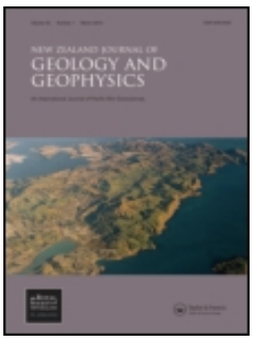

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MAORI OCCUPATION LAYERS AT D'URVILLE ISLAND, NEW ZEALAND

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ABSTRACT

Two occupation layers are well defined at many places on the western side of D'Urville Island. The older contains broken moa bones, many flakes of "baked argillite", and rare obsidian fragments; the younger contains abundant barracuda bones, relatively few flakes of "baked argillite", and no moa bones. A layer of Taupo Pumice of about A.D. 200 occurs as a primary deposit in three sections. If a constant rate of subsequent accumulation is assumed, the lower occupation layer formed at about A.D. 1000 and the upper at about A.D. 1500. These tentative dates may be revised when radio-carbon samples have been processed. The people of the older occupation layer, the first to reach the island, would appear to have exterminated the moa, traded in artifacts made from baked argillite, and probably moved south to hunt the moa in the South Island mainland. It is likely that they grew kumara on D'Urville Island. The people of the younger occupation layer lived mainly on exposed headlands that provide a good view of the seaward approaches to the island. They were probably driven south from the North Island and may have been driven further south later by continuing pressure from the north. Later occupation that extended into the historical period was mostly on the eastern and southern parts of the island, the population probably being smaller than during the two earlier periods.

INTRODUCTION

D'Urville Island is 20 miles long and 10 miles wide. It lies on the western side of Cook Strait, 60 miles north-west of Wellington and 50 miles north-east of Nelson, and is separated from the Marlborough Sounds area at the north-eastern extremity of the South Island by the narrow channel of French Pass; it would have been in a central position for Maori canoe voyagers. The topography is hilly and similar to that of the Marlborough Sounds, the post-glacial rise in sea level having drowned the old valleys and converted them into sheltered harbours, the largest two being Port Hardy at the north end and Greville Harbour near the centre of the western side. The western side of the island is exposed to the prevailing north-west winds; the eastern side is fairly sheltered.

The average annual rainfall is 60 in. and the mean annual temperature 52°F. There are few frosts on the exposed parts of the coast. Except for the wind-swept headlands and the sand dunes and sandbars, which were probably covered by scrub, forest originally covered the whole island. The forest was predominantly kohekohe (*Dysoxylum spectabile*) around the coast and in the warmer and more fertile parts, and beech (*Nothofagus*) in the higher, colder, and less fertile parts. Forest has been cleared from the western and northern part of the Island, but still covers the higher

ground and the steep eastern coast. That the forest cleared by Europeans had to be felled before being burnt suggests that the Maoris cleared all that would burn standing.

The relatively warm climate, and the sheltered inlets with an abundant and varied food supply, made the island favourable for human occupation, and the coastal occupation material is more widespread and thicker than in other parts of the South Island or in the North Island south of Napier or Wanganui. The occupation layers are fairly well exposed and have not been appreciably disturbed. An older and a younger layer were distinguished in many sections, the older containing broken fragments of moa bones, the younger many barracuda but no moa bones.

Maori quarries near French Pass, first described by Thomson (1918), give a particular archaeological interest to the geology of D'Urville Island. A belt of ultrabasic rock, commonly known as the "Mineral Belt", extends north from a few miles east of the City of Nelson through the centre of the island (Keyes, 1958). Serpentine makes up a large part of the ultrabasic belt. The quarries are confined to lenses of a distinctive rock that lie at the margins of the serpentine. This rock is hard, can be flaked readily, but is faily tough and takes a high polish. It occurs in large blocks with few flaws. The rock clinks when struck, breaks with a sub-conchoidal fracture, and is easily distinguished in most polished specimens by randomly distributed, usually lighter-coloured flecks. The colour ranges from light grey to almost black. A few specimens contain fragments of a prismatic shell. The specific gravity is about 2·7. Reed (1960) described the rock as a hydrothermally metamorphosed argillite and from X-ray patterns considered it to be largely albite. The rock is well known to all archaeologists working in the central part of New Zealand (Duff, 1946) as "baked argillite", a name which will be used here, but which does not fully express the distinctive nature of the material. Baked argillite is not confined to D'Urville Island, but occurs at numerous places along the ultrabasic belt to the south. It probably also occurs in the faulted continuation of the belt in western Otago but has not yet been reported there. The Maoris knew of many localities and quarried several (Skinner, 1914; Duff, 1946), but the importance of mining sites for other than local use would depend, then as now, on accessibility and ease of transport. The position of the quarries on D'Urville Island is shown by Fig. 1, those in the north having been recently found by Mr I. W. Keyes of the New Zealand Geological Survey.

Flakes are many times more numerous in the lower occupation layer at D'Urville Island than in any other occupation deposits in New Zealand seen by the writer, and far exceed the abundance of obsidian flakes at the Bay of Plenty. The abundance is such as to make it certain that adzes were made for trading and not merely for local use. By contrast, the upper occupation layer contains about the same number of flakes as do most occupation layers, and it is inferred that trading had ceased in this later period. There is no reason to suppose that a better stone or a more accessible source of baked argillite had been found, and the most likely reason for the change is that trade had been disrupted by constant warfare.

