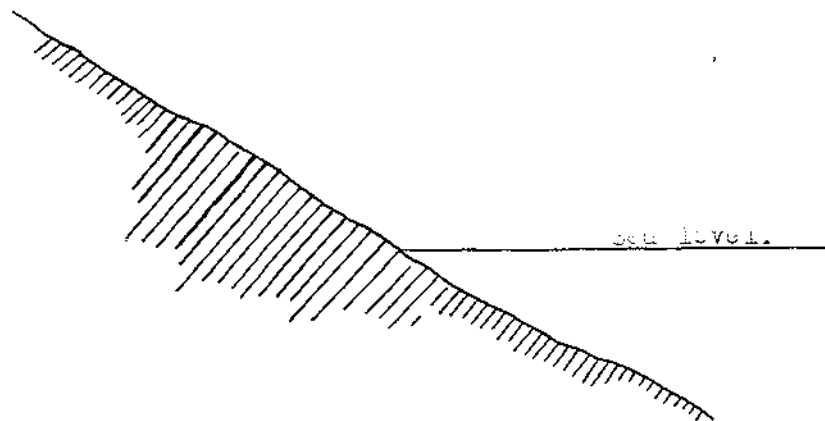


Diagram 1. The initial coastline falling steeply into deep water.

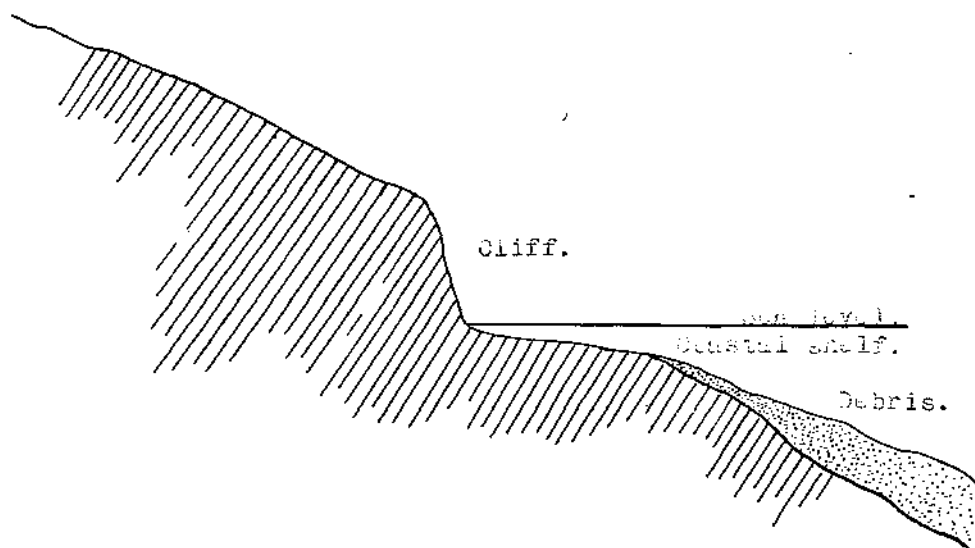


Diagram 2. The formation of cliffs by marine erosion but the condition existing where the debris formed is removed and deposited on the sea floor as rapidly as formed, the cliffs falling into deep water on the narrow coastal shelf formed.

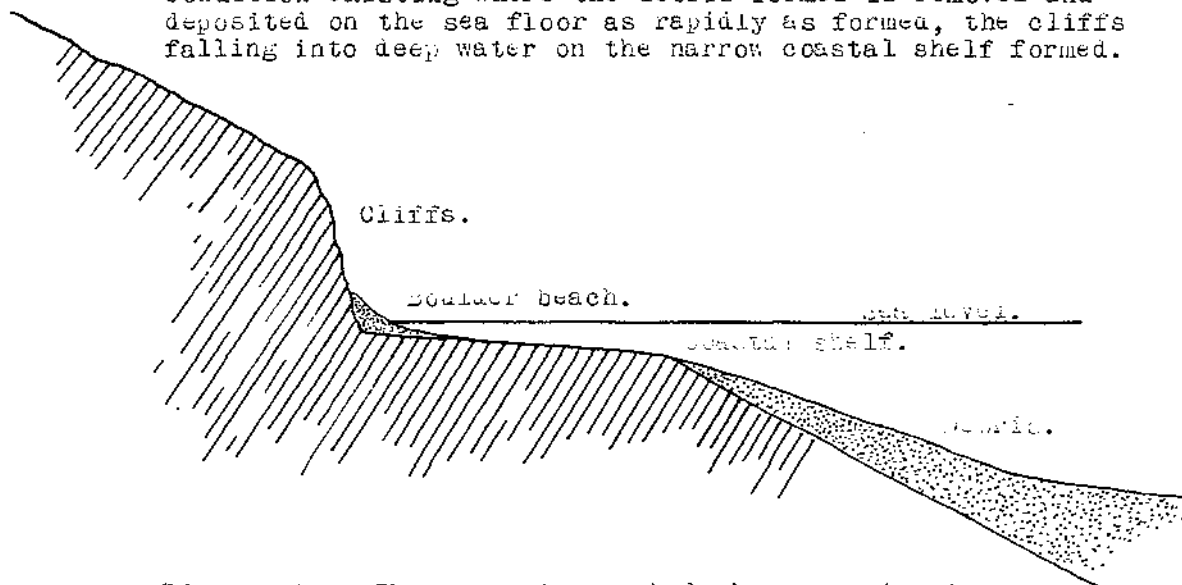


Diagram 3. The stage is reached where erosion is producing debris more rapidly than it can be transported away by the sea over the coastal shelf built partly of debris from the cliffs and partly cut in the basement rock conditions

forms the coastal shelf surrounding the Island, none being visible along the beaches. A narrow coastal rock shelf occurs at the northern end of Ngamanauraru Bay and at Ngatamahine but such is unusual. Owing to the discontinuous nature of the boulder beach it is not possible to traverse the coastline entirely by this means thus adding considerably to the difficulty of exploring the Island.

G E O L O G Y.¹

The Little Barrier forms the remains of an old Tertiary volcano probably co-eval in its activity with the "First" or "Second Period" volcanism of the Coromandel Peninsula. Most of the rocks are hypersthene andesites with numerous phenocrysts of felspar and may be divided into three readily recognizable types of lava flow :-

- (a) Massive grey lava flows,
- (b) Andesitic fragmentals, here loosely described as breccias, and
- (c) A readily weathered lava flow greatly resembling in its weathered state a fine-grained tuff.

The petrographical examination of a number of samples shewed "less diversity than is usually found in comparable areas of andesitic rocks" and indicates that in general the types are closely related to each other. None of the lavas sectioned shewed vesicular structure.

¹ I have to record my indebtedness to Professor J. A. Bartrum who kindly undertook the petrographical examination and reported on a number of rock samples collected on the Little Barrier.

Distribution.

The massive grey lava flows form the greater part of the mass of the Island and apparently represent the first extrusion from the volcanic vent, since they are overlaid by the breccias and subsequent lava flows. Subaerial denudation has, however, removed the overlying breccia from the greater part of the central and eastern portions of the Island. The massive andesite is also visible beneath the breccia at numerous points along the western coast e.g., at Haowhenua, Ngorengor^e, Te Hue Point and Ngatamahine Point. (See Plate 18).

The massive volcanics are usually jointed vertically and sometimes irregularly also on the horizontal plane while in some cases contorted flow-banding is apparent (Plate 19).

On the south side of Hingaiia there are large numbers of andesitic lava blocks, of microcrystalline facies, shewing a marked tendency to flake into thin sheets after the manner of a slate, (Plate 20). The source of these blocks, which form part of the landslide previously described, has not been observed.

The lava flow forming the cliffs north of Hingaiia is jointed in the vertical and imperfectly in the horizontal plane and contains numerous large felspar phenocrysts (2 - 3 mm. long) which weather readily at the surface, giving the rock a vesicular appearance.

Overlying the massive andesites on the northern, western and southern sides of the Island is a mass of andesitic breccia, in some places 120 metres (400 feet) in thickness. These andesitic fragmentals are normally weathered to a whitish, light-grey or slightly pinkish colour though in some of the breccias on the northern coast the colour varies from dark brown to a sombre red due to the presence of haematite. The angular inclusions vary greatly in size in different localities but a mean figure would be from 10 cms. (4 inches) to 50 cms. (20 inches). The breccias



PLATE 18. The junction between the massive lava flow and the overlying breccia at Raowhenua.



PLATE 19. Contorted flow-banding in a massive lava flow at Te Hue Pt. It was on the cliffs above that the Maori pa of the same name was situated. Toe-toe (*Arundo conspicua*) growing in the right foreground.



PLATE 20. Slabby andesite on the south coast of Hingaiā.

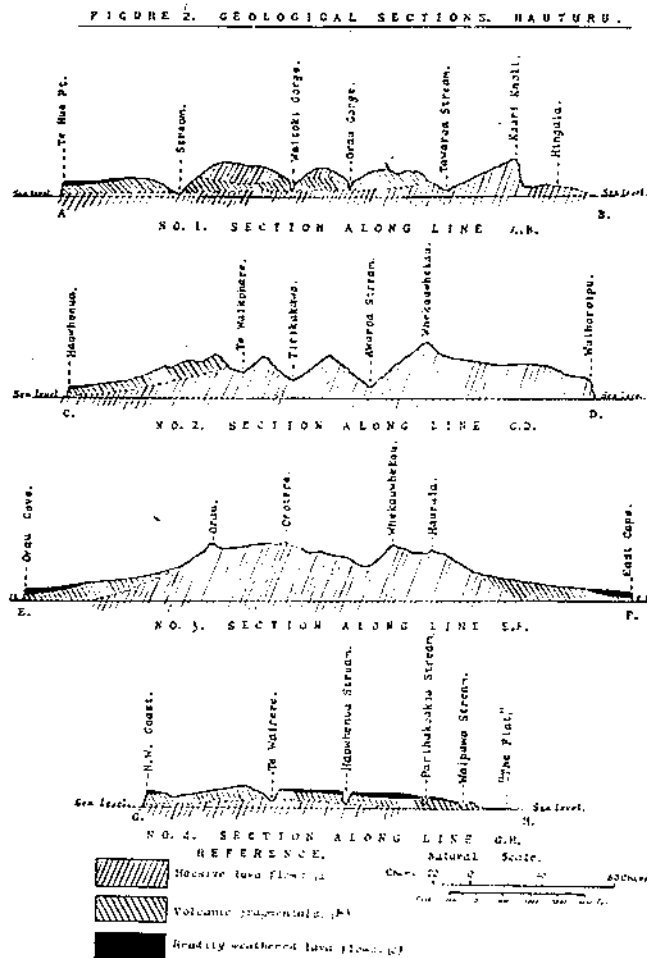


FIGURE 6. Geological cross-sections of Hauturu.

are well consolidated but weather readily; Professor Bartrum notes, "an interesting feature is the readiness with which the abundant glassy residum appears to break down into clay products".

Superimposed on the breccia is a much less extensive layer of a readily-weathered lava flow "^{rea}gently resembling ^{in its weathered state} a fine-grained tuff". This flow has not been observed in greater thickness than 30 metres (100 feet) at any point. It tops the cliffs at numerous places round the coast having nearly the same distribution as the breccia. It occurs on the cliffs south of Haurua Stream, on both the southern and northern sides of Haowhenua, north of Te Hue Point and at Orau Cove. The exposed faces of this type of lava weather perpendicularly and contain numerous small erosion cavities up to 0.5 m. or more in depth and of equal width giving the cliffs a peculiar honeycombed appearance. The distribution of this type of lava flow on the summits of flat-topped ridges suggests that it may consist merely of an accumulation of weathering products of the underlying breccia (19; P. 67) and such is probably the case but since it gives a distinctly characteristic type of vegetation it is for descriptive purposes here considered separately.

At the south end of Te Ananuiarau Bay the breccia, which is here dark red in colour, is 12 m. to 16m. in thickness and overlying a much jointed and shattered massive lava flow, is in turn overlaid by a great depth of massive lava flow, this forming the northern end of the western ridge system previously referred to. From an examination of the stream-bed of the Waitoki Stream, in which breccia occurs right to the head of the valley, it would appear as though a later and subsidiary eruption of lava took place after considerable erosion of the land-surface had occurred, filling two stream valleys. These lava flows, being more resistant to erosion than the adjacent breccia caused a reversal of topography, the streams cutting their beds down through the breccia of the old ridges to form the valley of the Waitoki and Orau Gorge (Section 1, Figure 6).

The actual locality of the volcanic vent is not now apparent, owing to the extensive denudation which has occurred since the period of eruptive activity, but from a consideration of the cross-section shown in Figure 6 it appears that such has probably been situated at no remote distance from the present summit of the Island, Mt. Hauturu.

Petrographic Description of Rocks Submitted to Profess-
-or J. A. Bartrum.

A number of specimens were submitted to Professor Bartrum and sectioned and examined by him.

Sections Nos. 1 to 6 are from massive lava flows (a), Nos. 7 to 10 are from breccia and No. 11 is a weathered lava of type (c).

Professor Bartrum reports as follows :-

"Eleven sections were out of different specimens submitted and displayed less diversity than usually found in comparable areas of andesitic rocks. Most of the types represented are hypersthene andesites with abundant phenocrystic

feldspar and a groundmass which varies from microcrystalline to hyalopilitic or almost vitrophyric. Two (Nos. 7 and 8) have an important proportion of quartz present in their strongly micropoecilitic groundmass, whilst a third (No. 2) contains occasional large corroded crystals of quartz perhaps as xenocrysts.

The exact classification of the more vitreous varieties and of the micropoecilitic types is not possible without chemical analysis.

An interesting feature is the readiness with which the abundant glassy residuum present in two or three of the thin slices appears to break down into clay products; No. 11, a beach boulder, illustrates this fact well, for the hand-specimen greatly resembles a fine-grained tuff. In this section, however, both feldspar and hypersthene are unaffected by weathering, though the reverse is the case for the matrix. It is therefore probable that other soft, relatively incoherent rocks collected, but not sectioned, similarly represent weather lavas. In one or two instances, notably in No. 2 the feldspar phenocrysts are greatly shattered, so that chemical weathering of them has been specially facilitated.

"Typical hyalopilitic types with much glassy residuum are Nos. 1, 4, 9 and 11. The groundmass of No. 2 is decomposed but appears to have been hyalopilitic, whilst that of No. 5 is irresolvable. Nos. 3, 6 and 10 are microcrystalline facies and Nos. 4 and 8 are micropoecilitic.

"The feldspar occurs usually as plentiful well-shaped small phenocrysts sometimes constituting as much as 35 per cent of the rock but rarely exceeding 0.5 mm in length. In No. 2, however, in which there are also one or two large phenocrysts of quartz, the feldspar is present as conspicuous crystals 2-3 mm in length and generally almost completely weathered to clay in the hand-specimen submitted. Occasional large feldspars have numerous small sieve-like inclusions of glass. Zonal structures are not infrequent and both Albite and Pericline twinning are common. The

usual variety approaches $Ab_{55}An_{45}$, but more acidic types appear also to be present.

"Hypersthene seldom is in excess of about 5 per cent and is in small sharp prisms usually under 0.4 mm in length. It is in somewhat larger crystals in No. 6, whilst in the boulder from the red breccia at Te Ananuiarau Bay (No. 10) it reaches about 10 per cent in amount and, in common with the materials of the groundmass, is strongly strained by hematite. Augite generally accompanies the hypersthene, but may be unimportant. Pyroxene is poorly represented in the groundmass, whilst magnetite also is sparse.

"In the micropoecilitic types (Nos. 4 and 8) the areas of quartz with its enclosures of laths of feldspar are conspicuous and attain a diameter of as much as 0.6 mm or more. In No. 8 these areas almost oust other material from the groundmass, whilst, in the same section, the phenocrystic feldspar is greatly reduced in amount and does not exceed about 10 per cent."

Follows a list of localities from which the specimens were collected :-

- | | |
|------------------------|---|
| | (No. 1 Hill slope boulder at the back of the caretaker's house. |
| Massive Type (a) | (No. 2 From the cliff at the north end of Hingaia. |
| | (No. 3 Slabby rock, south coast of Hingaia. |
| | (No. 4 Summit of Mt, Hauturu (Mt. Archeria). |
| | (No. 5 Ditto. Slabby rock collected by G. Bayliss. |
| | (No. 6 Haowhenua. |
| From Breccia. Type (b) | (No. 7 Boulder material common on east coast. |
| | (No. 8 Block from the breccia near Haowhenua |
| | (No. 9 Black rock fragment from the breccia south of Rocky Pt. |
| | (No.10 Red fragment from breccia at the south end of Te Ananuiarau Bay. |

Type (c) (No. 11 Beach boulder, east coast.

Probable Past Land Connections.

The general similarity of the volcanic rocks of Little Barrier to those of the Coromandel series would suggest that at some time the Island may have been a continuation of that peninsula. The surrounding sea, in the direction of Coromandel and Great Barrier has an average depth approaching thirty fathoms, which is considerably less than the supposed submergence which affected these northerly coasts in not-far-distant geological times. (Fig.7).

Frazer and Adams adduce evidence (Geology of the Coromandel Subdivision, N. Z. Geol. Survey, Bull. No. 4 n.s. p. 66) to shew that the submergence in the vicinity of Coromandel has been not less than 220 m. (700 feet). A depression of such magnitude would be sufficient to submerge land previously 158 m. (520 feet) above sea level to the level of the present ocean bed surrounding Little Barrier.

In view of the geological evidence tending in that direction, supported as it is by the affinities of the flora of the Island and by the presence there of tuataras, Peripitius and numerous indigenous land and fresh water molluscs, it may reasonably be assumed that the Island was at one time a portion of a prolongation of Coromandel Peninsula.

The Soils.

The soils of the Island vary widely according to locality and the rock from which they are derived. Also due to the precipitous nature of much of the Island, soil is frequently scanty, while the alluvium found in the narrow valley bottoms is largely mixed with rock fragments. The soils, on the whole, are very immature, the only exception to this being on the flat-topped spurs on the southern and western side of the Island (possibly

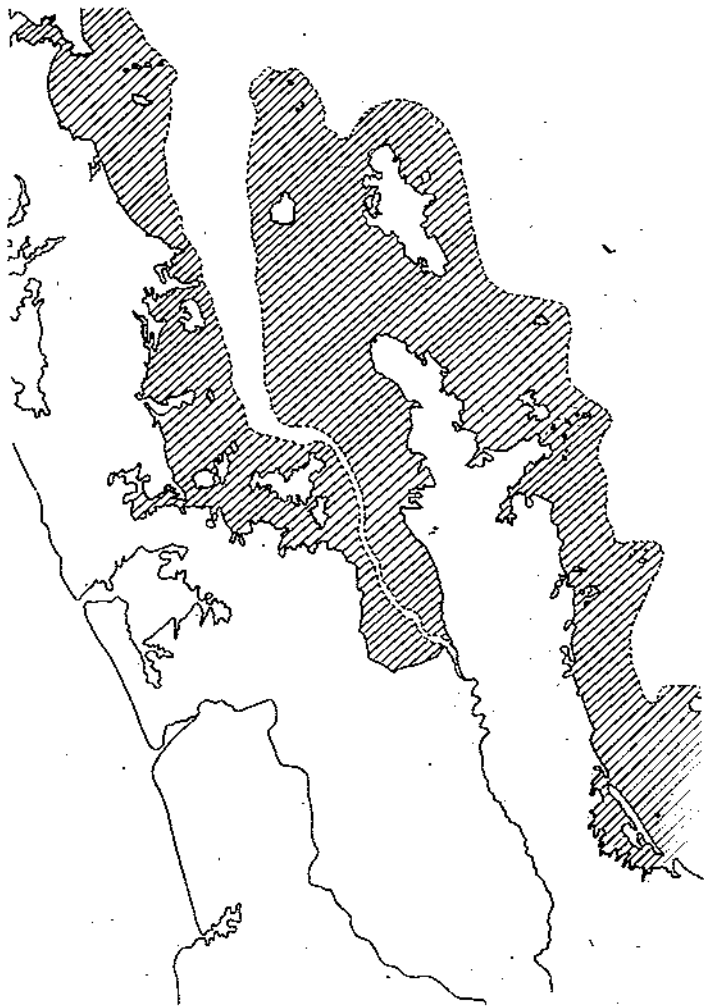


FIGURE 7. Shewing the probable extension of the land surface in the Hauraki Gulf and its environs in late Pliocene or Pliestocene times; indicated by the shaded areas in the map. At this period the Waikato River found an outlet to the sea down the valley of the Waihou and probably found an outlet through a wide tidal estuary separating Little Barrier from the North Auckland Peninsula while the Coromandel Peninsula was continued to include the Great and Little Barrier Islands, Cuvier and Moko Hineu.

also above Ngatamahine). At higher elevations the proportion of organic matter in the soil increases and on some of the high ridges comprises the greater part of the soil layer.

The immature soils analysed (Nos. 2 and 4) shew a high proportion of "available" phosphoric acid and potash and a low hydrogen ion concentration, one (No. 4) being distinctly alkaline. The high percentage of "available nutrients" and the high pH are presumably due to the rapid decomposition, by weathering, of the rock fragments with the freeing of bases from the feldspar, though in some of the samples, it may, as Aston suggests, be due also to sodium salts, carried inland by salt spray, being converted to sodium carbonate in the soil.

The more mature soils on the summits of the flat-topped ridges appear to be of a much more clayey texture and have a lower pH. The one analysed (No. 1) is also low in "available plant nutrients" and this may account for the slowness with which the manuka is regenerating to rain-forest.

Below is given in tabular form the results of the mechanical and chemical analysis of five Little Barrier soils.

No. 1 is from the manuka association on the seaward end of the Flagstaff range and is a hard grey soil of a clay texture.

No. 2 is taken from the sloping shelf of debris at the base of the breccia cliffs between Hut Bay and Lamb Bay creeks on the south side of the Island; it bears a covering of coastal forest.

