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Archaeological investigations at Maungarei: A large Māori settlement on a volcanic cone in Auckland, New Zealand

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ABSTRACT: Salvage excavations on the volcanic cone of Maungarei between 1960 and 1972 revealed a complex history of terrace construction and use, reflecting repeated occupations in the sixteenth and seventeenth centuries AD. The crater rim was extensively modified in the eighteenth century, after which use of the site seems to have ceased. Occupation of the cone was probably prompted by the need for defence, but it appears that only the two high points of the rim were actually fortified. A major use of the terraces was for roofed storage pits for garden produce.

Artefacts are typical of what is known of Auckland area material culture, showing reliance on local rocks of the Waipapa series for adzes, although obsidian was imported from five source areas. Food remains reflect a reliance on fish and shellfish for protein. The predominant fish catch was snapper, with a remarkable size range suggesting a variety of capture methods. Charcoal and mammal and bird identifications are described in specialist appendices. The charcoal and faunal remains show that the local environment was already highly modified by Māori when the northern slopes of Maungarei were occupied.

Maungarei meets the criteria for a transient settlement. Although the Auckland volcanic cones are usually perceived as exceptionally large sites, with populations numbering in the thousands, it is argued that the population of Maungarei at any one time would have been no greater than the number that could take refuge in, and defend, the larger of the two citadel areas.

KEYWORDS: Maungarei, volcanic cone, pā, transient village, faunal remains, material culture.

Introduction

The former Māori settlements on the volcanic cones of the Auckland area are among the most spectacular archaeological sites in New Zealand. Once part of a cultural landscape, including extensive garden areas and numerous open settlements, they now appear as terraced green islands rising out of a sprawling modern metropolitan area (Fig. 1). Some former cones have been completely destroyed by quarrying; all the survivors have been modified to a greater or lesser extent by quarrying, buildings, military installations, water reservoirs, roads and playing fields. The archaeological features on some of the main surviving cones have been mapped in considerable detail (see, for example, Fox 1977), but excavations have been relatively few and all have been salvage projects in response to threats of further degradation of the sites. The most extensive were a series of excavations carried out on Maungarei[1] between 1960 and 1972, which are the subject of this paper.

The only comparable site to have been investigated elsewhere in New Zealand is the volcanic cone of Pouerua in the inland Bay of Islands (Sutton *et al.* 2003), where

Fig. 1 Maungarei is a green island surrounded by industrial and residential developments. This May 2010 view from the south shows the old quarry face (now vegetated) with the main citadel area above it; a small old reservoir to the left of the quarry face; and, further left, a rocky protrusion at the base of the cone with traces of garden walls. The land at the top left is laid out for a new residential subdivision in the old quarry beyond Mt Wellington Domain (photo: Kevin Jones).

excavations were the culmination of a three-year research programme examining not only the cone but its intact surrounding landscape of gardens, hamlets and smaller fortified sites. In contrast to Pouerua, the excavations on Maungarei were constrained by the requirements of salvage. Even so, a considerable amount was learned about the complex history of this major archaeological site and the lives of its inhabitants.

The site and its setting

Maungarei (Site R11/12, formerly N42/4) is one of the four largest of some 30 cones in the Auckland volcanic field that were once sites of Māori settlement (Fox 1977; Bulmer 1996); it is also one of the better preserved examples. Situated in the eastern part of the Tāmaki Isthmus, not far from the western bank of the Tāmaki Estuary (Te Wai ō Taiki or, more formally, Te Wai ō Taikehu), it is a dominant feature in this part of Auckland (Fig. 2). The summit, about 134 m above sea-level, provides one of the best panoramic views of the region.

The prominent volcanic cone of Maungarei itself is part of a more complex eruptive centre. Volcanic activity here was relatively recent, most, if not all of it dating to about 9000 years ago. First to form was the explosion crater of Te Kai ā Hiku[2] (the Panmure Basin), a little to the south, which is now a tidal inlet of the Tāmaki Estuary (18 on Fig. 2). Renewed volcanic activity to the north was initially also explosive, resulting in tuff rings. This was followed by the formation of a low, double-crater scoria mound, known as Tauomā[3] (Purchas Hill), immediately to the north of Maungarei. Last to form was the higher and more complex cone of Maungarei itself (Searle 1964: 77–79, 1981: 117–125). Lava from the eruptions flowed to the west and south-west, forming an extensive lava field. Ash and tuff deposits survive on the north, east and south, and thinner deposits of ash extend east, to the banks of the Tāmaki Estuary, and southwest. This volcanic complex was first mapped in the

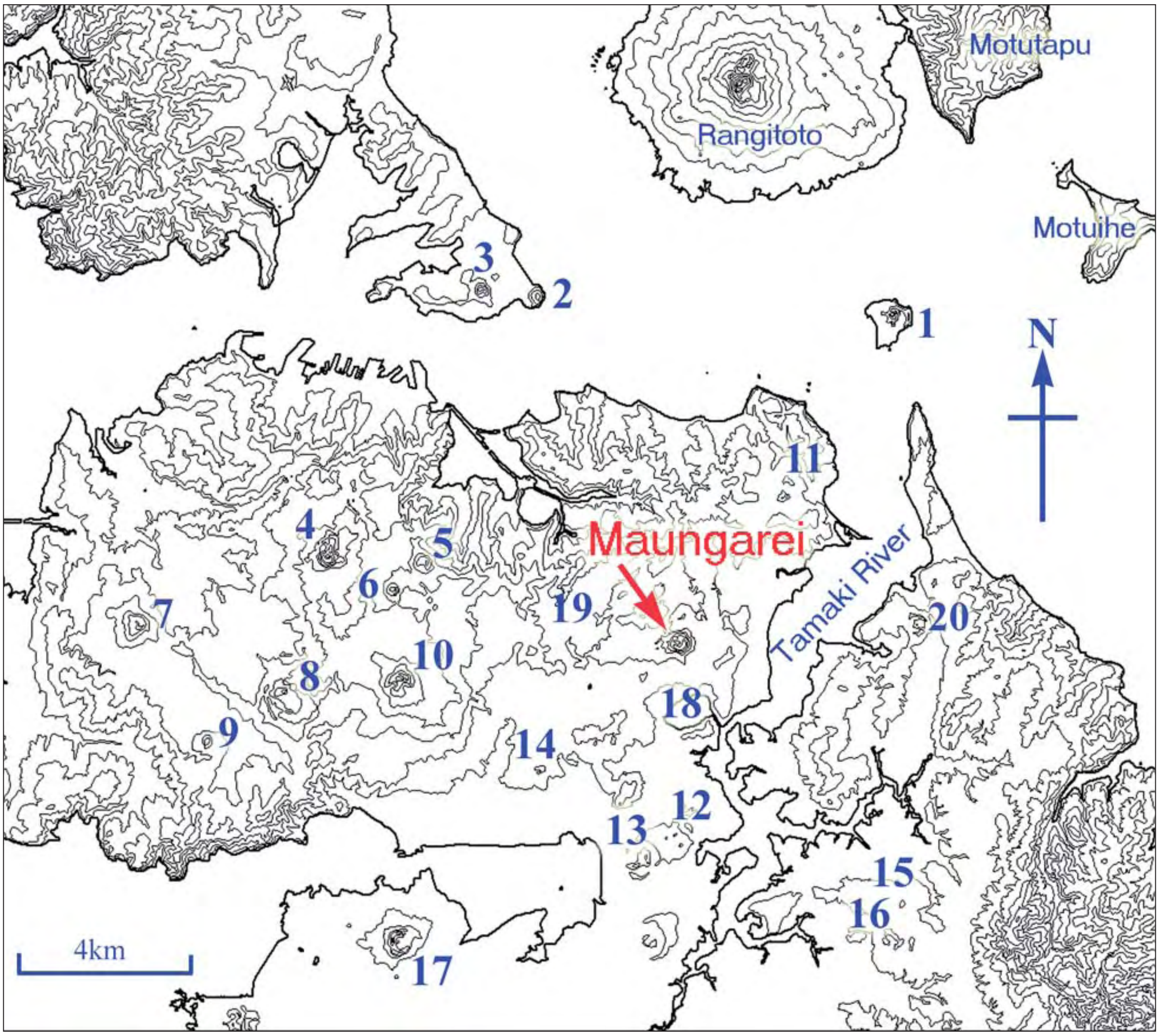

Fig. 2 The location of Maungarei (Mt Wellington) in the eastern part of the Tāmaki Isthmus, some other major scoria cone sites, and other places mentioned in the text. 1, Brown's Island/Motukōrea; 2, North Head/Maunga ā Uika (severely damaged); 3, Mt Victoria/Takarunga; 4, Mt Eden/Maungawhau; 5, Mt Hobson/Remuera; 6, Mt St John/Te Kōpuke; 7, Mt Albert (sometimes known as Ōwairaka, severely damaged); 8, Three Kings/Te Tātua (severely damaged); 9, Mt Roskill/Puketāpapa; 10, One Tree Hill/Maungakiekie; 11, Taylor's Hill/Taurere; 12, McLennan's Hills/Te Apunga ō Tainui (destroyed); 13, Mt Richmond/Ōtāhuhu; 14, Mt Smart/Rarotonga (destroyed); 15, Green Mount/Matanginui (destroyed); 16, Smale's Mount/Te Puke ō Taramainuku (destroyed); 17, Māngere Mountain/Te Pane ā Mataaho; 18, Panmure Basin/Te Kai ā Hiku; 19, Waiatarua; 20, Pigeon Mountain/Ohuiārangi (severely damaged).

nineteenth century by Hochstetter (Fig. 3), who recognised the Māori earthworks on the two cones. The radial lines on the northern tuff ring, which he did not explain, may possibly have been Māori garden boundary walls.

About 4 km to the northeast of Maungarei is the complex of small cones composing Taylor's Hill (Taurere), and a similar distance to the south were McLennan's Hills (Te Apunga ō Tainui, now quarried away), Mt Richmond (Ōtāhuhu), and Sturges Park (also destroyed). Lava from the east side of Te Apunga ō Tainui flowed north and south, as well as east towards the Tāmaki Estuary, and extensive areas from south of Sturges Park to north of Maungarei were blanketed in ash and tuff.

When Māori arrived in the area, the cones and surviving parts of the tuff rings were surrounded on all sides by fertile soils developed on the volcanic deposits. To the north and

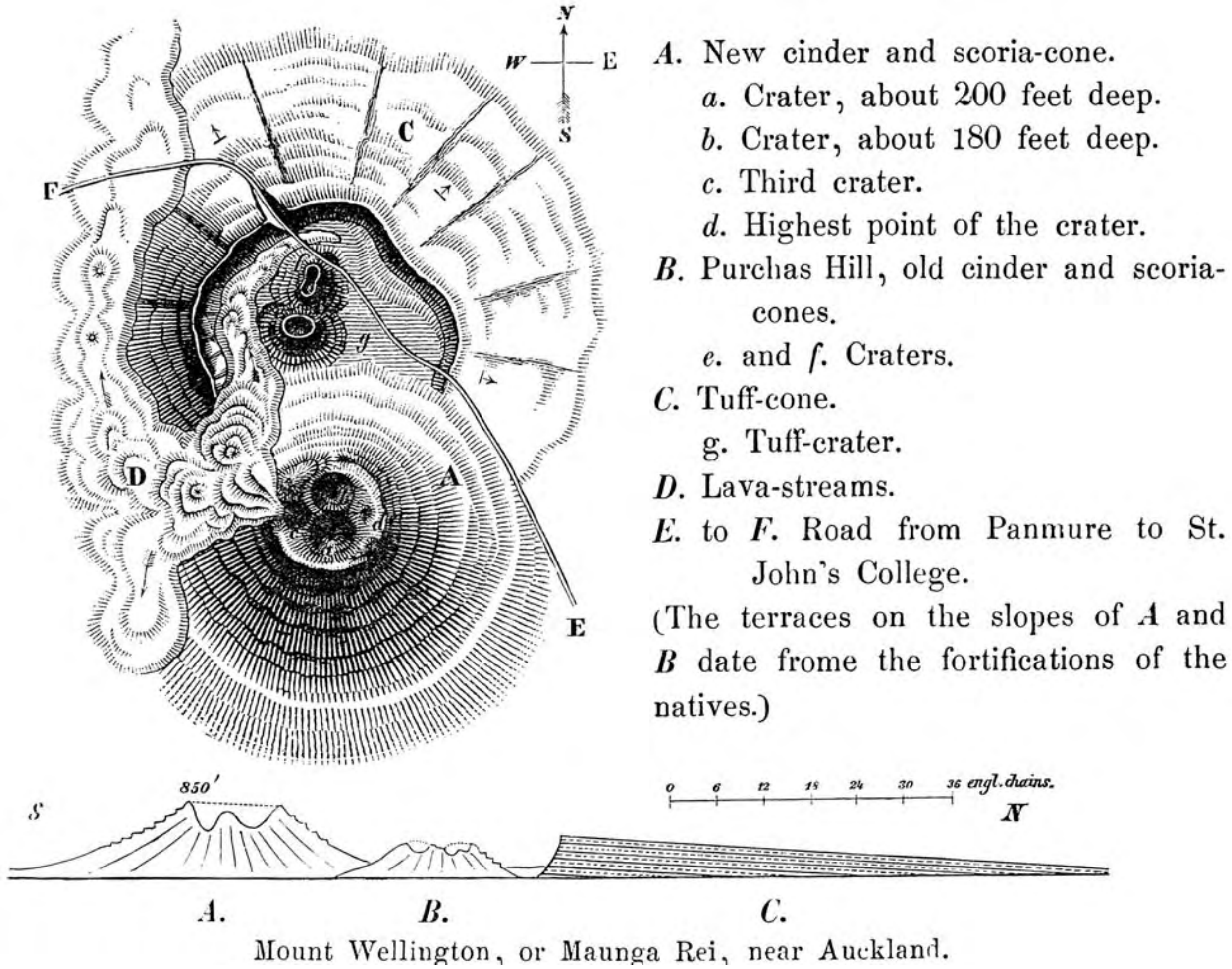

Fig. 3 Hochstetter's map of the eruptive complex of Purchas Hill (Tauomā) and Mt Wellington (Maungarei) before any damage had been done apart from the road (Hochstetter 1867: 237).

west of Maungarei, the lava flow had blocked the heads of tributary valleys, forming extensive areas of lake and swamp, notably at Waiatarua, only about 1.5 km from the western side of the mountain. The Tāmaki Estuary to the east was a source of shellfish, particularly cockles, and also fish, which entered the estuary itself. The estuary extends inland for about 15 km from its mouth. The semi-enclosed inlet of the Panmure Basin provides the nearest access to Maungarei, only about 500 m to the northwest. The entrance to the Panmure Basin is about 8 km from the estuary mouth. In pre-European times, Maungarei was strategically placed for rapid access by canoe to the Waitematā Harbour, Hauraki Gulf and North Island east coast generally. Some 4 km to the south were the portages that provided canoe access to the Manukau Harbour and the west coast. Thus the early residents of the district had easy access to potentially good garden land, swamps and lakes, and marine resources. Fresh water is generally found only on the periphery of the Auckland lava fields, as at Waiatarua. Freshwater springs were named and greatly valued by Māori. A fast-flowing spring beside the Panmure Basin may have been the nearest to Maungarei. It was named Te Waipuna ā Rangiātea (Murdoch n.d.: 6).

A number of pollen studies in recent years have revealed a Late Quaternary and Holocene environmental record for Auckland covering some 76,000 years (Horrocks *et al.* 2007: 5). After the last glacial maximum, conifer-hardwood forest dominated by *Prumnopitys taxifolia* (mataī) became the main forest cover. After about 10 000 yrs BP, *Dacrydium cupressinum* (rimu) became dominant and taxa such as species of *Metrosideros* (pōhutukawa and rātā) expanded, suggesting a change to moister conditions. Patchy expansion of *Agathis australis* (kauri), *Libocedrus* and *Phyllocladus* after about 7000 yrs BP suggests a change to drier conditions (Horrocks *et al.* 2007: 7). From this time until the arrival of humans, the nature of the vegetation appears to have been fairly constant.

A study of the small volcanic cone of Mt St John (Te Kōpuke), west of Maungarei, showed that when humans arrived a podocarp-hardwood forest dominated by *Metrosideros* grew on the rim and in the crater, with taxa such as *Elaeocarpus*, *Griselinia* and *Cyathea* also present (Horrocks *et al.* 2005: 219). It is likely that Maungarei would also have been forest-covered when Māori arrived in the vicinity.