In order to determine the relative importance of D'Urville Island as a source of finished, or more probably of roughed-out adzes, an attempt was made to estimate the number produced from the tonnage of flakes

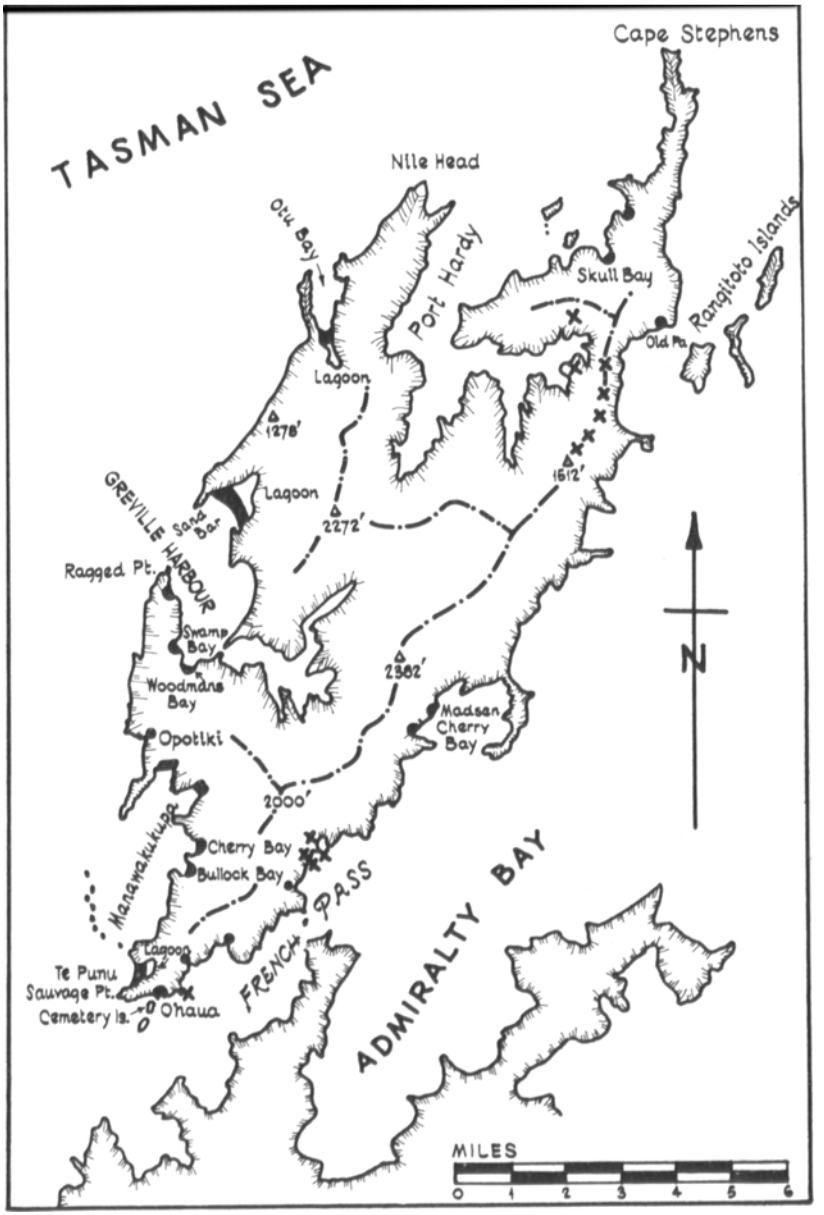

FIG. 1—Sketch map of D'Urville Island showing position of archaeological sites. Black areas represent occupation material and are proportional to volume exposed. Maori quarries in "baked argillite" shown by crosses.

now exposed in the occupation layers. The total tonnage, estimated at 60 tons, is taken as being not more than six times as large as the weight of adzes produced. The average adze weighs 1½ lb and therefore the number of adzes produced is estimated at not less than 15,000. Many heaps of flakes are still hidden and the total weight of flakes is probably several times greater than estimated. On the other hand, wastage may be underestimated.

Dogs were numerous during both occupation periods, their bones being present in most collections; their dung is abundant in the occupational layers but rare in the blown sand between the two layers and above the upper one. No dung was seen more than a few inches below charcoal or other evidence of human occupation. The dogs ate what was left over and doubtless stole what they could, and their diet gives a fair indication of that of their owners. In the younger occupation layer and in the sand above and below, the dung is almost entirely composed of fish bones; it thus agrees in content with the middens, in which fish bones, mostly barracuda, predominate. In the lower layer the dung is fine and powdery with a few fish bones, and consists mainly of finely ground bone. Most of the large bones, particularly the moa bones, have concave cavities and it is likely that the dogs lived largely on these bones and on the scraps of meat attached to them.

Dog dung and dog bones are far more abundant at D'Urville Island than they are in the occupation layers in the North Island, and it is inferred that the dog population relative to the human population was higher. This would be expected if hunting was more important than in the North Island, as there would be more scraps for dogs from birds and fish than from kumara, taro, and shellfish.

GREVILLE HARBOUR SANDBAR

Evidence for human occupation is most widespread at the sandbar on the northern side of Greville Harbour (Fig. 2). When covered by vegetation the area would have been favourable for human occupation, but it is now treeless and largely bare of vegetation and during the frequent strong westerlies it is swept by drifting sand.

The bar was built by the sea across the narrow part of a valley that had been drowned by the post-glacial rise in sea level. The lagoon cut off by the bar was first tidal, but became fresh as its level was raised by the growth of the sandbar. Except for the vegetation change the lagoon and sandbar would, during the earliest period of human occupation, have been similar to what they are now.

A layer of pebbles extends over the older dunes and thins out away from the coast. This is covered by the most recent dunes, but extends indifferently over the older ones and cannot have been deposited either by wind or by waves. The pebbles range up to two inches in diameter, contain a few fragments of worn molluscan shells, and are similar to the gravel that occurs as pockets on the present day beach. A foredune, possibly no more than a few hundred years old and about 30 ft wide, extends