No. 3 is a sample from an elevation of approximately 500 m. (1,600 feet) on the track to the summit of Mt. Hauturu in tawa-tawhero forest.

No. 4 is a young soil containing 30 per cent of stones over 2 mm. and was collected from luxuriant semi-coastal forest on the south side of Hingaia (Pohutukawa Flat).

TABLE NUMBER 1.

Mechanical Analysis of Little Barrier Soils.

	No. 1.	No. 2.	No. 3.	No. 4	¹ No. 5
Stones and Gravel; Over 2 mm.	Nil	7.2	8.9	30.1	2.8
Analysis of fine earth passing 2 mm. sieve.					
Coarse sand	2.24	2.93	3.09	57.53	7.82
Fine sand	13.04	17.06	16.60	17.41	22.10
Silt	24.75	30.80	21.40	10.95	29.55
Clay	46.00	33.60	21.00	5.15	26.95
Moisture lost at 100 C.	6.37	8.58	21.65	2.89	5.45
Loss by solution	2.57	3.19	6.53	2.72	2.86
Difference figure	5.03	3.84	9.73	3.35	5.27
Totals	100.00	100.00	100.00	100.00	100.00

Results are percentages on air dried soil.
¹ Analysed by R. Murray.

TABLE NUMBER 2.

Chemical Analysis of Little Barrier Soils.

	No. 1.	No. 2.	No. 3.	No. 4	¹ No.5
Volatile Matter					
² At 100 C.	6.37	8.58	21.65	2.88	5.45
On ignition	17.55	17.33	27.05	5.71	15.29
Total nitrogen	0.252	0.310	0.429	0.166	0.164
1 per cent citric acid extract ("Available plant food")					
Potash K ₂ O	0.014	0.04	0.016	0.030	0.018
Phosphoric acid P ₂ O ₅	0.002	0.011	0.005	0.050	
Exchangeable calcium (CaO) (Hissin k's method).	0.157	0.432	0.114	0.524	0.084
² Hydrogen ion concentration	pH4.96	6.16	5.03	8.15	5.3
Moisture content of soil at "sticky point".	45.2	53.0	71.4	31.6	42.4
Percentages (except ²) are calculated on soil dried at 100 C.					

¹ Analysed by R. Murray

No. 5 Te Waikohare delta fan just to the west of the caretaker's house enclosure. A hard dry stony soil.

Other soils were collected but have not been analysed. They appear to have no particular features not shown by the above soils.

Climate.

Unfortunately few statistics are available in relation to the climate of the Island except by inference from meteorological records kept at Auckland 72 km. (45 miles) south westward. Since December 1932 rainfall records have been kept by the caretaker at the Island but other data is lacking.

The rainfall as shown by a little over a year's record would appear to be considerably heavier than that at Auckland though the days with rain in 1933 were fewer than at Auckland. The heaviest day's rain recorded in 1933 was 4.4 inches on 3rd February, while on 16 days over 100 points of rain were recorded. Precipitation at the summit of the Island is doubtless heavier than at the caretaker's residence at sea level. What is more important in respect of the vegetation, the humidity at higher altitudes must also be high by reason of the frequent cloud-cap on the Island.

No figures are available in regard to wind intensity but the vegetation bears ample testimony to the fact that winds, particularly from the west and south-west, are frequently severe.

Temperatures are mild and frosts of infrequent occurrence even in severe winters. Mid-day temperatures in many of the sheltered ravines may rise considerably but no information is available. Auckland figures are given as a guide to probable mean temperatures.

The climatic conditions ruling in many of the sheltered parts of the Island must be nearly sub-tropical and its suitability for plant growth is attested by the wealth and luxuriance of the plant forms found there.

TABLE NUMBER 3.

Monthly Means of Temperature, Etc., at Auckland.

<u>Month</u>	<u>Mean Temperatures</u>			<u>Mean Rainfall</u>		<u>Bright Sunshine. Hours</u>
	<u>Maximum F</u>	<u>Minimum F</u>	<u>Mean F</u>	<u>for 74 years Inches</u>	<u>Days</u>	
January	73.6	59.0	66.5	2.67	10.4	220
February	74.1	62.6	67.0	3.05	9.7	187
March	71.9	57.7	64.9	3.02	11.2	173
April	67.7	54.6	61.2	3.43	13.9	142
May	62.6	50.7	56.8	4.63	18.5	128
June	59.1	47.8	53.5	4.92	19.4	114
July	57.5	46.0	51.7	4.95	20.8	121
August	58.1	46.1	52.2	4.22	19.4	150
September	60.7	48.5	54.6	3.64	17.5	149
October	63.5	50.9	57.2	3.69	16.5	169
November	66.9	53.5	60.3	3.32	15.9	192
December	70.8	56.9	63.9	2.90	11.6	209
Year	65.5	52.9	59.1	44.44	184.8	1.954

Figures from "The New Zealand Official Year Book", 1930.

TABLE NUMBER 4.

Monthly Rainfall at Little Barrier and Auckland for 1933/1934.

Month	<u>Little Barrier</u>				<u>Auckland</u>			
	<u>Inches</u>	<u>Days</u>	<u>Inches</u>	<u>Days</u>	<u>Inches</u>	<u>Days</u>	<u>Inches</u>	<u>Days</u>
	<u>1933</u>		<u>1934</u>		<u>1933</u>		<u>1934</u>	
January	2.63	10	1.87	8	1.48	10	1.57	10
February	8.14	12	12.56	11	7.75	19	8.17	18
March	4.07	11	3.11	9	0.76	11	1.67	9
April	2.72	10	4.62	15	2.39	16	3.33	18
May	9.15	20	3.93	12	6.42	24	5.60	18
June	3.54	11	7.18	11	2.67	14	6.48	19
July	8.46	18	5.66	11	5.03	12	5.97	19
August	2.51	12	6.12	16	4.02	15	2.95	15
September	7.80	12	4.64	10	4.43	17	2.08	12
October	3.23	8	1.73	11	2.91	16	2.17	14
November	6.41	13	3.35	10	2.48	15	1.17	9
December	2.38	7	1.50	13	2.15	7	2.38	10
Year ¹	61.04	144	56.27	137	42.49	176	43.54	171

Figures from "New Zealand Gazette".

¹ Heaviest fall 4.4 inches on 3rd February.

Sixteen days with 100 points or over recorded.

THE PLANT COVERING.

Introductory - the plant covering as a whole.

The plant associations.

Artificial induced associations.

- (1) Meadow communities.
 - (a) *Dactylis glomerata* association.
 - (b) *Carex virgata* - *Mariscus ustulatus* association.

Indigenous induced associations.

- (2) Manuka association.
- (3) *Pteridium esculentum* colonies.
- (4) *Phormium tenax* - *Pseudopanax Lessonii* association

Modified associations.

- (5) Transition forest.
- (6) Modified *Muehlenbeckia complexa* association.
- (7) Pohutukawa forest, Te Titoki Pt.

Primitive associations.

- (8) Cliff communities.
 - (a) Succulent sub-association.
 - (b) *Arundo conspicua* - *Arthropodium cirrhatum* association
 - (c) Pohutukawa forest, cliff type.
 - (d) Grass and scattered shrub association.
- (9) *Muehlenbeckia complexa* association.
- (10) Coastal scrub.
- (11) Coastal forest.
- (12) Semi-coastal forest.
- (13) Pohutukawa forest, Hingaia.
- (14) Rata - Tawa forest.
- (15) Kauri communities.
 - (a) Kauri sub-association
 - (b) Kauri - *Nothofagus truncata* - Rata association.
- (16) *Nothofagus truncata* forest
- (17) Tawhero - Tawa forest
- (18) *Quintinia* - *Ixerba* - *Metrosideros umbellata* association.
- (19) Summit scrub.

THE PLANT COVERING.

Introductory.

Hauturu is, perhaps unique as being one of the few remaining large forested areas still retaining its primitive facies undisturbed by introduced mammals. Large forested areas in other localities (Hen and Chickens excepted) have almost invariably been modified to greater or lesser extent by the destructive agency of pigs, deer, goats or cattle. Certainly a considerable area on Hauturu was at one time destroyed by human agency, but this area has almost entirely reverted to manuka forest unhindered by grazing animals for the last thirty years and provides an interesting ecological study in regeneration to dicotylous rain forest.

Before proceeding to a detailed account of the plant associations a brief outline of the vegetation as a whole may be given. (Fig 8.)

Owing to wind intensity, and frequently to lack of suitable edaphic conditions, forest growth rarely commences immediately behind the storm beach but is usually sheltered by a fringe of wind-clipped coastal scrub, the canopy of which is shorn to an even slope, grading at the top of the boulder beach, into mats of Muehlenbeckia complexa with which may be associated Sicyos angulat Calystegia sepium, C.Soldanella and Tetragonia trigyna (Plate 36:) while on the landward side the scrub grades gradually into coastal forest. Behind the narrow belt of coastal forest typical of the south-western coast, from Haowhenua to Waimanga Creek, the cliffs rise abruptly, either devoid of all vegetation save perching halophytes, or where root-hold is sufficient, scattered spreading pohutukawas (Metrosideros excelsa) have established on the cliff face (Plate 38).

From Waimanga Creek to Whekau Creek the cliffs are formed of the readily weathered lava flow (type.c.) previously mentioned and rise sheer from the boulder beach, being devoid of

Showing The Distribution of the Main Plant Associations on Hauturu.

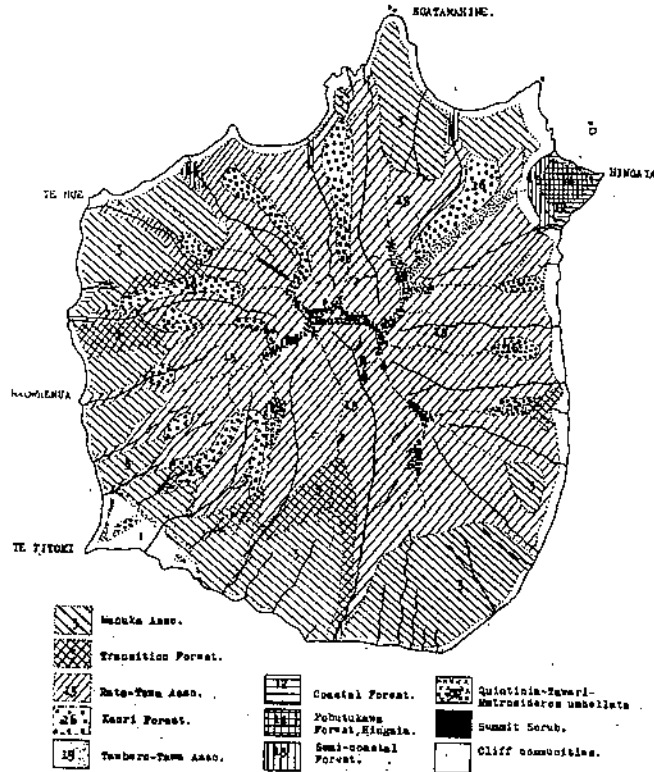


FIGURE 8 Shewing the distribution of the principal plant associations on Hauturu. These have been numbered similarly to the list given in Appendix 6 of spermophytes and pteridophytes found on the Island. Owing to the small scale of the map it has only been possible to shew the more important associations.

three hundred metres.

Above the kauri and rata-tawa communities, tawhero (Weinmannia sylvicola) becomes more in evidence forming tawhero-tawa association which in turn gives way at higher altitudes to a summit association of Quintinia serrata-Ixerba brexioides and Metrosideros umbellata (syn. lucida) (see foreground of Plate 12). On the highest peaks this is in turn supplanted by a wind ephar-mone of "summit scrub" composed of practically the same species.

¹Figure 9 shews in graphical form the gradual transition in the relative frequency of the main physiognomic members of the Island forests and their distribution with respect to altitude (Approx.). Thus rata (Metrosideros robusta) is most abundant in the valleys, at low elevations and decreases in numbers gradually to an elevation of 350 m. after which the decrease is more rapid, the last rata disappearing at an elevation slightly over 600 m. (2,000 feet). Tawa is relatively abundant over a wide altitudinal range, while as the rata dwindles in numbers its place is gradually taken by increasing numbers of tawhero (Weinmannia sylvicola) till the rata-tawa forest gives place by gradual transition to a tawhero-tawa association. (Plate 21).

Owing to such gradual transitions, wide tension belts occur between some associations and the sharp definition of boundaries between them is not possible. No attempt has therefore been made to delimit with accuracy the locality in which any given association occurs nor can the descriptions be read as being typical of any particular quadrat, but rather as presenting a generalized description of the association as a whole.

¹ The diagram is based on observation only and is intended only to be explanatory of the gradual altitudinal changes which occur in the vegetation.

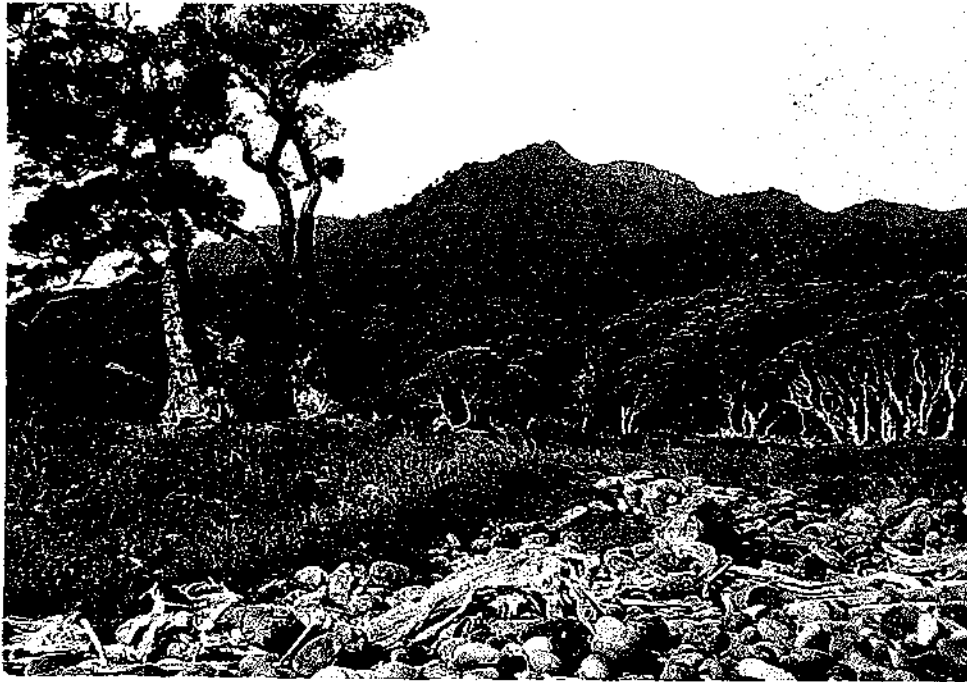
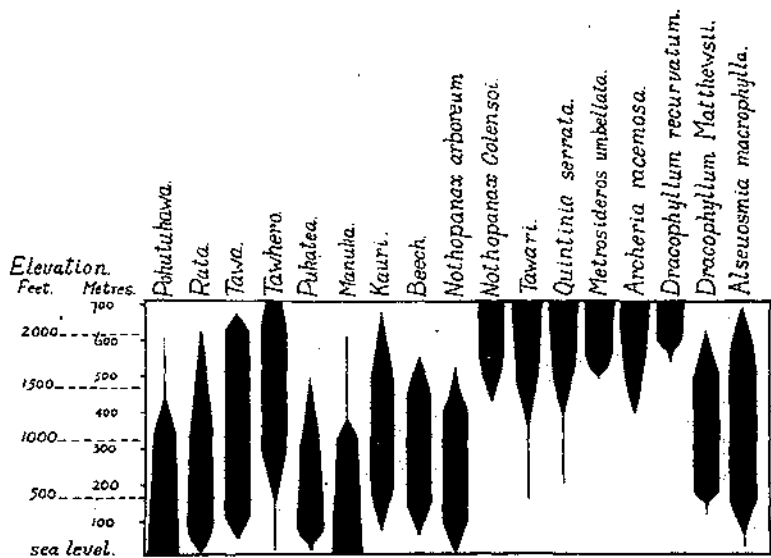


PLATE 21. A general view of the island illustrating the rapid altitudinal changes which occur on proceeding inland from the coast. Mt. Herekohu (2,220 ft.) in the distance.



Altitudinal distribution of main physiognomic plants on Hauturu.

FIGURE 9. Shows the approximate altitudinal distribution and frequency (within the species) of the main physiognomic plants on Hauturu. It should be noted that all the plants shown as occurring at a given elevation do not necessarily occur in the same plant association. The diagram is based on observation only, not on actual counts.

THE ARTIFICIAL AND INDUCED ASSOCIATIONS.

As has been remarked at an earlier stage, a considerable part of the south-western side of the Island and also the northern point was felled by the Natives for firewood in the eighties and early nineties of last century, while fires and stock added to the ravages. Rahui te Kiri in giving evidence before the Native Land Court in 1895 estimated that there were about one thousand sheep and thirty head of cattle on the Island at that time. Most of these were grazed on the southern side of the Island, but some were also grazing on the flat-topped plateau above Ngatamahine as there is a record in a report from the ranger that cattle were being removed from the north-east side in 1893. The stocking and burning on this side of the Island, however, appears to have been less severe as judged by the rate of regeneration of the rain forest. When the Island was acquired by the Government and practically all stock removed the affected area immediately commenced to regenerate. Mr. Shakespear informs me (private communication) that in 1897 the ridges on the south-western side were mostly in low manuka scrub with scattered patches of grass, while all the gullies as far as East Cape contained areas of grassland which were grazed upon by the cattle. In the early days of the occupation of the Island by the Crown, twenty-five to thirty head of cattle were kept by the caretaker, but this number was gradually reduced as the grassland area became overgrown and regeneration in manuka took place until at the present time the number of cattle on the Island is only sufficient to provide the caretaker with supplies of milk and butter. "The Flat" (Marae-roa) on the south-west side of the Island and the lower parts of the ridges above Te Waikohare were in grass while the ridge above Ngatamahine Pt., was in low manuka scrub. (1897)

In the forty years during which regeneration has been proceeding, a dense manuka forest having all the semblance of permanence has sprung up and the only grassland remaining is an

area of approximately sixty acres on the flat surrounding the caretaker's residence.

Here the plant covering consists of :-

- (a) A graminaceous association with cocksfoot (Dactylis glomerata) dominant.
- (b) A Cyperaceous association in the moister parts with Mariscus ustulatus and Carex virgata co-dominant.

The Dactylis glomerata Association.

When the Island was purchased by the Crown "The Flat" was largely under cultivation; there were several areas in kumaras, and some corn which the Natives later removed. There were also other enclosed areas which had previously been in crop and these had been grassed in cocksfoot and ryegrass, being used, while the brush fences lasted, to retain the sheep used by the caretaker for mutton. Several small patches of manuka on "The Flat" were cleared, burnt, and sown in cocksfoot and ryegrass. During the hearing of the Native Land Court in 1895 one witness described "The Flat" as being in good ryegrass and clover which he estimated should carry three sheep per acre.

With a reduction in the number of stock carried on the Island "The Flat" has been only lightly grazed with the consequence that tall growing erect forms of grasses have tended to be favoured to the detriment or exclusion of the finer species. Such a habitat has proved exceptionally favourable to cocksfoot (Dactylis glomerata) and it is physiognomic over the greater part of "the Flat". Paspalum dilatatum is now well established though chiefly along tracks and owing to its greater palatability is being closely grazed by the stock. This closer grazing allows white clover (Trifolium repens) to thrive and it will be interesting to see whether, as time goes on, the Paspalum dilatatum will produce a condition unfavourable to cocksfoot (Dactylis glomerata) and be-
l. A species of sweet potato (Ipomoea batatas).

come ~~the~~ dominant. Indian doab (Cynodon dactylon), Poa pratensis and New Zealand rice grass (Microlaena stipoides) are also abundant while twenty-one other species of grasses are more or less common (see list). Besides grasses some sixty introduced weeds occur and of these catsear (Hypochaeris radicata), Ribgrass (Plantago lanceolata) and Linum marginale are abundant. Several indigenous ferns persist in the association, Doodia media, Hypolepis tenuifolia and Adiantum aethiopicum being abundant on boulder heaps where they are relatively protected from the trampling of stock.

The Mariscus ustulatus, Carex virgata Association (Plate 22)

In the damper parts of "The Flat", really remnants of the old lagoon, the grasses, dominant over the remainder, are replaced by Mariscus ustulatus and Carex virgata with pohuehue (Muehlenbeckia complexa) occurring as a cushion plant in the drier parts. The spaces between the sedge tussocks are occupied by Carex lucida, hairy buttercup (Ranunculus sardous), convolvulus (Calystegia sepium), Poa pratensis, redshank (Polygonum Persicaria), Paspalum scorbiculatum and Hypolepis tenuifolia. In the wetter places Paspalum scorbiculatum becomes more evident and Juncus polyanthemos and Centella uniflora enter, the change continuing till in the wettest areas only Paspalum scorbiculatum and Centella uniflora occupy the interspaces between the Mariscus and Carex virgata.

THE INDIGENOUS INDUCED ASSOCIATIONS.

Unhampered by grazing animals or by fires the majority of the area earlier cleared has rapidly reverted to forest which after forty years' growth may be classified as :-

- (1) Manuka forest - covering areas previously cleared and burnt.
- (2) Transition forest - a belt between the primitive forest and that which is entirely re-growth.



PLATE 22. The *Mariscus ustulatus* - *Carex virgata* association on "The Flat". Note the dark inflorescences of the *Mariscus*, the *Muehlenbeckia* in the left foreground and the fine grass-like leaves of the *Carex*.



Plate 23. The manuka association on "The Flat" with its characteristic undergrowth of *Coprosma* scrub, with *Doodia media* and *Uncinia australis* and *Carex lucida* on the forest floor.

THE MANUKA FOREST. (Plate 23 & 24).