The nearest pollen core site to Maungarei is at Waiatarua. Although the impact of human arrival could not be detected in the Waiatarua core described by Horrocks *et al.* (2002), the forest surrounding the lake during the last 3000 years was dominated by *Dacrydium*, *Prumnopitys* and *Metrosideros*, with other tall trees such as *Agathis* and *Phyllocladus* also well represented (Horrocks *et al.* 2002: 344). The range of plants found at Waiatarua is a good indication of what the vegetation in the vicinity of Maungarei was like when Māori first arrived.

A multiproxy analysis of cores from the Tāmaki Estuary found that Māori forest clearance in the estuary catchment was indicated by increased sedimentation and a sharp decline in forest taxa pollen, associated with an increase in bracken (*Pteridium esulentum*) and grass pollens (Abrahim 2005). By the time of European settlement, Maungarei, like the rest of the Tāmaki Isthmus, was surrounded by fern and scrub.

Māori occupation was not confined to Maungarei itself. Tauomā and the tuff rings also bore evidence of terraces and pits. Unfortunately, no study was made of these, or of the field systems which, by analogy with evidence surviving until recently in other parts of Auckland, once extended outwards from the base of the cone. Mundy in 1847 visited Mts Wellington (Maungarei) and Halswell (now Mt Richmond or Ōtāhuhu), and noted 'hundreds of scoria walls, evidently the enclosures of former potato-gardens' under high fern extending out for half a mile (800 m) (Mundy 1855: 260). Tauomā and the tuff rings immediately to the northeast have been almost completely destroyed by quarrying, and the surrounding areas have been quarried or built on, or both. Now, almost all the surviving archaeological evidence is within the Mt Wellington Domain and that, too, has been progressively damaged over a long period. A small surviving area of former gardens has recently been identified and set aside as a stone fields reserve on the edge of the residential area to the west of the mountain.

At the time of the excavations described in this paper, the only recorded archaeological sites in the area were Maungarei, some vestigial pits (now long destroyed) on Tauomā, the historically documented sites of Mokoia and Mauinaina to the east (shown on Brown's (1960) map of major Auckland sites), one burial site, and a pit and terrace site. Mitigation work in recent decades has revealed the remains of numerous midden and pit sites around the Panmure Basin and along the west bank of the Tāmaki Estuary to the south, suggesting that there was once a rich archaeological landscape in this part of Auckland.

History and traditions

Little has been published about the Māori history of Maungarei. Graham stated that the name means 'watchful mountain' and refers to the vigilance of the eighteenth-century Waiōhua inhabitants, who could not be taken by surprise by the invading Ngāti Whātua under Kāwharu (Graham 1980: 5; Simmons 1980: 18). According to Te Warena Taua (pers. comm. 1992), the full name is Te Maungarei ā Pōtaka, after Pōtaka, a prominent leader who lived there and is believed to have been buried there. Murdoch (n.d.: 3, 10) gives the name Te Rua ā Pōtaka specifically for the western side of the mountain. An alternative name for the mountain is Maunga ā Reipae after a Tainui ancestress, who travelled north in the form of a bird and landed on the mountain (Murdoch n.d.: 10).

Stone (2001) has relatively few references to Maungarei in his thorough review of the Māori history of Auckland. He notes that it was occupied, along with Maungawhau (Mt Eden) and Maungakiekie (One Tree Hill), at a relatively early time by Ngāti Huarere, a Te Arawa group (2001: 15). It was subsequently occupied by the Waiōhua and was sacked, along with those other two great pā, by a Ngāti Maru war party under Rautao in the latter part of the seventeenth century (2001: 25). However, it was not mentioned as one of the great pā of the region in the time of Kiwi Tāmaki in the mid-eighteenth century, when Maungakiekie, Māngere and Ihumatao (Maungataketake/Ellett's Mountain) were the leading citadels (2001: 36).

Although Taurere (Taylor's Hill) was attacked by the Te Taoū group of Ngāti Whātua during their first assault on the region in the mid-eighteenth century (Stone 2001: 40),[4] Maungarei apparently was not. This was possibly because, as Graham claimed (1980: 5), the inhabitants were too watchful, or perhaps because these people, if there were any living there at that time, were not the prime focus of Te Taoū revenge.

Stone also discusses in some detail the Tainui tradition that Ngāti Maniapoto invaded Tāmaki and overthrew Maungakiekie and Maungarei (2001: 53–55). He argues that this attack must have taken place in the earlier half of the eighteenth century, not the beginning of the nineteenth century as argued by Kelly. A large number of those slain at Maungarei were rolled into a lava tube on the west side of the mountain, and the place was named Ruapōtaka (the pit for spinning tops) for that reason (Kelly 1949: 278). This is quite a different explanation for the name Pōtaka than that given above. A deep shaft into a lava tube on the western side of the mountain, known as Ruapōtaka or 'the fairy hole', was explored in 1927 and found to contain human bones. The shaft was subsequently concreted over by the Domain Board (Baker 1987: 106).

Although much of the pre-European history of Tāmaki concerns Waiōhua and Ngāti Whātua, by the end of the eighteenth century people related to the Hauraki iwi of Ngāti Paoa were established on the west bank of the Tāmaki Estuary (Stone 2001: 23), probably not far from Maungarei, which was by then unoccupied. A tuku whenua (gift of land), which extended as far inland as Waiatarua, was made to them by Ngāti Whātua. They never occupied Maungarei, their principal settlements being Mokoia and Mauinaina to the south and east of Maungarei, closer to the Tāmaki Estuary. These people were intimately related to Waiōhua as well (G. Murdoch, pers. comm. 2010).

In 1820, Reverend John Butler, travelling with Samuel Marsden, visited Mokoia and Mauinaina and climbed to the summit of Maungarei. He described his experience as follows:

> When we arrived at the foot of the mountain, and began to ascend the side, I found, on examination, the grass and fern growing upon burnt earth and calcined cinders, which led me to conclude that it had been a volcano.
>
> Reaching the summit, I found a large crater, and proportionately deep, but the eruption must have ceased long since, as the grass grows spontaneously at the bottom of it. The prospect from the summit is grand and nobly pleasing. I observed twenty villages in the valley below, and, with a single glance, beheld the largest portion of cultivated land I had ever met with in one place in New Zealand. Having taken a general survey, we returned by another path to the Eppah (pah), where we found Mr. Marsden enjoying a friendly chat with the people. (Butler 1927: 97–98)

From this it is clear that Maungarei had been unoccupied for some time, but that the fertile soils along the west bank of the Tāmaki Estuary were supporting a substantial population. Captain Cruise, who visited the area in August 1820, commented on the size of the settlement of Mokoia and the extent of the hamlets and gardens stretching south towards the portages. White potatoes were well established in these gardens (Cruise 1824: 215–216).

In 1821, Mokoia and Mauinaina were attacked and taken by Hongi Hika and many of the inhabitants slain. Thereafter, the area was vacated (Stone 2001: 88–90).

The land on which Maungarei is situated was part of a very large block purchased by the Crown from the Māori owners in 1841. A pattern of subdivision laid out in 1863 included an area of 72 acres (29.14 ha) marked Government Reserve (Survey Office Plan 913B). In 1881, the present Mt Wellington Domain, covering essentially the same area, was gazetted under the Public Reserves Act 1877 and the first Domain Board was appointed. In 1909, part of the southern face of the mountain within the existing Domain was gazetted as a Quarry Reserve. The Domain was administered by Domain Boards until 1960, when the Mt Wellington Borough Council assumed the duties. With local government amalgamation in 1989, Auckland City Council became responsible for the Domain. The history of the Domain is described in more detail by Baker (1987: 105–108).

History of investigations

The archaeological values of the Auckland volcanic cones had been recognised since the early days of European settlement in Auckland (e.g. Mundy 1855: 260; Hochstetter 1867: 164). However, modern archaeological investigations began only in the 1950s. The appointment of Jack Golson as the first lecturer in prehistory at the then Auckland University College, along with the establishment of the Auckland University Archaeological Society and the New Zealand Archaeological Association, coincided with and encouraged the growth of public interest in the preservation of archaeological sites. The Auckland cones were the subject of an early campaign to secure better preservation and management of these magnificent sites (Golson 1957). The first rescue excavation on one of the cones took place at Taylor's Hill (Taurere) between 1954 and 1956 (Leahy 1991). Although the stratigraphy and features uncovered seemed complex at the time, the excavation provided little preparation for what was to be experienced at Maungarei.

Maungarei became the focus of archaeological interest early in 1960, when it was selected for an intensive mapping

Fig. 4 Maungarei in 2010, showing the location of excavated areas and the two tihi, or citadels. The extensive terracing on the eastern slopes (right) extends through the wooded area to the boundary of the Domain (photo: Google Earth).

exercise as part of the newly established site recording scheme (Groube 1960). At this time, the cone had already been damaged by building on the slopes outside the Domain on the north side, by the quarry on the southern face, by the construction of a small reservoir low down on the southwest side, and by tracks to the small reservoir and to the summit. Little remained of Tauomā and the tuff rings, described above, and that little disappeared in the intervening years, along with almost all of the stone garden walls that in 1960 were still visible on the western side of the cone, beyond the Domain.

Shortly after the mapping project began, a major new threat to the site emerged with the Auckland City Council decision to build a reservoir in one of the craters. This would breach the rim at its lowest point and destroy a number of Māori earthworks. The then National Historic Places Trust provided a grant that enabled the Auckland University Archaeological Society to employ two people full time and undertake a rescue excavation (A on Fig. 4) from March to late May 1960 (Golson 1960).

In 1964, the Mt Wellington Borough Council unveiled plans for a major development of the mountain, including a road to the summit, a large parking area, a revolving restaurant, and an artificial ski lane down the slopes. The Auckland University Anthropology Department carried out an excavation on the crater rim (B on Fig. 4) for one week in November 1965. A Golden Kiwi Grant for South Pacific Research to Auckland University enabled 15 people to be employed (Brown 1966: 105–106). Immediately after this excavation, the development plans were put on hold.

The proposal to build a road to the summit was revived in 1970. Three areas affected by the proposal were investigated by the New Zealand Historic Places Trust and the Auckland Museum on several occasions between August 1971 and August 1972. Financial support from the Mt Wellington Borough Council enabled two people to be employed. The excavations were on a terrace on the northeast part of the crater rim, two large terraces on the northern slopes below the reservoir, and the presumed garden on the protrusion at the foot of the western side (C, D, and E, respectively, on Fig. 4). As a result of these excavations and a collaborative approach between archaeologists, the Mt Wellington Borough Council and the Lands and Survey Department, the road proposal was modified to its present form. The terraces on the northern slope were damaged, but the other two areas remained intact.

The excavations

The underlying natural material in the various excavated areas was normally unweathered scoria – a light, porous volcanic material, essentially 'frothed up lava' (Searle & Davidson 1973: 2). This could be dug into relatively easily by the inhabitants of the site, and crumbled readily into rubble- and gravel-like pieces. Most of the cultural deposits encountered in the excavations consisted of cultural debris mixed with coarse or fine scoria derived from the construction of terraces and pits on the mountain.

On part of the northern slope, scoria was overlain by volcanic ash. The transition from scoria to ash was abrupt. On the lowest part of the crater rim, vesicular basalt lava was found to underlie scoria.

Area A: the lowest part of the crater rim

The 1960 excavations were directed by Jack Golson. Day-to-day supervision was by Les Groube; he and Bob Cater were employed to work full time on the excavation. Volunteers took part in some numbers at weekends and, occasionally, on weekdays. The Auckland University Archaeological Society's Easter excavation was held at the site, with participants living at the old residential School for the Deaf on the northern toe of the mountain.

These excavations were the most complex and produced the most detailed information about earthworking on the mountain. Unfortunately, they were not completed before construction began on the reservoir and only some areas

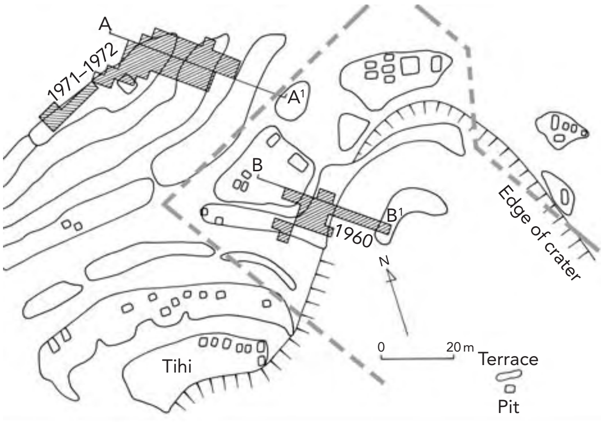

Fig. 5 The layout of excavations in Areas A (1960) and D (1971–72). The dashed line indicates the approximate extent of destruction caused by the reservoir.

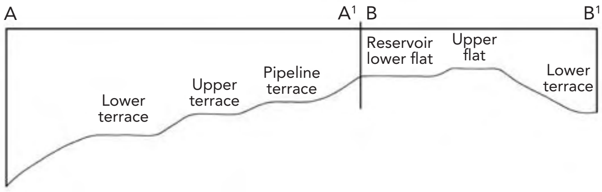

Fig. 6 Surface profile through Areas A and D (see Fig. 5 for locations).

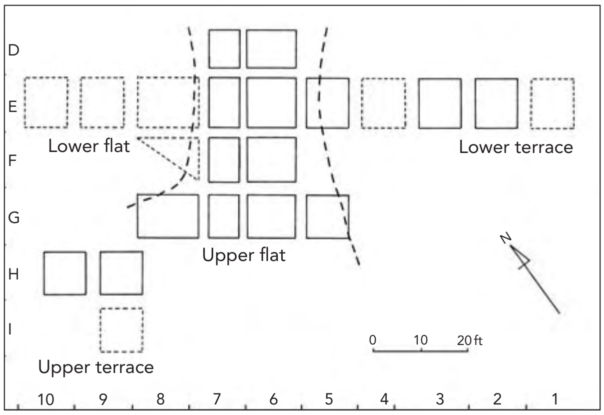

Fig. 7 Layout of the 1960 excavations.

were fully recorded. The following account has been put together from the preliminary reports (Golson 1960, 1961), surviving notes, plans and sections made available by Professor Golson, and the photographic archive in the Anthropology Department at Auckland University, augmented by photographs (mostly social) taken by people who took part in the excavation. I took part as a student volunteer and made some of the surviving notes and sections relating to the Upper Flat.

Fig. 8 A view of the Upper Flat in Area A from one of the terraces of the secondary tihi, 1961. The crater, now filled by the reservoir, is to the right (photo: Anthropology Department, University of Auckland).

Fig. 9 The Lower Flat (front) and Upper Terrace (rear) in Area A, with the edge of the Upper Flat to the left, 1961 (photo: Anthropology Department, University of Auckland).

The configuration of the northern part of the mountain before construction of the reservoir and the relationship of the 1960 excavations and those of the summer of 1971/72 are shown in Figs 5 and 6. Fig. 5 indicates the grids laid out in the two areas. Details of the squares actually excavated are given below.

The 1960 excavations were centred on a flat area or saddle, which constituted the lowest part of the crater rim and extended down to a terrace inside the crater and out on to a slightly lower flat area with several visible surface pits (B^1 to B in Fig. 6). The aim of the excavation was: 'to dig a complete section from the lower terrace, covered beneath the grass with scoria boulders, up the crater scarp, with its surface scattering of shell, over the upper flat on which no surface features were present, across the lower flat with its dispersed rectangular pits clear to the outer edge of the rim' (Golson 1960: 31). Had time and resources enabled this plan to be completed effectively, we would know a great deal more about the complex history of this part of the site.

To the southwest of the excavation, the crater rim rose steeply to a secondary tihi (citadel), most of which still survives, although its northern face has been reshaped to form the batter above the reservoir. To the northeast, the crater rim rose less steeply to a flat knoll with some large pits visible on the surface, and then curved sharply to the southeast, rising fairly steeply towards a terrace (Area C) partly excavated in August 1971. The flattened area at the lowest point of the rim extended as a terrace to the northeast inside the crater. The approximate extent of earthworks destroyed by the reservoir construction is indicated in Fig. 5.