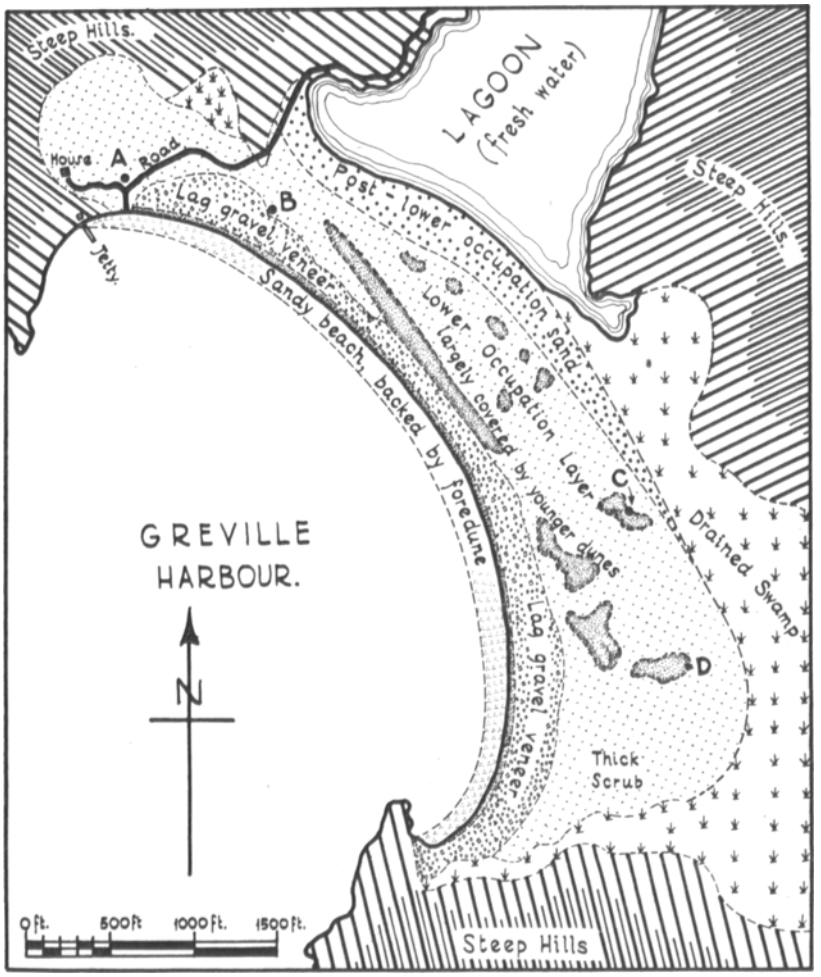

FIG. 2—Sketch map of sandbar on north side of Greville Harbour, based on paced traverses with additions from air photos. Sites of measured sections shown by letters "A" to "D".

for the whole length of the sandbar on the seaward side. The main sandbar slopes up steeply inland from the foredune and is covered by an even pebble layer that is strictly confined to the surface. Traces of calcified tree roots in sandy soil (? cabbage trees) were found at a few places below the pebble layer, but at most places the pebbles rest on slightly rusty sand that appears to be the lower part of an old soil horizon. In this part the pebbles are clearly a lag deposit of material too coarse and heavy to be blown away by the wind. Here nothing can be determined about the age of the pebbles except that they are younger than the sand below. Inland

the pebbles pass into the top of a soil horizon where they are distributed through a few inches to a foot of material. Throughout the whole belt, the pebble layer is nowhere more than a few inches below the earliest evidence for human occupation, and when undisturbed is mostly in sandy soil rather than in sand. Pebbles are rare or absent at the few places where a soil is associated with the upper occupation layer. It is thought that the pebbles were carried inland as part of the sandy gravel during the early period of human occupation, in order to improve the soil for kumara cultivation. The practice of adding gravel to soil was widespread in those parts of New Zealand where soil or climate were marginal for the growth of kumara (Rigg and Bruce, 1923; Best, 1925; Taylor, 1958). The alternative explanation, that the pebbles were used near settlements to prevent sand from being wind-blown, fails to explain their uniform distribution.

Four sand belts extend for the whole length of the bar (Fig. 2). On the west is the narrow foredune that may be only a few hundred years old. Next is the belt of old sand with a lag veneer of pebbles, bones, baked argillite flakes, and oven stones. Next again is the belt in which the pebbles occur in undisturbed soil and are partly covered by young dunes that are migrating inland. Finally, on the east at the edge of the lagoon, is a belt that has probably all been deposited since the first period of occupation.

From the central part, the bar has grown by additions to west and to east, the eastern additions being from sand that has been transported across the whole width of the sandbar. Within the central belt there are many places where sand accumulation has been substantially continuous. At a few places recent erosion has exposed a section from undisturbed sand below the pebble layer to the top of recent dunes, but at most places excavation is needed to reach below the pebble layer. Flakes of baked argillite are common over the whole length of the central part of the sandbar, and in total weigh about 60 tons. Where undisturbed, the layer of flakes is thickest near the base of the lowest level of occupation, at about the level of the pebble layer. Associated with the flakes of baked argillite are cylindrical rubbing stones of Maitai Sandstone and anvil stones mostly of Brook Street Volcanics. Other heavy rocks are not uncommon, the most conspicuous being lumps of a coarse-grained rodingite up to six inches through, which is not known from D'Urville Island but is common at many places along the "Mineral Belt" to the south. Flakes of obsidian are not uncommon in the lower occupation level, and are probably from the volcanic rocks of the central North Island. Many well finished artifacts have been collected from the lag deposits of D'Urville Island, and only inferior specimens now remain on the surface.

Of interest in showing one of the stages in the manufacture of adzes is a heap of baked argillite rock fragments that had been selected as being suitable for working. The fragments are all similar in shape and size, being roughly oblong and about 15 × 6 × 5 in. Together they weigh about 130 lb, and would make a full load for a man.

The sandbar, being now largely bare of vegetation, and being protected by the sea on one side and by the lagoon on the other, has not been much disturbed by livestock. Over large areas the sand has been blown

away down to resistant soil or occupation material, and much of the surface now exposed is as it was when abandoned by the early inhabitants. Ovens are intact, with the charcoal of the last fire within them. Of some interest are rectangular patterns set out in pebbles on the old soil, which may have been arranged by Maori children. There is no obvious trace of buildings or of any spacing of ovens to suggest possible sites of buildings.