Although varying according to its position the manuka forest is characterized by the complete dominance in the upper canopy of Leptospermum ericoides and Leptospermum scoparium; by a lower layer of scrubs 1 - 2 metres high composed predominantly of Coprosma rhamnoides, C. arborea and C. spathulata and a ground layer of lower vegetation. A striking feature of this community is the paucity of forest trees coming on to take the place of the manuka at its death and it appears as though the manuka will enjoy a fair degree of permanence before it is replaced by true rain-forest. On the ridge north of Te Wairere Stream large manuka have been uprooted by wind, the open spaces so formed only slowly regenerating in manuka. This lack of forest seedlings is probably due to the fact that during the Maori occupation the area was not only cleared and burnt but was also grazed over by stock so that the reserves of seed in the soil were progressively depleted while reseeding over comparatively long distances is a slow process.

The forest canopy is open varying in height from 3 - 10 metres according to edaphic conditions and exposure, while the illumination on the forest floor is bright making conditions unsuitable for most forest seedlings. Below the manuka canopy is a layer of scattered forest trees which, however, do not materially affect the ground illumination and but rarely penetrate the manuka canopy.

On "The Flat" where the manuka forest has been to some extent modified by grazing animals the canopy is 6 - 10 metres in height and composed almost entirely of white manuka (Leptospermum ericoides) though occasional Leptospermum scoparium occur. Scattered five-finger (Nothopanax arboreum) occur under the canopy but any distinct layer is lacking until at 1 - 2 metres in height is a dense growth of Coprosma rhamnoides, C. spathulata and C. arborea with wiry interlacing stems. The forest floor (Soil No. 5) is dry and unsuitable for most ferns being occupied by Doodia media, Carex

lucida, C. dissita, C. inversa, Uncinia australis and U. riparia. Epiphytes are conspicuously absent and except for Clematis indivisa and Parsonsia heterophylla lianes are also lacking. (Plate 23).

In the valleys regeneration has proceeded more rapidly and there is distinct evidence of an early return to rain forest. The canopy is denser, the ground damper, and conditions generally more suitable for the growth of forest seedlings while occasional mature puriri (Vitex lucens) kohekohe (Dysoxylum spectabile) and taraire (Beilschmeidia taraire) remain along the stream banks. The Coprosma scrub is largely replaced by juvenile forest trees such as karaka (Corynocarpus laevigata), porokaiwhiri (Hedycarya arborea) rewarewa (Knightia excelsa) and mahoe (Meliccytus ramiflorus) while tree ferns (Cyathea dealbata and C. medullaris) juvenile nikaus (Rhapalostylis sapida) and a more hygrophytic shade element makes its appearance.

As one rises from the valleys on to the plateau-like ridges, however, the soil becomes drier and more clayey in texture, (No. 1.), the forest canopy decreases in height and becomes more open, allowing brilliant illumination of the forest floor. Red manuka (Leptospermum scoparium) becomes co-dominant with the Leptospermum ericoides, the canopy growth is less abundant and an irregular layer of small trees makes its appearance. Where presumably the greatest damage by stock occurred this layer contains few forest trees, consisting mainly of scattered five-finger (Nothopanax arboreum), white maire (Olea lanceolata) akepiro (Olearia furfuracea toru (Persoonia toru), kohuhu (Pittosporum tenuifolium), P. umbellatum, mapau (Suttonia australis) and ponga (Cyathea dealbata).

Below these there is an irregular but usually dense shrub layer composed of juveniles of the above species, shrubby Coprosmas, mingimingi (Cyathodes acerosa and Leucopogon fasciculatus), thickets of Gahnia lacera, Koromiko (Hebe salicifolia and H. macrocarpa) and occasional small plants of Astelia trinervia, while near the sea Helichrysum glomeratum is abundant. (Plate 24).



PLATE 24. The manuka association on one of the moister ridges shewing the different type of undergrowth which characterises this type of forest. Note the *Pittosporum umbellatum* (with large leaves), the *Astelia trinervis* and *Cyathea dealbata* in foreground and the more open *Coprosma* scrub.



PLATE 25. Modified *Muehlenbeckia complexa* association shewing its invasion by *Poa pratensis*.

The forest floor is frequently covered in mosses; Bryum truncorum, Stereodon cupressiformis, Thuidium furfurosum and Tortella Knightii are common while scattered Carex lucida, blue-berry (Dianella intermedia), Doodia media, Lindsaya linearis, Schizea fistulosa and Uncinia riparia also occur.

In the driest parts of the ridges the canopy may be only 3 - 6 metres in height and very open, with scattered juvenile kohuhu (Pittosporum tenuifolium), Pittosporum umbellatum, mapau (Suttonia australis), akepiro (Olearia furfuracea) and koromiko (Hebe salicifolia, and H. macrocarpa) the forest floor being occupied by a dense growth of Cladium Vauthiera, Gahnia lacera, Lepidosperma laterale and Schoenus tendo and in open places Gahnia gahniaeformis, Lindsaya linearis and Schizea fistulosa.

On the area above Waimaomao Bay, where presumably the depletion of forest seed reserves by fires and stock has not been so severe, the manuka shows a more typical mainland type of regeneration with juvenile kauri (Agathis australis) and tanekaha (Phyllocladus trichomanoides) making their appearance under the canopy. The manuka (Leptospermum spp.) here grows very densely with long thin trunks; Coprosma arborea is abundant as a tall shrubby tree, while Clematis indivisa and Rubus australis are not uncommon.

Epiphytes throughout the association are few in number owing chiefly to the low humidity conditions prevailing, but partly also to the lack of suitable positions for perching plants; the only ones at all abundant in the association are, Asplenium adiantoides, A. flaccidum, Astelia Solandri, Cyclophorus serpens, Marina mucronata and Polypodium diversifolium.

Several plants of X Coprosma Cunninghamii occur though no trace of Coprosma propinqua was observed; possibly stray seeds of the hybrid have been carried thence from the mainland.

PTERIDIUM ESCULENTUM COLONIES.

On the sides of the boulder bank surrounding "The Flat" (Te Marae-roa) and at the entrance of several of the streams (Te Awaroa, Tirikakawa etc.) on the southern side of the Island dense colonies of bracken (Pteridium esculentum) have grown up on areas previously cleared.

The bracken (Pteridium esculentum) grows densely to a height of 1.5 - 2 metres (to the exclusion of all other growth) usually on dry somewhat open soils.

Phormium tenax - Pseudopanax Lessonii association.

This association is characteristic of the steep banks of gorges fronting the sea, more particularly on the south side of the Island. The flax (Phormium tenax) and Houpara (Pseudopanax Lessonii) form a dense almost impenetrable thicket 2 - 3 metres high. Karo (Pittosporum crassifolium) and wharangi (Melicope ternata) may also be present. The intervening ground is devoid of vegetation except for scattered plants of Asplenium lucidum and Pteris comans.

THE MODIFIED ASSOCIATIONS.

TRANSITION FOREST.

This title has been applied to a considerable area between the primitive forest and the induced manuka association. Compared with the manuka forest it is characterized by a much more vigorous and varied under growth, five-finger (Nothopanax arboreum) becoming noticeably more abundant, and by an increase in the size and number of beech (Nothofagus truncata) while young kauris (Agathis australis) and taraire (Beilschmiedia Taraire) make their appearance. It may probably be regarded as a much modified remnant of a former kauri - Nothofagus truncata - rata association similar to that still remaining on the east coast

ridges of the Island. It has probably been subject to the ravages of bullocks (4) which probably destroyed much of the undergrowth and was also damaged by the fires which swept the lower slopes of the Island prior to its purchase by the Crown. Sufficient of the larger trees, however, have survived to give a distinct character to the area.

The upper canopy is irregular, much higher than in the manuka, and composed of beech (Nothofagus truncata) up to two feet in diameter and of kauris (Agathis australis) with occasional taraire (Beilschmiedia Taraire). The kauri and beech have suffered from undue exposure and many of them present a much battered appearance with many dead branches.

The lower strata of smaller trees 6 - 10 metres high consists of red and white manuka (Leptospermum scoparium and L. ericoides), Coprosma arborea, which occasionally forms dense colonies of young trees 5 - 6 metres high, heketara (Olearia Rani) and juvenile Nothofagus truncata.

Below these again comes a layer of shrubs 2 - 4 metres high consisting of ¹Alseuosmia macrophylla, rangiora (Brachyglottis repanda), hange-hange (Geniostoma ligustrifolium), koromiko (Hebe macrocarpa), juvenile rewarewa (Knightia excelsa), minge-minge (Leucopogon fasciculatus), mahoe (Melicytus ramiflorus), five-finger (Nothopanax arboreum), akepiro (Olearia furfuracea), toru (Persoonia toru), mairehau (Phebalium nudum), Pittosporum Huttonianum, P. umbellatum, Pseudopanax discolor makes its appearance, and mapau (Suttonia australis). The increase in density and variety of this layer is a characteristic feature of the transition forest. Seedlings become more abundant on the forest floor which is damper,

¹ N.B. These lists give only the more important physiognomic members of the various plant "layers". A full list of the members of each association is furnished in the analysis at the end of the paper. In the text, where no indication of frequency is given, the species are placed in alphabetical order.

more shaded and has a covering of decaying organic material. Such conditions are more favourable to ferns while the lack of illumination checks the growth of Cyperaceae so characteristic of the manuka forest. Such ferns as Trichomanes reniforme, mamuku (Cyathea medullaris) and Lindsaya cuneata make their appearance but conditions are still not favourable for the majority of species. Kahakaha (Astelia trinervia), Carex lucida, C. dissita, blue-berry (Dianella intermedia), Lycopodium volubile, hook grass (Uncinia australis), and Uncinia riparia also occur on the forest floor.

Lianes are slightly more common than in the manuka association. Clematis indivisa, mange-mange (Lygodium articulatum), Metrosideros perforata, aka (Metrosideros scandens), supplejack (Rhipogonum scandens) and bush-lawyer (Rubus australis and R. schmidelioides), are present but rarely plentiful.

Epiphytes are sparse being limited to Asplenium flaccidum, A. adiantoides, kahakaha (Astelia Solandri), Cyclophorus serpens, Hymenophyllum sanguinolentum, Lycopodium Billardiere, and Polypodium diversifolium.

MODIFIED MUEHLENBECKIA COMPLEXA ASSOCIATION. (Plate 25)

The primitive Muehlenbeckia complexa association typical of certain parts of the boulder beach and coastal shelf has formed an excellent trap for the seeds of many exotic weeds and grasses leading in some cases to considerable modification of the primitive association. Chief among the exotics are wild oats (Avena fatua) barren brome (Bromus sterilis), N.Z. hair-grass (Festuca bromoides), catsear (Hypochaeris radicata), Poa pratensis, ink-weed (Phytolacca octandra), and ribgrass (Plantago lanceolata).

Of these Poa pratensis is the most aggressive, its underground rhizomes penetrating deep down among the scanty soil of the

boulders making it very resistant to drought and providing a means of rapid reproduction more certain than seed under these conditions. Avena fatua, Bromus sterilis and Festuca bromoides while plentiful are of less consequence owing to their annual nature. Phytolacca octandra forms large bushes and occurs widely distributed over the Island, its seeds being carried by birds.

The ultimate fate of Muehlenbeckia complexa association invaded by Poa pratensis is hard to foretell; probably a balance will eventually be reached with the members more or less co-dominant.

MODIFIED POHUTUKAWA FOREST, TE TITOKI POINT

(THE SPIT). (Plate 26 & 27).

This association occupies an area of boulder bank on the southern side of Te Titoki Pt., extending for a distance of about 200 metres southwards. It then, for no apparent reason, ceases abruptly (possibly due to fire in pre-European days) while the boulder bank continues with practically no plant covering.

The forest is composed almost exclusively of pohutukawa trees (Metrosideros excelsa) 5 - 8 metres high and fairly widely spaced. The only other trees present are mahoe (Meliccytus rami-florus), ngaio (Myoporum laetum), tawapau (Sideroxylon novozelandicum), and puriri (Vitex lucens); of these only tawapau and mahoe are at all common.

The ground is composed of bare andesitic boulders, the illumination is brilliant and hence the floor is nearly devoid of plant covering. Pohuehue (Muehlenbeckia complexa) occurs abundantly with long straggling stems and with it Cyclophorus serpens also abundant on the bare boulders. Catsear (Hypochaeris radicata), Poa pratensis, Danthonia pilosa, Asplenium lucidum, A. flaccidum, Avena fatua, Peperomia Urvilleana and Carex lucida are also plentiful, while scattered plants of Bromus sterilis,



PLATE 26. Looking along the boulder bank from the south at the edge of the pohutukawa forest, Te Titoki Pt. Note how the forest ends abruptly and the boulder bank continues with only a covering of modified Muehlenbeckia association or Pteridium esculentum (on right.). The ancient burial place of Ngapuamataehu lies just within the fringe of the pohutukawas.

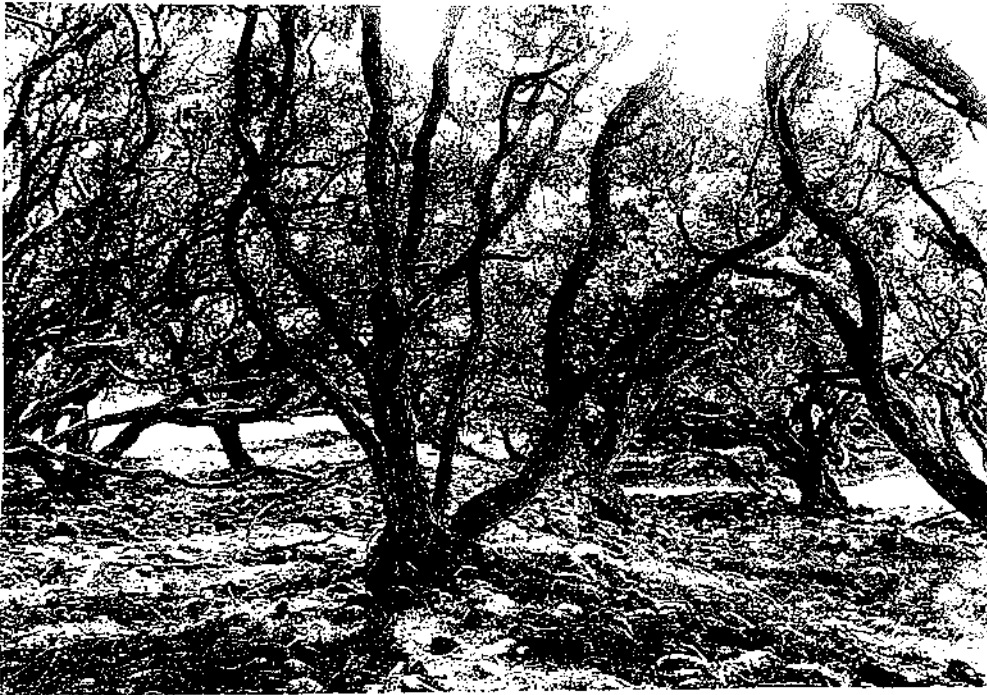


PLATE 27. Within the pohutukawa forest at Te Titoki Pt. shewing the open canopy and the paucity of ground vegetation.

Coprosma rhamnoides (as a mat plant), cocksfoot (Dactylis glomerata), Oplismenus undulatifolius, Pellaea rotundifolia, Polypodium diversifolium, Senecio lautus, rauriki (Synchus oleraceus) and Wah lenbergia gracilis, also occur but not in sufficient numbers to appreciably diminish the bareness of the forest floor. Epiphytes and lianes are lacking.

THE PRIMITIVE ASSOCIATIONS.

Cliff Communities :-

- (a) Succulent association.
- (b) Toe-toe, Arthropodium cirrhatum association.
- (c) Grass and scattered shrub communities.

With over twelve miles of coastal cliffs a considerable variation in the plant covering occurs. Not only do the cliffs vary in their exposure to salt spray but also in the rooting conditions offered for plants, the variation depending partly on the rock type and partly on the rate of marine erosion.

SUCCULENT ASSOCIATION.

On the steepest faces or where excessive salt spray is experienced, halophytes alone are found, often hanging in festoons from precarious rooting places; chief among these are Mesembryanthemum australe, Pimelia prostrata, P. Urvilleana, Rhagodia nutans, Salicornia australis and Spergularia media. In positions where excessive spray falls, as on small rocky islets adjoining the coast, or low down on exposed cliffs. Mesembryanthemum australe may be the only member present. On the northern coast Asplenium obtusatum occurs over limited areas but is nowhere abundant. With less spray the Mesembryanthemum becomes of less importance and is often supplanted by Salicornia australis or prostrate mats of taupata (Coprosma retusa). Angelica rosaefolia, Apium pro-

tratum, Chenopodium triandrum, Senecio lautus and Tetragonia trigyna are also frequently associated with the typical halophytes.

TOE-TOE; ARTHROPODIUM CIRRHATUM ASSOCIATION.

On sheer cliffs of weathered lava (type C), ^(Plate 28) the only vegetation is frequently toe-toe (Arundo conspicua) or colonies of Renga lily (Arthropodium cirrhatum). These find secure rooting in the recesses so characteristic of the weathering of this type of cliff and flourish abundantly. Few, if any, other plants seem associated with them in these situations. This association also occurs for some distance inland up the steep sides of many of the gorges.

An interesting variant of the toe-toe association occurs in Te Ananuiarau and other bays on the northern side of the Island. Here on a narrow sloping ledge at the base of the cliff toe-toe ^(Plate 29) (Arundo conspicua) exists co-dominant with Carmichaelia australis and Carmichaelia Williamsii (Plate 30), while flax (Phormium tenax), prostrate taupata (Coprosma retusa), Hymenanthera novae-zealandiae, and ngaio (Myoporum laetum) also occur together with littoral grasses, halophytes and Mariscus ustulatus, Euphorbia glauca, toa-toa (Haloragis erecta), Cook's scurvy grass (Lepidium oleraceum), Nasturtium stylosum, centaury (Erythraea centaurium) Gnaphalium luteo-album and G. japonicum.

A curious dwarfed form of Carmichaelia australis (Plate 31) occurs on the edge of this association in several places. The branchlets are thin and barely 2 mm wide; the whole plant spreading and prostrate with ascending branchlets 20 - 30 cms high. Leaves abundant in the shaded portions of the mat; $\frac{1}{2}$ - 1 inch long 1-foliolate or 3 - 5 foliolate. Flowers not seen but fruit plentiful. Pod ovate, $\frac{1}{4}$ inch long, short acute point; seeds one per pod, dark red when ripe.



PLATE 28.

On left; a sheer cliff of weathered lava to the south of the entrance of Haurua Stream on the east coast showing the type of scattered growths of toe-toe and renga lily which occur.

PLATE 29.

On right; the toe-toe association at the base of the cliffs in Te Anau Bay. Note in addition to the toe-toe the *Carmichaelia australis* and *C. Williamsii* (marked with a cross) and also the heads of *Mariscus ustulatus*.





PLATE 30. *Carmichaelia australis* (on left) and *Carmichaelia Williamsii* (on right) placed side by side for comparison - not actually growing under these conditions.



PLATE 31. A narrow-leaved prostrate form of *Carmichaelia australis* found growing at the base of the cliffs on the N.W. coast.

GRASS AND SCATTERED SHRUB COMMUNITIES.

On many sloping cliffs, due probably to the rock being difficult for their roots to penetrate, or to the rapid rate of marine erosion, pohutukawas (Metrosideros excelsa) are either absent or present only as stunted trees or large sprawling shrubs at intervals over a steep grassy slope.

Accompanying these are various wind epharmones of Carmichaelia australis, Coprosma lucida, tutu (Corymbria ruscifolia), koromiko (Hebe salicifolia), Helichrysum glomeratum, Hymenanthera novae-zelandiae, manuka (Leptospermum scoparium), flax (Phormium tenax), karo (Pittosporum crassifolium) and houpara (Pseudopanax Lessonii) and on the northern coast Carmichaelia Williamsii.

These shrubs are usually somewhat remotely spaced, the intervening spaces being either bare or more usually occupied by drought resisting grasses, herbs and ferns. Agropyrum multiflorum, Asplenium lucidum, Blechnum Banksii, Bromus sterilis, Cheilanthes Seiberi, Danthonia semi-annularis, Deyeuxia Forsteri, D. Billardieri, Dichelachne crinita, Dichondra repens, Linum monogynum, Mesembryanthemum australe, Nothoclaena distans, Oplismenus undulatifolius, Oxalis corniculata, O. stricta, Poa anceps, Polycarpon tetraphyllum, Rhagodia nutans, Salicornia australis, Scirpus nodosus, rauriki (Sonchus oleraceus), ratstail (Sporobolus capensis syn indicus), and Whalenbergia gracilis, are all abundant plants under these conditions, the precise constitution of the association varying according to situation.

This type of association occurs at Haowhenua, behind and to the north of Hingaia (Pohutukawa Flat) and in many places along the north-west coast as well as on ledges and more sloping parts of numerous cliffs on the remainder of the coast.

POHUTUKAWA CLIFF COMMUNITIES.

Wherever sufficient roothold offers the cliffs are dominated by pohutukawa (Metrosideros excelsa) in great abundance. Only where it may be surmised shore regression is proceeding rapidly and the cliffs are constantly changing, or where the nature of the rock makes roothold insufficient does the pohutukawa release its dominance. (Plate 32). The massive jointed andesite characteristic of much of the east coast is especially suitable for the growth of pohutukawa it offers excellent rooting, yet is sufficiently resistant to erosion so that the trees have time to become well established and live to maturity. Under such conditions the cliffs are virtually clothed in pohutukawa, in some places for 300 m. (1,000 feet) from the sea (Plate 33).

Much of the breccia characteristic of the remainder of the coastline erodes at too rapid a rate to allow more than shrubby pohutukawas ever to become established; under these circumstances the cliffs are covered in more rapidly establishing species such as the open grassy community previously described (Plate 32). However, on the sheltered south-west and south coasts where marine erosion is much less effective even this type of cliff supports a covering of spreading pohutukawa.