Fig. 7 illustrates the extent of the 1960 excavations, based on a surviving plan and augmented by photographic evidence. Several additional points should be made. This plan does not indicate that a number of baulks were removed; this will be apparent from Figs 10 and 11. Photographs show that the position of the three squares on the Upper Terrace as taken from the surviving plan is incorrect; they were fully aligned with squares E9 and E10. An unpublished report on the geology of the excavations (Kear n.d.) includes a plan that depicts square E11 on the Lower Flat as being at least partly excavated. Lastly, photographs also show that in the final stages of the excavation a trench was dug towards the eastern part of the Lower Flat to a large pit visible on the surface. This appears to have been a 3 ft-wide (90 cm) trench along the southeast side of what would have been square D9, which then turned to intersect the pit at right angles to its long edge.

Fig. 8 shows a fairly early stage of the excavation of the Upper Flat. Very little has been done as yet in squares G5 (lower right) or D6 and D7 (uppermost). Fig. 9 shows excavations extending to the Lower Flat and Upper Terrace, with the pits on the Upper Flat more fully exposed.

Excavation was by hand trowel according to natural layers. Since the principal objective of the excavation was to understand the structural history of this part of the site, great attention was paid to stratigraphic detail. As time ran out, some fill layers were shovelled out in an attempt to complete parts of the excavation before bulldozers moved in. During excavation, artefacts, bone fragments, charcoal pieces and unusual shells and stones were collected by hand. It was not practical to sieve the deposits, containing as they did large quantities of scoria gravel and rubble.

The Upper Flat

Excavations began on the Upper Flat (Fig. 8); the area laid out initially was almost completely excavated and fairly thoroughly recorded. During the excavation, and for the purposes of the following discussion, the long line of squares from the Lower Terrace to the Lower Flat was deemed to run from south to north; in the squares on the Upper Flat, the north sections are those nearest the Lower Flat, the south sections those nearest the Lower Terrace, and the east and west sections those parallel to the long axis of the excavation.

Kear (n.d.) described the natural stratigraphy in this area as vesicular basalt lava underlying unweathered scoria. Both deposits dipped inwards towards the crater. Weathered brown clay had developed on these deposits through normal soil-forming processes, and was covered by a thin topsoil. The brown clay varied in thickness up to 45 cm in flat areas or depressions where it would have been increased by slope wash from higher ground. Digging and redeposition of these natural deposits, with the addition of greater or lesser amounts of cultural debris (shells, charcoal, etc.) produced the various other layers encountered during the excavation.

Kear (n.d.) distinguished between *slope debris*, consisting of two contrasting lithologies that were well bedded; and *man-made deposits*, in which the bedding was, 'at best, crude and chaotic'. The slope debris was a result of human activity higher up the mountain but had come to rest in its present position through natural processes, whereas the obviously man-made deposits were the result of human activity, such as pit filling and rubbish dumping, in the immediate vicinity.

Removal of turf and topsoil (layers 1 and 2) revealed a few patches of fairly fragmentary shell midden and some small hāngi (earth ovens), and patches of stones on a uniformly flat, gritty, largely sterile surface of scoria rubble and gravel (layer 3). The most significant of these features was a low mound of shell midden in square F7, which extended into F6. Layer 3 was at first thought to be natural. However, it was found to be a deliberately laid surface covering and sealing four large pits and some further patches of midden and ovens in the tops of their fills and in the intervening natural surfaces.

The pits themselves were dug partly into natural scoria (and in one place into the underlying lava), but partly into earlier cultural deposits. These included both slope debris consisting of redeposited cindery scoria containing occasional shells and charcoal fragments, and more concentrated midden or fill layers. It became apparent that the southern part of the Upper Flat had been considerably extended and built up beyond the natural surface of the crater.

The plan of the pits and scarp features is shown in Fig. 10. It indicates the probable original bases of the pit walls and the extent to which the walls have eroded or crumbled because of the loose material (whether natural or redeposited) through which they were dug.

Pit A was between 114 cm and 122 cm deep. Not shown on Fig. 10 but evident in photographs are one or two additional postholes towards the western end of the pit and the remains of a retaining wall of scoria blocks along the western edge. Fig. 11 (upper) indicates the nature of the fill layers as they appeared in the west face of squares F6 and F7. The earliest fill was a lens of fine yellowish-brown material on the south side. A layer of burnt organic material lapped down from the surface of this to cover the bottom of the pit. In this part of the pit the lower burnt layer was separated by a fine, dark soil layer from a similar but higher burnt layer. Above this on the northern side of the pit, layers of loosely packed whole shells were interspersed with layers of finer soil or scoria. The bulk of the pit fill was mixed loose material containing scoria, stones, shell and earth. On the surface of this fill on the north side was a black layer with some shell, associated with several scoop features, possibly fire scoops.

Pit B was similar in depth to Pit A, but smaller in plan. The excavation data suggest that it had a single central row of postholes. The two excavated were about 30 cm and 33 cm deep. To the east, this pit, like the others, was dug into natural scoria, but its western end was dug entirely through a deep series of slope debris deposits, which had built up on the natural slope of the crater before pit construction began (Fig. 11, upper and middle). Although the south and west edges of the pit were quite clear, the distinction between pit fill and earlier fill was blurred on the northern edge, where only the base of the pit wall was clearly defined. The pit fill is best described on the basis of the east face of squares G5 and G6 (Fig. 11, middle). Towards the base of the walls,

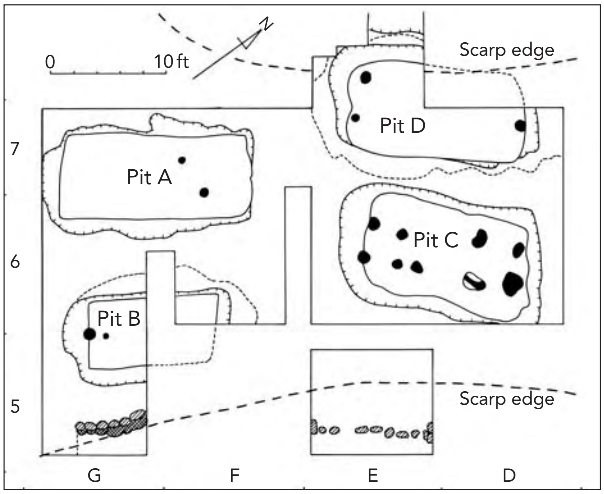

Fig. 10 Features on the Upper Flat in Area A. Postholes are shown as filled circles. Remains of scoria-block walls are shown as diagonally hatched ovals.

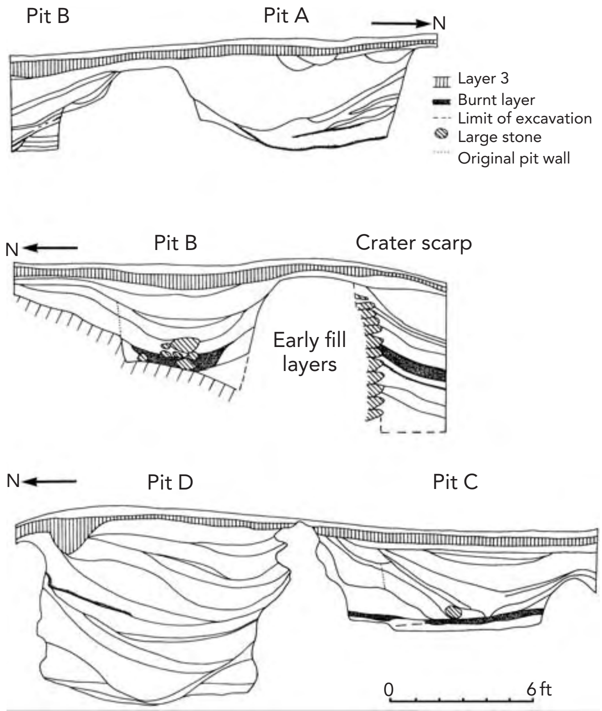

Fig. 11 Cross sections through the pits on the Upper Flat in Area A. Upper, west face of squares F6 and F7; middle, east face of squares G6 and G5; lower, east face of squares E7 and E6.

the fill consisted of lenses of mixed scoria gravel and finer material, while the centre contained a thick layer of burnt organic material. Above this was a largely sterile layer of scoria and earth with some large scoria blocks, and above that a finer layer of scoria with charcoal and shells scattered through. The upper part of the fill consisted of loosely packed shell with lumps of scoria. A black layer with scattered shell, similar to that on top of the fill of Pit A, was immediately below layer 3.

Pit C was similar in depth to Pits A and B. Its walls were very eroded and its floor uneven. Nine postholes were defined in the floor, ranging in depth from about 20 cm to 46 cm. There was some indication that this pit may have been redug and reduced in width at some stage. If so, most of the postholes, in two groups of four, would have belonged to the first stage. Pit C also had an extensive burnt layer just above its floor (Fig. 11, lower). The lower fill layers, particularly those on the northern side, were very loose and rubbly, and some contained considerable shell. The upper layers, on the other hand, were finer and more compacted.

Pit D was much deeper than the others (between 230 cm and 245 cm) and was largely dug into lava. Only three postholes were found in the area excavated: the one nearest the scarp to the Lower Flat was more than 75 cm deep and the other two 30 cm deep. Against the bases of the pit walls were fairly fine, compact fill layers of scoria and earth. Above these and in the centre were several loose, rubbly layers. A thin layer of loosely packed shell lensed in from the south. An earthy layer separated this from a layer of burnt organic material about halfway up the fill. This burnt layer was at about the same depth below the surface as the burnt layers on the floors of the other three pits. The upper fill layers were finer and more compacted, with only occasional shell and charcoal.

The general arrangement of these pits suggested that they were constructed at about the same time. However, it is possible that Pit D was abandoned first, perhaps because of construction of the Lower Flat.

The Inner Scarp and Lower Terrace

The two squares on the edge of the crater (E5 and G5) yielded vital but complicated information about the history of modification of this part of the site.

Part of an intact, well-built retaining wall of scoria blocks was exposed in square G5 (Fig. 11, middle). This wall separated early layers of slope debris and fill, contained behind it, and later deposits thrown down from the Upper Flat onto the sloping crater wall. The layers between the retaining wall and Pit B were not excavated, but were assumed to be similar to those into which the western end of Pit B had been dug. The more recent slope layers were not

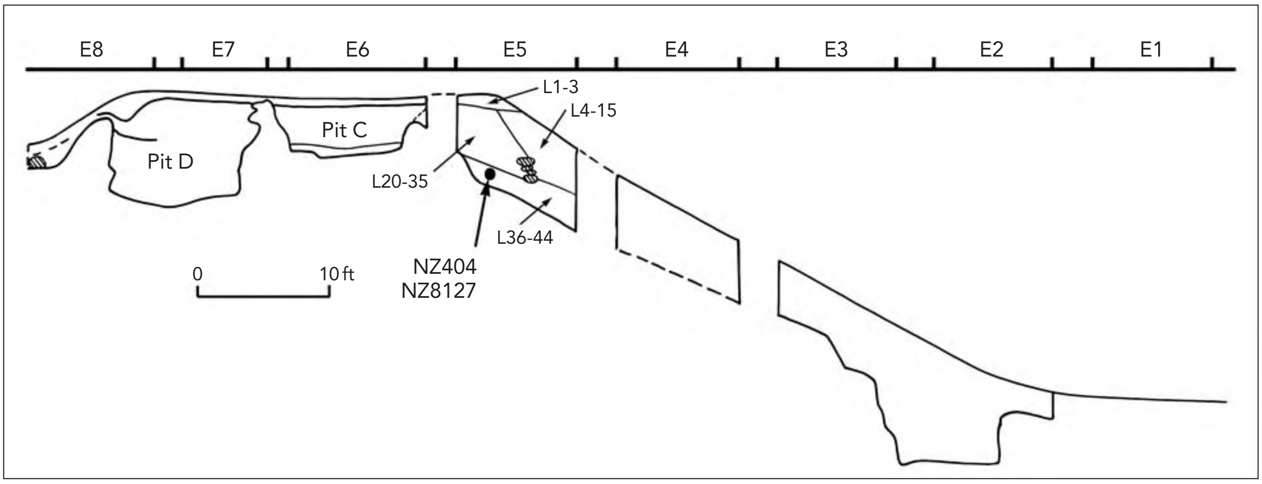

Fig. 12 The long cross section through Area A. The context of radiocarbon-dated charcoal samples NZ404 and NZ8127 is shown.

unlike those of the various pit fills. A burnt layer appeared midway up the section, with tightly packed shell separating a thin lower lens from the thicker upper part of the layer. Beneath the burnt layer were several layers of fine scoria with varying amounts of scattered shell. Above the burnt deposit was a series of layers of scoria and shell, culminating in scattered, fragmentary shell immediately below the topsoil.

Square E5 presented extremely complicated stratigraphy which, nonetheless, suggested a similar picture to that in square G5. Here, the scoria-block retaining wall had largely disappeared, and only traces of the lowest courses remained. Of the east and west sections, critical to the debate, only the west was fully recorded, as bulldozing for the reservoir destroyed part of the east wall before the section could be drawn. In Fig. 12, a mirror image of the west wall has been interpolated into the long section, as the two walls of the square were not dissimilar.

It was clear that in square E5, a series of earlier cultural layers (20 to 35) had been cut back to form a new scarp at the inner edge of the Upper Flat; that a retaining wall, now largely destroyed, had been built to hold the edge of the scarp; and that a new series of midden and spoil layers (4 to 15) had been thrown down the scarp from the Upper Flat, accumulating on top of the earliest layers (36 to 44), which continued undisturbed beneath the base of the scoria retaining wall. The position of the sample that provided the first radiocarbon date for the site (NZ404) is indicated. This consisted of scattered charcoal near the original ground surface and may represent initial clearance of vegetation on the site. A second sample from the same context (NZ8127) was subsequently dated. If there is any equivalent in this square to the burnt layer part way up the sequence of younger layers outside the walled scarp in square G5 (Fig. 11, middle), it would appear to be layer 15, an ashy zone at the very base of the sequence of younger layers.

Debate during excavation centred on exactly which layers in square E5 pre-dated the cutting of the scarp and where the later layers began. This issue, argued passionately in 1960, seems less important now and I have chosen the interpretation that seems to fit best with the surviving photographs and section drawings.

In the north face of square E5, a clearly defined posthole appeared to have been dug from the surface of layer 22 and sealed by layer 21. This suggested structural activity on an old surface before the construction of the Upper Flat in its present form.

The long scarp down to the Lower Terrace and the terrace itself were found to carry deep and extensive deposits of scoria rubble and midden. Square E4 was not completely excavated and only the upper layers in the east wall were drawn before the bulldozers moved in (Fig. 13). All that can be illustrated for this square is the estimated depth of deposit. The eastern halves of squares E3 and E2, however, were fully excavated and the east walls were recorded in detail. An astonishing feature of this area was a deep pit-like feature at the base of the steep scarp. This feature was about 240 cm wide. Its wall at the base of the scarp was about 200 cm deep, while the opposite wall was about 137 cm deep. Apart from an early layer resting on the surface of the Lower Terrace in square E2, through which the pit appeared to have been dug, the entire stratigraphic sequence of pit fill and overlying slope deposits appeared to post-date the pit.

Fig. 13 Reservoir construction engulfs the excavations in Area A, June 1961 (photo: Bob Jolly).

The pit fill and subsequent slope deposits were similar to fill layers elsewhere – a mixture of scoria rubble, finer gritty scoria and shell. The lower fill, particularly, contained large amounts of rubble. There is no record of a burnt layer in the area excavated; a description of the bottom-most layers in the base of the pit has not survived, but the existing section drawing does not seem to indicate anything comparable to the burnt layer that appears in various sections on the Upper Flat.

The Outer Scarp and Lower Flat

Excavations on the Lower Flat were mainly conducted during the closing stages of the excavation. Work continued here while bulldozers were at work in the crater, destroying the excavations on the Inner Scarp and Lower Terrace. Unfortunately, no original documentation other than photographs has survived.

Golson's interpretation, based on observation at the time, was unequivocal (Golson 1960: 33). The northern wall of Pit D and part of its fill had been cut away by the formation of the Outer Scarp. Photographs show that there was a stone retaining wall along the Outer Scarp also. The lower courses were uncovered in square E8 in a position not unlike that of the corresponding course of stones in square E5.

Photographs also show one or more extraordinarily deep squares on the Lower Flat. These are presumably either or both of squares E8 and E9. The excavation was more than 200 cm deep in this area. The fill was compact and relatively undifferentiated earth with only occasional flecks of shell. Similarly deep deposits appear to have extended through square D9 almost to the edge of the large pit that was visible on the surface. All that can be said of this area is that it contained one or more very large, deep pits, comparable in size to Pit D.