The earliest inhabitants chose convenient rather than defensive sites. The thickest deposits are in sheltered spots and are as abundant near the old shore of the lagoon out of view of the sea as they are immediately behind the crestal ridge.

Moa bones are common and fairly evenly distributed in all areas of lag deposits, there being, in general, several fragments within each 100 ft by 100 ft area. The bones are all broken and are mostly leg-bone fragments a few inches long. *Megalapteryx hectori,* the smallest moa, and a large species of *Dinornis*, possibly *robustus,* one of the largest moas, are represented.

The presence of moa bones with Maori occupational material is not in itself conclusive evidence that the Maori hunted the moa or even that Maori and moa lived there at the same time because deep wind erosion produces a veneer of lag material in which heavy objects of different ages are mixed. However, at the sandbar, the remains of tree roots and the base of an old soil indicate that only a few feet of pre-occupation sand has been eroded. Moreover, no trace of moa bones was found in the pre-occupation sand, either here or elsewhere on the island, and it is thus most unlikely that the bone fragments were derived from below the level of occupation. The absence of complete large bones also suggests that the bones are not those of birds that died naturally.

Fragments of moa bone were found in the older occupation layer at all places where a careful search was made, and are almost certainly the source of fragments in the lag gravels. A drilled-out fragment was found in the lower occupation layer at Ohaua, at the southern end of the island, and two worked fragments in lag deposits at the Greville Harbour sandbar.

It is thus reasonably certain that the early people either hunted the moa or obtained moas by trade. Moa crop stones are fairly numerous on D'Urville Island, and a few moa skeletons have been found in limestone caves, but the total area of the island is small, and it is likely that most of the moas came from the South Island, possibly in exchange for artifacts of "baked argillite".

SECTIONS ON GREVILLE HARBOUR SANDBAR

Most archaeological sections on the sandbar, and on the other parts of the island, are so thin that individual occupation layers cannot be distinguished, but in the four sections described below two distinct occupation layers are separated by a layer of sand or soil. The most northerly is clearly exposed at the junction of the track to the house north of the beach with that from the jetty to the homestead at the head of the lagoon (A on Fig. 2).

Section A, Greville Harbour

	Ft
Poor soil with marram grass	0·1
Blown sand, rare land snails	10·0
Occupation layer, barracuda jaws, bird bones, dog dung with fish remains, many shells	0·5
Blown sand with scattered charcoal, rare land snails	10·0
Occupation layer, moa bones, many baked argillite flakes	0·5
Soily sand with pebbles	0·5
Blown sand with powdery dog dung, charcoal	0·5
Blown sand, rare land snails, no charcoal	3·0

The section is near the top of the ridge between sea and lagoon. The base is about 30 ft above mean high water spring tide (M.H.W.S.T.) and rests on rock which slopes up steeply to hills north of the section. Sand has accumulated more rapidly here than to the south and the two occupation layers are well separated. The following animals are represented by the bones in the upper occupation layer, and by surface bones that have accumulated above the lower occupation layer: barracuda, parrot fish, little blue penguin, Maori rat, dog, small mammal (possibly a cat).

Section B (Fig. 2) is 700 ft east of Section A and is similar, being also at the top of the ridge between the sea and lagoon.

Section B, Greville Harbour

	Ft
Blown sand, rare dung with fish remains, rare land snails, few shellfish	7·0
Shellfish layer (pipis, periwinkle), barracuda jaws, many ovens of rounded stones, few baked argillite flakes	0·5
Blown sand	4·0
Occupation layer in soily sand, many baked argillite flakes, anvil stones, and probably moa bones, pebbles, shell fish	1·0
Blown sand	3·0

The section is preserved beneath a recent dune and is surrounded by areas from which the sand has been eroded down to, or to just below the lower occupation layer, and the contents of the two layers are well exposed but mixed. Fragments of moa bones that are almost certainly from the lower layer are common. Samples of shellfish were taken from the lower and upper occupation levels for radiocarbon dating.

The third section is over half a mile to the south-east and is near the old lagoon edge at the time of the early occupation period. Dune sand has been blown off and the upper occupation layer is at the surface.

Section C, Greville Harbour

	Ft.
Loose sand with barracuda jaws in oven with charcoal	0·2
Poorly developed soil	0·2
Blown sand	1·5
Charcoal	0·1
Well developed soil, charcoal and pebbles	1·0
Base of charcoal layer, few pebbles	0·5
Rusty blown sand (dug out)	2·0

The two layers are distinct, but the lower layer has not been concentrated by erosion and no moa bones were found. About 700 ft away the bones and crop stones of a medium-sized species of moa (*?Euryapteryx geranoides*) were found embedded in the top of the pebble layer.

The fourth section is exposed a quarter of a mile to the south and is also near the former edge of the lagoon.

Section D, Greville Harbour

	Ft
Brown sand	10·0
Occupation layer, pipis and fish bones	0·2
Well developed brown soil	0·5
Loose brown sand	0·1
Well developed soil with a few pebbles at top, moa bone, burnt stumps	1·5
Blown sand	2·0

The most important feature is the well developed soil, representing several hundred years of weathering, between the occupation layers. A leg bone of a medium sized moa was found embedded in the top of the soil at the base of the section. At the same level prostrate logs 6 in. through are partly charred, and charred roots extend down into the soil below. A sample of charcoal for radiocarbon dating was taken from the outside of the log.

SOUTH SIDE OF GREVILLE HARBOUR

Three important sites lie on the southern side of the outer part of Greville Harbour (Fig. 1). The most easterly is at the western end of the bay at Woodman's Homestead.