Where sufficient roothold offers the pohutukawa (Metrosidero excelsa) is usually accompanied by other coastal species such as Astelia Banksii, rangiora (Brachyglottis repanda), Coprosma lucida, Cordyline Banksii, tutu (Coriaria ruscifolia), whau (Entelia arborescens), Hymenanchera novae-zelandica^a, manuka (Leptospermum scoparium), wharangi (Melicope ternata), ngaio (Myoporum laetum), karo (Pittosporum crassifolium), houpara (Pseudopanax Lessonii) and tawapau (Sideroxylon novo-zelandicum) Peperomia Urvilleana occurs abundantly both epiphytic and rupestral while accompanying halophytes are not uncommon.

Ferns are sparse and restricted to Asplenium lucidum,



PLATE 32. Looking towards Ngatamahine from Te Hue Pt. Shews very distinctly the influence of type of lava flow on the cliff vegetation. The cliffs devoid of vegetation are of breccia while the pohutukawa clad promontory in the middle distance is a massive lava flow - the end of the western ridge system previously referred to.

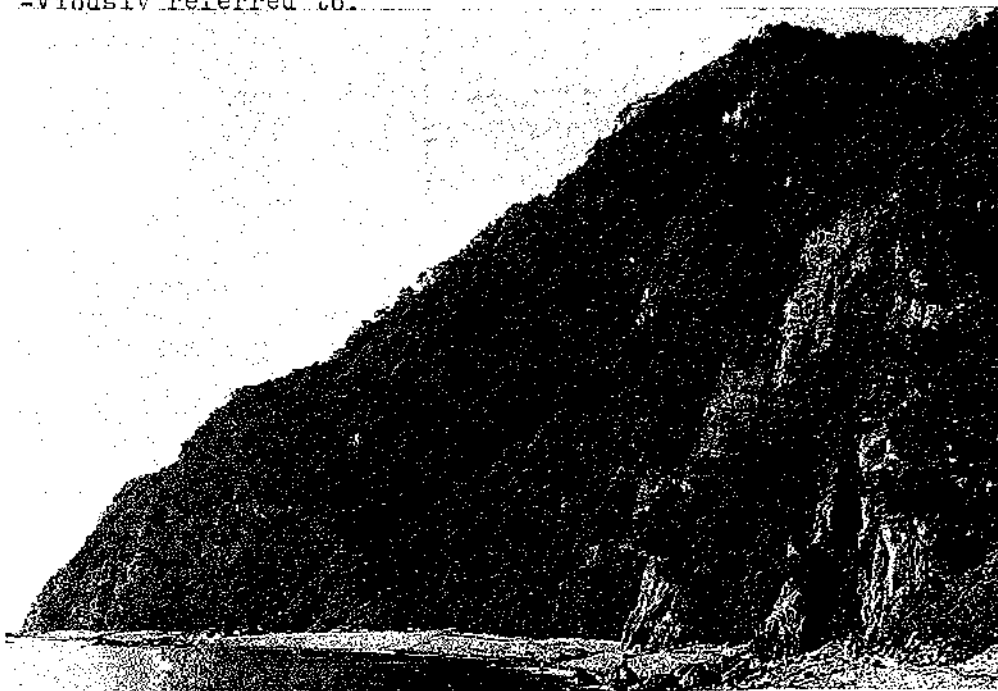


PLATE 33.

Looking south along the coast from Hingata shewing typical pohutukawa cliff forest on jointed massive lava flow.

A. flaccidum, Cyclophorus serpens, Polypodium diversifolium,
Polystichum Richardii, and bracken (Pteridium esculentum).

MUEHLENBECKIA COMPLEXA ASSOCIATION.

In its primitive state few other species enter into competition with the pohuehue (Muehlenbeckia complexa) and in the van of advancing vegetation over the raw boulders it holds, with Cyclophorus serpens almost undisputed sway. It acts as a coloniser trapping seeds and humus so gradually leading to its own extinction. The Muehlenbeckia forms a dense but open mat of interlacing wiry stems often completely hiding the boulders from view. On the seaward edge Cyclophorus serpens frequently leads the van over the boulders to be later smothered by the trailing stems of the pohuehue (Muehlenbeckia complexa). (Plate 34.)

Other species occurring in the association are Asplenium lucidum, Calystegia sepium, C. Soldanella, and Euphorbia glauca, while less abundant are Cardamine heterophylla, Pellaea rotundifolia, Polypodium diversifolium, Rhagodia nutans, Senecio lautus and Stellaria parviflora.

On the boulder banks surrounding "The Flat" where apparently shore progression has been, if not still^{is} occurring, the pohuehue (Muehlenbeckia complexa) association covers a wide strip, the outer edge as described above, the inner edge invaded by advancing grasses adapted to the dry conditions - notably Microlaena stipoides now accompanied by a host of exotics (see "Modified Muehlenbeckia complexa Association".)

SUCCULENT ASSOCIATION; TETRAGONIA TRIGYNA COLONIES. (Plate 35)

In many places on the boulders Tetragonia trigyna forms colonies often of considerable extent. Such colonies are characterized by their light lemon-green colour, the fleshy hastate



PLATE 34. *Muehlenbeckia complexa* association on the boulder bank round "The Flat". Note also the *Asplenium lucidum* on the right and the *Euphorbia glauca* with its upright growth in the mid-distance.



PLATE 35. A colony of *Tetragonia trigyna* on the boulders near the entrance of Parihakoakoa Stream. *Rumex crispus* in the left background, *Calystegia sepium* in the foreground and *Sicyos angulata* at the base of the *Phormium tenax*.

leaves and bright red drupes of this species. No Tetragonia expansa appears to occur on the Island. Calystegia sepium and Sicyos angulata frequently occur sprawling over these colonies.

COASTAL SCRUB. (Plate 36 & 37).

Coastal scrub may be considered as a wind-epharmone of coastal forest. Except in sheltered positions it usually occurs as a seaward fringe to the coastal forest, of varying width according to the prevailing wind intensity. The physiognomic feature of the association is the wind shorn scrub canopy sloping seawards where it merges by imperceptible stages with the Muehlenbeckia of the foreshore, while landwards it passes into tall coastal forest. It is here arbitrarily defined as from 0.5 - 2 metres in height.

The chief members are rangiora (Brachyglottis repanda) taupata (Coprosma retusa), Coprosma lucida, karaka (Corynocarpus laevigata), kohe-kohe (Dysoxylum spectabile), hange-hange (Geniostoma ligustrifolium), Hymenanthera novae-zelandiae, kawakawa (Macropiper excelsum), wharangi (Melicope ternata), mahoe (Melicytus ramiflorus), parapara (Pisonia Brunoniana), karo (Pittosporum crassifolium), and mapau (Suttonia australis). (Plate 36).

Ferns are sparse Asplenium lucidum, Cyclophorus serpens Pteridium esculentum and Pteris comans being the only common ones.

This association is common on the south side of the Island fronting the fringing coastal forest and particularly well developed near the entrances to streams. In front of cliffs there appears to be a decrease in wind intensity, a buffer layer of comparatively still air being formed in front of the cliff.

Fronting Hingaia (Pohutukawa Flat) a totally different type of scrub exists. Here the soil is extremely rocky and "immature", the plants often growing on what is apparently bare rock. A greater variety exists here than elsewhere in the coastal scrub and several species usually epiphytic become rupestral. The scrub



PLATE 36. Te Titoki Pt. from the south. *Muehlenbeckia complexa* at the head of the boulders, grading into coastal scrub on the right with fringing pohutukawa along the foreshore.



PLATE 37. Coastal scrub at Hingaia with young pohutukawa colonising over the boulders, while mature trees overhang the scrub above.

is less wind-swept and owes its occurrence more to unfavourable edaphic conditions than to wind intensity. At Hingaia Pt., where shore progradation is apparently occurring, pohutukawa (Metrosideros excelsa) forms an advance guard colonising the boulders. Outside the fringe of juvenile pohutukawas may be a belt of scattered Phormium tenax with Asplenium flaccidum, Angelica rosaefoliae and pohuehue (Muehlenbeckia complexa). (Plate 37).

The coastal scrub at Hingaia contains in addition to the members already mentioned tce-toe (Arundo conspicua), Astelia Banksii, kahakaha (Astelia Solandrii), puka (Grisilina lucida), Hymenanthera novae-zelandiae, Pittosporum cornifolium, houpara (Pseudopanax Lessonii), and Senecio Kirkii, while mature Metrosideros excelsa overhang the scrub, without, as is elsewhere the case, affording wind protection.

Sicyos angulata occurs sparsely as a sprawling liane on the coastal fringe at various places round the coast but is rarely abundant.

COASTAL FOREST COMMUNITIES. (Plates 38, 39 & 40).

The coastal forest communities may conveniently be described as :-

- (a) Coastal forest occurring as a fringe at the base of the cliffs.
- (b) Pohutukawa forest, Hingaia, resulting from the operation of edaphic rather than climatic factors.
- (c) Semi-coastal forest, with tawa and taraire sub-dominant to pohutukawa.

Coastal forest.

Coastal forest occurs as a fringe of varying width on a sloping shelf of debris at the base of the cliffs on the greater part of the south-western and eastern coast. In windswept

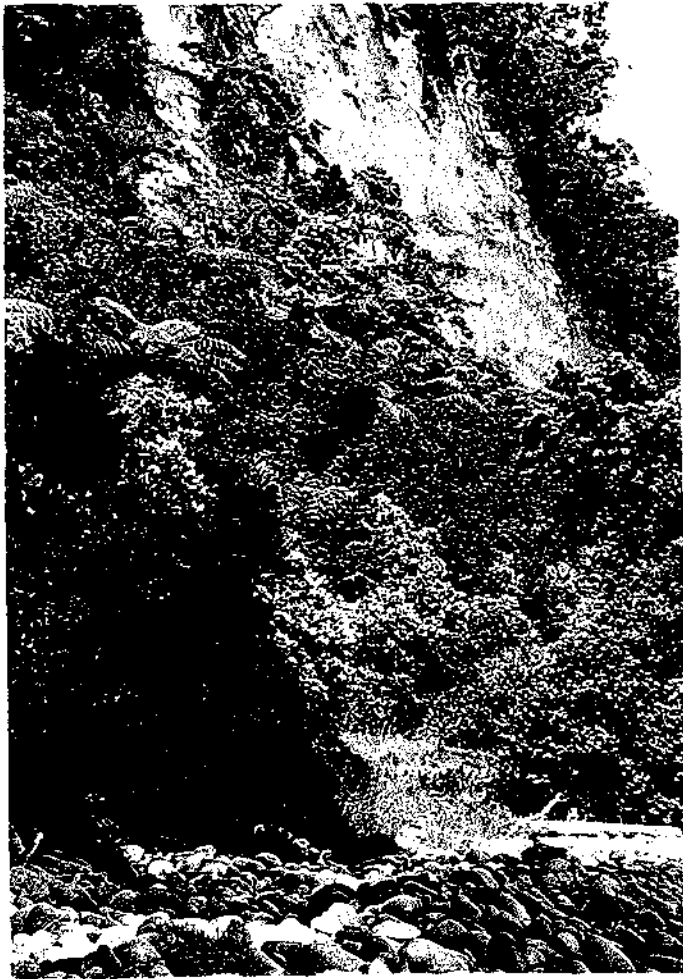


PLATE 38. The fringing coastal forest typical of the south coast. Fohutukawa on the extreme right end on the cliff above; mamaku (*Cyathes medullaris*) prominent in the forest, also rangiora (*Brachyglottis repanda*) shewing with white leaves.



PLATE 39. Another view along the south coast shewing a slightly different type of coastal forest with *Phormium tenax* prominent along the shore, rangiora and *Coprosma retusa*.

positions it is protected on its seaward edge by a fringe of coastal scrub. In more sheltered positions it may commence right on the edge of the boulder beach.

Where the shelf is narrow, karo (Pittosporum crassifolium) kawakawa (Macropiper excelsum), taupata (Coprosma retusa) and karamu (Coprosma robusta and C. lucida) often form the greater portion of the association but where the shelf is wider the variety of species increases and many forest dwellers make their appearance.

Pohutukawas usually form a fringe along the beach, and behind the combined shelter of these and the coastal scrub comes the true coastal forest, its canopy 6 - 12 metres high and formed of karaka (Corynocarpus laevigata), mamaku (Cyathea medullaris), kohekohe (Dysoxylum spectabile), Fuchsia excorticata, manuka (Leptospermum scoparium), wharangi (Melicope ternata), mahoe (Melicytus ramiflorus), pohutukawa (Metrosideros excelsa), parapara (Pisonia Brunoniana), tawapau (Sideroxylon novo-zelandicum), and puriri (Vitex lucens). (Plate 38 & 39).

Under this canopy there frequently occurs a dense growth of kawakawa (Macropiper excelsum) the plants growing very luxuriantly. Owing to the dense shade thrown by these colonies little ground vegetation occurs under them.

Elsewhere the forest floor is more open with scattered shrubs and ferns. Hangehange (Geniostoma ligustrifolium), mapau (Suttonia australis), Coprosma lucida, houpara (Pseudopanax Lessonii) and juvenile wharangi (Melicope ternata), kohekohe (Dysoxylum spectabile), karaka (Corynocarpus laevigata) and matata (Rhabdothamnus Solandri) are plentiful. (Plate 40).

Ferns common are Asplenium bulbiferum, A. flaccidum, A. lucidum, A. lamprophyllum, Adiantum affine, Blechnum lanceolatum, Cyclophorus serpens, Polypodium diversifolium and Pteris comans.

Epiphytes are sparse, kahakaha (Astelia Solandri), Astelia Banksii, Asplenium flaccidum, A. adiantoides, Cyclophorus serpens and Peperomia Urvilleana occur while lianes with the exception of



PLATE 40. Interior of coastal forest at Hingaita illustrating the rocky nature of the ground here and the sparse soil. The trunk of a pohutukawa shows on the right, a juvenile kohexone (Dysoxylum spectabile) in the foreground, perching Astelia, and on the foreground Asplenium lamprophyllum.

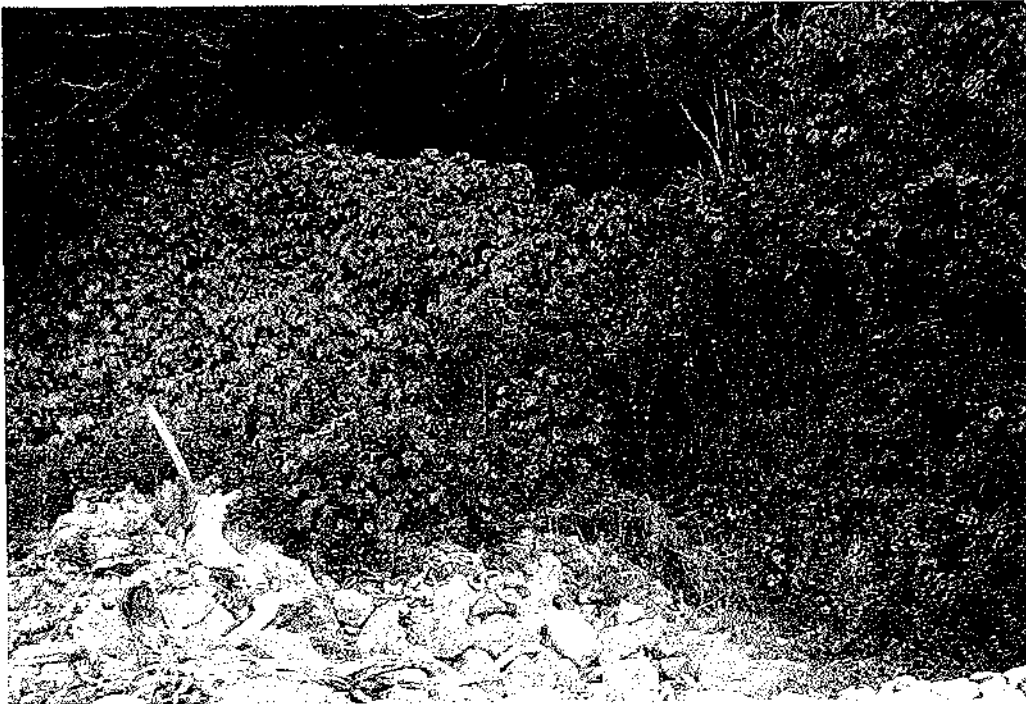


PLATE 41. A colony of whau (Antelia arborescens) on the east coast showing Sicyos angulata sprawling over the bushes on the right.

clermatis (Clematis indivisa) and supplejack (Rhipogonum scandens) are absent.

Whau colonies. (Plate 41.)

At several places on the east coast minor landslips have occurred and these have been colonized by a dense growth of whau (Entelia arborescens) which at the time of my visit were 2 - 3 metres in height, straight stemmed and growing luxuriantly. Some leaves measured 50 cms by 50 cms with petioles 38 cms long.

Numerous herbs occupied the ground, Bidens pilosa, Carex Forsteri, Deyeuxia Billardieri, Epilobium rotundifolium, E. nummularifolium, Erechtites Atkinsoniae, Gnaphalium japonicum, G. Collinum, toatua (Haloragis erecta), Parietaria debilis, inkweed (Phytolacca octandra), Poa anceps, Sicyos angulata, poroporo (Solanum aviculare), Solanum nigrum, Uncinia australis, and many other forms occurred. It is interesting to note the diversity of herbs arising on ground thus freshly cleared and the admixture of an introduced element into the association. Such an association is, no doubt, but a passing phase in the regeneration of pohutukawa forest.

POHUTUKAWA FOREST, HINGAIA. (Plates 42 & 43).

This association occupies the greater part of Hingaia (Pohutukawa Flat) covering an area of approximately twenty-three hectares (sixty acres) in extent. Hingaia (meaning "fallen") is an old landslip of large dimensions (see section on topography) and the forest floor, if such it may be called, consists of huge andesitic fragments thrown irregularly together by the landslip. ^{rock} Between the boulders huge caverns still exist, while soil is scanty, being only such as is provided by the weathering of ^{the} andesite or by the gradual accumulation and decay of organic matter. Under such conditions only plants adapted



PLATE 42. The canopy of the pohutukawa forest, Hingaiia.



PLATE 43. The edge of the pohutukawa rock forest, Hingaiia. Note the Astelia abundant on the forest floor, mahoe (Melicytus ramiflorus) in the left foreground.

to rocky situations or provided with special means of conserving moisture can subsist.

The canopy consists almost entirely of widely spreading somewhat open headed pohutukawa (Metrosideros excelsa), while rata (Metrosideros robusta) occurs plentifully as a small canopy tree 5 - 7 metres high. The canopy is, however, very open and irregular, leaving the forest floor brilliantly illuminated. (Plate 42)

There is no distinct shrub layer in this community, but scattered trees of Coprosma lucida, puka (Grisilina lucida), Pittosporum cornifolium, Pittosporum Huttonianum, Senecio Kirkii and mapau (Suttonia australis) are plentiful while rangiora (Brachyglottis repanda), hangehange (Geniostoma ligustrifolium) Helichrysum glomeratum, kawakawa (Macropiper excelsum), and wharangi (Melicope ternata) are less common. (Plate 44).

Covering the summits of the boulders to the exclusion of nearly all else is a dense growth of Astelia Solandri, Astelia Banksii, and Astelia trinervia. These grow luxuriantly to a height of 0.8 - 1.4 metres overhanging and obscuring the crevices between the boulders, so making progress very difficult. Accompanying the Astelia are other common "sun epiphytes" such as Asplenium adiantoides, A. flaccidum, Cyclophorus serpens, Polypodium diversifolium, and Peperomia Urvilleana.

On the shaded sides of the boulders occur Polypodium dictyopteris, Polypodium australe and Trichomanes-humile.

Epiphytes are fairly abundant and include the species already noted and in addition Bulbophyllum pygmaeum, Dendrobium Cunninghami, Farina mucronata and Lycopodium Billiardieri.

This association is probably unique but the task of exploring it is a slow and laborious one so that it has been somewhat imperfectly covered. A considerable area, devoid of vegetation, has been observed from the cliff above to exist towards the centre of the flat but efforts to reach this have not so far met with success owing to the difficulty of location when on the flat and the slow rate of



PLATE 44. The interior of the pohutukawa rock forest, Hingaiā showing the widely spread open canopy of the forest and the luxuriant growth of Astelia Banksii and Astelia Solandri (left) on the summits of the boulders. Pittosporum cornifolium in the foreground and Griselinia lucida on the right.



PLATE 45. The interior of semi-coastal forest at Hingaiā where the boulders are covered by a layer of soil. The tall straight trunk is that of a Beilschmeidia taraire, on the left a puriri (Vitex lucens) stems and the leaning trunk is that of a pohutukawa. The palm is a nikau (Rhopalostylis sapida) while in the foreground is a young pate (Schefflera digitata), Asplenium bulbiferum and Freycinetia Banksii.

progress possible. It is difficult to surmise why such a barren area should exist where growth is usually so luxuriant.

SEMI-COASTAL FOREST.

Semi-coastal forest occurs at the seaward end of many of the streams as a transition phase between coastal forest and the ratatawa communities. It also occurs irregularly on Hingaia, its distribution coinciding with more favourable rooting conditions owing to the presence of soil interspersed among or completely covering the boulders. This soil (No. 4) is extremely fertile and the vegetation is correspondingly luxuriant though this is probably in some measure due also to the shelter from cold winds afforded by the high cliffs surrounding Hingaia.

The canopy is dominantly pohutukawa (Metrosideros excelsa), but in many places tarairē (Beilschmeidia Tarairē) and kohekohe (Dysoxylum spectabile) become sub-dominant, the pohutukawa widely spread and forming the upper canopy, while below this comes a much denser canopy of Beilschmeidia Tarairē, tawa (Beilschmeidia Tawa), karaka (Corynocarpus laevigata), Dysoxylum spectabile, rewarewa (Knightia excelsa), mahoe (Meliccytus ramiflorus), rata (Metrosideros robusta), tawapau (Sideroxylon novozelandicum) and puriri (Vitex lucens). (Plate 45.).