The Upper Terrace

The Upper Terrace was the last area to be destroyed by the bulldozers and appears in the final photographs as a tiny grassy island in the midst of a scoria wilderness. Despite its late destruction, however, no notes or plans have survived and there are only a few photographs of the initial stages of work in this area. General views of the excavation indicate similar evidence here to what was encountered on the Upper Flat. In his interim report, Golson (1960: 34) described inter-cutting cooking pits immediately beneath a scoria rubble or gravel deposit similar to layer 3 on the Upper Flat. A circular pit 1 m wide and a large posthole were the only other features exposed at the time he was writing. Photographs suggest there was at least one sizeable infilled pit in squares H9 and H10. Kear (n.d.) described typical slope debris deposits in square I9; one photograph of I9 in the distance shows that these were of some depth.

Discussion

Despite the lack of detail about parts of the excavation, a general interpretation can be developed.

The earliest activity in the area seems to have included modification of the tihi above and to the southwest of the Upper Flat, with the resulting deposition of slope debris in squares G5 and G6 and probably also in square I9, and the burning of vegetation and deposition of rubbish on the unmodified ground surface in squares E5 and G5 (the early fill layers on the edge of the crater).

Then came the construction of the Upper Flat in its present form, by cutting the inner scarp at the edge of the crater, building its retaining wall, and digging the pits, which seem to have been designed as a group to fit on the newly defined area. The Upper Flat at this time extended an unknown distance to the north, and the shape and extent of the Lower Flat, if it existed at all, are unknown. The Lower Terrace and its pit may also have been constructed at this time.

The first of the pits to be partly filled may have been Pit D. It is likely that the other three were all abandoned at about the same time, and that a single fire accounts for the distinctive burnt layers in all the pits and outside the retaining wall in square G5. If so, there appears to have been some dumping of spoil over the scarp in the vicinity of square G5 before the fire and while three of the pits were still in use. However, if the ash zone at the bottom of the later fill deposits in square E5 is also part of the same fire, there was little or no dumping in that area before the fire.

Then followed a major dumping episode, during which all the pits were filled and large amounts of debris were thrown down the crater slope. The origin of this material must have been either the Lower Flat or, more probably, the higher points to the northeast and southwest of the Upper Flat. After the pits were completely filled, the surface was used for a few small fires and a little midden was deposited. Then a layer of largely sterile scoria was deliberately laid to form a new surface. Only a small amount of occupation took place on this surface – most noticeably the deposition of a small heap of shell midden in square F7.

Fig. 14 The 1965 excavations in Area B, high up on the crater rim. The principal tihi (citadel) is out of sight to the right rear (photo: Wilfred Shawcross and Anthropology Department, University of Auckland).

Unfortunately, the Upper Terrace and Lower Flat cannot be tied closely to this sequence. The only possible link between the Upper Terrace and the Upper Flat is the presence on the former of a scoria layer similar to layer 3 on the latter. However, it seems reasonably certain that the Lower Flat in its present form took shape after the construction of the Upper Flat and its pits, and certainly after the abandonment and infilling of Pit D. It is therefore possible that all the complex sequence of pit building on the Lower Flat, suggested by the deep deposits in the excavated squares in the centre of the flat and the presence of visible pits on the periphery, took place after the cessation of pit building and use on the Upper Flat.

Area B: the southeast part of the crater rim

In November 1965, Wilfred Shawcross directed the excavations on an extensive flat area of the crater rim between the middle and uppermost defensive ditches (B on Fig. 4). The flattened area extends for about 130 m northeast of the innermost ditch. It follows the curve of the crater rim, facing outwards towards the Tāmaki Estuary, and is backed by a bank along the lip of the crater. This flat is partially subdivided by

Fig. 15 The excavation in Area C on the crater rim in 1971. The large volcanic cone of Mt Eden/Maungawhau is visible on the skyline to the left (photo: Janet Davidson).

low, right-angled extensions from the bank, which do not reach to the outer edge of the flat.

A large area of this flat was laid out in squares and the turf removed (Fig. 14). In the majority of the squares, sterile scoria was found immediately beneath the thin topsoil. This extensive flat was probably formed by cutting back into the natural curve of the rim. Either it was an open space and perhaps assembly point on this high part of the site, or the site ceased to be used before any planned structures could be built. It is highly likely that the construction of this flat area destroyed earlier evidence of occupation in this part of the site, but it is possible that traces of earlier structures remain in the bank at the edge of the crater, which was not tested during the excavations.

Area C: the northeast part of the crater rim

A smaller flat area, lower down on the same part of the rim between the middle and lower defensive ditches (C on Fig. 4), was investigated under my direction over a period of 10 days in August 1971 and a further three days in August 1972. A varying number of volunteers took part (Fig. 15).

This area, designated 'the pit area' at the time, is not unlike the flat investigated by Shawcross in 1965, but on a much smaller scale. It is the first significant flat area after a fairly steep climb up a narrow stretch of rim from the present car park. The route would once have passed the group of pits, now destroyed, on the knoll just to the north of the Upper Flat in Area A. The lowest transverse ditch is now almost invisible; the flat on which the pit area is situated begins about 25 m up-ridge from it. It is a long terrace extending for about 70 m and, like the larger flat further up, it faces outwards over the outer slopes. The northern end, where the investigation took place, is right on the crater rim; there is an increasingly thick bank on the edge of the crater, from which one subdividing arm extends onto the terrace in the area investigated (Fig. 16). The only features visible before excavation were several depressions along the outer edge near the northern end. The largest exposure of shell midden recorded during the earlier mapping of the site was on the scarp immediately below this group of depressions.

The excavations were designed to sample the depressions on the outer edge of the flat, another depression a little further along the terrace, and the flat area abutting the edge of the crater and the beginning of the bank.

The pits

The row of depressions proved to be pits, as expected (Fig. 17). For the most part, they had been dug directly into

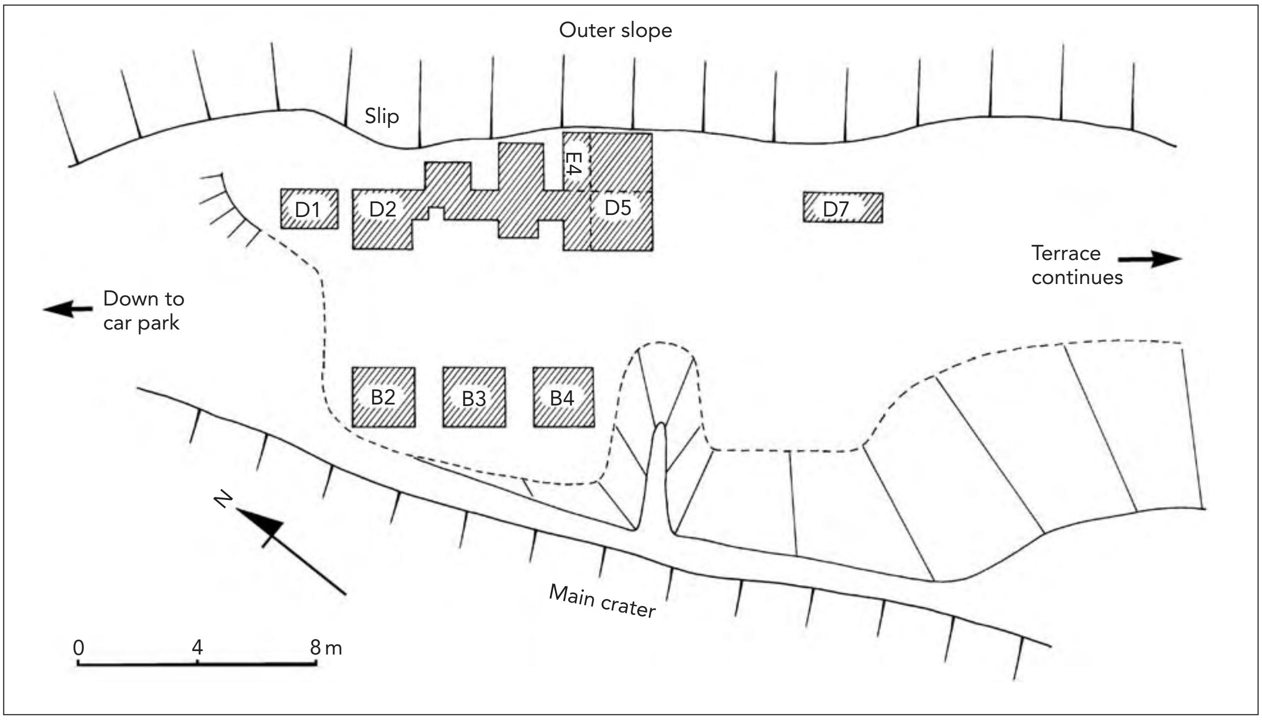

Fig. 16 Layout of the excavations in Area C in 1971 and 1972.

a natural reddish scoria and, although there were scatters of midden and stones and some smaller features on the surface between them, there was insufficient stratigraphy to demonstrate relationships between the pits (Fig. 18).

Pit 1 was a small rectangular pit with a well-preserved scoria-block facing on three sides and a bare natural scoria wall at the inner end. The quality of the facing was comparable to that in square G5 in Area A. The floor of the pit measured about 110 × 80 cm and its maximum depth would have been about 80 cm; the surviving facing was 70 cm high. No post-holes were found either in the floor or around the edges. The fill was a mixture of scoria, earth and midden, with more midden at the bottom and against the northwestern wall, and a very black lens at the top of the fill, just beneath the topsoil.

Pit 2 was longer and narrower, dug into the natural scoria on three sides but into fill layers towards the outer edge of the flat. It had a scoria-block facing along the wall nearest to Pit 1, but natural scoria walls on the other side and the inner end. The outer end was not established. It was probably at about the point where the facing on the side petered out; there was a concentration of stones at this point. However, the excavators followed the natural scoria wall on the other side into further midden layers. Pit 2 appears to have cut into, or been cut by, another pit or other feature in the relatively unstable fill deposits on the outer slope. The fill of Pit 2 was an undifferentiated deposit of scoria with charcoal and some shell; as with Pit 1, there was a blacker lens in the top of the fill beneath the topsoil, and several noticeable black patches were observed on the surface of the fill. A single small post-hole, 20 cm in diameter and 16 cm deep, was found in the floor. Assuming that the outer wall was near the end of the stone facing, the pit would have measured about 220 × 80 cm. The facing was only 50 cm high, but the depth of the pit from the original ground surface could have been about 70 cm.

Pit 3 was the largest and deepest pit, and the most eroded. Two quadrants were excavated in 1971 and the other two in 1972. The pit floor measured about 300 × 150 cm. Allowing for erosion of the edges, the depth from the original ground surface may have been about 110 cm. No postholes were found in the floor and there was no trace of a facing. The presence of a 30 cm-deep posthole in the top of one wall and the very eroded nature of parts of the walls raised the possibility that a superstructure had been supported on posts erected around the top of the pit rather than in the floor. The fill was divided into upper and lower portions by

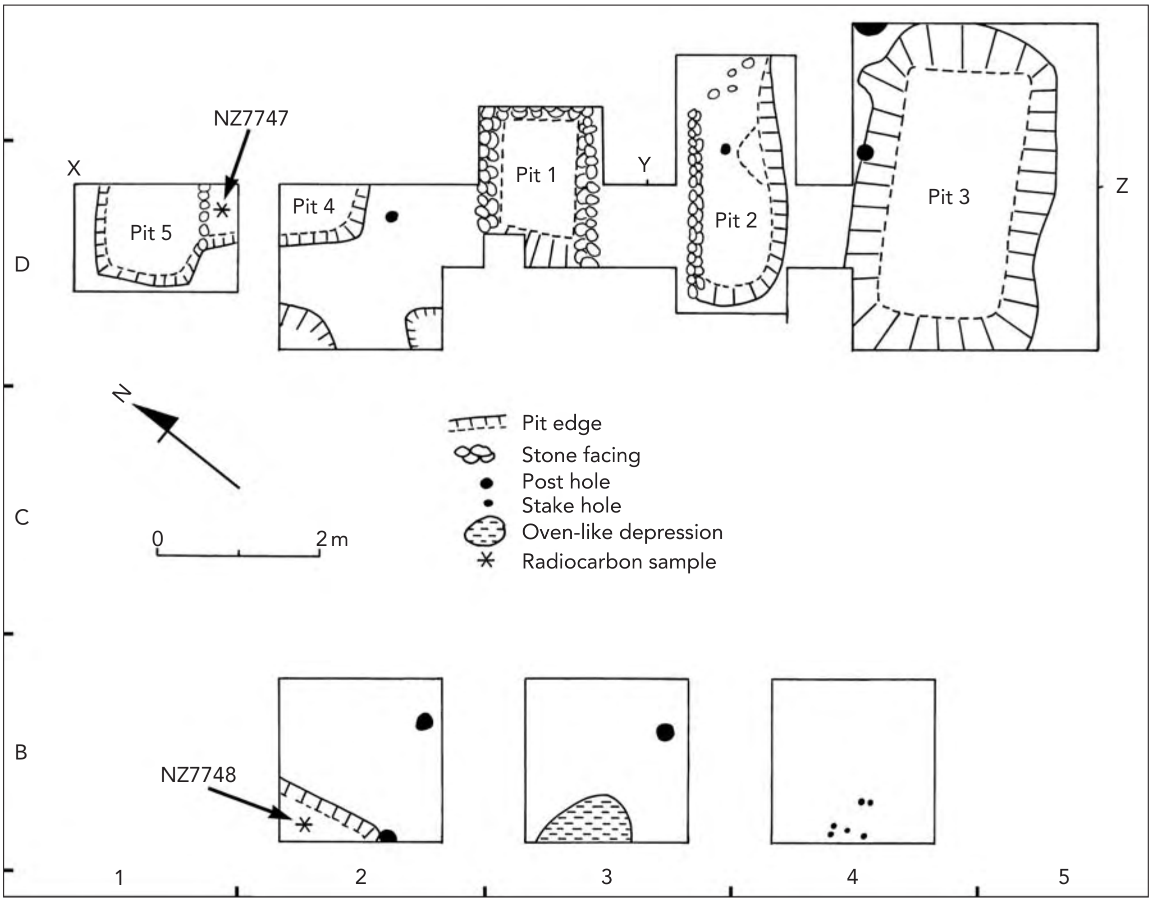

Fig. 17 Excavated features in Area C. The contexts of radiocarbon-dated shell samples NZ7747 and NZ7748 are shown.

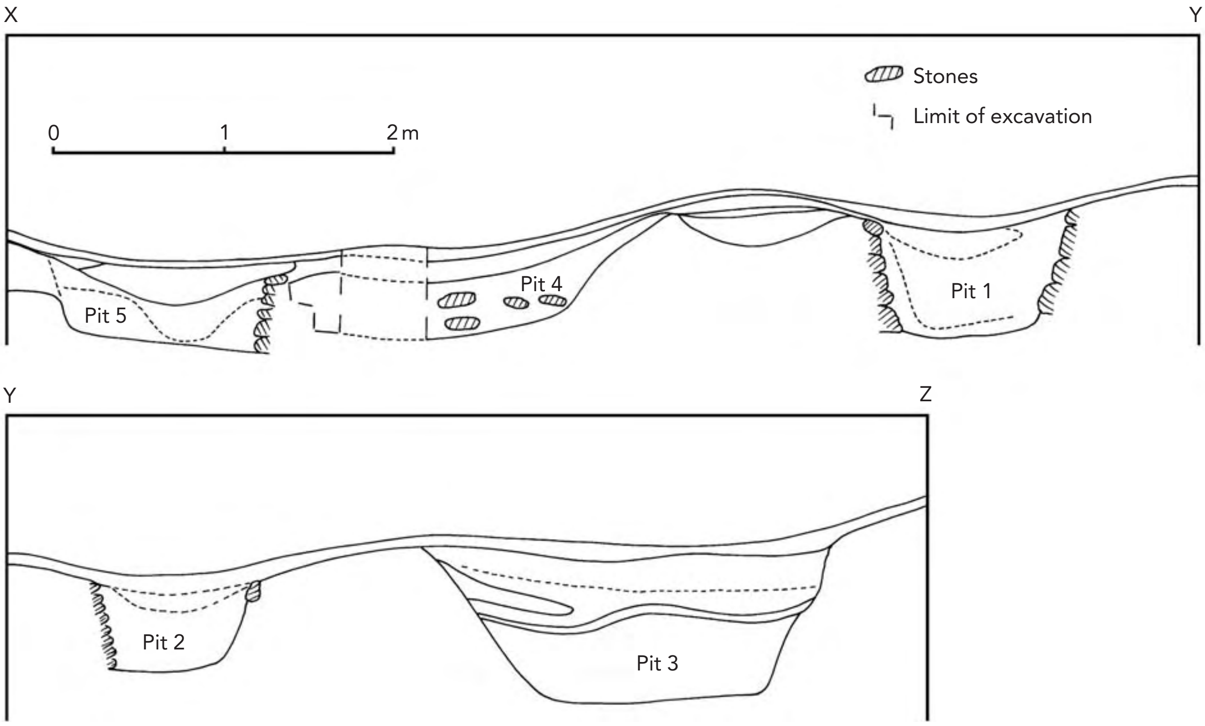

Fig. 18 Cross section through the pits in Area C (see Fig. 17 for X, Y, Z).

a wavy layer of ash and charcoal. The bottom fill was loose and contained a lot of scoria rubble; the top fill was also rubbly, with some shell in the upper part and considerably more shell and some fish bones in the lower part.