Woodman's Homestead, south side Greville Harbour

	Ft
Occupation layer, dark gravelly soil	0·7
Gravel, no charcoal	0·7
Gravel with charcoal	0·2
Light brown fine gravel	1·0
Sandy clay with gravel	1·2
Taupo Pumice, well defined layer, lumps up to 3 in.	0·3
Brown clay soil	1·0
Beach gravel as at present day, down to M.H.W.S.T.	2·0

The two charcoal layers probably correspond to the two occupation layers already described to the north, but no bones are exposed and correlation is hypothetical. The layer of sea-borne Taupo Pumice is the most important feature of the section. It is well defined, extends for several hundred feet, and is almost certainly primary. In this and in the other sections in which Taupo Pumice was found, the earliest evidence for human occupation is well above the pumice. The pumice is well dated by radiocarbon at about A.D. 200 by samples taken in the North Island, and if the average rate of subsequent accumulation is assumed to have been constant, the earlier period of occupation would have been at about A.D. 1000 and the later at about A.D. 1500.

The two occupation layers can be traced west up the hill at the end of the bay where post holes from the upper occupation layer extend down through the lower one.

At Swamp Bay, a quarter of a mile to the west, occupation material covers a small sandbar that separates Greville Harbour from a swamp that was originally a lagoon, similar in origin but smaller than that on the north side of the harbour. The sandbar is about an acre in extent and is partly covered by trees, some of which are several hundred years old. There has been little erosion, the only exposed section being that on the coast at the east end of the bay.

East end of Swamp Bay, Greville Harbour

	Ft
Fair soil on light-coloured sand	0·2
Occupation layer, shellfish, bird and fish bones	0·7
Light sand	0·2
Occupation layer, baked argillite flakes, moa bones	1·5
Brown blown sand	2·0
Scattered lumps of Taupo Pumice at base of above	0·2
Grey-brown gravelly soil and boulders	3·0
Bedrock at about M.H.W.M. (mean high-water mark).	

Fish remains (not barracuda), bird bones, including large and medium-sized moas, and dog bones, were found in the lower occupation layer and barracuda, bird, and seal bones in the upper layer.

Several holes were sunk to the base of the occupation material on the sandbar, but the deposits are so thin that the two layers could not be distinguished. Flakes of baked argillite are abundant, and the occupation material is probably mostly that of the early period.

The most westerly bay on the south side of Greville Harbour lies just inside Ragged Point, the southern headland of the entrance. Wind-eroded dune sand covers about an acre. The two occupation layers are well defined but were not seen together in section. Moa bones are common in lag gravels at the east side of the bay and have probably been derived from the base of an occupation layer from which large penguin, seal, and moa bones were collected.

Near the centre of the bay is one of the largest heaps of baked argillite flakes on the island. Partly completed adzes were common at this place in 1940, but none now remain exposed. A layer of pebbles similar to that on the north side of the harbour covers much of the sand, but is not as continuous. It was traced inland and is best developed on sandy soil; it is present even where the slope would seem to be too steep for agriculture.

Middens with abundant barracuda bones and bones of horse mackerel, banded parrot fish, and leather jacket lie at the back of the steeply sloping beach just beyond the limit of storm waves, and rest on clean sand.

WESTERN COAST

For several miles south of Ragged Point the coast is steep and without deep bays. The single small bay on the western coast between Ragged Point and Opotiki Peninsula contains a 2-ft-thick occupation layer with barracuda jaws resting on weathered brown sand. The underlying layers were not examined.

East of Opotiki Peninsula is the half-mile-long Opotiki Bay, which is sheltered and favourable for human occupation. A 50-ft cliff, cut in an old scree, fronts most of the bay. The flat behind is mostly in well established pasture that extends over numerous Maori pits and fortifications. Thick occupation layers show at the few places where the soil is being eroded. The following section was measured near the coast about 50 ft east of the point where the main stream enters the bay.

Opotiki Bay Section

	Ft
Grass on moderately well developed soil	1·0
Occupation layer with shellfish and barracuda jaws	0·2
Blown sand	1·0
Occupation layer, mostly shellfish	0·5
Occupation layer, mostly bones, including moa	0·5
Blown sand, light-coloured at top, darker below	2·0
Scree and gravel, top 10 ft above M.H.W.M.	10·0

The upward increase in proportion of shellfish to bones indicates a significant deterioration in diet during the early occupation period.

Bones of fish (mostly snapper), large penguin, pigeon, moa, fur seal, and dog, and abundant flakes of baked argillite were collected from the base of the lower occupation layer.

Opotiki Bay is one of the most favourable localities for detailed archaeological examination at D'Urville Island. The numerous pits and fortifications require to be dated, and the several acres of undisturbed occupation material are likely to provide artifacts from both layers if carefully excavated.

Manawakukupa is a large bay about a mile east of Opotiki. A thin occupation layer with numerous argillite flakes was traced along the north side and is overlain by soil with charcoal and a few shellfish that probably represents the upper layer, but there is no blown sand or soil wash and the total thickness of Holocene beds is small. The bay itself is backed by alluvial flats, the old lagoon having been filled with gravel. The most favourable occupation sites, near the stream at the coast, have been disturbed by building and no clear sections were seen.

Two small exposed bays – Cherry Bay (Otarawa) and Bullock Bay (Otuatangi) – lie a mile and a mile and a half to the south of Manawakukupa. Both have sandbars that enclose small swampy flats about two acres in

extent. At Cherry Bay the flat has been ploughed but appears to have been an area of early Maori agriculture. The following section is exposed at the coast where a drain cuts through the gravel bar:

Cherry Bay (Otarawa) Section

	Ft
Occupation layer, shellfish, charcoal, small fish bones, and dog dung with fish bones	2·0
Clean blown sand	0·5
Occupation layer, snapper and dog bones, dog dung of ground bones	0·5
Loose gravel, at least	2·0
Taupo Pumice in 4-in. lumps, well defined layer	0·3
Loose gravel, top about 3 ft above M.H.W.S.T.	2·0

The beach is prograding slowly and has advanced about 6 ft in the last 50 years. The Taupo Pumice is not exposed beneath the thickest occupation layers but slopes up steeply fifty feet back from the coast, defining the position of the front of the beach in A.D. 200. As in the other section, no trace of human occupation shows below or immediately above the Taupo Pumice.