The undergrowth is irregular in height forming no distinct layers. Nikaus (Rhopalostylis sapida) are plentiful and thrive remarkably, some attaining astonishing spreads. One specimen measured had leaves 6.6 metres (22 feet) long, while the individual leaflets were 1.2 metres (4 feet) long and over 7.5 cms (3 inches) wide. (Plate 48.). While these are exceptional, they serve to illustrate the general luxuriance prevailing. Beilschmeidia Tarairē, B. Tawa, karaka (Corynocarpus laevigata), juvenile kohe-kohe (Dysoxylum spectabile), mangaeo (Litsaea calicaris), and tawapau (Sideroxylon novozelandicum) occupy much of the shrub

layer and this accounts in part for its lack of uniformity. Associated with these are rangiora (Brachyglottis repanda), Coprosma grandifolia, whau (Entelia arborescens), 'hangehange (Geniostoma ligustrifolium), kawakawa (Macropiper excelsum), Nothopanax arboreum, matata (Rhabdothamnus Solandri), and pate (Schefflera digitata).

On the forest floor and covering every boulder is an almost incredibly dense covering of Asplenium lamprophyllum, Asplenium bulbiferum, Asplenium lucidum, Asplenium adiantoides, Blechnum lanceolatum, Dryopteris pennigera, Hymenophyllum demissum, H. dilatatum, H. sanguinolentum, Peperomia Urvilleana, Polypodium pustulatum, and Polypodium dictyopteris, and Trichomanes humile.

In damper places supplejack (Rhipogonum scandens) and kiekie (Freycinetia Banksii) are plentiful in company with colonies of nikaus.

Astelia Solandri, A. Cunninghamii, Asplenium adiantoides, Bulbophyllum pygmaeum, Dendrobium Cunninghamii, Marina mucronata, Grisilina lucida and Lycopodium Billardieri are not uncommon epiphytes but rarely plentiful except on pohutukawa trees (Metrosideros excelsa),

Lianes are not abundant; supplejack (Rhipogonum scandens) and kiekie (Freycinetia Banksii) occur in the damper parts while with the exception of Clematis indivisa the only others are the climbing ferns Arthropteris tenella, Polypodium pustulatum and mange-mange (Lygodium articulatum).

RATA-TAWA COMMUNITIES.

The term rata-tawa has been used in a somewhat broad sense as descriptive of the forest characteristic of the valleys and valley sides. As has been mentioned earlier such a community

varies constantly in the proportion of its main members and also in the associated species according to changing conditions.

Perhaps the most notable feature of the community is the almost complete absence of Taxads. Miro (Podocarpus ferrugineus) and totara (Podocarpus totara and P. Hallii) are sparsely distributed but nowhere abundant; other Taxads are either absent or have been observed only infrequently as isolated mature trees or as juvenile plants apparently recently introduced.

In open valleys rata (Metrosideros robusta) is physiognomic, rearing its huge irregular canopy of leaves high above the surrounding trees. ^(Plate 46) In Tirikakawa valley pukatea (Laurelia novae-zealandiae) are abundant, practically every tree bearing a large rata (Metrosideros robusta) now well established but not yet having killed its host. It would appear that in some cases at least rata (Metrosideros robusta) may be a succession to pukatea (Laurelia novae-zealandiae). Intermingled, but with its canopy considerably below that of the rata (M. robusta), is Beilschmeidia tawa, abundant on all but the highest parts of the island (Figure 9). Near the sea taraire (Beilschmeidia taraire), is frequently plentiful with occasional large puriri (Vitex lucens), overhanging the stream. Karaka (Corynocarpus laevigata), kohekohe (Dysoxylum spectabile), Fuschia excorticata, rewarewa (Knightia excelsa), and mahoe (Melicytus ramiflorus) are also plentiful in such situations. Nearer the source of the stream (i.e., at higher elevations), tawhero (Weinmannia sylvicola) becomes plentiful in association with tawa (Beilschmeidia tawa), mahoe (Melicytus ramiflorus) and Fuschia excorticata, such also being typical of the deep gorges on the northern side of the Island.

Along the banks of the streams where illumination is more intense, there occurs a wealth of relatively high light intensity demanding trees and shrubs such as makomako (Aristotelia serrata), rangiora (Brachyglottis repanda), mamaku (Cyathea medullaris), Coprosma grandifolia, heketara (Olearia Rami), nika (Rhapalostylis sapida) and pate (Schefflera digitata). ^{(Plate 47, 48 & 49).} The lower layer of vege-

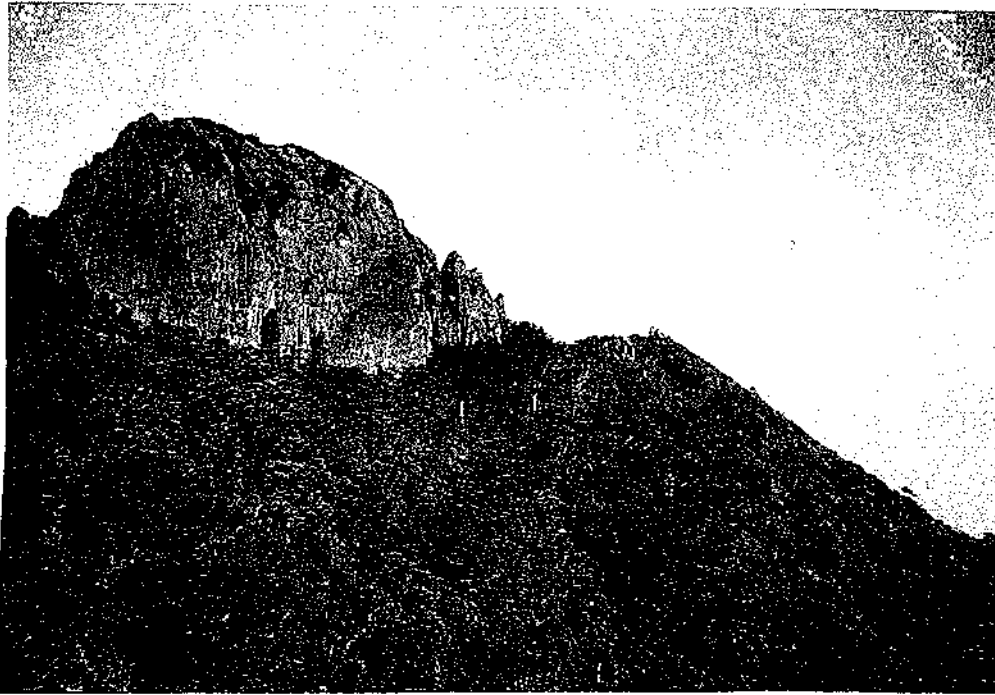


PLATE 46. Mt. Haurua showing the canopy of the mata-tawa forest in the foreground.



PLATE 47. The upper reaches of Awarua Stream showing the stony stream bed and the almost tropical luxuriance of the vegetation clothing the banks.

tation is irregular and open, of Alseuosmia macrophylla, kiekie (Freycinetia Banksii), karamu (Coprosma robusta), hangehange (Geniostoma ligustrifolium), mapau (Suttonia australis) and matata (Rhabdothamnus Solandri). On the open creek bed such forms as Callitriche Muelleri, willow-weed (Epilobium rotundifolium, E. nummularifolium and E. insulare), cudweed (Gnaphalium Keriense, G. collinum) and catsear (Hypochaeris radicata) frequently occur.

As elevation increases the proportion of tawa (Beilschmeidia tawa) and tawhero (Weinmannia sylvicola) in the canopy increases; rata (Metrosideros robusta) follow up the valleys to an elevation of approximately 600 metres (2,000 feet) and smaller specimens are found on many of the ridges but the tendency is definitely for the rata to decrease in numbers with increase in elevation.

On the flat-topped ridge to the south of Pohutukawa Gully at an elevation of 400-500 metres the canopy consists of tawa, (Beilschmeidia tawa), tawari (Ixerba brexioides) many large miro (Podocarpus ferrugineus) up to one metre in diameter and tawhero (Weinmannia sylvicola) with occasional hinau (Elacocarpus dentatus). The shrub layer is dense and composed of Alseuosmia macrophylla, kiekie (Freycinetia Banksii), heketara (Olearia Rani) five-finger (Nothopanax arboreum) and juvenile tawa and miro. Progress through the undergrowth is rendered difficult by a profusion of the wiry stems of mange mange (Lygodium articulatum) and rope-like supplejack (Rhipogonum scandens). Swordfern (Blechnum discolor) is abundant on the forest floor in association with beds of Hymenophyllum demissum and Trichomanes reniforme. Conditions are hygrophytic and favour a wealth of shade epiphytes, Astelia Banksii, A. Cunninghamii, Asplenium flaccidum, Hymenophyllum spp., Lyco-podium Billardieri, climbing ratas (Metrosideros perforata, M. scandens) and Trichomanes reniforme being abundant.

Throughout the association beech (Nothofagus truncata)

porokaiwhiri (Hedycarya arborea), miro (Podocarpus ferrugineus), totara (Podocarpus totara and P. Hallii), rewarewa (Knightia excelsa), hinau (Elaeocarpus dentatus), tawari (Ixerba brexioides), in higher levels, and kauri (Agathis australis) are not uncommon canopy trees.

Under the canopy occurs an irregular layer of juvenile forest trees in addition to which are Coprosma arborea, C. grandiflora, five-finger (Nothopanax arboreum), maire (Olea Cunninghamii, O. lanceolata), Persoonia toru, Pseudopanax discolor (in higher parts), mapau (Suttonia australis) and toro (Suttonia salicina). The density of this layer depends in large measure on the "light minimum" of the dominant canopy trees; where this is low as in the case of Beilschmeidia taraira undergrowth is sparse or lacking while where high (e.g. Nothofagus truncata) and illumination on the forest floor relatively bright the density of this layer increases.

In the shrub layer Alseuosmia macrophylla is abundant often to the exclusion of almost all else; with it may be kiekie (Freycinetia Banksii) occasionally in colonies, kawakawa (Macropiper excelsum) near the sea, horopito (Drymis axillaris) at higher levels, mingimingi (Leucopogon fasciculatus) hangehange (Geniostoma ligustrifolium), Senecio Kirkii and rangiora (Brachyglottis repanda). The undergrowth tends to be more open than might be expected in virgin forest; the ground is stony and usually steep; in damp hollows, such as the heads of valleys there is frequently a profusion of hanging supplejack (Rhipogonum scandens) stems, but progress while necessarily slow on account of the nature of the ground is rarely seriously impeded by undergrowth.

Ferns are abundant; mangemange (Lygodium articulatum) with its wiry climbing stems is, apart from supplejack (Rhipogonum scandens) the chief hindrance to easy progress through the forest. On the forest floor beds of Hymenophyllum demissum, H. dilatatum

and Trichomanes reniforme are plentiful; in valleys and in the northern gorges the damp banks bear an abundant growth of Asplenium bulbiferum, Blechnum lanceolatum, B. procerum and Dryopteris pennigera. In the Waitoki stream several colonies of para or king fern (Marrattia fraxinea) occur but none have been observed elsewhere; Lindsaya viridis occurs in several of the valleys but is nowhere abundant. Asplenium lamprophyllum, A. bulbiferum, Blechnum lanceolatum and Leptopteris hymenophylloides are abundant throughout the association, while Microlaena avenacea, Libertia pulchella, Corysanthes rivularis and Uncinia riparia are also plentiful.

With the exception of kiekie (Freycinetia Banksii), mangelange (Lygodium articulatum) and supplejack (Rhipogonum scandens), already mentioned, lianes are not abundant with the exception of several species of climbing ratas (Metrosideros spp.), Clematis indivisa, C. parviflora, Parsonsia heterophylla, Rubus australis and R. Schmidelioides are widely distributed in the association but rarely plentiful.

Epiphytes are abundant, and there can be distinguished (29) an upper layer of sun epiphytes on the branches of the tall trees and a lower layer of shade epiphytes. The upper sun epiphytes are particularly abundant on rata (Metrosideros robusta) the chief species ^{of epiphytes} being kahakaha (Astelia Solandri), A. Cunninghamii, Asplenium adiantoides, Dendrobium Cunninghamii, puka (Grisilina lucida), Pittosporum cornifolium, and Polypodium diversifolium. The shade element is more numerous consisting chiefly of hygrophytic ferns, orchids, liverworts and mosses such as Asplenium adiantoides, Blechnum filiforme, Earina mucronata, E. autumnalis, Hymenophyllum spp., Lycopodium Billardieri, Polypodium dictopteris, P. pustulatum, Tmesipteris tannensis, Trichomanes reniforme, T. humile and T. venosum. Conditions, however, are scarcely humid enough for the fullest development of the shade epiphytes except in the valleys or in the upper reaches of the association where more hygrophytic conditions prevail.



PLATES 48 & 49.

Two views down Crau Gorge showing the magnificent nikaus and the general type of stream-side vegetation in the rata-tawa forest.



KAURI COMMUNITIES.

The kauri communities (Agathis australis) of the Island occupy many of the ridges up to 1,500 feet elevation but rarely form pure stands. They may be subdivided into :-

- (1) Kauri sub-association.
- (2) Kauri - Nothofagus truncata - rata sub-association.

KAURI SUB-ASSOCIATION. (Plate 50).

This association presents few features peculiar to the Island. The kauri are rarely very large, the biggest being only about seven feet in diameter, while the stands are rarely very dense, the trees being somewhat distantly spaced and short in the barrel. The undergrowth consists chiefly of juvenile tawa (Beilschmeidia tawa) Coprosma grandifolia, Coprosma lucida, nei-nei (Dracophyllum Matthewsii), tawari (Ixerba brexioides), rewa-rewa (Knightia excelsa), sandle-wood (Mida salicifolia), five-finger (Nothopanax arboreum), miro (Podocarpus ferrugineus), toro (Suttonia salicina), and tawhero (Weinmannia sylvicola). These species form an uneven layer four to six metres in height yet sufficiently widely spaced to leave the ground fairly brightly illuminated. Taraire (Beilschmeidia taraire) is lacking from the association.

The forest floor is occupied by abundant Alseuosmia macrophylla, Astelia Solandri, Astelia trinervia, Blechnum discolor, Blechnum Fraseri, Gahnia xanthocarpa, minge-minge (Leucopogon fasciculatus), Pseudopanax discolor, Senecio Kirkii, and kie-kie (Freycinetia Banksii).

At higher elevations wide tension belts occur between the kauri sub-association and the tawhero-tawa association; also at lower levels between the kauri sub-association and the rata-tawa



PLATE 50. A view down the Maitoki Gorge showing the canopy of the kauri forest on the ridge to the right.



PLATE 51. The interior of the kauri-Nothofagus-rata association on one of the east coast ridges. A slender kauri trunk shows in the distance - *Astelia trinervia* and *Alseuosmia macrophylla* in the foreground.

communities.

KAURI - NOTHOFAGUS TRUNCATA - RATA SUB-ASSOCIATION.

This sub-association while more distinctive in type and characteristic of certain of the east-coast ridges may probably be more correctly considered as a tension belt where conditions are equally favourable for each of the three dominant species. However its characteristics are such that for descriptive purposes it is here considered as a distinct sub-association. The kauri (Agathis australis) give a distinct outward facies to the association but appear less prominent from within, few being of large size. The beech (Nothofagus truncata) and rata (Metrosideros robusta) form a lower canopy. Some of the beech attain a diameter of 0.6 metres but are rarely very high while the rata (Metrosideros robusta) are scattered and not of large size. Associated with these in the upper canopy are tawhero (Weinmannia sylvicola), tawa (Beilschmeidia Tawa), hinau (Elaeocarpus dentatus), and rewa-rewa (Knightia excelsa).

A lower layer 3 - 5 metres high consists of juvenile Beilschmeidia Tawa, nei-nei (Dracophyllum Matthewsii), tawari (Ixerba brexioides), Nothopanax arboreum, Pseudopanax discolor, Quintinia serrata, toro (Suttonia salicina) and mapau (Suttonia australis). (Plate 51).

On the forest floor is a dense tangle of Alseuosmia macrophylla, Astelia trinervia, Astelia Solandri, Blechnum procerum, Coprosma lucida, kie-kie (Freycinetia Banksii), Hymenophyllum sanguinolentum, Polypodium diversifolium and Senecio Kirkii are common terrestrially while Astelia Solandri, Astelia Cunninghamii, Asplenium adiantoides, Earina mucronata and Earina autumnalis occur epiphytically.

NOTHOFAGUS TRUNCATA FOREST.

Beech forest (Nothofagus truncata) occurs on several of the east coast ridges of the Island at an elevation of 230 - 350 meters (approximately) sometimes as a pure association; sometimes co-dominant with kauri and rata (Metrosideros robusta).

On the seaward end of the ridge to the south of Pohutukawa Gully a typical beech forest occurs on a flat-topped spur. The beech (Nothofagus truncata) are often 50 - 75 cms., in diameter and 16 metres in height; the canopy open and somewhat irregular allowing bright illumination on the forest floor. Associated with the beech are occasional rata (Metrosideros robusta) and young kauri (Agathis australis) while slightly below the beech canopy are scattered small tawa (Beilschmeidia Tawa), tawhero (Weinmannia sylvicola) and miro (Podocarpus ferrugineus). (Plate 52).

The shrub layer is, like the canopy, open and irregular consisting of somewhat remotely spaced Alseuosmia macrophylla, Coprosma grandifolia, Corokia buddleoides, nei-nei (Dracophyllum Matthewsii), minge-minge (Leucopogon fasciculatus), juvenile Nothofagus truncata, Nothopanax arboreum, Pseudopanax discolor, Senecio Kirkii, and mapau (Suttonia australis).

Covering the stony forest floor is a dense growth of kahakaha (Astelia Solandri) and Astelia trinervia with occasional kie-kie (Freycinetia Banksii).

Trailing from the low shrubs is plentiful mange-mange (Lygodium articulatum) but other lianes are rare or absent while epiphytes are uncommon except on rata (Metrosideros robusta) or large Nothofagus truncata. Those noted include Astelia Solandri, Astelia Cunninghamii, Asplenium flaccidum, Dendrobium Cunninghamii, sanguinolentum, Earina autumnalis, Hymenophyllum, Pittosporum cornifolium, and Polypodium diversifolium.

At higher elevations, further up the ridge, the forest gradually changes, the canopy becoming denser and the beech (Notho-



PLATE 52. The interior of beech forest (Nothofagus truncata) on the ridge to the south of Ponutukawa Gully. Astelia trinervis in foreground and Astelia Solanari on rata on right.



PLATE 53. A photograph in lawhero-tawa forest shewing the abundant epiphytic growth of Hymenophyllaceae, Barina mucronata, Asplenium flaccidum and Astelia Cunninghamii. In the right foreground is Nothopanax Colensoi and in the mid-foreground Pseudopanax discolor.

fagus truncata), dwindling in importance as Beilschmeidia Tawa, Weinmannia sylvicola, Ixerba brexioides and occasional rewa-rewa (Knightia excelsa), miro (Podocarpus ferrugineus), hinau (Elaeocarpus dentatus) and kauri (Agathis australis) enter into the canopy.

The shrub layer also increases in density while with less brilliant illumination of the forest floor the Astelia becomes more scattered and Blechnum discolor, Blechnum procerum and kie-kie (Freycinetia Banksii) become abundant. So with increase in altitude and more hygrophytic conditions the association passes into a typical tawhero-tawa association.

TAWHERO-TAWA ASSOCIATION.

On many of the ridges above 450 metres (1,500 feet), tawhero (Weinmannia sylvicola) forms almost pure associations, the canopy ^{being} moderately dense with few associated trees. Tawa occur only sparsely except on the transition into other associations or as juveniles beneath the tawhero. The undergrowth is dense and luxuriant consisting of Archeria racemosa (in higher parts), horopito (Drymis axillaris), tawari (Ixerba brexioides), Nothopanax Colensoi, Pseudopanax discolor and Quintinia serrata and less commonly Coprosma gandifolia, nei-nei (Dracophyllum Mathewsii), Nothopanax arboreum, maire (Olea lanceolata), heketara (Olearia Rani), pate (Schefflera digitata), Senecio Kirkii and toro (Suttonia salicina).

High humidity conditions seem characteristic of the association and ferns both terrestrial and epiphytic are particularly abundant. The tawhero (Weinmannia Sylvicola), often up to 1.3 metres in diameter and branching almost immediately into many stems are draped in a mantle of filmy ferns and mosses completely concealing the branches right up to the leafy canopy. Hymenophyllum spp., Trichomanes spp., and Polypodium spp., are abundant (see list)¹ and in company with Asplenium flaccidum, Earina autumn-
1. Appendix, p.93 et seq.

alis, Farina mucronata, Lycopodium Billardieri and Tmesipteris tannensis drape every branch and trunk. (Plate 53)

The forest floor is composed almost entirely of a thick brown layer of decaying vegetation which gives readily under the feet and supports a nearly continuous carpet of Asplenium bulbiferum, Blechnum discolor, B. fluviatile, Dianella intermedia, Hymenophyllum demissum, H. dilatatum, Leptopteris hymenophylloides, Lindsaya cuneata var. Lessonii, Trichomanes reniforme and T. strictum, and scattered plants of Corysanthes rivularis, Libertia pulchella, and Uncinia riparia.