Pit 4 was a rectangular pit of undetermined length and width. It may originally have been about 80 cm deep although the existing fill was only 50 cm deep. The fill was very rubbly in square D2 but considerably finer, with more midden, in square D1. Shells from this part of the fill were used for the radiocarbon sample NZ7747. This pit was cut by the later Pit 5, which had a scoria-block retaining wall where the two pits intersected.

Pit 5 was dug into natural scoria on its inner end but into an earlier fill of loose brown scoria with occasional shell along the northern side. It was about 110 cm wide and may have been about 2 m long with an original depth of 60–70 cm. The bottom of the fill consisted of loose shell midden, stonier towards the retaining wall. Above this was a blacker layer with stones, and there was a thick lens of orange material (presumed to be redeposited volcanic ash) in the top.

At the conclusion of the 1971 investigation, Pits 1, 3 and 5 were refilled over plastic sheeting. In 1972, Pit 1 was re-excavated and Pit 3 reopened and fully excavated as part of a programme of interpretation of the features on the site. They have since partially refilled as a result of natural processes.

Other features

Contrary to expectation, no pits were revealed in the area of square D7 (Fig. 16). Black shelly soil was fairly continuous under the topsoil in the eastern part of the rectangle and filled some scoops and depressions to depths of up to 40 cm. In the northwestern corner, where the surface was slightly higher, compacted natural scoria was encountered immediately under the topsoil. There were no definite postholes, ovens or hearths.

Squares B2 to B4, where a cooking area or building might have been expected, were equally disappointing. On the inner side of squares B3 and B4, towards the crater, there was a thin layer of charcoal-stained scoria between the topsoil and the underlying natural scoria. This was associated with a group of small stakeholes in square B4 and a possible oven in square B3. There was also a single posthole in square B3.

In square B2, the charcoal-stained scoria was above a layer of brown fill about 20 cm deep; beneath this was another thin black layer representing an earlier occupation surface. This in turn covered a shallow pit or terrace feature, only a small part of which was exposed. This was filled with lenses of scoria rubble and shell, from which the radiocarbon sample NZ7748 was taken.

The only other features encountered were in square D2, where parts of two midden-filled depressions and a solitary posthole were uncovered.

Discussion

The majority of features encountered in this excavation were clearly associated with the construction and use of the flat area. Although there was more evidence of occupation here than on the larger flat investigated by Shawcross, it was still insubstantial compared with the complex deposits lower down the site, and could be considered a poor return for the energy that would have been needed to construct the flat in the first place.

Earlier use of this part of the site is indicated by vestiges of occupation at the north edge of the flat: the pit-like feature in B2 and the fill into which the north wall of Pit 5 was dug. It is likely that more extensive earlier deposits and structures were removed during construction of the flat and deposited, presumably, on the slopes below.

The principal activity on the terrace, as revealed by excavation, was the construction and use of the pits along the outer edge. This lasted long enough for Pit 4 to be replaced by Pit 5. The pits do not seem to have been accompanied by a significant amount of residential occupation. Although there are traces of cooking, this appears to reflect fairly limited activity rather than actual residence in the immediate vicinity.

The pit fills probably signal renewed construction activity somewhere in the vicinity, presumably slightly further up the rim. These fills are not pure rubbish dumps, but redeposited layers, which usually incorporate some midden. This dumping was not sufficient to fill the pits completely and their upper edges have eroded quite markedly. It can be assumed that no further significant activity took place on this flat area after the pits ceased to be used.

Area D: terraces on the northern slope

The main investigation in 1971–72 focused on the large terraces on the northern slope below the reservoir, which were due to be damaged by construction of the road down the mountain from the car park at the edge of the reservoir. The excavations here took place between 22 November 1971 and 15 January 1972, and were jointly directed by

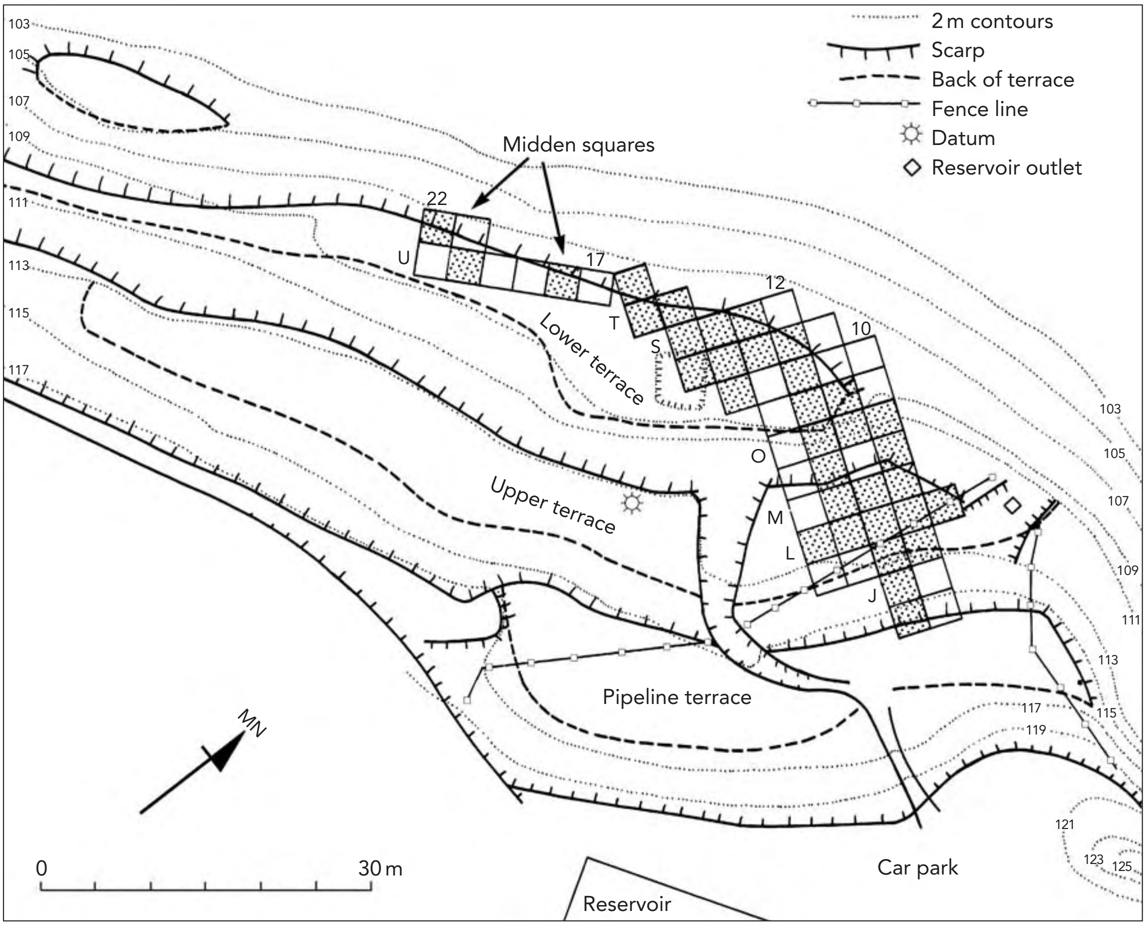

Fig. 19 Area D, excavated in 1971–72, showing terrace contours and excavation grid.

J.R. McKinlay of the New Zealand Historic Places Trust and the author. Two other people were employed full time and a varying number of volunteers also participated.

The two lowest terraces below the reservoir (designated the Upper Terrace and the Lower Terrace on Figs 6 and 19) did not appear to have been affected by reservoir construction or other recent activity, apart from the bulldozing of a path across the Upper Terrace, which had left some debris on the Lower Terrace. The Pipeline Terrace, on the other hand, appeared to have sustained some interference during reservoir construction. Mapping of the terraces by McKinlay in 1971 highlighted a remarkable feature – the surface of each terrace was almost exactly level from one end to the other. The only definite surface feature visible on any of the terraces in 1971 was a large rectangular pit near the centre of the broader northern part of the Lower Terrace.

The excavations concentrated on the northern ends of the Upper and Lower terraces and the outer edge of the Lower Terrace (Fig. 19), as these were the places most likely to be damaged by road construction. A 3 m grid was set out over the main excavation area; within this, 2 m squares were excavated, leaving 1 m baulks, in the expectation that deep

Fig. 20 The excavations in Area D in January 1972. The Upper Terrace is in the foreground, with part of the Lower Terrace visible in the centre and the Midden Squares to the left (photo: Janet Davidson).

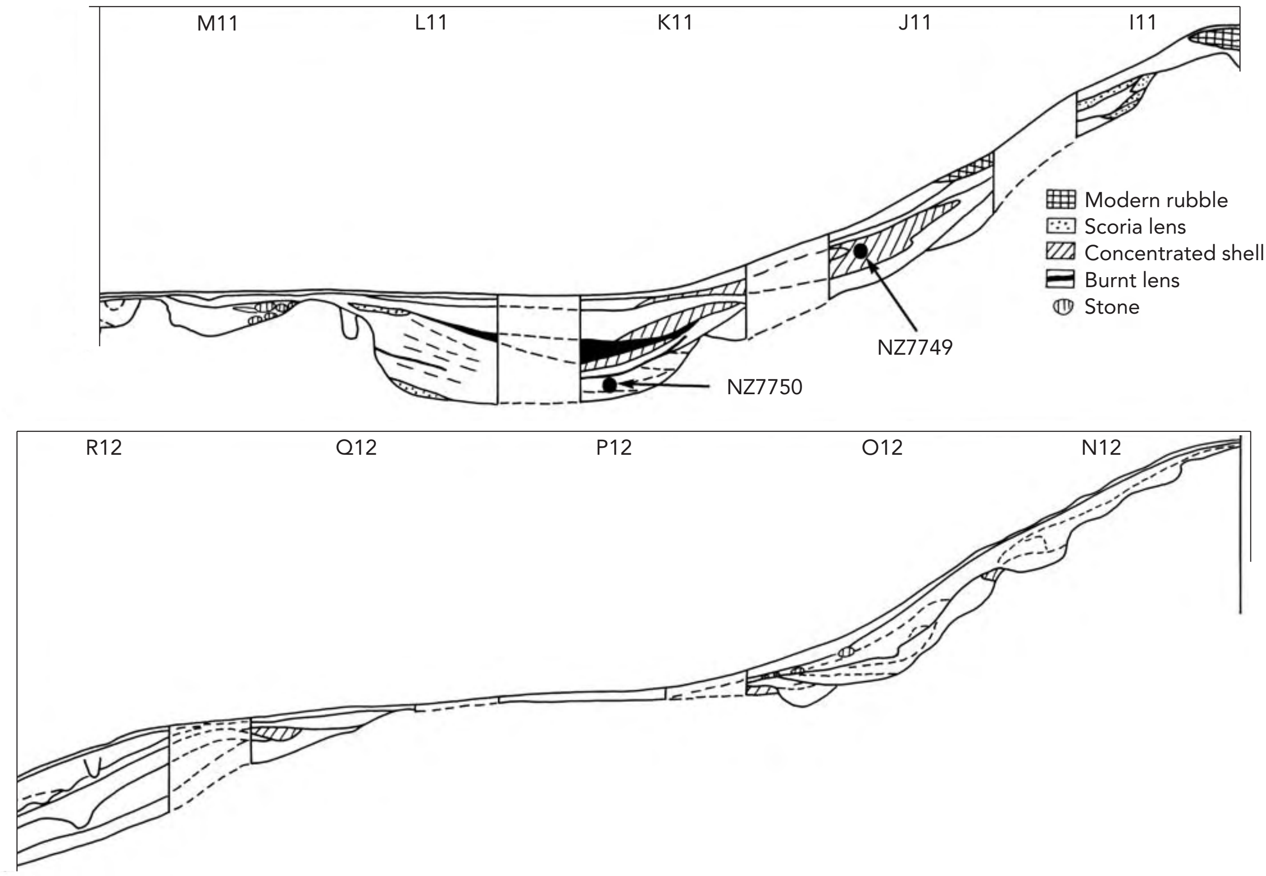

Fig. 21 The long cross section through the Upper and Lower terraces in Area D. The contexts of radiocarbon-dated shell samples NZ7749 and NZ7750 are shown.

stratigraphy similar to that found on the Upper Flat in 1960 might be encountered. Excavations began on the Upper Terrace, moving progressively down across the Lower Terrace and southwards to what became known as the Midden Squares (U18, U21 and V22) (Fig. 20).

Fig. 21 illustrates the long cross section across the two terraces. Both were formed by cutting back into the slope of the hill to form a flat surface backed by a scarp considerably steeper than the original slope of the hill. Pits and other features were then dug into this flat surface and in most cases refilled. Rubbish was cast down the scarps after they had formed and was also dumped into disused features on their surfaces.

Two factors complicated the excavations in this part of the site. First, the underlying natural material varied between cindery scoria and relatively soft, bright orange clay derived from volcanic ash. The change from scoria to ash occurred suddenly in the southernmost part of the excavation on the Upper Terrace, and similarly on the southern edge of the excavations on the Lower Terrace. Second, rabbits had caused considerable disturbance in some areas, particularly in the fills of pits.

The Upper Terrace

Much of the northern end of the Upper Terrace was a flat scoria surface in which numerous features had been dug and then filled (Fig. 22). The limit of this surface is shown by the dotted line running from square L9 through M10 and M11. North and west of this line, the terrace surface was built on a series of fill layers, mostly interpreted as slope debris deposited above the old soil that developed on the original scoria slope.

There was no trace of the original soil horizon or the slope debris layers in squares I11 and J11 on the scarp above the terrace. Most of the deposits on this scarp appeared to be relatively recent, ranging from modern rubble derived from the reservoir construction, to thick lenses of shell midden that appeared to post-date the infilling of a large pit on the terrace below. Shell from one of these lenses provided the radiocarbon sample NZ7749.