At Bullock Bay (Otuatangi) the swampy alluvial flat was not cultivated by the Maori. The only exposures are at the north end of the beach where sand has been blown up over the foot of a rocky headland. As at the north side of Greville Harbour, the sand is being stripped from the seaward side, leaving a lag accumulation, and is accumulating near the foot of the hill where occupation layers are buried 6–10 ft below the surface. Moa bones are rare in the lag deposit and were not found in place. The following section is exposed between the lag deposit and the area of sand accumulation:

Bullock Bay (Otuatangi) Section

	Ft
Light-coloured brown sand	0·5
Shelly gritty sand	0·5
Dark occupation layer, fish bones, dog dung with fish bones, small bird bones (little blue penguin and pigeon)	0·5
Clean sand with a few pebbles	1·5
Sand with rock fragments	1·0
Gritty sand, base about 15 ft above M.H.W.S.T.	2·0

The occupation layer that is present is probably the upper one, the lower being possibly represented by the sand with a few pebbles. A mixed collection contains bones of tuatara, large penguin, little blue penguin, spotted shag, small petrel, red-billed gull, pigeon, kakapo, and sea lion.

SOUTHERN COAST

From Bullock Bay almost to the southern end of the island the coast is steep and without inhabitable bays. At the south end two bays are separated by a low saddle over the ridge that extends south-west from the central

ridge to Sauvage Point, the southern extremity of D'Urville Island. The western bay – Te Puna – is fully exposed to westerly gales. A lagoon about five acres in extent is separated from the sea by a sandbar of about two acres. The sandbar appears to have been cultivated by Maoris but occupation layers are thin, possibly because the site is so exposed.

Evidence of human occupation is abundant at Ohaua, on the eastern side of the ridge. The swampy alluvial flat within the bay is surrounded by sand-veneered hills that are less steep than almost anywhere else in the southern part of the island. Much of the area appears to have been in Maori cultivation, a small area being cultivated by Maoris in historical times. The site is windswept and, except for two springs near the coast, water is scarce. The best exposures are along a drain that has recently been cut through the centre of the alluvial flat. The drain cuts through a heap of baked argillite flakes that reach a maximum thickness of two feet and extend for about 50 ft. The following section was measured at the north end of the heap, the lower three feet of the section being excavated:

Ohaua Section – drain through alluvial flat

	Ft
Loose shelly sand	1·0
Old sandy soil, possibly a poorly developed occupation layer	1·5
Occupation layer, many flakes of baked argillite; sample collected from same layer 60 ft seaward contains unidentified fish bones, moa bones (including worked fragment), and seal bones	0·7
Dark sand	0·5
Charcoal layer, no shells or bones seen	0·2
Beach or blown sand, no charcoal	2·5
Water table, about 7 ft above M.H.W.S.T.	

The moa bones (*Dinornis* sp. and medium-sized moa) and the abundant flakes of baked argillite make it certain that the occupation layer is the older one.

About 500 ft south-west the following natural section is exposed in the side of a small gully facing Cemetery Island – a small island connected with D'Urville Island by a short gravel bar at low tide.

Ohaua Section – gully facing Cemetery Island

	Ft
Well developed soil in grass	0·2
Loose blown sand	0·8
Shell midden, barracuda jaws, dog dung with fish remains	1·0
Flakes of baked argillite	1·0
Dark sand with few shells, powdery dog dung	1·0
Light-coloured sand	0·2
Brown clay, base at M.H.W.M.	10·0

The shell midden contains abundant barracuda jaws and is correlated with the younger occupation layer. The older layer is probably represented by the layer of flakes and by the underlying sand with powdery dog dung.

Cemetery Island itself is extremely exposed both to the prevailing westerlies and to easterly winds, but from the highest point an excellent view is obtained of French Pass, the eastern seaward approach to Ohaua, and of the approaches from Nelson and the western North Island coast. In spite of the exposed position, occupation material is widespread at the northern end of the island, extending from the small beach facing D'Urville Island up to the highest point. The material on the beach has been largely concentrated by the wind, and many artifacts, some of polished greenstone, have been collected in the past. In spite of the evident signs of dense occupation, flakes of baked argillite are far less common than at the more sheltered sites in the main island. No moa bones were found in the well exposed lag gravels. The occupation layer is up to two feet thick and contains many barracuda jaws. The deposits appear to be entirely those of the later occupational period and their great development at this exposed site provides some indication of the conditions of life of the time. The weather is unlikely to have been very different from now, and the most likely explanation for the relatively thick occupation layer on this exposed site is that it was used as a lookout for approaching canoes. It is likely that warfare was chronic and that the inhabitants were relatively weak. By contrast, the people of the lower layer lived mostly in sheltered positions and were evidently less concerned with possible surprise attacks.

Baked argillite has been quarried by the Maoris about a mile east of Ohaua at the first point at which French Pass becomes visible from sea level. The site is littered with chips from workings at high-water-mark and at a point 50 ft higher. Large blocks are still easily obtained and there is no indication that the quarry had been abandoned because of increased difficulty in working. As at the quarry on the eastern side of French Pass described by Thomson (1918), there is no sign that fire was used and no obvious clues as to how the rock was worked. In a small bay 500 ft west of the quarry, flakes of baked argillite, that are doubtless from the quarry, are abundant at the base of a single occupation layer about a foot thick.

EASTERN COAST

From Ohaua to French Pass and then along the east coast as far north as Madsen, the bays are small with little or no sandy soil that could have been cultivated easily. Except for recent clearing, the forest extends down to the coast, and it is unlikely that much of this part was cleared of forest in pre-European times. Occupation layers occur in all the favourable bays, but they are thin and the population was probably small and shifting. Flakes of baked argillite are abundant and the deposits are probably mostly those of the early period. The coast was not examined closely from French Pass to Cherry Bay a mile south of Madsen.