On some of the southern ridges of the Island, including that traversed by the track to the summit of Mt. Hauturu, a slightly different type of association occurs in which tawa and rata feature as subdominant to the tawhero. The ground is drier, probably owing to greater exposure to the prevailing wind, and the hygrophytic element of the typical association is much reduced. Alseuosmia macrophylla, Coprosma grandifolia, nei-nei (Dracophyllum Matthewsii), tawari (Ixerba brexioides), rewa-rewa (Knightia excelsa), Nothopanax arboreum, toru (Persoonia toru), Podocarpus Hallii, Pseudopanax discolor, Quintinia serrata, and toru (Suttonia salicina), and less commonly Archeria racemosa form the undergrowth but the draping filmy ferns characteristic of the tawhero association of the northern slopes are much reduced or lacking. Hymenophyllum demissum, H. sanguinolentum, H. dilatatum, H. Funbridgense, H. multifidum and Trichomanes reniforme occur epiphytically with Asplenium flaccidum, Farina autumnalis, F. mucronata, Dendrobium Cunninghamii, Polypodium grammitidis and P. diversifolium, but the shade epiphytes lack the abundance and luxuriant growth of the northern slopes. Terrestrially Blechnum discolor, B. fluviatile, Dianella intermedia, Freycinetia Banksii, Hemitelia Smithii, Leptopteris hymenophylloides, Uncinia riparia and beds of Hymenophyllum demissum, H. dilatatum and Trichomanes reniforme occur.

QUINTINIA-IXERBA-METROSIDEROS UMBELLATA ASSOCIATION.

This association occurs on all the higher ridges of the Island, its distribution being, in large measure, controlled by wind intensity, On the exposed western side of ridges the association descends to a much lower level than on the sheltered eastern side of the same ridge. The wind factor is, however, of importance mainly in its effect on the canopy of the forest, since the forest interior is essentially hygrophytic in nature due to the high humidity condition constantly prevailing. The ridge tops frequently have a covering many feet deep of semi-humified organic matter containing practically no mineral particles, the real soil surface being exposed only on the steep sides of the ridges.

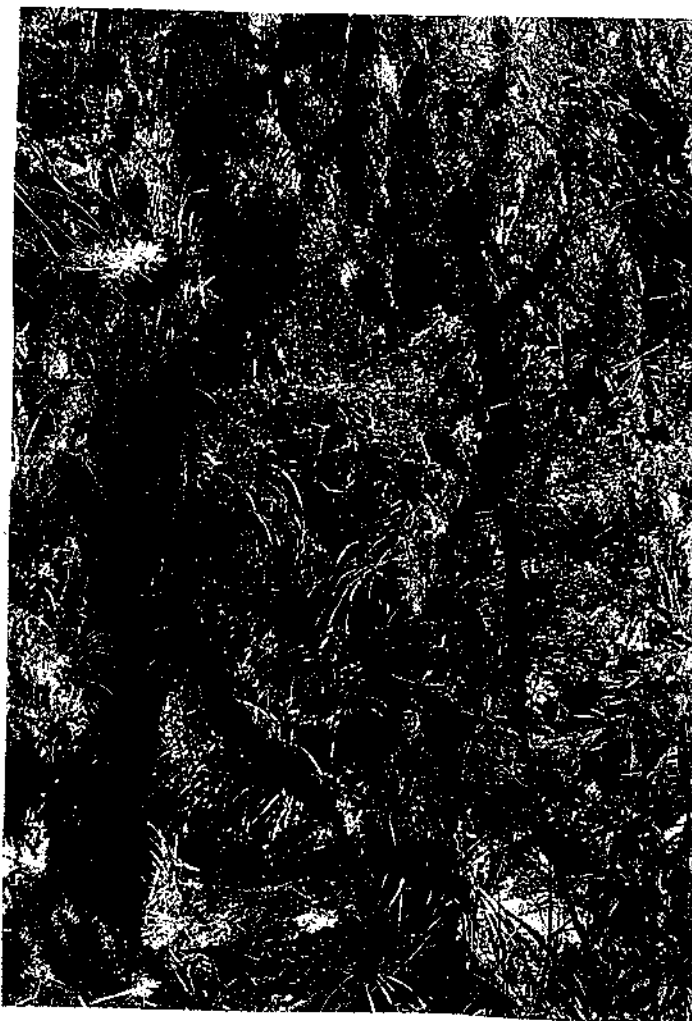
The association is intermediate between forest and sub-alpine scrub being only 4- 6 metres in height and lacking the successive layers of vegetation, so characteristic a feature of the rata-tawa association. The canopy consists dominantly of Quintinia serrata, tawari (Ixerba brexioides) and southern rata (Metrosideros umbellata syn. lucida). This latter is particularly noticeable with its rounded compact canopy of light green leaves in striking contrast to the dark green upright growth of the tawari (Ixerba brexioides). Associated with these in the upper canopy are Archeria racemosa with its racemes of beautiful pink bell-like flowers, mountain nei-nei (Dracophyllum recurvatum), mistletoe (Elytranthe tetrapetala), broadleaf (Grisilina littoralis), Nothopanax Colensoi, toa-toa (Phyllocladus glaucus), thin barked totara (Podocarpus Hallii), Pseudopanax discolor and tawhero (Weinmannia sylvicola). Scattered dwarfed kauri (Agathis australis) and miro (Podocarpus ferrugineus) also occur.

The stiff windswept branches of the trees run at all angles, often closely pressed to the ground, rendering progress (Plate 55). through the growth slow and laborious. Undergrowth is nearly lacking; scattered plants of Alseuosmia macrophyllum, Drymis



Plates 54 & 55.

Photographs taken in the
Quintinia - Ixerba - Metro-
sideros umbellata association
on the summit of Hauturu.
Note the wealth of epiphytes
and mosses on the trees and
the abundance of moisture
loving ferns etc. on the
forest floor.



axillaris, Leucopogon fasciculatus and Senecio Kirkii occur but are rarely abundant.

On the forest floor of the ridge tops and draping the branches from forest floor to canopy is a host of hygrophytic mosses, liverworts, lichens and filmy ferns. Trichocolea australis with graceful fern-like fronds, Cyathophorum bulbosum, Dicrancloma cylindropyxia, D. chrysodrapaneum, Campylopus clavatus, Sciadocladus Menziesii and epiphytically Bazzania novae-zelandiae^{and} Hypopterygium novae-seelandiae are abundant. Associated with these mosses and liverworts is a copious epiphytic shade element including Hymenophyllum multifidum, H. Tunbridgense, H. scabrum, H. ferrugineous, H. dilatatum, Polypodium Billardieri, P. australe, P. grammitidis, Polystichum adiantiforme, Tmesipteris tannensis, Trichomanes Lyallii, and Marina mucronata. (Plate 54)

On the moss carpets of the forest floor many ferns and herbs flourish; Corysanthes rivularis, Dianella intermedia, Libertia pulchella, Lindsaya cuneata var. Lessoni, Nertera dichondraefolia Pterostylis Banksii, Trichomanes reniforme and T. strictum are abundant.

Where openings in the canopy allow more light to reach the forest floor large thickets of Gahnia pauciflora and Phormium Colensoi occur while the large white rata (Metrosideros albiflora) grows abundantly sprawling over the ground or as a liane. Mange-mange (Lygodium articulatum) supplejack (Rhipogonum scandens) and white rata (Metrosideros perforata Forst. syn. M. scandens Sol.), also occur sparingly in the association.

A remarkable feature of the "sun" epiphytes in the association is the presence of large plants of flax (Phormium Colensoi) and Gahnia pauciflora flourishing in epiphytic stations presumably due to the high humidity conditions prevailing, since neither species is specially adapted for water conservation. (Plate 56 & 57) Other "sun" epiphytes are Astelia Solandri, A. Cunninghamii, Dendrobium Cunninghamii and Pittosporum Kirkii, but these are never plentiful.



PLATE 56. *Gahnia pauciflora* epiphytic in the summit flora owing to the high humidity conditions prevailing.



PLATE 57. *Phormium Colensoi* growing in epiphytic station in the summit flora.

SUMMIT SCRUB.

Where wind intensity reaches a maximum on exposed peaks or on the crests of some of the high ridges a wind epharmonie of the Quintinia-Ixerba-Metrosideros umbellata association occurs, its occurrence being due also in part to the hard stony nature of the ground in such places.

The constitution of the scrub varies considerably from place to place. On the summit of most of the peaks it consists of a scrub 1 - 3 metres in height depending largely on the nature of the edaphic conditions. Archeria racemosa, Astelia Solandri, Astelia trinervia, Dracophyllum recurvatum, Elytranthe tetrapetala tawari (Ixerba brexioides), Metrosideros umbellata, Nothopanax Colensoi, Phormium Colensoi, Quintinia serrata, mapau (Suttonia australis), tawhero (Weinmannia sylvicola), are common members of the association wherever it occurs. The steep rock faces of the peaks shew considerable variation in their covering and will be treated individually.

Herekohu (The Thumb) is surmounted by a scrub composed of the above species while on the steep sides is a low scrub of Astelia trinervia, Blechnum minor, Gleichenia Cunninghamii, Metrosideros albiflora and Phormium Colensoi.

The scrub on Mt. Ohakiri contains in addition to the species already mentioned Pseudopanax discolor and Coprosma lucida while terrestrially is a dense growth of Astelia trinervia, Metrosideros albiflora, Phormium Colensoi, and a number of hygrophytic shade elements including Blechnum minor, Dendrobium Cunninghamii, Hymenophyllum multifidum, H. sanguinolentum and Trichomanes reniforme. On the steep rock walls is a dense growth of Blechnum vulcanicum, Dendrobium Cunninghamii, Earina autumnalis, Metrosideros albiflora and M. perforata (Forst.)

The summit of Hauturu (Mt. Archeria) has been partially cleared round the trigometrical station and the vegetation there is more varied and includes Danthonia semi-annularis, Gahnia pauciflora, Gaultheria antipoda, Leucopogon fasciculatus, Lycopodium volubile, Pteridium esculentum, Schoenus tendo, Senecio Kirkii, and Thelymitra longifolia.

On the northern face of Mt. Hauturu and on many of the exposed points of the ridge leading thence to Kiriraukawa shrubs are lacking from the scrub which consists of Astelia trinervia, Gahnia pauciflora, and Phormium Colensoi with occasional Dracophyllum recurvatum rearing their candelabra like growth high above the other vegetation.

On Haurua (Bald Rock), (Plates 46 and 58) the vegetation is more varied and in a wind scrub 0.8 metres high a wide variety of plants occur including kauri (Agathis australis), Kahakaha (Astelia Banksii), A. trinervia, Asplenium flaccidum, A. adiantoides, Blechnum vulcanicum, karamu (Coprosma robusta), tutu (Coriaria ruscifolia), Dendrobium Cunninghamii, blue-berry (Dianella intermedia), Dracophyllum recurvatum, mistletoe (Elytranthe tetrapetala), snow-berry (Gaultheria antipoda), koromiko (Hebe salicifolia), Hymenophyllum Tunbridgense, H. dilatatum, tawari (Ixerba brexioides), rewarera (Knightia excelsa), manuka (Leptospermum scoparium), Leucopogon Fraseri, L. fasciculatus, Lycopodium volubile, Metrosideros umbellata, M. albiflora, M. excelsa (blooming freely), Nothopanax Colensoi, mountain flax (Phormium Colensoi), Pittosporum umbellata, Polypodium diversifolium, Pseudopanax discolor, Quintinia serrata, Senecio Kirkii, Trichomanes reniforme and tawhero (Weinmannia sylvicola).

A feature of the summit flora of the Island is that it lacks the high mountain flora which characterises Te Moehau. No true alpine species have been observed on Hauturu; even Celmisia Adamsii which occurs on several peaks of lower elevation ^{on the mainland} to the northwards is lacking from the Island.

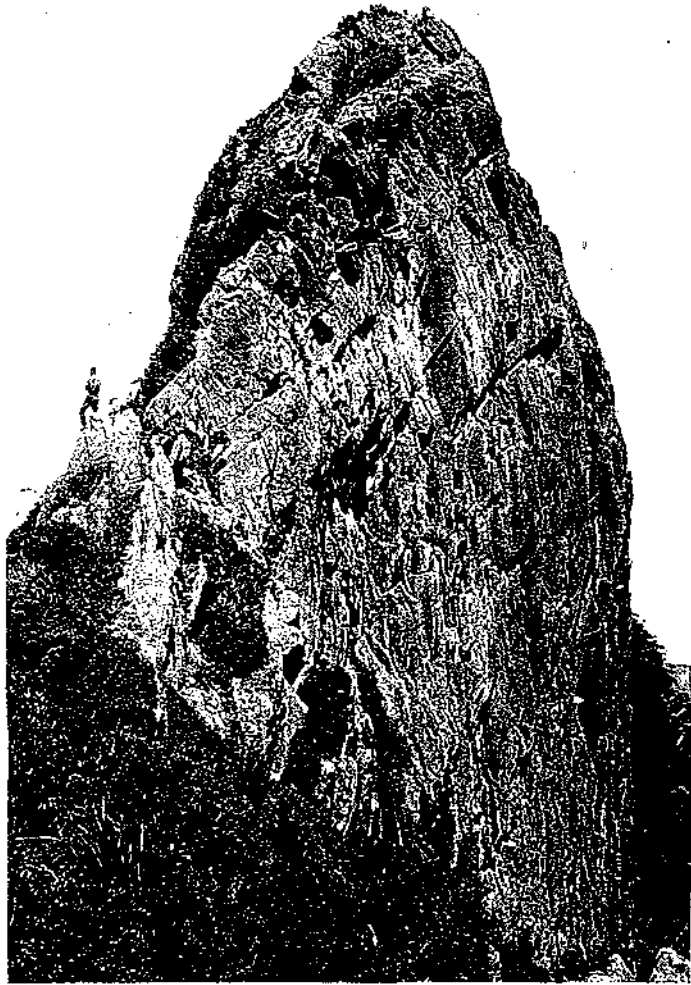


PLATE 56. Mt. Haurua shewing the windswept summit scrub on the peak and ridge in the foreground. The sheer rock-face on the right is about 110m. (350ft.) in height.



PLATE 57. Te Ananuiarau Bay on the N.W. coast, the only place where *Carmichaelia Williamsii* was found.

AFFINITIES OF THE FLORA.

Hauturu is included by Cockayne in the Thames sub-district of the south Auckland botanical district and both ecologically and floristically it shews more resemblance to the Coromandel peninsula than to the forest of the adjacent mainland at Cape Rodney.

The Island lacks the real high mountain flora characteristic of Te Moehau, its chief feature being the absence of rimu (Dacrydium cupressinum) as a member of the dicotylous rain forest and the general paucity of Taxads (miro (Podocarpus ferrugineus) excepted); also the absence of many species for which conditions seem suitable, e.g., cabbage tree (Cordyline australis), Hoheria populnea, paritaniwha (Elatostemma rugosum), kowhai (Sophora tetra-
ptera)¹, kumarahou (Pomaderris elliptica), Fimelea prostrata var. erecta, Dracophyllum Urvilleana, putaputaweta (Carpodetus serratus) and Pteris macilenta.

The absence of some species usually characteristic of manuka forest is probably accounted for by the fact that the manuka forest on the Island is of only recent development and the cleared area has regenerated in species naturally present on the Island before the destruction of the dicotylous rain-forest. Other species common in manuka heath or forest on the adjacent mainland have had insufficient opportunity to spread and colonize at such a distance (23 km.), and as Cockayne has pointed out (8. p. 73), "it is the community as a whole which moves and not its individuals except in the community itself; in fact with hardly an exception, long distance journeys for species, except by extremely short stages, appear impossible".

It would appear, however, from the presence of occasional plants of tarata (Pittosporum eugenoides), titoki (Alectryon ex-
celsum) and rimu (Dacrydium cupressinum) that dispersal is effective

¹ Has been introduced in recent years and is now spreading abundantly, near the caretaker's residence.

even over this distance (23 km.), but the difficulty of establishment in a closed association must be immense, though apparently not impossible since odd plants (presumably in some cases recent introductions) do occur.

Hauturu has, in common with the remainder of the Thames sub-division, the following characteristics mentioned by Cockayne (8. p.382):-

- (1) extensive kauri-tawa forests.
- (2) true *Nothofagus* forest.
- (3) one of the species locally endemic to the sub-division. (*Pittosporum Huttianum*).
- (4) several southern species which extend no further north, viz., *Nothopanax Colensoi*, *Pseudopanax discolor*, *Blechnum vulcanicum*, *Elytranthe tetrapetala*, and *Archeria racemosa*. This botanical evidence in favour of a Coromandel connection at some past time is supported by the geological formation of the Island. (Fig.7)

The absence of *Elatostemma rugosum*, is perhaps, one of the strongest arguments against a North Auckland land connection for Hauturu, since this species is abundant on the coast at Omaha.

The presence of *Garnichaelia Williamsii* on the northern coast is of interest as providing a station mid-way between the Poor Knight Islands and the Alderman Islands. It appears not unlikely that closer survey of some of the other outlying islands of the Hauraki Gulf might shew that this species has a more general distribution than has in the past been supposed. Its presence on Hauturu might easily have escaped notice since it is confined to one bay (Te Ananuiarau) on the most inaccessible part of the coastline and the same may apply in other stations. Its distribution at coastal points such as East Cape, The Alderman Islands, Hauturu and the Poor Knight Islands might suggest that the seed has been sea-borne rather than that the present stations are

remnants of a once wider distribution. (5).

Numbers of the plants collected appear to be of extremely local occurrence and this no doubt also accounts for the fact that a number of species observed by earlier collectors have not been confirmed by the present survey. Blechnum Banksii, Carex pumila, Cotula minor, C. australis, Dactylanthus Taylori, Dryopteris velutina, Hypolepis distans, Pellaea falcata, tarata (Pittosporum eugenioides), Sarcophilus adversus, and Typha angustifolia, (See Plate 60). and numerous other species were seen only as single specimens or occupying a very limited area, often only two or three square yards in extent. This appearance of rarity is undoubtedly more apparent than real since, even during a reasonably prolonged stay on the Island, only a small part of the total area is actually traversed and even that somewhat imperfectly.

AUTECOLOGY.

An analysis of the indigenous species present on Hauturu shews many more ^{species} than either Waipoua or Kapiti but shews little appreciable difference in the proportions of the various groups.

T A B L E 5.

Analysis of life-forms of Hauturu, Waipoua and Kapiti, (indigenous pteridophytes and spermophytes).

	<u>Hauturu</u>		<u>Waipoua</u> ¹		<u>Kapiti</u> ¹	
	<u>Number</u>	<u>Percentage</u>	<u>No.</u>	<u>Percentage</u>	<u>No.</u>	<u>Percentage</u>
Trees	81	23.1	66	27.5	40	13.5
Shrubs	32	8.8	28	11.6	22	9.4
Herbs	181	51.9	101	41.6	126	56.6
Epiphytes	30	8.6	25	10.4	11	5.7
Parasites	3	0.86	-	-	1	0.4
Lianes	<u>24</u>	6.4	<u>21</u>	8.7	<u>18</u>	8.8
Totals	351		241		218	

¹ Figures for Waipoua and Kapiti taken from the published reports of Dr. L. Cockayne (6; 7).

T A B L E 6.

Analysis of indigenous flora of Hauturu, Waipoua, Kapiti and New Zealand, according to botanical classes.

	<u>Hauturu</u>		<u>Waipoua</u>		<u>Kapiti</u>		<u>New Zealand</u>	
	<u>No.</u>	<u>Percentage</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Pteridophytes	86	24.5	63	26.1	43	19.7	166	9.0
Gymnosperms	8	2.2	11	4.5	2	0.9	20	1.0
Monocotyledons	74	21.0	45	18.6	47	18.0	428	23.3
Dictotyledons	<u>183</u>	52.1	<u>122</u>	50.5	<u>126</u>	57.8	<u>1229</u>	66.7
Totals	351		241		218		1843	

¹ Figures for New Zealand from Cockayne's "Veg. of New Zealand" 2nd edition. p. 400.



PLATE 60. The only habitat where raupo (*Typha angustifolia*) was found on the island; illustrates the very limited areas over which some species are found.



PLATE 61. Large-leaved Barrier *Ahabdothamnus Solandri* on the left; ordinary mainland form on the right.

The higher proportion of herbs in the Hauturu and Kapiti flora is probably due to the presence of open cliff communities which are lacking in the Waipoua area. The large number of species of indigenous plants found on Hauturu gives a good index of the variety of habitat provided in the area and also indicates the wide variety of plant associations which is so made possible. A marked feature of the Hauturu area is the large number of pteridophytes occurring; 86 species being recorded as against 63 from Waipoua and 43 from Kapiti.

The 351 species of indigenous plants present on the Island represent 78 families, the principal families (numerically) being, Filices 81 species, Cyperaceae 25, Compositae 21, Gramineae 16, Rubiaceae 12, Liliaceae 12, Myrtaceae 11, Orchidaceae 11, Arctaliaceae 8, Taxaceae, Epacridaceae and Pittosporaceae 7 species each, Onagraceae 6, Lycopodiaceae and Umbelliferae 5 species each.

The 78 families are represented by 193 genera of which the largest numerically are Blechnum 12 species, Carex 10, Coprosma 9, Hymenophyllum 9, Metrosideros 8, Pittosporum 7, Asplenium 6, Trichomanes 6, Gahnia, Polypodium and Adiantum 5 species each.

Large leaved coastal forms.

As has been remarked by previous writers (Ckn. 5, W.R.B. Oliver 28; T. Kirk 23), many coastal plants on the outlying islands of the Auckland Peninsula shew a great increase in leaf size over that of the same or related species on the adjacent mainland.

On the Little Barrier this tendency towards unusual leaf size is apparent in many species including whau (Entelea arborescens), nikau (Rhapalostyllum sapida), kawakawa (Macropiper excelsum), parapara (Pisonia Brunoniana), ngaio (Myoporum laetum) and matata (Rhabdothamnus Solandri). The leaf size of some of the Rhabdothamnus Solandri is particularly striking and might almost lead one to formulate a new variety or even species. Leaves

have been measured 3 cms., by 4 cms., as compared with the usual 2 cms., of mainland specimens. (Plate 61). The flowers, however, while slightly larger than the mainland form do not show the same variation as the leaves; only transplant experiments will determine whether or not the leaf size is specific or merely epharmonic.

The large leaved form of Macropiper excelsum is known as var. major (Cheesm) and is said to be distinguished by the larger size of leaf (10 - 20 cms., as compared with 5 - 12 cms., in the species), and by the greater length of the flower spike (often over 15 cms., long).