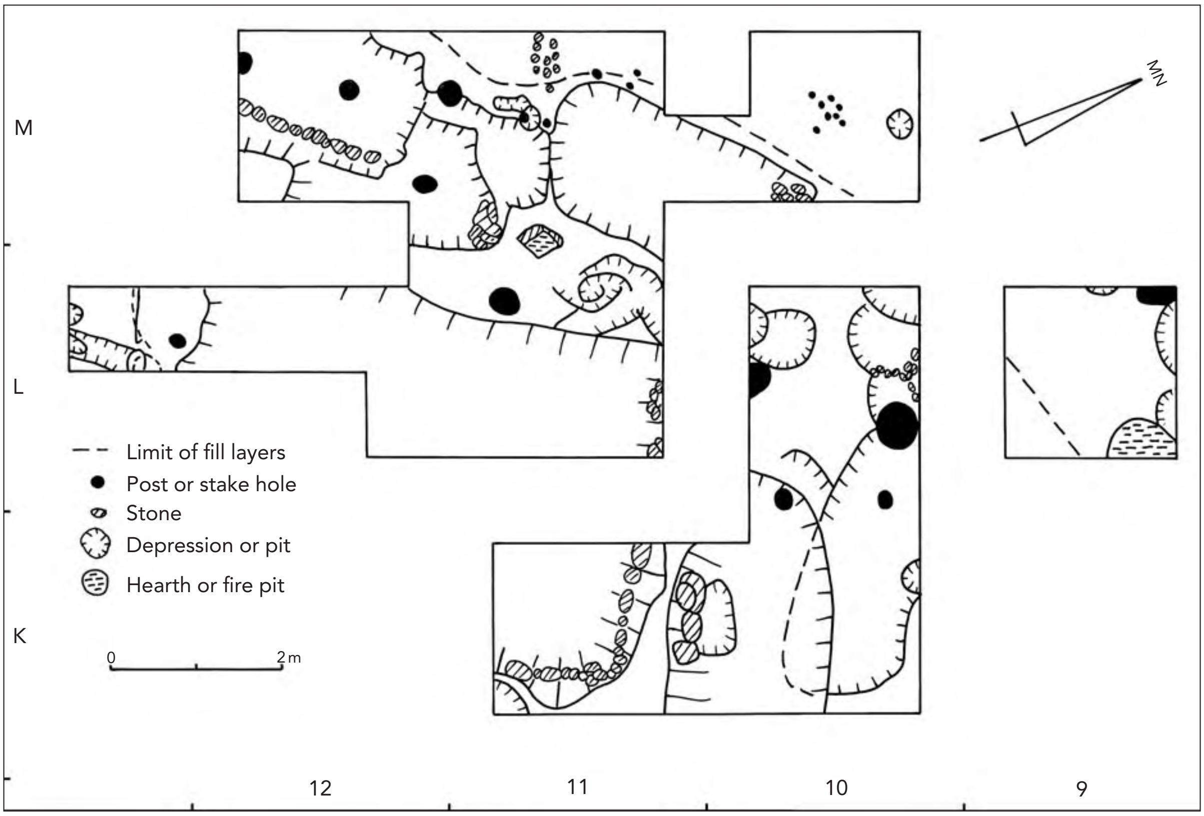

Fig. 22 Excavated features on the Upper Terrace in Area D.

An interpretation of the pits on the Upper Terrace is given in Fig. 23. The scoria surface was very crumbly and the edges of the pits badly eroded; intensive rabbit burrowing, particularly in Pits 4 to 7, had also helped to blur the relationship between different features.

Pit 1 was about 120 cm deep with a floor that measured approximately 550 × 350 cm. It had a partially intact scoria-block facing on the north and east sides; at its northwest corner, the wall was eroded and the fill layers lapped over into an amorphous feature, which in turn was cut through by a later posthole. The fill of Pit 1 is illustrated in Figs 21 and 24. It is clear that this large pit was filled progressively and perhaps over quite a long period from the south, with a series of layers of earth containing scattered midden, which presumably derived from activities further south on the terrace. There was a thick and distinctive burnt layer in the northern part of the fill, which was reminiscent of the burnt layer in parts of the 1960 excavation. Shells from beneath the burnt layer in square K11, which was nonetheless relatively late in the infilling of the pit, provided the radiocarbon sample NZ7750.

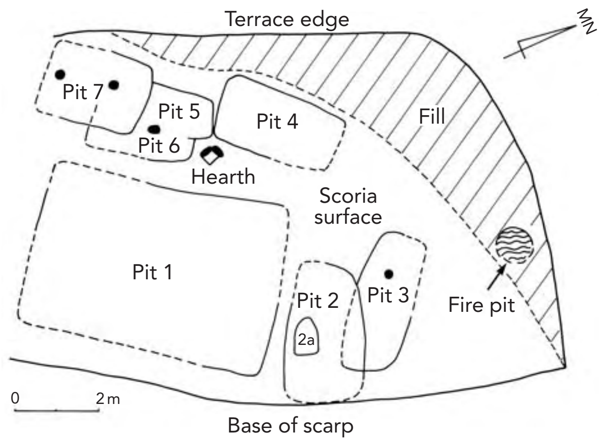

Fig. 23 Interpretation of the features on the Upper Terrace in Area D.

Although the south edge of the pit was established, it had been modified by the construction of a smaller, later pit whose extent was not fully traced in the fill of the larger pit. Several postholes and a slot-like feature in the natural ash surface immediately south of Pit 1 were considered possibly to belong to a building, perhaps a house, whose relationship to the pit was not established.

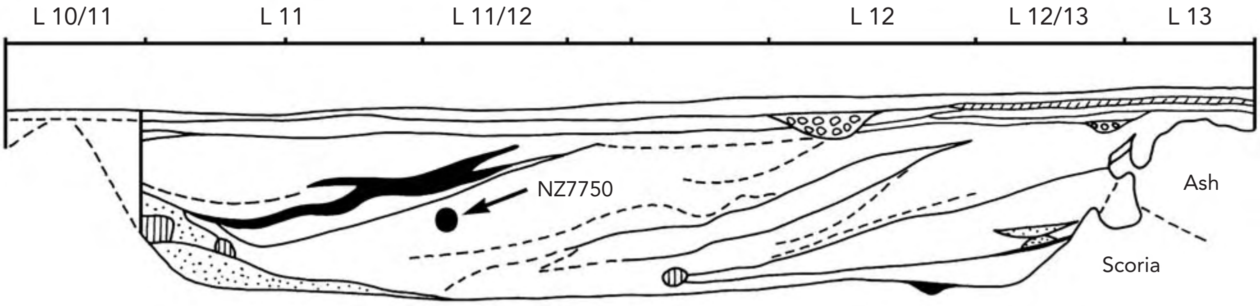

Fig. 24 Cross section through Pit 1 on the Upper Terrace in Area D. The approximate position of radiocarbon-dated shell sample NZ7750 in the stratigraphy of the pit fill is shown.

Pit 2 was about 60 cm deep and its floor was estimated to measure 280 × 130 cm. This pit was an irregular, rounded rectangle in plan, with a shelf-like feature beyond the west end. The fill contained an unusually large amount of fish bones.

Pit 2a was a bin pit dug through the floor of Pit 2 to a depth of about 25 cm. It is thought to have been dug from high up in the fill of pit 2.

Pit 3 was an oval, boat-shaped pit, about 55 cm deep. The floor was about 280 × 120 cm. It had one posthole, jammed with a large stone.

Pit 4 was about 90 cm deep with a floor area measuring about 250 × 120 cm. It had an intact scoria-block facing at the north end and traces of a collapsed facing at the south end. No postholes were found in the floor. The fill was a series of layers of earth and scoria with scattered midden.

Pit 5 was 50 cm deep. Its floor was only about 70 cm wide and its length unknown; it may have been a bin pit of square rather than rectangular plan. The small area of floor remaining was quite uneven.

Pit 6 was about 70 cm deep with a floor measuring about 200 × 120 cm. It had a complex fill of earth, scoria and midden. One posthole was found in the floor.

Pit 7 was about 100 cm deep. The floor was about 120 cm wide and its length was probably 250 cm. In the southwest corner it had been dug partly into fill layers above the old ground surface; elsewhere it had scoria walls, with an intact scoria-block facing on the east side. The fill was brown earth with midden, interrupted in the middle by a layer of scoria rubble and shell. There were two postholes in the floor.

The nature of the stratigraphy and the interference of rabbits made it difficult to determine the relative ages of the pits. Pit 3 was clearly later than Pit 2, but the relationship of Pit 2 to Pit 1 was not established. It was thought that Pit 4 was probably later than Pit 5, and Pit 7 later than Pit 6. During excavation, it seemed that Pit 5 was later than Pit 6. However, it later became apparent that ash from the hearth near the intersection of Pits 5 and 6 extended over the top of the fill of Pit 5 but ceased at the edge of Pit 6. The alignment of the pits can also be considered in proposing a sequence. In this case, Pits 4, 7 and 1, and possibly 3, might form a planned arrangement.

It is suggested that Pits 5 and 2 may be the earliest features, followed by the hearth. This consisted of two stones set at an angle, partly enclosing a thick rectangular patch of ash, and surrounded by more scattered ash. Possibly associated was the posthole to the southeast. If this hearth was in a building, all other postholes have been destroyed by later pit construction. Pit 6 was the next to be built. Last was the main group of 4, 7, 1 and, perhaps, 3. The pits on the outer edge of the terrace seem all to have been filled rapidly and covered over with a deliberately laid scoria-rubble surface. Pit 1 may have taken longer to fill.

Even later in date would be the small pit cut into the southern end of Pit 1. The relationship of the possible building in this area to the pits is not known.

Other features on the Upper Terrace are either late, or cannot be related to the pit sequence. They include the definite fire pit on the very edge of the terrace, various scoops and depressions filled with dark soil and midden in the terrace surface, postholes and stakeholes along the western edge, two postholes towards the centre, and two scatters of burnt stone – each the equivalent of a kete (basket) full – in squares M11 and L10. The presence of a small hāngi just below the topsoil above the fill of Pit 1 (Fig. 24) should also be noted.

A large posthole in square L10 and a smaller one in the baulk between squares K10 and L10 (dug into the fill of Pit 2) were post-European. One contained a concrete post.

The Lower Terrace

The Lower Terrace was formed, at least at its northern end, in the same way as the Upper Terrace: by cutting back into the natural slope to form a flat surface backed by a steep scarp. By the time this terrace was built, there was already a considerable build-up of slope debris layers above the original ground surface, following the original slope line, and these layers were truncated as part of terrace formation (Fig. 21). Only the uppermost deposit on the slope below the terrace in square R12, for example, may have been laid down at the time of terrace formation or during the life of the terrace. These earlier slope layers also formed the bulk of the deposits in squares S13, S14, T15 and T16. The extent of the scoria surface is shown in Fig. 25.

The original base of the scarp at the back of the terrace was identified in squares O11 and O12, and it was apparent that quite a lot of material had been thrown down the scarp from the Upper Terrace after the Lower Terrace was constructed (Fig. 21).

On the northeast tip of the terrace, the original scoria surface was covered by a very shallow topsoil. The only significant features here were the remains of a burial and a large posthole, 60 cm deep, with packing stones in the bottom (Fig. 25).

The burial had apparently been placed in a small pit, 75 × 65 cm in plan and about 65 cm deep. The body is thought to have been in a crouched position with the head to the east and the feet to the west. The pit was reopened at some time by means of an extension on the south side. Most of the bones were removed, leaving only the radius and ulna of one arm and most of the bones of one foot, which had all been hard up against the walls of the original pit. At the time of excavation, the burial pit had an upper fill, about 40 cm deep, of dark grey-brown earth in which some small pieces of obsidian were found, and a lower fill of soft orange-brown earth and white sandy grains. There were extensive traces of kōkōwai (red ochre). A very small bone needle or pin was found between the arm bones. These remains were taken to Dr Ranginui Walker of the Auckland District Māori Council to determine reburial by the appropriate people. No study of them was undertaken.

To the south of this open area of terrace was a group of pits. Two had been completely filled in; the third was the large pit visible on the surface, which had been only partly filled.

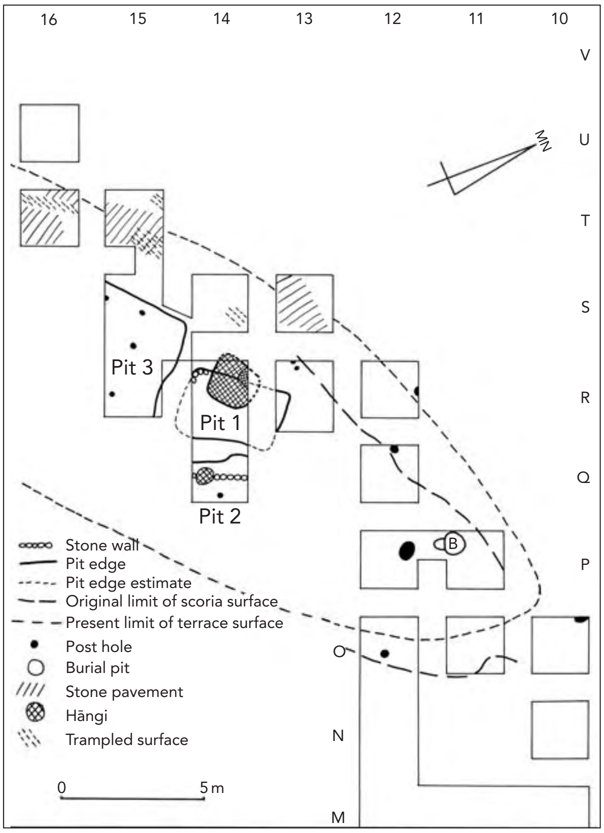

Fig. 25 Excavated features on the Lower Terrace in Area D.

Pit 1 was about 100 cm deep with a floor of about 300 × 180 cm. It had an undifferentiated fill of earth and stone, with a lens of charcoal near the bottom. Traces of scoria-block facing were found in the southwest corner. No postholes were located in the floor.

Pit 2 was only partly exposed and its dimensions are unknown. It was only about 80 cm deep but its floor was clearly considerably more than 200 × 100 cm. It had a scoria-block facing all along its west wall, quite some distance out from the natural scoria face. During excavation it was assumed that there was only one pit, with the facing constructed well out from the pit wall and the gap then filled with rubble. On reflection, however, it seems possible that there were two pits: an earlier shallower one, with a natural scoria wall; and a later deeper one, with a stone retaining wall set into the fill of the earlier pit. One posthole was found in the floor of this pit.

Pit 3 was the large pit visible on the surface. Because it had not been fully filled, its walls were very eroded and its actual dimensions accordingly difficult to establish. It may have been between 450 cm and 600 cm long and about 100 cm

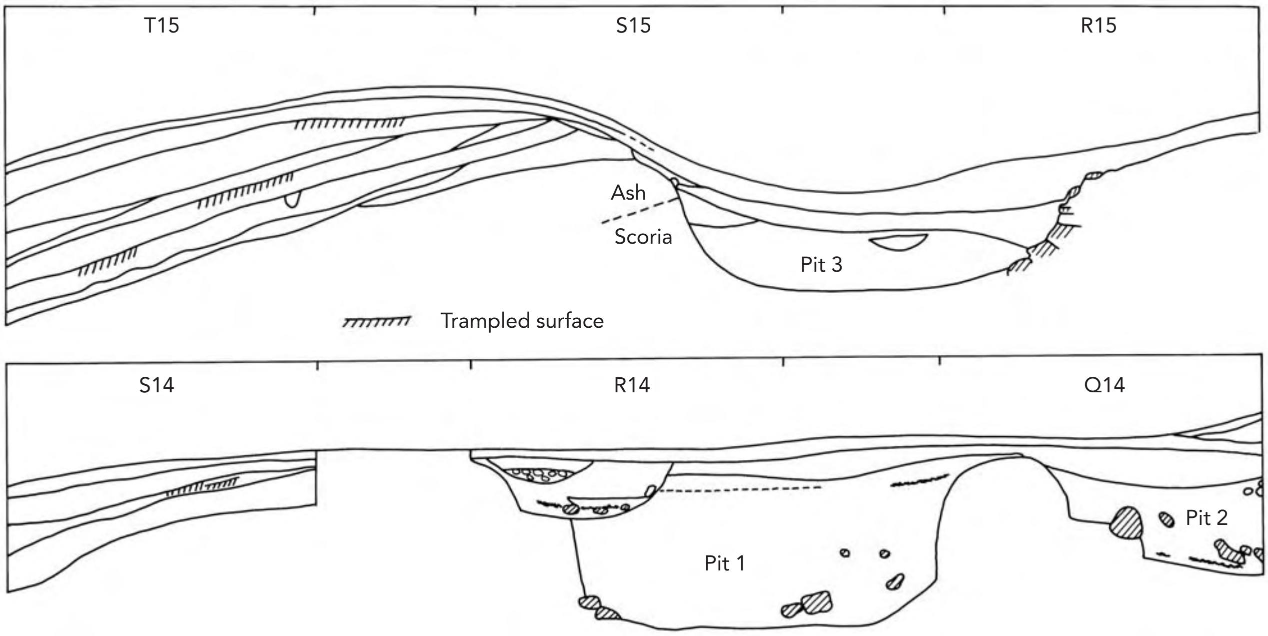

Fig. 26 Cross sections through features on the Lower Terrace in Area D and the slope below. Note the hāngi features above Pit 3 and the trampled surfaces in both slope areas.

deep. Well-preserved postholes were found in this pit. The two at the base of the west wall were 45 cm and 30 cm deep, and the two away from the wall 30 cm and 35 cm deep. There was also a stakehole, more than 30 cm deep but only 8 cm wide, which was not aligned with the posts.

Because it was left unfilled, Pit 3 appears to have been the most recent feature on the terrace. It is possible, however, that all the pits were constructed at the same time, and that Pits 1 and 2 were deliberately filled to provide a flat surface for other activities whereas Pit 3 was not. The same brown earth deposit covered and sealed Pits 1 and 2.