On the coast at the north side of the main stream at Cherry Bay, three thin occupation layers occur in four feet of sandy gravel. The upper layer is at the surface and probably represents occupation during the last few

hundred years, in agreement with historical records. At Madsen a gravel fan covers several acres, but it is stony and not easily cultivated. Poorly exposed sections show thin occupation layers only.

The remainder of the east coast was examined from a launch running close in. Most is extremely steep with small bays and little flat land. The only ocupation layers seen are at "The Old Pa" south of Patuki in the northern peninsula, where the following section is exposed at the coast against the southern headland.

Old Pa Section, north-east coast

	Ft
Fine gravelly soil	0·7
Occupation layer	0·2
Gravelly soil	1·0
Occupation layer	0·3
Gravelly soil	3·0
Scree	1·5
Occupation layer	1·0
Scree, base at M.H.W.M.	2·0

No bones were seen, and correlation of the three occupation layers is uncertain.

NORTHERN COAST

The northern part of D'Urville Island is a narrow windswept peninsula with a few small bays on the western side. One of the largest, the bay north of Skull Bay, was examined. About a quarter of an acre of occupation material has been concentrated by the wind. Flakes of baked argillite are common and small fragments of moa bones are rare. A 2-ft-thick occupation layer is exposed but its age is uncertain.

Port Hardy lies to the south-west of the northern peninsula, and opens to the north. No large areas of occupation material are known and the harbour was not examined closely. The coast is mostly steep and much is still forested to high-water mark.

Except for Otu Bay, two miles north of Greville Harbour, the northern part of the west coast is a straight high-cliffed coast. Otu is a narrow short harbour that faces directly west and is consequently exposed to the prevailing wind. A fresh-water lagoon about half a mile long lies behind a narrow sandbar. The locality is favourable for human occupation and occupation material is fairly abundant. Unfortunately much of the sand has been wind-eroded and disturbed by livestock. The clearest section seen is at the north side of the stream where it leaves the lake.

Otu Section, north side of lake outlet, 600 ft from beach

	Ft
Fairly well developed soil in grass	0·2
Light-coloured sand	0·2
Occupation layer, sandy with scattered pebbles	1·0
Sandy soil	1·5
Occupation layer with oven stones	0·2
Brown clayey sand with a few pebbles, base at stream level	2·0

The two occupation layers probably correspond with those to the south, but no bones were found to check correlation. A few fragments of moa bones and abundant flakes of baked argillite were seen on the eroded sand on the south side of the bay. They are probably derived from an old soil with pebbles, similar to that on the north side of Greville Harbour, which covers the bottom of two narrow gulches and extends up for a hundred feet above sea level. A primary deposit of Taupo Pumice is exposed at storm-beach level about 20 ft back from the present storm beach. As at the other localities where Taupo Pumice was found, there has been little aggradation since the Taupo eruption, and no evidence for any change of more than a few feet in the level of the sea. The pumice cannot be related to the occupation layers lying further inland.

CONCLUSIONS

Many sections contain two distinct occupation layers older than the historical one that is known on the eastern side of the island only. Taupo Pumice, well dated by radiocarbon at about A.D. 200, occurs as a primary sea-transported layer at the base of three sections. Until radiocarbon samples have been processed, the age of the occupation layers can only be estimated from average stratigraphic thicknesses. These suggest A.D. 1000 for the older layer and A.D. 1500 for the younger, but both estimates may be several hundred years in error. Correlation of the eight most complete sections is shown in Fig. 3.

The people of the older layer were the first to reach the island. Moa bones are present in this layer in almost all sections and, as moa bones are absent from the younger occupation layer, it is reasonably certain that the moa, relatively abundant on the island before human occupation, was eaten and finally exterminated by these first people.

In spite of the fact that the eastern side of the island is more sheltered, and more suited for fishing, the older occupation material is abundant only on sandy flats suited to Maori agriculture, which are almost entirely on the western side. This distribution indicates that agriculture was important. Kumara is the only important Maori food plant that could have been grown, and the layer of pebbles closely associated with the older occupation material is like those in kumara soils elsewhere in New Zealand, and strongly suggests that this plant was an important part of the diet.

Correlation of the lower occupation layer with the "Moa Hunter" deposit of Wairau Bar is reasonably good: adzes of baked argillite, either from D'Urville Island or from the mainland nearby, are very common in "Moa Hunter" sites from Wairau Bar to Waitaki River (Duff, 1950, p. 190), and several distinctive artifacts attributed to the "Moa Hunter" period by Duff (1950, pp. 153, 195, 204) have been collected from D'Urville Island.

The more northerly position of D'Urville Island and the warmer climate make it likely that population built up there earlier than in the bleaker "Moa Hunter" sites to the south.

The suggestion that the early people cultivated the kumara conflicts with the traditonal view held by Duff (1950, p. 192) and Buck (1958, p. 50),