It is interesting in this respect to review the specimens in the Dominion Museum herbarium.

T A B L E 7.

Measurements of Dominion Museum herbarium specimens of Macropiper excelsum and var. major.

Locality	Width of mature leaves cms.	Approx. area of leaf. sq. cms.	Average area of leaves sq. cms.	Length of flower spik cms.	
Denham Bay, Sunday Is., Kermadecs.	9	58	75	4 $\frac{1}{2}$ - 12	
	10	79			
	11 $\frac{1}{2}$	93			
	9 $\frac{1}{2}$	70			
Chatham Islands	15	153	129	None on specimen.	
	12 $\frac{1}{2}$	114			
	13 $\frac{1}{2}$	130			
	13	120			
Green Charlotte Sound	14 $\frac{1}{2}$	144	131	None on specimen.	
	13 $\frac{1}{2}$	130			
	13	120			
Kermadecs. Collected by Mr. W.R.B. Oliver, 1900	8 $\frac{1}{2}$	54	43	10	
	7 $\frac{1}{2}$	42		11	
	6 $\frac{1}{2}$	35		10	
	13 $\frac{1}{2}$	114			
	11	39		74	11 $\frac{1}{2}$
	9	38			10
	7	38			8
Norfolk Island Collected by Mr. R. S. Bell	9 $\frac{1}{2}$	70	59	None on specimen	
	9	53			
	10	79			

It will be observed that the specimens from Queen Charlotte Sound and the Chatham Islands are considerably larger leaved than those from areas where the varietal form is said to exist, while any of the specimens of var. major would, as far as leaf size is concerned, easily pass as species type.

In respect of Macropiper excelsum some interesting measurements were made of leaf size in several localities and the average leaf area of mature leaves from a number of plants is shown below in tabulated form.

T A B L E 8.

Comparison of leaf area of mature leaves of Macropiper excelsum
from different localities.

Locality	Latitude	Approx. Average Rainfall	No. of Leaves Measured	Average area in sq. cms.	Probable Error of Mean.	Av.Area Highest Tree.	Average Lowest Tree.
Palmerston North	40° 32'	97 cms	481	64.9	+ 0.64	87.9	39.1
Waiwera (N 'k.)	36° 34'	112 "	264	78.8	+ 1.21	121.2	56.2
Matapouri Bay	35° 33'	150 "	133	97.7	+ 1.44	128.4	76.4
Little Barrier	36° 12'	150 "	193	119.7	+ 1.37	135.9	107.9

While the number of leaves measured and the localities in which observations have been made are too limited to allow of any definite conclusions, the evidence would suggest that leaf size in Macropiper excelsum forms a graded series dependant on a variety of factors, but largely influenced by temperature (latitude), illumination and humidity. Measurement of a limited number of plants at Little Barrier suggested that small leaf size was correlated with short internodes and vice versa, probably due to different light habitats.

However, Mr. B. Sladden writes as follows, (private communication):-

"In appearance the variety ~~of~~ major (of Macropiper excelsum) is certainly quite distinct from the typical Macropiper excelsum and I have had both forms growing together in my shrubbery at Tauranga. I have never seen var. major growing on the mainland nor have I seen any forms that might suggest intermediates between the two. I took special notice of Macropiper growing along the coast about Mercury Bay in order to determine the point but all the examples met with were the common species of the mainland. On the other hand a few miles away on the islands of the Mercury Group the varietal form grows in profusion and great luxuriance.

My experience of the plant is that the variety grows more quickly from the seedling stage than the species, and flowers and fruits earlier. The leaves are decidedly larger, but not necessarily nine nerved, very smooth and shining and the flower spike and fruit much larger than in the mainland form. In the variety the young growth of wood is invariably a light green in colour in marked contrast to the darker stems of the species."

If the var. major is a distinct jordanon, as Gockayne has tentatively suggested, and as Mr. Sladden's evidence would tend to

shew, it seems difficult to account for the fact that it should be restricted to the outlying islands since these have undoubtedly, at no very distant time (geologically) been connected with the adjoining mainland (Falla and Sladden 32). On the other hand, if it is merely an epharmonic form induced by local conditions it seems equally difficult to see any reasons for its present distribution, since one would suppose that many places in the North Auckland Peninsula would have similar environmental conditions to the off-shore islands.

The situation in regard to leaf size is one of considerable interest but reliable data is at present lacking or confined to a few isolated measurements of individual leaves, which are insufficient from which to draw reliable conclusions. Only carefully planned transplant experiments, coupled with investigation of the factors likely to cause variation in leaf size in the various localities, can yield results of a reliable nature; our knowledge at the present time is too limited to draw even tentative conclusions.

THE INTRODUCED FLORA.

The introduced element of the flora numbers 83 species belonging to 26 families, of which the most important are, Gramineae 21 species, Compositae 11, Leguminosae 10, Polygonaceae 5, Caryophyllaceae 5, and Labiatae 4 species. Of this number 59 species are confined entirely to the induced meadow communities of "The Flat" or to the garden surrounding the caretaker's residence. The remaining 24 species are found in addition in "open" coastal communities such as the "Grass and scattered shrub" communities of the cliffs, or to associations such as the "Pohutukawa forest", Te Titoki Pt., or Muehlenbeckia association where the association is comparatively "open" and subject to heavy annual seeding from the nearby meadow communities. Five species are recorded as established only in associations other than the meadow communities; these are Briza minor, and Vulpia myuros on open grassy cliffs, Chenopodium urbicum

and Brassica oleracea on the shore-front and Erechtites Atkinsoniae in whau colonies on the east coast.

No "aliens" have been recorded from closed forest communities. Occasional catsear (Hypochaeris radicata) is found on open rocky creek-beds and inkweed (Phytolacca octandra) is abundant in all open situations around the coast owing to the ready dispersal of its seeds by birds.

On open grassy cliffs Sporobolus capensis (syn. indicus) is abundant as also are Bromus sterilis, Festuca bromoides, Avena fatua, Erigeron canadensis and catsear (Hypochaeris radicata). Other less commonly observed species are centaury (Erythraea centaureum), suckling clover (Trifolium dubium), Polycarpon tetraphyllum, mouse-eared chickweed (Cerastium vulgatum), catchfly (Silene gallica), English hairgrass (Aira caryophyllea) and Phalaris minor.

It is fairly safe to say, that, were grazing animals entirely removed from "the Flat", and the meadow communities permitted to regenerate in forest, not more than twenty of the "alien" species would survive on the Island; of these only Poa pratensis (see "Modified Muehlenbeckia association"), Sporobolus capensis and possibly Phytolacca octandra can be considered as being in any way aggressive; the other species which might survive merely occupy bare spaces in "open" coastal communities.

THE ISLAND AS A BIRD SANCTUARY.

It was indeed a happy choice which selected Hauturu as a bird sanctuary, for its rugged topography and inhospitable coast render it comparatively secure from the visits of unauthorized persons while it affords ample cover and a variety of food and habitat for bird life probably unequalled elsewhere. The only landing place providing easy access to the interior of the Island and the rare birds which frequent the little-traversed streams and ridges, is amply safeguarded by the caretaker's residence. In this respect it appears desirable that every encouragement be give

fishermen or yachtsmen wishing to replenish their water supply to do so at the spring near the caretaker's residence rather than at some point remote from the caretaker's surveillance.

Remembering that, as a sanctuary, the Island provides one of the few remaining places in this country where our native birds and plants may still be studied and observed in their natural habitat, it appears desirable that the tracks already existent and giving access to various parts of the Island from the caretaker's residence should be kept open in order to facilitate the work of those desirous of studying the flora and fauna of the Island. Such tracks in no way impair the value of the Island as a sanctuary give no easier access to unauthorized persons and indeed render easier the surveillance of the Island by the caretaker.

The birds appear to be as numerous as can be supported by the food supply on the Island, and thriving, their only enemies being wild domestic cats, hawks and rats. The caretaker is, however, alert to the necessity of reducing, if possible, the numbers of these enemies and has accounted for a number of cats and numerous rats during his comparatively short residence on the Island.

The birds of the Island have been listed by Mr. W.R.B. Oliver (27). All the land birds there listed have been observed by the author with the exception of the marsh-rail (Porzana pusilla), saddle-back (Creadion carunculatus) and the yellow fronted parrakeet (Cyanorhamphus auriceps). The rifleman (Acanthisitta chloris) is not common but a number of pairs have been observed. Stitchbirds (Notiomystis cincta) are relatively abundant, particularly in the deep ravines on the northern side of the Island and seem to have escaped the extinction which appeared to be their fate previous to the setting aside of the Island as a sanctuary.

Perhaps, however, the myriad petrels, which make night in the Island forest a thing long to be remembered, are the most interesting feature of the Island's avifauna. At least six species of petrel are known to nest on the Island and their breeding habits are still but imperfectly known and offer a wide field for in-

vestigation, little having been done since the researches of Reischek in the 80's of last century.

Renewed efforts should be made to introduce the kakapo (Strigops habroptilis) on the Island and other species fast becoming rare on the mainland should be transferred and liberated there before they share the same fate as the huia.

THE ISLAND AS A PLANT SANCTUARY.

As has been previously remarked the Little Barrier is unique as being one of the few remaining large forested areas retaining its primeval vegetation unharmed by introduced grazing animals. It behoves New Zealanders ^{to see} that every care be taken that the Island remains inviolate in this respect, for on the mainland primitive New Zealand forest will before many decades be a thing of the past.

Probably no other area could have been selected giving such a variety of plant habitat or such a large number of plant species. The chief danger which must be guarded against is that of fire. The dried herbage on "The Flat" constitutes the greatest danger in this respect, but the caretaker is fully alive to the situation and is doing everything possible to minimize the hazard.

The few stock kept by the caretaker to supply milk and butter graze on the cocksfoot pasture of "The Flat", only entering the manuka for shade or water and never wandering far; they appear to be doing little or no damage to the native flora, and the expense of confining them by fencing appears unwarranted.

CONCLUSION.

The Little Barrier is a heritage of which every New Zealander may be justly proud, for it serves at once as a sanctuary for both our flora and fauna, and preserves intact for future generations a piece of "Old New Zealand" - now a fast fading memory.

In conclusion I should like to thank the many friends who by their interest or assistance have helped in the compilation of this paper. The comrades who accompanied me on my several visits

to the Island, Mr. R. Nelson and Mr. W. H. Hardgrave (caretakers on the Island), and members of the Massey Agricultural College staff and of various Government Departments, with whom I came in contact, have by their support and interest made light what might otherwise have been an arduous undertaking.

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APPENDIX NO. 2.

NOTICE APPEARING IN "AUCKLAND STAR" JUNE 7th 1892.

"Notice is hereby given that negotiations were entered into in the year 1881 by the Government to Purchase or Acquire Hauturu, or the Little Barrier Island, from the Native Grantees, and that under Section 2 of the Government Native Land Purchase Act, Amendment Act 1873, all persons other than aboriginal owners or occupiers of the Island, who cut timber or trespass thereon, will be proceeded against for unlawful occupation, intrusion or trespass.

(Signed) Gerhard Mueller,

Commission^{er} of Crown Lands,

Lands and Survey Office,

6th June 1892.

Auckland."

APPENDIX NO. 3.

EXTRACT FROM THE "NEW ZEALAND HERALD" January 7th 1892.

NOTICE RE LITTLE BARRIER.

As Mr. J. A. Tole has not come to a proper agreement with the Natives interested in the sale of the Little Barrier the sale thereof is withdrawn. Tenetahi has permission to lease the whole of the Island; any applicants to address Tenetahi, Little Omaha. And further Mr. P. Langan has no claim whatever in the said Island. The timber on the Island may be bought independently of a lease.

(Signed) Paratene
Rahui
Tenetahi
Miria
Rapata
M. Taiawa
Ngapeka
Ngawhare

APPENDIX NO. 4.

AGREEMENT BETWEEN TENETAHI AND THE CROWN.

It is hereby understood that in signing the deed transferring Hauturu to the Queen, no money (consideration) is to be paid to any of the Owners until all of them sign the said transfer and that if all the other said Owners consent to Tenetahi receiving the whole of the said money (£3,000) the same shall be paid to him for distribution amongst all the Owners according to their respective shares.

(Signed) H. F. Edger
Tenetahi. "

2nd October 1891.

APPENDIX NO. 5.

The title to Hauturu was issued subject to the following conditions and restrictions, "On the Estate of the Owners in the above named block; that is to say, that the land therein comprised shall be inalienable by Mortgage or by lease for a longer period than twenty-one years or by sale to anyone soever except only to Her Majesty the Queen, Her Heirs and Successors."

* LIST OF INDIGENOUS PTERIDOPHYTES AND SPERMOPHYTES OBSERVED ON HAUTURU.

Abbreviations used : D = dominant. **
A = abundant, innearly all typical quadrats.
P = plentiful, in 30% or more of quadrats.
U = uncommon, only a few specimens observed.
N = not uncommon, in less than 30% of quadrats.

A S S O C I A T I O N S.

Dactylis glomerata, assc.
Carex virgata - Mariscus ustulatus, assc.
Manuka association.
Phormium tenax - Pseudopanax Lessoni, assc.
Transition forest.
Pohutukawa forest, Ti Titoki Pt.
Pohutukawa cliff forest.
Grass and shrub communities, cliffs.
Muehlenbeckia complexa assc.
Coastal scrub, South coast.
Summit scrub.
Coastal forest.
Semi-coastal forest.
Pohutukawa forest, Hingaia.
Rata - Tawa forest.
Kauri forest.
Kauri - Nothofagus forest.
Nothofagus truncata forest.
Tawhero - Tawa forest.
Quintinia - Tawari - Metrosideros umbellata assc.

SPECIES and NATURAL ORDER.

PTERIDOPHYTA.

Hymenophyllaceae.

	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Hymenophyllum sanguinolentum (Forst.f.)Sw.	-	-	P	-	A	-	-	-	-	-	N	N	-	-	-	-	-	-	-	-
H.----- australe. Willd.	-	-	-	-	-	-	-	-	-	-	-	-	U	-	U	-	-	-	-	-
H.----- dilatatum.(Forst.f.)Sw	-	-	-	-	-	-	-	-	-	-	P	U	N	-	P	-	N	-	A	I
H.----- demissum.(Forst.f.)Sw	-	-	U	-	-	-	-	-	-	-	N	P	-	A	N	P	N	A	I	I
H.----- scabrum. A. Rich.	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	-	-	-	A	I
H.----- flabellatum. Lab.	-	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	-	-	P	I

* In the preparation of this list of species I have been materially assist- ed by Mr. W. R. B. Oliver, of the Dominion Museum who kindly furnished me with copies of the late Mr. Cheeseman's and his own unpublished lists of plants collected on the Island; also by Dr. H. H. Allan, Palmerston North, Miss L. C. Cranwell, Auckland Museum, Miss L. B. Moore, Auckland University College and Miss E. M. Heine, Dominion Museum for assistance given in the identification of various specimens collected.

** These are approximations only, based on observations not actual counts of quadrats, the term quadrat being used only in the sense of meaning a limited area.

Hymenophyllaceae (Continued)

Hymenophyllum ferrugineum. Colla.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	N		
H.----- Tunbridgense.(L.)Sm.	-	-	-	-	-	-	-	-	-	-	N	-	-	-	P	-	-	-	-	P	P		
H.----- multifidum. (Forst.f.)Sw.	-	-	-	-	-	-	-	-	-	-	N	-	-	-	N	-	-	-	-	A	A		
Trichomanes reniforme. Forst.f.	-	-	U	-	N	-	-	-	-	-	P	U	-	P	N	P	A	-	-	A	A		
T.----- Lyallii.(Hook.f.)Sw.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	U	-	-	N	N		
T.----- humile. Forst.f.	-	-	-	-	-	-	-	-	-	-	-	N	N	-	P	-	-	-	-	P	-		
T.----- venosum R.Br.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	-	N	-		
T.----- strictum. Menz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	A	P	
T.----- elongatum. A.Cunn.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	A	N

Cyatheaceae.

Dicksonia squarrosa.(Forst.f.)Sw.	-	-	U	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	-	-	U		
Cyathea dealbata. (Forst.f.)Sw.	-	-	P	-	N	-	-	-	-	-	-	-	-	-	-	N	-	-	-	-	-		
C.----- medullaris.(Forst.f.)Sw.	-	-	-	-	N	-	N	-	-	-	-	P	N	-	P	-	-	-	-	U	U		
C.----- Cunninghamsi.Hook.f.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	U	-	-	-	-		
Hemitelia Smithii. (Hook.f.)Hook.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	N	P

Polypodiaceae.

Polystichum Richardi.(Hook.)J.Sm.	-	-	-	P	-	-	A	N	-	-	-	A	N	-	-	-	-	-	-	-	-							
P.----- hispidum.(Sw)J.Sm.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	N						
P.----- adiantiforme.(Forst.f.)J.Sm.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	N	P					
Dryopteris decomposita.(Spreng.)Kun.	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
D.----- velutina.(A.Rich.)Kun.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	U	-	-	-	-	-					
D.----- punctata.(Thunb.)C.Chr.	None	observed.	T.F.C.!																									
D.----- pennigera.(Forst.f.)C.Chr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	P	-	A	N	N	-	N	-
Arthropteris tenella.(Forst.f.)J.sm.	-	-	U	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-
Lindsaya linearis. Sw.	-	-	A	-	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L.----- cuneata var.Lessonii.(Bory.)Hook.f.	-	-	N	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	P	-	A	P	-	-	-	-
L.----- viridis. Col.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	-	-	-	-	-	-
Asplenium adiantoides.(L.)C.Chr.	-	-	N	-	N	N	N	-	-	-	-	N	N	P	A	A	-	-	-	-	N	U	-	-	-	-	-	-
A.----- obtusatum. Forst.f.	-	-	-	-	-	-	-	-	-	-	-	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A.----- lucidum. Forst.f.	-	-	P	P	N	P	A	P	P	N	-	A	A	A	P	-	-	-	-	U	-	-	-	-	-	-	-	-
A.----- bulbiferum. Forst.f.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	A	-	A	-	-	-	-	-	-	-	-	-	-
A.----- lamprophyllum. Carse.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A	A	-	A	-	-	-	-	-	-	-	-	-
A.----- flaccidum. Forst.f.	-	-	N	N	P	P	N	N	-	-	-	N	N	-	N	P	N	-	N	N	N	-	-	-	-	-	-	-

1. T.F.C. is used throughout this table as an abbreviation for the name of the late Mr. T.F. Cheeseman. The exclamation mark indicates that no specimens have been seen.

Cyclophorus serpens.(Forst.f.)C.Chr. - - A - P A A - A N - P P A P - - - N -

Gleicheniaceae.

Gleichenia microphylla. R.Br. - - - - U - Miss Shapewear - T.F.C.!

G.----- Cunninghamsi. Heward - - - - - - - - - - N - - - U - - - U -

Schizaeaceae.

Schizaea fistulosa. Labill - - N - - - - - - - - - - - - - - - -

S.----- dichotoma. Sm. - - - - U - - - - - - - - - - U - - - - -

Lygodium articulatum. A.Rich. - - N - P - - - - - - - - N - A A - P A N

Osmundaceae.

Leptopteris hymenophylloides.(A.Rich.)Pr. - - - - - - - - - - - - N - - - P N -

Marrattiaceae.

Marattia fraxinea. Sm. - - - - - - - - - - - - U - - - - - -

Ophioglossaceae.

Ophioglossum coriaceum A. Cunn. None observed. T. Kirk !

Botrychium australe. R. Br. None observed. Miss Shakespear. T.F.C.!

Lycopodiaceae.

Lycopodium Billardieri. Spring. - - - - N - - - - - - - - N N P N N N P N

L.----- densum. Labill - - N - U - - - - - - - - - - - - - - - -

L.----- Cernuum. -L. - - - - - - - - - - - - - - - - N - - - - - -

L.----- volubile. Forst.f. - - N - N - - - - - - N - - - - - - - - - -

Tmesipteris tannensis. Bernh. - - - - - - - - - - - - - - P N - - A A

SPERMAPHYTA.

Pinaceae.

Agathis australis. Salisb. - - N - P - - - - - U - U - N D D N N U

Taxaceae.

Podocarpus totara. Don. - - - - - - - - - - - - - - N - - - U

P.----- Hallii. T. Kirk. - - - - - - - - - - - - - - N - - - P

P.----- ferrugineus. Don. - - U - N - - - - - - - - - - N P - N N A

P.----- dacrydioides. A. Rich. - - - - - - - - - - - - - - U - - - - -

Dacrydium cupressinum. Sol. - - - - - - - - - - - - - - U - - - - -

Phyllocladus trichomanoides. Don. - - N - - - - - - - - - - U - - - - -

P.----- glaucus. Carr. - - - - U - - - - - U - - - U - N - - A

Typhaceae.

Typha angustifolia. L. - - - - - - - - - - U - - - - - - - -

* Syn. G. circinata. Swart .

Iridaceae. (Continued)

Libertia pulchella. Spreng - - - - - N - - - A A

Orchidaceae.

Dendrobium Cunninghamsi. Lindl - - U - N - N - - - P P N A P A P P N N

Bulbophyllum pygmaeum. Lindl. - - - - U - - - - - - N P N - - - N -

Earina mucronata. Lindl. - - U - N - - - - - - N N N A P P P P P

E.... autumnalis.(Forst.f.)Lindl. - - U - N - - - - - N - - - N N P P N N

Sarcochilus adversus. Hook.f. - - - - - - - - - - - U - - - - -

Orthoceras strictum. R.Br. None observed. T.F.C. !

Microtis unifolia.(Forst.f.)Reichen- - N - - - - - - - - - - - - - - -

Pterostylis Banksii. R.Br. - - - - - - - - - - - - - - - N - - - N

Acianthus Sinclairii. Hook.f. None observed. T.F.C. !

Corrysanthes rivularis.(A.Cunn.)Hook.f. - - - - - - - - - - - P - - - A A

Gastrodia Cunninghamii. Hook.f. - - - - - - - - - - - U - - - - -

Piperaceae.