Evidence of cooking activity was quite widespread on the Lower Terrace and seemed to have taken place at various times. Early evidence of cooking was a hāngi dug into the natural scoria surface of the terrace in square O12 beneath the subsequent build-up of rubbish layers on the scarp. Another possibly early example was a scoop depression dug through the lower slope debris layers in the west of square S14. There was also evidence of cooking in square Q12. The main concentration, however, was on top of the pits, both on the surface covering Pits 1 and 2, and in the upper part of the fill of Pit 3. This appears to represent the very last activity on the terrace. A large hāngi had been dug into the western wall of Pit 1 (Fig. 26); there was a small one dug into its fill, another in the top of the fill of Pit 2 and another in the fill of Pit 3. Much of the fill of Pit 3 was a dense black hāngi-derived deposit.

Isolated postholes were found in various places but there was no evidence of any actual buildings. The postholes in squares O12, Q12 and R12 were all about 30 cm deep. A much larger hole in the northwest corner of square O10 appeared to be a modern disturbance and not a possible candidate for a palisade posthole.

A notable feature of the Lower Terrace was a series of surfaces in squares S13, S14, T15 and T16 (Fig. 26). The most recent of these was a stone or rubble pavement just below the topsoil (Fig. 25). In some places this was a dense layer of small stones, and in squares S13 and T16 it was bounded by a deliberately laid row of much larger stones on the outer edge. In other places the stones were more scattered; it was not possible to identify the pavement with any certainty in square S14.

On top of the layer below the pavement in squares T15 and T16 (and the equivalent layer in square S14), a hard, trampled surface was identified. In square S14, two similar surfaces were found, one above the other near the top of the same layer. In square T15, similar trampled surfaces were found on two earlier layers (Fig. 26).

It seems likely that these trampled surfaces represent paths along the outer perimeter of the terrace and, indeed,

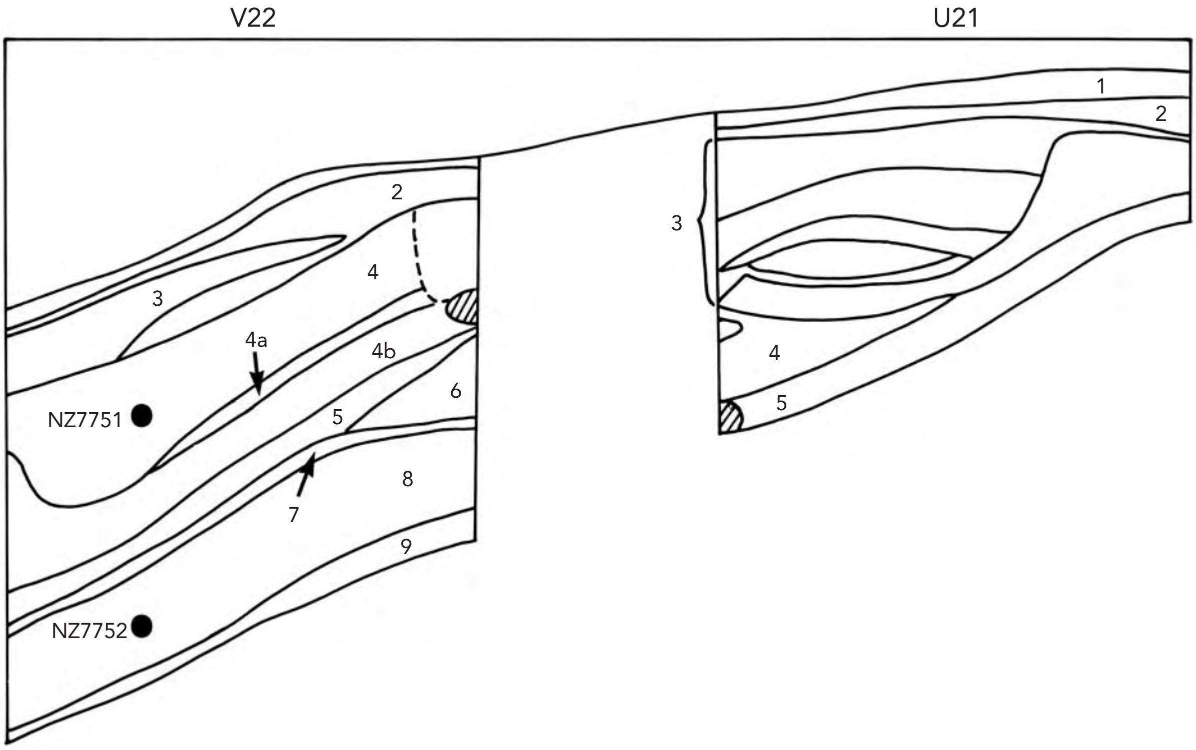

Fig. 27 Cross section through the Midden Squares in Area D (the north face of square V22 and mirror image of the south face of square U21). The contexts of radiocarbon-dated shell samples NZ7751 and NZ7752 are shown. The layers are as follows. Square U21: 1, turf; 2, brown earth with yellow granules; 3, variable fill – from top, grey-brown earth with shell, similar with less shell, rubbly, ashy, earthy; 4, brown earth with scattered shell; 5, rubble. Square V22: 1, turf; 2, grey-brown earth with shells; 3, large scoria rubble; 4, fine earth with much broken and scattered shell, a, more granular, b, less shell; 5, rubbly with many whole shells; 6, heavy rubble; 7, black ashy earth with dense broken shell; 8, loose lenses of shell and rubble; 9, stony rubble.

the site at various times. The presence of three such surfaces at different levels in square T15 is particularly important, since it suggests that the slope debris layers accumulated gradually and not as a result of one frantic period of activity. Only the uppermost trampled surface and the stone pavement were contemporary with the construction and use of the Lower Terrace. The presence of earlier trampled surfaces suggests, however, that there was a well-used route along this part of the site over a longer period.

The Midden Squares

The three squares to the south of the main excavations on the Lower Terrace (U18, U21, V22), together with square U16, revealed deep deposits of loose scoria rubble and midden (Fig. 27). In squares U16 and V22 these deposits simply followed the original line of the slope. In squares U18 and U21, however, the lower layers followed the slope but the upper layers built up the surface to its present almost flat appearance. In these two squares, the dumping may have taken place over a short period, to provide the flat surface around the perimeter of this part of the site. Shells from two successive midden layers in square V22 provided the radiocarbon samples NZ7752 and NZ7751.

Discussion

In considering the formation and use of the terraces in this part of the site, Kear's (n.d.) distinction between slope debris and man-made deposits is useful. In most of the squares around the periphery of both terraces, the original scoria slope was covered with a sterile soil that presumably represented the pre-occupation ground surface. On top of this in most areas were what appeared to be slope deposits – predominantly earth and scoria with only occasional shell fragments. Deposits of this type were found to the north of the terraces in squares L9, N10 and P10, as well as along the western side of the Lower Terrace. These deposits presumably represent human activity higher up the hill before the terraces were constructed. The trampled surfaces on several layers in square T15 and the presence elsewhere of burning on the surfaces of various slope layers suggest that a number of episodes of earthworking higher up the mountain gave rise to these slope debris deposits. Only the uppermost deposits in these squares and the deposits on the scarps between the terraces appear to be truly man-made deposits, in each case probably cast down from the terrace immediately above.

The Midden Squares, on the other hand, contain layers more closely resembling man-made deposits, cast down from somewhere fairly close at hand, partly, at least, to build up the surface of the terrace.

It does not seem likely that the Lower Terrace could have been constructed before the Upper Terrace. If it had been in existence when the Upper Terrace was constructed, it would have received spoil from the construction activities above. There is no clear evidence as to whether the two were built simultaneously, or whether the Upper was built first. The large amount of scoria that must have been derived from digging the Upper Terrace and its pits is not identifiable on or around the Lower Terrace, but nor is the material derived from the digging of the Lower Terrace apparent on its outer edges. It is likely that whatever the order of building, the Upper, Lower and Pipeline terraces were in use at the same time.

Of the various domestic activities that might be expected, storage is the best represented, followed by cooking, with dwelling, as usual, most difficult to identify. It is possible that there was a house on the Upper Terrace, represented by the hearth, before the main phase of pit construction. There may also have been another house, of indeterminate age, south of Pit 1. However, no concentrations of portable artefacts were found in either area to support these possibilities. There was no evidence of houses on the excavated part of the Lower Terrace.

The presence of the largely exhumed burial on the Lower Terrace was unexpected. The large post nearby may have been associated with it, marking it in some way. The proximity of cooking activities is surprising. Although the main concentration of cooking above the filled pits may have taken place after the burial was removed, there was an early hāngi close by, in square O12, and further cooking activity of uncertain age in square Q12. These associations suggest a more relaxed approach to burials than would now be tolerated. It is also possible, however, that the burial and its exhumation took place at a time when the terrace was unoccupied and no memory of its use for cooking was retained.

No evidence of fortification or even fencing was found on either terrace. It is fairly evident, however, that the Lower Terrace was an important thoroughfare over a long period, with trampled paths eventually being superseded by a stone-paved surface. It is perhaps not surprising that these paths were in roughly the same place as the modern road down the mountain.

Area E: garden area on the western side

The so-called 'garden area' is on a protrusion at the base of the mountain, extending to the western boundary of the Domain, beyond which quarrying has destroyed a large part of the lava field. There are known to be one or more lava tubes in this area and it is possible that one runs under the centre of the protrusion.

The only obvious surface features are two low stone walls (one running east to west across the middle of the area and the other along the northern edge) and a small area of terrace or pit construction immediately to the southeast of the central wall. The lower flattish area just to the north also has some possible stone wall features but these have been disturbed by pipelines associated with the reservoir. In August 1971, a line of squares (row M) was opened along the proposed route of the new road down the mountain, which ran across the middle of this presumed garden area. These squares were designed to section the two stone walls and sample the area between them (Figs 28 and 29). The excavation overlapped with the excavation of Area C on the crater rim and lasted for nine days.

One of the problems in this area, as in other parts of the site, was the variability of the natural surfaces on and in which cultural features had been constructed. It became apparent that scoria was close to the surface under both the stone walls but dipped in the area between them, forming a natural hollow in which clay derived from volcanic ash had accumulated. Pit construction was easier and pit walls were more stable in this intermediate area.

Stratigraphy throughout this area was simple. Under the topsoil was a very stony soil, varying in colour from black to brown. This overlay the natural scoria or clay, which in places were a fairly bright orange or yellow colour. Various cultural features were identified in the squares but, in marked contrast to Areas A, C and D, there were no midden deposits.

The walls

The stone wall on the northern edge of the garden area consisted of a dense concentration of fist-sized and smaller stones sitting on top of the brown soil, presumably on the old ground surface (Fig. 30). There appeared to be no

Fig. 28 The excavation in Area E in 1971. The more prominent of the low stone walls is visible running along the naturally raised area through the upper excavated squares (photo: Janet Davidson).

structure to the wall, at least in the excavated part. In the southeast of square M3, extending into M4, a charcoal-stained surface at the same level as the base of the wall covered the fill of a pit-like feature spanning the two squares.

In squares M9 to M11, the natural scoria was close to the surface and in places quite hard. The central stone wall had been built along the line of a natural hump in this ground surface. It appeared to have been constructed by laying two parallel rows of large stones and heaping smaller stones between them (Fig. 31). The stony soil in squares M10 and M11 was noticeably blacker in the vicinity of the wall and browner away from it.

Other features

The pit-like feature in squares M3 and M4 had well-preserved walls and a rather uneven scoria floor. No postholes were found in the exposed part. Assuming that it was a pit rather than a ditch, it could have measured about 300 × 140 cm. The depth from the original ground surface would have been about 70 cm. Four distinct postholes,

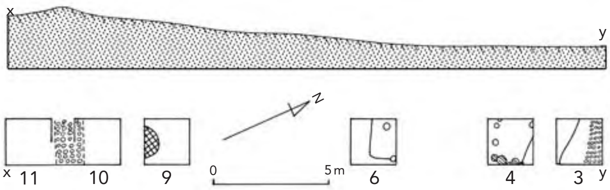

Fig. 29 The excavation in Area E. The cross section X–Y shows the ground surface. A stone wall runs along the highest part.

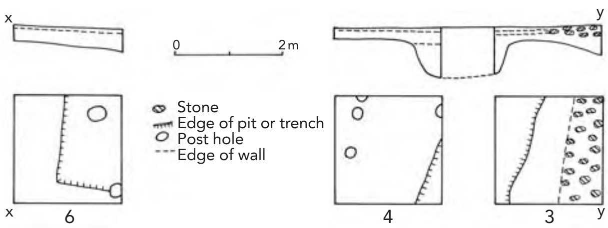

Fig. 30 Features in the northern part of Area E.

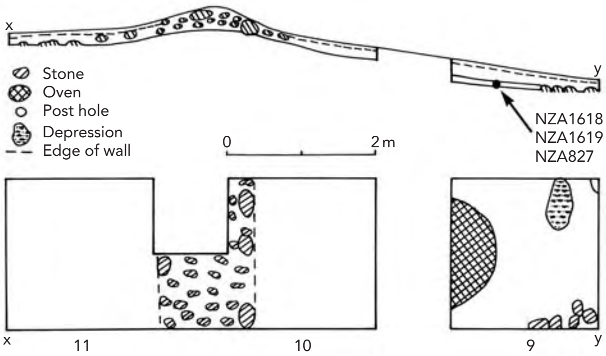

Fig. 31 Features in the southern part of Area E, which sectioned the stone wall that runs on top of a natural ridge. The context of the radiocarbon-dated charcoal sample, which gave the results NZA827, NZA1618 and NZA1619, is shown.

ranging in depth from 20 cm to 40 cm, were the only other features in square M4.

Part of a larger pit was the only feature in square M6. This had near-vertical walls and a smooth, apparently trampled floor with one large (50 cm-deep) posthole. There was also a well-defined wall slot in the eastern wall. If this slot was in the centre of the end wall, the pit would have been about 2 m wide. The depth was between 90 cm and 100 cm. There was a hearth-like depression in the surface of the brown soil above the pit fill.

The only cultural features in square M9 were a possible posthole in the northwest corner and a large, shallow hāngi pit in the southern half of the square. In the surface of the natural scoria were a number of shallow, amorphous holes, which did not appear to be cultural in origin. Charcoal from this square provided the radiocarbon sample that gave the determinations NZA827, NZA1618 and NZA1619 (Fig. 31).

Discussion

This area is today quite exposed to the wind, which throws some doubt on its usefulness as a garden. However, it is possible that it was used for gardening at an early stage in the occupation of the site, when there may have been trees in the immediate vicinity to provide shelter. The soil is so stony throughout that the walls can hardly have been the result of stone clearance; they are best interpreted as boundary walls. The noticeably darker soil in the vicinity of the walls may reflect the additional use of brush fences or windbreaks, or some other heaping of organic material.

The most striking feature of Area E is the almost complete absence of occupational debris. Two weathered shell fragments and one fish spine were collected during excavation and there was no refuse to indicate what had been cooked in the hāngi in square M9. The two pits appear to have been dug, used and then refilled with material derived from the digging of other pits in the vicinity; at no time was occupational debris available in the vicinity for dumping into the pits. The excavated sample is too small to permit any estimate of how many pits are in this area; only two possible pits are now visible on the surface.

In view of the special position of this area, isolated between the occupied parts of the cone and the more extensive garden areas below, it may not be too fanciful to ask whether this was a special garden area, perhaps associated with garden rituals.

Subsequent investigations on the northern slopes

In February 1972, road construction down the northern slopes exposed a thick fill of shell and redeposited soil, scoria and rubble running along the slope from square U16 on the Lower Terrace in Area D to a small terrace immediately to the west of the Midden Squares, which was effectively destroyed by the roadworks. A burial was disturbed in this area, exposing bones representing parts of a leg, arm, hands and feet. In 1983, further human remains were found to be eroding in the same area (Coates 1984). It seems likely that this was the remainder of the previous burial, as the bones from the two exposures can be accounted for by one individual (stone edging at the front of the hole from which the bones were eroding in 1983 might have been put there by the bulldozer operator in 1972).

In 2008, a small excavation was carried out well below the road on the northern slopes, at a point where it was intended to join a new pipe to the existing pipes from the reservoir, which are buried on the slope. The excavation was mainly in the fill from the original pipe-laying, but traces of slope wash including midden were also found (Foster 2008).