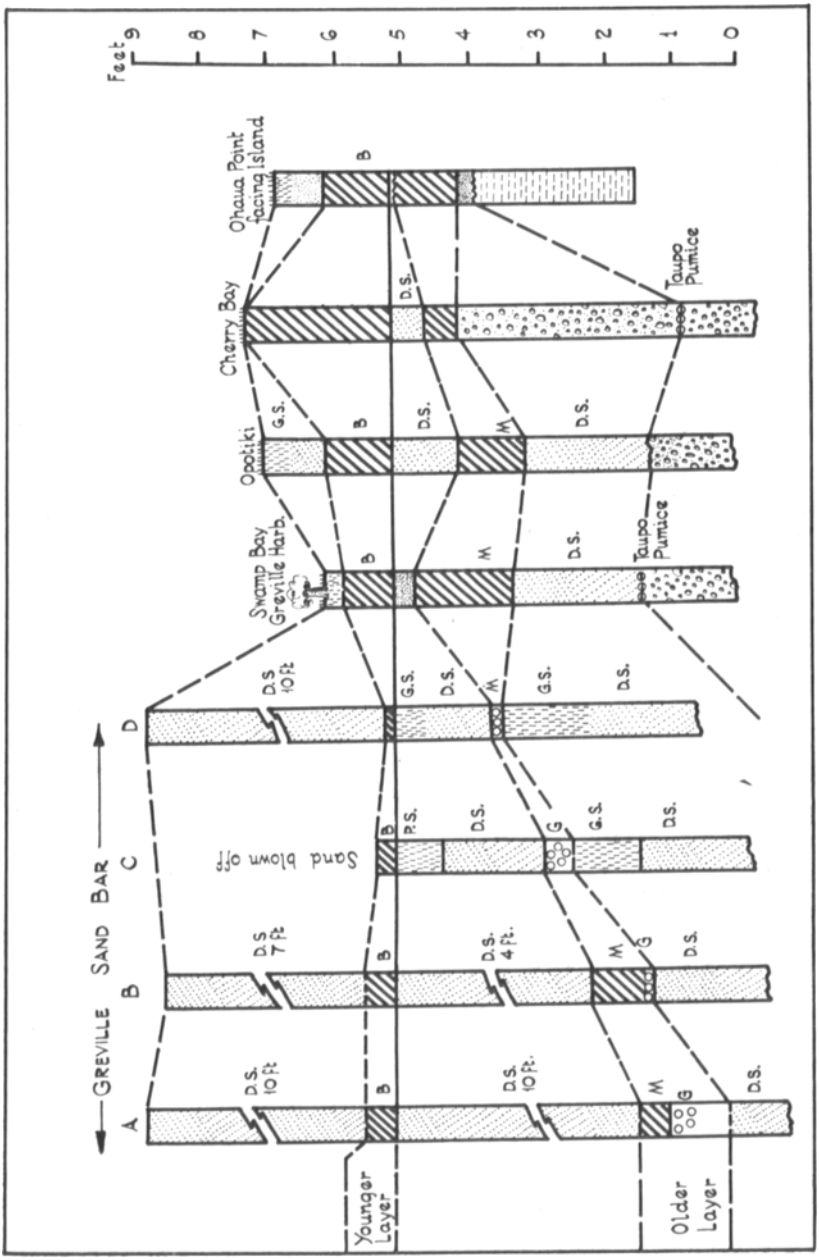

FIG. 3—Correlation of the more important archaeological sections measured on D'Urville Island. D.S., dune sand; G.S., well developed soil; P.S., poorly developed soil; B, bones of barracuda; G, beach gravel inferred to have been transported by Maoris; M, bones of moa.

who considered that they were a pre-Fleet people and that the pre-Fleet people did not have cultivated plants. But it is of interest that pits, thought to be storage-pits for kumara, have been described by Golson (1959, p. 45) associated with deposits of about A.D. 1300 at Coromandel.

It is suggested that the kumara was brought to New Zealand by some of the first people who rapidly increased in numbers and spread over the warmer coastal parts of the North Island. Because later arrivals would have had a negligible genetic effect once the population had built up to more than a few thousand, these early people must include most of the ancestors of the present Maoris. Hunting and fishing were probably most important at first, but as the people learned to grow kumara under New Zealand conditions and selected strains from this tropical plant suited to the temperate climate, a greater proportion of food was obtained by agriculture. Moas would have been killed and driven back from the populated coast but would have remained abundant in the colder southern part of the North Island and in the South Island.

As the population increased, moas would have been hunted in the south, at first during summer trips, and later from permanent camps in the South Island. When the hunters moved south into colder regions, they would have found kumara more difficult to grow and would have become essentially a hunting and fishing people. The extremely high proportion of baked argillite adzes relative to those of somewhat inferior local rock over the central part of New Zealand indicates that trade flourished during this period of southern exploration. Inevitably, because of the relatively small habitable southern area, and because of their hunting life, the southern population remained small and scattered while that in the north continued to increase and become more organised.

Intensive warfare probably started over land in the more densely populated areas in the north, weaker tribes being driven inland and southward. The upper occupation layer at D'Urville Island may represent a stage in one of these forced southern migrations. The moa had been exterminated, the trade in baked argillite had apparently ceased, and conditions were less favourable than for the early people. This occupation layer shows conclusively that barracuda formed an unusually high proportion of their diet. This is difficult to understand, in view of the range of fish now available, unless barracuda were then more easily obtained in large quantities than other fish. Presumably these people were finally driven south, to be replaced by those who lived mainly on the east coast and who remained until historical times.

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REFERENCES

BEST, ELSDON. 1925: Maori Agriculture. *N.Z. Dom. Mus. Bull. 9.*

BUCK, P. (Te Rangi Hiroa). 1958: "The Coming of the Maori." Maori Purposes Fund Board, Whitcombe and Tombs, Wellington.

DUFF, R. 1946: Native Quarries of Baked Argillite (N.Z.). *Rec. Canterbury Mus. 5 (2)*: 115–24.

DUFF, R. 1950: "The Moa-Hunter Period of Maori Culture." Department of Internal Affairs, Wellington.

GOLSON, J. 1959: Culture Changes in Prehistoric New Zealand, *in* "Anthropology in the South Seas." Avery & Sons, New Plymouth.

KEYES, I. W. 1958: Blackstone. *J. Polynes. Soc. 67 (2)*: 158–61.

REED, J. 1960: Soda-Metasomatized Argillites Associated with the Nelson Ultramafic Belt. *N.Z J. Geol. Geophys. 2 (5)*: 905–15.

RIGG, T.; BRUCE, J. A. 1923: The Maori Gravel Soil of Waimea West, Nelson, N.Z. *J. Polynes. Soc. 32 (2)*: 85–92.

SKINNER, H. D. 1914: An Ancient Maori Stone-Quarry. *Trans. N.Z. Inst. 46*: 324–9.

TAYLOR, N. H. 1958: New Zealand Prehistory and Soil Science. *N.Z. Sci. Rev. 16 (9–10)*: 71–9.

THOMSON, J. A. 1918: Maori Rock-Quarries on D'Urville Island. *N.Z. J. Sci. Tech. 1 (6)*: 321–2.