Macropiper excelsum.(Forst.f.)Miq. - - - N - - N - - - P - A A N P - - - - -

Peperomia Urvilliana. A. Rich. - - N - - P A - - N - P A N N - - - - -

Chloranthaceae.

Ascarina lucida. Hook.f. None observed. T.F.C. !

Fagaceae.

Nothofagus truncata. Col. - - N - A - - - - - - - - - N U D D - -

Urticaceae.

Parietaria debilis. Forst.f. - - - - - - - - - - - N - - - - - - - - -

Proteaceae.

Persoonia toru. A. Cunn. - - N - N - - - - - - - - - N N N - N -

Knightia excelsa. R.Br. - - N - N - - - - - - N N N - P P P N N -

Santalaceae.

Mida salicifolia. A.Cunn. - - - - - - - - - - - N N - - - - -

Loranthaceae.

Elytranthe tetrapetala.(Forst.f.)Engl. - - - - - - - - - A - - - - U - - - A

Korthalsella salicornioides.(A.Cunn.)Van.Tiegh. Miss Shakespear. T.F.C. !

Balanophoraceae.

Dactylanthus Taylora.Hook.f. - - - - - - - - - - - U - - - - -

Polygonaceae.

Polygonum serrulatum. Lag. None observed. T.F.C. !
 Rumex flaxuosus. Sol. P - - - - -
 Muehlenbeckia australis.(Forst.f.)Meissn. None observed. T.F.C. !
 M.----- complexa.(A.Cunn.)Meissn.
 A D - - - A - - D - - - - -

Chenopodiaceae.

Rhagodia nutans. R.Br. - - - - - N A N - - - - -
 Chenopodium triandrum. Forst.f. - - - - - U - - - - -
 Salicornia australis. Soland. - - - - - N - - - - -

Nyctaginaceae.

Pisonia Brunoniana. Endl. - - - - - U - - U - N U - - - - -

Aizoaceae.

Mesembryanthemum australe. Sol. - - - - - N - - - - -
 Tetragonia trigyna. Banks. & Sol. - - - - - U N N - - - - -

Caryophyllaceae.

Stellaria parviflora. Banks & Sol. - - - - - N - - - - -
 Spengularia media.(L.)Presl. - - - - - N - - - - -

Ranunculaceae.

Clematis indivisa . Willd. - - A - N - N - - - - N N P N - - - N -
 C.----- parviflora. A.Cunn. - - N - - - - - - - - N - - - - -
 Ranunculus hirtus. Banks & Sol. None observed. T.F.C. ! Miss Shakespear
 R ----- rivularis. Banks & Sol. None observed. T.F.C. !

Magnoliaceae.

Drimys axillaris. Forst. - - - - - N - - - - P A

Monimiaceae.

Hedycarya arborea. Forst. - - - - - U - N - - - - -
 Laurelia novae-zealandiae. A.Cunn. - - - - - A - - - - N -

Lauraceae.

Beilschmiedia Taraire.(A.Cunn.)Benth. & Hook. - - - - N - - - - N A - P - - - - -
 B----- Tawa.(A.Cunn.)Benth. & Hook. - - - - - A - D N P N D -
 Litsaea calicaris.(Sol.)Benth. & Hook. - - - - - N - U U - - - - -

Cruciferae.

Nasturtium stylosum.(D.C.)Schulz. - - - - - U - - - - -
 Cardamine heterophylla.(Forst.f.)Schulz. - - - - - N - - - - -

Cruciferae. (Continued)

Lepidium oleraceum. Forst.f. - - - - - N - - - - -

Crassulaceae.

Tillaea Sieberiana. Schultz. None observed. T.F.C. !

Saxifragaceae.

Quintinia serrata. A. Cunn. - - - - - A - - - - N A - P D

Ixerba brexioides. A. Cunn. - - - - - A - - - - N A N N A D

Pittosporaceae.

Pittosporum tenuifolium. Banks & Sol. - - P - N - - - - - N - - - - -

P.----- Huttonianum. T.Kirk. - - N - N - - - - - N N - - - - -

P.----- crassifolium. A.Cunn. - - - P - - A P - A - A - - - - -

F ----- umbellatum. Banks & Sol. - - A - P - - - - - U - - - - -

P.----- Kirkii. Hook.f. - - - - - - - - - - N N - - - P

P.----- cornifolium. A.Cunn. - - U - U - - - - - N U A N - - N - -

P.----- eugenioides. A.Cunn. - - - - - - - - - - U - - - - -

Cunoniaceae.

Weinmannia sylvicola. Sol. - - - - U - - - - - A - N - P a a P D N

Rosaceae.

Rubus australis. Forst.f. - - N - N - - - - - - - N N - - - -

R.--- schmidelioides. A.Cunn. - - - - N - - - - - - - N N - - - -

Acaena sanguisorbae. Vahl. U - - - - - U - - - - -

Leguminosae.

Carmichaelia Williamsii. T.Kirk. - - - - - U - - - - -

C.----- australis. R.Br. - - P - - - N P - - - U N - N - N - - -

C.----- " (narrow leaved variety) - - - - - U - - - - -

Sophora microphylla. Ait. Probably introduced to the Island.

Geraniaceae.

Geranium dissectum var. glabratum. Hook.f. P - - - - - U - - - - -

G.----- pilosum. Forst.f. A - - - - - - - - - - - - - - -

G.----- microphyllum. Hook.f. None observed. T.F.C. !

Pelargonium inodorum. Willd. None observed. T.F.C. !

Oxalidaceae.

Oxalis corniculata. L. - - - - - P - - - - -
 O.----- stricta. L. - - - - - U P - - - - -

Linaceae.

Linum monogynum. Forst.f. - - - - - P - - - - -

Rutaceae.

Phebalium. nudum. Hook. - - N - N - - - - - N - - - -
 Melicope ternata. Forst. - - - N - - A - - N - P U U - - - - -

Meliaceae.

Dysoxylum spectabile.(Forst.f.)Hook.f. - - - - - N - - N - A A - A N - - - -

Euphorbiaceae.

Euphorbia glauca. Forst.f. - - - - - A - - - - -

Callitricheae.

Callitriche verna. L. None observed. T.F.C. !
 C.----- Muelleri. Sond. - - N - - - - - N - - - - -

Coriariaceae.

Coriaria ruscifolia. L. - - - - - P N - - N - - - - -

Corynocarpaceae.

Corynocarpus laevigata. Forst. - - - - - N - - N - A A - - - - -

Sapindaceae.

Alectryon excelsum. Gaertn. - - - - - - - - - U - - - - -
 Dodonaea viscosa. Jacq. - - N - - - U - - - - -
 Do

Rhamnaceae.

Pomaderris phyllaefolia. Lodd. - - N - - - - - - - - - -

Elaeocarpaceae.

Elaeocarpus dentatus (Forst.)Vahl. - - - - - - - - - U U U N - -
 Aristotelia serrata.(J.R. & G.Forst.)Oliver. - - - - - - - - - P - - - - -

Hoheria populnea. A.Cunn. None observed. T.Kirk. !

Tiliaceae.

Entelia arborescens. Forst. - - - - - P - - - - N U - - - - -

Violaceae.

Melicytus ramiflorus. Forst. - - N - N N N - - A - A A - A - N - N -
 M.----- macrophyllus. A.Cunn. None observed. W.R.B. Oliver !

Thymelaeaceae.

Pimelia prostrata (Forst.) Willd. - - - - - N - - - - -
P.----- *Urvilleana*. A.Rich. - - - - - N - - - - -

Myrtaceae.

Leptospermum scoparium. Forst. - - A - P - N A - - U N - - N - P - - -
L.----- *ericoides*. A.Rich. N - D - A - - N - - - N - U N - P N - -
Metrosideros scandens. (Forst.)Druce.
 * *syn. M.florida*. Sm. - - P - A - - - - - A - - - A N P N A P
M.----- *umbellata*. Cav.
syn. M.lucida. A.Rich. - - - - - A - - - - N - - - D
M.----- *albiflora*. Sol. - - - - - A - - - - - A
M.----- *carminea*. W.R.Oliv.
syn. diffusa. Sm. - - - - N - - - - - N - - - -
M.----- *diffusa*. (Forst.) W.R.Oliv.
syn. M.hypericifolia. A.Cunn. - - - - - N - - - -
M.----- *perforata*. (Forst.) Rich.
syn. M. scandens. Sol. - - - N - - - - - A A N - A -
M.----- *robusta*. A.Cunn. - - - - - P A D - D - U -
M.----- *excelsa*. Sol.
syn. M. tomentosa. A.Rich. - - N - - D D A - - U A D D - - - -
Myrtus bullata. Sol. - - N - - - - - U N - - - -

Onagraceae.

Epilobium junceum. Sol. - U - - - - -
E.----- *alsinoides*. A. Cunn. None observed. T. Kirk !
E.----- *rotundifolium*. Forst.f. - U - - - - - N - - - -
E.----- *nummularifolium*. R. Cunn. - - - - - N - - - -
E.----- *insulare*. Haussk. - - - - - U - - - -
Fuchsia excorticata. (Forst.) L. - - - - - N U - A - N - - -

Haloragidaceae.

Haloragis erecta. (Murr.) Schindler.
 P - - - - -
H.----- *depressa*. (A.Cunn).Walp. - - N - - - - -

Araliaceae.

Nothopanax Edgerleyi. (Hook.f.)Harms. - - - - - N N - - N -
N.----- *Colensoi*. (Hook.f.)Seem. - - - - - A - - - - N - - N A

Sapotaceae.

Sideroxylon novo-zelandicum. (Muell.) Hemsl.

- - - - - P A - - - - - P N - N - - - - -

Oleaceae.

Olea apetala. Vahl.

None observed. T.F.C. !

O.--- Cunninghamsi. Hook.f.

- - N - N - - - - - - - - - - N N - - -

O.-- lanceolata. Hook.f.

- - P - P - - - - - - - - - - A P - N N -

O.-- montana. Hook.f.

None observed. W.R.B. Oliver. !

Loganiaceae.

Geniostoma ligustrifolium. A.Cunn.

- - N - P - - - - - P - A A U A P - - - - -

Apocynaceae.

Parsonsia Heterophylla. A.Cunn.

- - N - - - - - - - - - - U - - P - - - - -

Convolvulaceae.

Calystegia sepium. (L.)R.Br.

N P -

C.----- tuguriorum. (Forst.f.)R.Br.

None observed. T.Kirk.!

C.----- Soldanella. (L.)R.Br.

- - - - - - - - - - - N - - - - - - - - - - -

Dichondra repens. Forst.

- - P - - - - - N A - - - - - - - - - - - - - - -

Verbenaceae.

Vitex lucens. T.Kirk.

- - - - - N - - - - - - - - - - N N - N - - - - -

Solanaceae.

Solanum nigrum. L.

N - - - - - - - - - - U - - - - - - - - - - - - - - -

S.----- aviculare. Forst.f.

- - - - - - - - - - N U - N - - - - - - - - - - - - - -

Scrophulariaceae.

Hebe salicifolia. (Forst.f.)Punnell.

- - N - - - - - A - - - - - U U - - - - - - - - - -

H.--- macrocarpa. (Vahl.)Ckn.& Allen.

- - N - N - - - - - N - - - - - - - - - - - - - - - -

Gesneriaceae.

Rhabdothamnus Solandri. A. Cunn.

- - U - - - - - N - - - - - N N - P - - - - - - - - - -

Myoporaceae.

Myoporum laetum. Forst.f.

- - - - - N A N - - - - - N - - - - - - - - - - - - - - -

Plantaginaceae.

Plantago Raoulii. Decne.

- - - - - - - - - - N - - - - - - - - - - - - - - - -

Rubiaceae.

Coprosma macrocarpa. Cheesem.

None observed. W.R.B. Oliver. !

C.----- grandifolia. Hook.f.

- - - - - - - - - - - - - - - - P - A A - P P N

C.----- lucida. Forst.f.

- - - - - N - P N - A P A A P P A P - - N

Rubiaceae. (Continued)

| | |
|---|---|
| <i>Coprosma robusta.</i> Raoul | - - A - - U - - - P P A - - A - - - N N |
| X.C.---- <i>Cunninghami.</i> Hook.f. | - - U - - - - - - - - - - - - - |
| C.----- <i>arborea.</i> T.Kirk. | - - A - A - - - - - - - - P - - - - |
| C.----- <i>spathulata.</i> A.Cunn. | - - P - - - - - - - - - - - - - |
| C.----- <i>rhamnoides.</i> A.Cunn. | U - A - N N - - - - - - - - - - |
| C.----- <i>retusa.</i> Hook.f. | - - - - - - - - U A - A - - - - - |
| <i>Nertera Cunninghami.</i> Hook.f. | - - - - - - - - - - - - - N - - - - |
| N.----- <i>dichondraefolia.</i> (A.Cunn.) Hook.f. | - - - - - - - - - - - - - - - - A |
| <i>Galium umbrosum.</i> Sol. | None observed. Miss Shakespear. T.F.C.! |

Caprifoliaceae.

| | |
|---|---------------------------------------|
| A ^{se} <i>Myosmia macrophylla.</i> A.Cunn. | - - N - A - - - - - U U - A A A A A N |
|---|---------------------------------------|

Cucurbitaceae.

| | |
|----------------------------|-----------------------------------|
| <i>Sicyos angulata.</i> L. | - - - - - U - - N - - - - - - - - |
|----------------------------|-----------------------------------|

Campanulaceae.

| | |
|--|-------------------------------------|
| <i>Lobelia anceps.</i> L. | N - - - - - N - - - - - N - - - - - |
| <i>Wahlenbergia gracilis.</i> (Forst.f.) Schrad. | - - N - - U U P - - - - - - - - - - |

Compositae.

| | |
|---|--|
| <i>Lagenophora pumila.</i> (Forst.f.) Cheesem. | - - N - - - - - - - - N - - - - - - |
| <i>Olearia furfuraceae.</i> (A.Rich.) Hook.f. | - - A - N - - - - - - - - - - - - - |
| O.----- <i>albida.</i> Hook.f. | None observed. Miss Shakespear. (plentiful). |
| O.----- <i>Rani.</i> (A.Cunn.) Ckn. | - - P - P - - - - - - - - A N N N N U |
| <i>Gnaphalium Keriense.</i> A.Cunn. | - - - - - - - - - - - - - P - - - - - |
| G.----- <i>luteo-album.</i> L. | - - N - - - - - - - - - - - - - - - |
| G.----- <i>japonicum.</i> Thunb. | - - - - - N - - - - - - - - - - - - - |
| G.----- <i>collinum.</i> Lab. | - - N - - - - - - - - - - - - - - - |
| <i>Helichrysum glomeratum.</i> (Raoul.) Benth & Hook. | - - A - - - N N - - - U - U - - - - - |
| <i>Cassinia retorta.</i> A.Cunn. | None observed. W.R.B.Oliver.! |
| <i>Siegesbeckia orientalis.</i> L. | None observed. T.Kirk. ! W.R.B.Oliver.! |
| <i>Bidens pilosa.</i> L. | - - - - - N - - - - - - - - - - - - - |
| <i>Cotula coronopifolia.</i> L. | None observed. T.F.C.! |
| C.----- <i>australis.</i> (Less.) Hook.f. | - - - - - U - - - - - - - - - - - - - |

Compositae. (Continued).

| | |
|----------------------------------|---------------------------------------|
| Cotula minor. Hook.f. | - - - - - U - - - - - |
| Centipidia orbicularis. Lour. | None observed. T.F.C.! |
| Erechtites arguta. (A.Rich.)D.C. | U - N - - - - N - - - - |
| E.----- scaberula. Hook.f. | None observed. T.F.C.! |
| Senecio lautus. Forst.f. | - - - - - U - - N - - - - |
| S.----- Kirkii. Hook.f. | - - P - A - - - - P - - A A A A N A N |
| Brachyglottis repanda. Forst. | - - N - N - A - - P - A N U N - - - - |

LIST OF INTRODUCED SPERMOPHYTES NATURALISED ON HAUTURU.

Gramineae.

| | |
|---|---------------------------|
| ^{as} Panicum dilatatum. Poir. | A P - - - - - |
| Panicum sanguinale. L. | N - - - - - |
| Phalaris minor. | N - - - - - N - - - - - |
| Anthoxanthum odoratum. L. | P - N - - - - - |
| Holcus lanatus. L. | P - - - - - |
| Aira caryophyllea. L. | N - U - - - - N - - - - |
| Avena Fatua. L. | U - - - - P - N N - - - - |
| Cynodon Dactylon. Pers. | A - - - - - |
| Briza minor. L. | - - - - - N - - - - - |
| Dactylis glomerata. L. | D - - - - N - - - - |
| Poa annua, L. | N - - - - - |
| P.- pratensis. L. | A P - - - A - - - - - |
| Festuca elatior. L. | N - - - - - |
| F.----- bromoides. L. | P - - - - - N - - - - - |
| Bromus sterilis. L. | N - - - - P - P - - - - |
| B.----- hordaceus. | A - - - - - |
| B.----- unioloides. H.B.K. | P - - - - - |
| Lolium. Perenne. L. | N - - - - - |
| Sporobolus capensis Kunth. (Syn.S.indicus). | A - - - - - A - - - - - |
| Vulpia Myurus. L. | - - - - - U - - - - - |
| Agrostis tenuis. L. | U - - - - - |

Juncaceae.

| | |
|---------------------|------------------------|
| Juncus bufonius. L. | None observed. T.F.C.! |
|---------------------|------------------------|

Polygonaceae.

| | |
|--------------------------|---------------|
| Polygonum Persicaria. L. | N P - - - - - |
| P.----- aviculare. L. | N - - - - - |
| Rumex obtusifolius. L. | N - - - - - |
| R .-- crispus. L. | N - - - - - |
| R.--- acetosella. L. | N N - - - - - |

Chenopodiaceae.

| | |
|------------------------|-----------------------|
| Chenopodium murale. L. | A garden weed. |
| C.----- urbicum. L. | - - - - - U - - - - - |

Phytolacaceae.

| | |
|-------------------------|---------------------------------|
| Phytolacca octandra. L. | N - - - - - N N N - N - - - - - |
|-------------------------|---------------------------------|

Portulacaceae.

| | |
|-------------------------|----------------|
| Portulacca oleracea. L. | A garden weed. |
|-------------------------|----------------|

Caryophyllaceae.

| | |
|-----------------------------|---------------------------|
| Silene gallica. L. | U - - - - - N - - - - - |
| Cerastium vulgatum. L. | U - - - - - N N - - - - - |
| Stellaria media. Cyr. | U - - - - - - - - - - - |
| Spergularia. rubra. Presl. | None observed. T.F.C. ! |
| Polycarpon tetraphyllum. L. | N - - - - - P - - - - - |

Ranunculaceae.

| | |
|-----------------------------|---------------|
| Ranunculus sardous. Crantz. | N P - - - - - |
|-----------------------------|---------------|

Fumariaceae.

| | |
|------------------------|----------------|
| Fumaria muralis. Sond. | A garden weed. |
|------------------------|----------------|

Cruciferae.

| | |
|---------------------------------|-----------------------|
| Brassica oleracea. L. | - - - - - U - - - - - |
| Capsella Bursa-pastoris. Medic. | U - A garden weed. |
| Coronopus didymus. Sm. | N - A garden weed. |

Leguminosae.

| | |
|-------------------------|-------------------------|
| Medicago lupulina. L. | U - - - - - |
| M.----- arabica. Medic. | N - - - - - |
| Trifolium repens. L. | A - - - - - |
| T.----- dubium. Sibth. | N - - - - - N - - - - - |
| T.----- pratense. L. | U - - - - - |
| T.----- glomeratum. L. | U - - - - - |
| Lotus angustissimus. L. | P - - - - - |

Leguminosae. (Continued)

Lotus hispidus. Desf. P - - - - -
 Vicia hirsuta. Gray N - - - - -
 V.--- sativa L. N - - - - -

Geraniaceae.

Geranium molle. L. N - - - - -

Oxalidaceae.

Oxalis cernua. Thunb. Garden weed

Tropaeolaceae.

Tropaeolum majus. L. A garden weed

Linaceae.

Linum marginale. A.Curr. A - - - - -

Euphorbiaceae.

Euphorbia Peplus. L. U - - A garden weed

Malvaceae.

Malva sylvestris. L. A garden weed.
 Modiola multifida. Moench. P - A garden weed.

Umbelliferae.

Foeniculum vulgare. Mill. U - U - - - - -

Primulaceae.

Anagallis arvensis, L. U - - - A garden weed.

Gentianaceae.

Erythraea centaurium. Pers. U - N - - - - N - - - - -

Boraginaceae.

Myosotis palustris. Lam. U - - - A garden weed.

Labiatae.

Mentha arvensis. L. P - - - - -
 M.---- pulegium. L. N - - - - -
 Prunella vulgaris. L. N - - - - -
 Stachys arvensis. L. U - - - A garden weed.

Scrophulariaceae.

Veronica agrestis. L. - - - - A garden weed.
 V.----- serpyllifolia. L. - - - - A garden weed.

Plantaginaceae.

Plantago major. L. N - - - - -

Plantaginaceae. (Continued)

Plantago lanceolata, L.

A - - - - -

Rubiaceae.

Galium parisiense, L.

U - - - A garden weed.

Gerardia arvensis, L.

N - - - - -

Compositae.

Erigeron canadensis, L.

U - - - - - N - - - - -

Onicus lanceolatus, Willd.

P - - - - -

Carduus pycnocephalus, L.

N - - - - -

Lapsana communis, L.

N - - - - -

Picris echioides, L.

N - - - - -

Stephanos capillaris, L.

P - - - - -

Hypochaeris radicata, L.

A - P - - P - N - - - - -

Taraxacum officinale, L.

N - - - - -

Sonchus oleraceus, L.

N - - - - N - N - - - - -

Tragopogon porrifolius, L.

U - - - A garden weed.

Erechtites Atkinsoniae, F. & M. Fragm.

- - - - - N - - - - -