Chronology

The chronology of occupation on Maungarei, based on radiocarbon dates, was discussed in an earlier paper (Davidson 1993). The contexts of the samples are discussed in the account of the excavations, above, and shown on Figs 12, 17, 21, 24, 27 and 31.

There are 11 radiocarbon dates in all. Charcoal sample NZA827 produced a large standard error (the CRA was

Table 1 Radiocarbon determinations for Maungarei (Ch1, charcoal no information on species; Ch2, charcoal selected by Rod Wallace; Sh, marine shell).

	Lab. no.	CRA	$\delta^{13}C$	Sample type	Probability	Cal BP range
Late Horizon	NZ7747	526 ± 50	+0.8	Sh	68.2%	260–80
					95.4%	275–0
Middle Horizon	NZ7748	668 ± 50	+0.2	Sh	68.2%	410–260
					95.4%	470–140
	NZ7749	655 ± 50	+1.0	Sh	68.2%	410–250
					95.4%	460–130
	NZ7750	685 ± 50	+0.9	Sh	68.2%	420–270
					95.4%	490–190
	NZ7751	674 ± 50	+0.4	Sh	68.2%	410–270
					95.4%	480–180 93.8%
					95.4%	170–140 1.6%
	NZ7752	732 ± 50	+0.5	Sh	68.2%	440–310
					95.4%	500–260
Early Horizon	NZA1618	403 ± 49	-26.7	Ch2	68.2%	500–430 34.8%
					68.2%	410–390 4.0%
					68.2%	380–320 29.4%
					95.4%	500–310
	NZA1619	383 ± 54	-26.4	Ch2	68.2%	490–430 21.2%
					68.2%	410–320 47.0%
					95.4%	500–300
	NZ8127	391 ± 44	-26.7	Ch2	68.2%	490–430 29.9%
					68.2%	410–320 38.3%
					95.4%	500–310
	NZ404	509 ± 40	—	Ch1	68.2%	500–455
					95.4%	510–440 80.6%
					95.4%	360–330 14.8%

230 ± 110, $\delta^{13}C$ = -25.72). When this was queried, two new runs of the sample were undertaken (NZA1618 and NZA1619). The laboratory then advised that the initial result (NZ827) should be disregarded and the other two (NZA1618 and NZA1619) taken as a more acceptable indication of the age of the sample (R. Sparks, pers. comm. 1990). The conventional radiocarbon ages are given in Table 1, together with the dates corrected for marine reservoir and secular effects in years Cal BP using the OxCal program (Bronk Ramsey 2005). The SH04 curve was used for the terrestrial sample (Reimer *et al.* 2009), and Marine09 for the marine samples with a value of ΔR of -7 ± 45 years (McCormac *et al.* 2004). The age ranges are presented in Fig. 32.

The five shell dates for the Middle Horizon and three of the four charcoal dates for the Early Horizon were

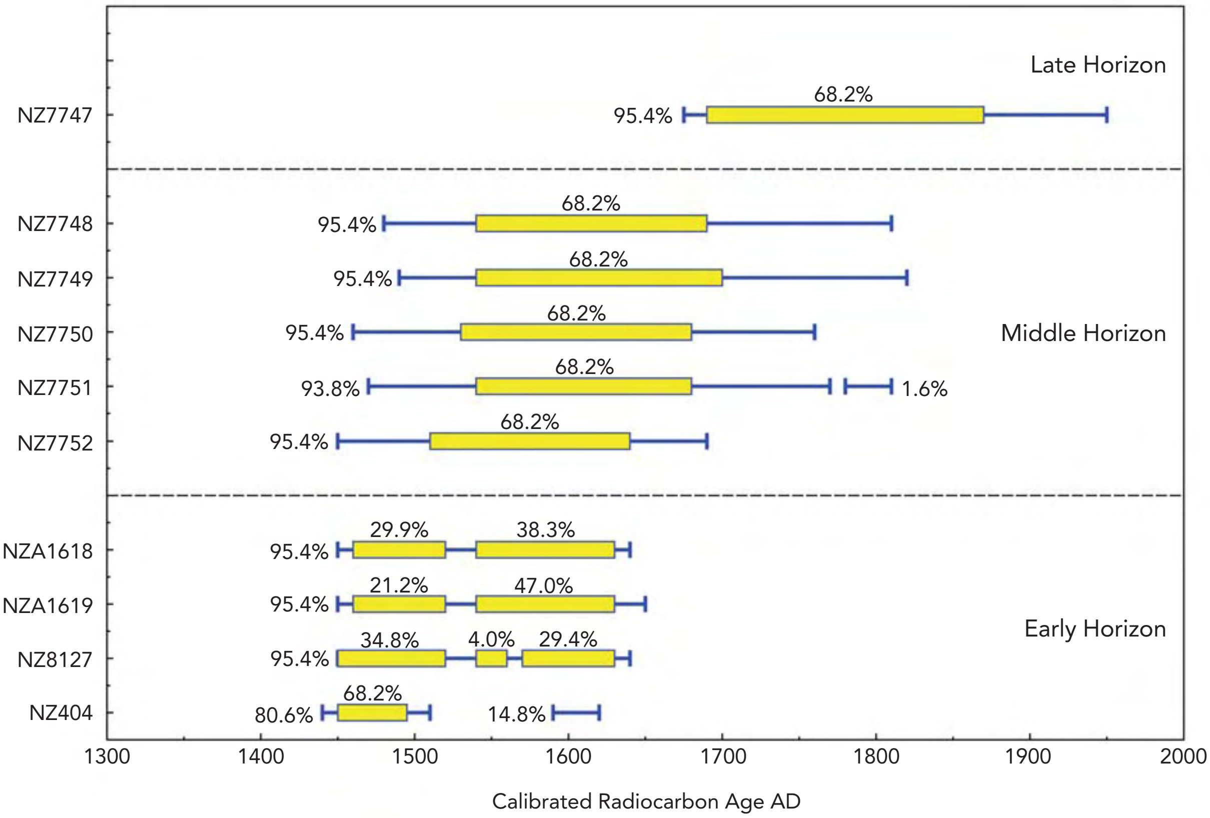

Fig. 32 Maungarei radiocarbon dates in years Cal AD after secular correction and calibration using the OxCal program (Bronk Ramsey 2005). The SH04 curve was used for the terrestrial samples (Reimer *et al.* 2009) and Marine09 for the marine samples with a value of ΔR of -7 ± 45 years (McCormac *et al.* 2004). The dates are grouped into three time horizons.

satisfactorily pooled using the OxCal program to give an overall age assessment for each of these two horizons. The date obtained on charcoal by Golson (1961) could not be included as the charcoal was unidentified and the $\delta^{13}C$ was not measured. However, its context was identical with that of the sample dated as NZ8127. There is only one date for the Late Horizon.

The 68.2% probability ranges are:

Late Horizon AD 1690–1870
Middle Horizon AD 1580–1660
Early Horizon AD 1460–1510 (34.6%),
AD 1560–1620 (33.6%).

Extending the ranges to the 95.4% probability gives:

Late Horizon AD 1675–1950
Middle Horizon AD 1540–1680
Early Horizon AD 1450–1630.

The three horizons warrant some explanation. The Early Horizon was established on the basis of the charcoal date from square E6 in Area A. The sample comes from just above the original ground surface and antedates all the subsequent activity in Area A: the construction of the Upper Flat, the building of its pits and their infilling, and the limited subsequent use of the resulting flat area. It is thus likely to be at least slightly earlier than any of the deposits dated by the shell samples NZ7748 to NZ7752, which have been grouped in the Middle Horizon. The other two dates allocated to the Early Horizon are charcoal dates from Area E, the garden area. They cannot be linked stratigraphically to any other part of the site, but their close similarity to the early sample from Area A suggests that they represent early clearance of Area E, which, unlike the other areas, was never subsequently used for habitation.

Four of the shell dates relate to the period of construction and use of the terraces in Area D. NZ7752 is stratigraphically earlier than NZ7751 in one of the Midden Squares not stratigraphically linked to the Lower Terrace itself (Fig. 27). NZ7750 from the fill of Pit 1 on the Upper Terrace is stratigraphically earlier than NZ7749 from the scarp above the Upper Terrace (Fig. 21). These two pairs are not stratigraphi-cally linked. The fifth shell date in the Middle Horizon is from the earlier phase of activity in Area C on the crater rim, which was largely obliterated by later remodelling, pit construction and filling. In Area C, there is a clear separation between NZ7749, which groups with the Middle Horizon dates in Area D, and the sole date from the Late Horizon, NZ7747, which relates to the filling of pits on the remodelled surface that postdates NZ7749.

The pooling of the five Middle Horizon dates suggests that virtually all the activity in Area D took place between AD 1540 and 1680, and may well have taken place within the narrower time span of AD 1580–1660. The earlier phase of activity in Area C also fell in this period.

The single Late Horizon date barely overlaps with the pooled Middle Horizon dates and fails to do so at the 68.2% range. The remodelling of the crater rim could therefore have followed very soon after the Middle Horizon activities, but could also have taken place almost any time during the 1700s. The radiocarbon date does not preclude an even later event, but historical evidence that occupation of the site had ceased before the early 1800s and the sparseness of traditional references to it make an early or mid-1700s date for the late horizon more likely.

The charcoal samples are not easy to interpret. The three calibrated dates and the pooled result all have two (and in one case three) intercepts on the calibration curve. At this point it is not possible to say whether there really is an Early Horizon, or whether these samples date events indistinguishable from those of the Middle Horizon. However, the fact that Golson's (1961) date, NZ404, has a stronger probability of falling within the earlier intercept of NZ8127 from the same context in Area A offers some support for the possibility of initial occupation of Area A before AD 1500.

In conclusion, it can be said that the main period of occupation in Area A on the lowest part of the crater rim and the terraces of Area D on the adjacent outer slopes took place over a fairly brief period in the later 1500s and earlier 1600s, and that there was also activity further up on the northeast part of the crater rim at this time. The remodelling of the northeast part of the crater rim and, arguably, also Area B to the southeast nearer the tihi, was a later event, resulting in little actual occupation. Whether or not the charcoal dates represent an Early Horizon, it is clear from the evidence of fauna and charcoal discussed below that by the time the Middle Horizon occupation took place, the settlement on Maungarei existed in a landscape already highly modified by Māori activity.

Structural history

Like the large volcanic cone site of Pouerua in the inland Bay of Islands, Maungarei has been subjected to 'a vast number of occupation and construction events' (Sutton *et al.* 2003: 227). In contrast to Pouerua, however, most of these appear to have taken place over a relatively short period.

In the areas excavated, there is rather little evidence of initial forest clearance. The old soils on the original slopes of the mountain, identified inside the crater in Area A and on the flanks below the terraces in Area D, seem soon to have been covered by slope debris and cultural deposits originating from the second tihi and probably also from the lower northeast part of the crater rim.

The excavations on the southeast of the crater rim (Area B), adjacent to the main tihi, revealed an extensive, freshly created scoria surface with virtually no evidence of activity of any kind. It is unlikely that this part of the rim, close to the summit, had never been used for housing, storage, or cooking; it must therefore be assumed that, in its present form, it represents a late remodelling, which removed evidence of earlier activity and redeposited it on the slopes below. As noted above, it is possible that vestiges of earlier occupation remain to be found in the bank along the edge of the crater.

The narrower terrace on the lower northeast part of the rim (Area C) also consisted mainly of a freshly created scoria surface. Here, several relatively small pits had been dug, presumably used, and then partly filled, but there was only minimal evidence of cooking or other activity in the adjacent area investigated. On this part of the rim, however, there had clearly been earlier occupation, evidenced by the remains of a pit or other feature on the crater edge, and by the earlier fill layers on the outer edge, into which the pits had been partly dug. The very extensive shell midden just below the outer edge of the terrace (which was too large to have resulted from the minimal activity on the present terrace surface) is further evidence that significant reshaping of this part of the rim had also probably removed and redeposited a lot of debris of earlier occupation.

The lowest part of the crater rim (Area A), on the other hand, had received a considerable amount of redeposited material, as well as undergoing its own process of remodelling. The slope debris deposits in squares G5 and G6 in particular, through which Pit B was largely dug, reflect considerable structural activity on the second tihi area above. Both the terraces on this tihi today have partially filled pits on their surfaces, which are likely to post-date the construction and use of the upper flat below. It is reasonable to assume, therefore, that there has been ongoing modification of this tihi area from before the construction of the Upper Flat until after its pits were abandoned, and that much of the material from earlier use of the tihi has been redeposited down the slope. It may be noted that some of the largest pits visible on the surface of the cone today are on a terrace to the west of the main tihi area. This terrace and its pits are also likely to be a late feature, construction of which may have obliterated evidence of earlier activity on that part of the rim.

The excavations revealed no traces of small sloping terraces comparable to those that characterised the earliest use of the Pouerua cone. All the excavated terraces on Maungarei are large and, as noted above, the Upper and Lower terraces in Area D on the northwestern flank, which were surveyed with precision, are remarkably level from end to end. One of the principal functions of the terraces on this part of the mountain seems to have been for pit storage. Because of the crumbly nature of the scoria, it is only possible to dig a certain number of pits on a terrace before the terrace surface becomes unsuitable for further pits. The use of scoria-block facing and retaining walls can extend the life of a terrace and its pits to some extent, but eventually the terrace must be abandoned or its surface significantly lowered. The prevalence of scoria rather than ash on Maungarei is the probable explanation for the apparent reduction of the surface of the crater rim. Once scoria has been dug up and loosened, there is nothing that can be done with it except to throw it down the slope, starting a process that eventually results in the formation of Kear's (n.d.) slope deposits considerably further down. Each remodelling lowers the rim, or previous terrace, leaving little or no evidence of its predecessor.

This process of lowering results in constant redeposition of cultural material. At one extreme, this forms slope deposits consisting mainly of scoria with only a few inclusions of shell and charcoal. At the other extreme, a primary midden deposit may be dug up, mixed with a little scoria, and redeposited only a short distance further down. This may result in inverted stratigraphy.

Much of the occupation in Areas C and D could have taken place during a period of only 80 years between AD 1580 and 1660. The final reshaping of the crater rim in Areas B and C was probably slightly later, after AD 1690. Construction and use of the Upper Flat in Area A was probably contemporary with the occupations of Area D, but the last refilling of the pits and laying of a flat scoria surface with few signs of occupation may have been part of a final remodelling of the entire crater rim.

This reconstruction is necessarily incomplete. There has been no excavation on the much more extensively terraced eastern slopes of the cone (see Fig. 53 below), an area that may well have been occupied earlier and more continuously than the northern slopes. It might be expected that evidence of occupation would be concentrated on the parts of the cone exposed to the sun, but this does not seem to be the case. The most extensive terracing is around the north-east to southeast slopes, facing the Tāmaki Estuary and the Panmure Basin, with less evidence of terracing on the western slopes. Although a significant part of the south side has been modified by the old quarry, the eastern terraces appear to have continued towards the south. There is extensive terracing on the southern slopes of other large cones, most notably Maungawhau/Mt Eden, suggesting that sun was not the major factor in determining settlement location on cones. Exposure to westerly winds may have been a limiting factor on the western side of Maungarei, as some modern informants have suggested (G. Murdoch, pers. comm. 2010).

Artefacts and other portable items

Evidence of the manufacture and use of tools and other objects was widely scattered through the deposits, but the assemblage is very small in relation to the volume of deposit excavated. This is probably partly due to the difficulty of hand-picking objects from the scoria matrix of the deposits, but partly also because no definite living or working floors were found in the excavations. The assemblage is discussed in three categories: bone and shell items; the stone assemblage, both worked and unworked; and European artefacts.

Obvious artefacts and most of the obsidian from the 1971–72 excavations were catalogued in the Auckland War Memorial Museum's archaeology register (numbers prefixed AR) soon after the excavations. Artefacts and unworked stone found during recent processing of material from these excavations and all such material from Area A, returned from Canberra, have been given 'field numbers' prefixed by MW. This material is held in the Auckland War Memorial Museum.

Bone and shell items

Adornment

Personal adornment is evidenced by a tattooing chisel and two simple pendants, and perhaps also by two perforated scallop shells.

The tattooing chisel is a segment of long bone, probably bird bone, cut flat across the butt and perforated by drilling from both sides. The teeth are indicated by scarfs in the bone but the working edge of the instrument has been damaged (Fig. 33C). This item was found on the same surface as the second trampled path in square T15 on the Lower Terrace in Area D in 1971–72, and can therefore be assumed to predate the construction of the terrace.

A small pendant (Fig. 33D) was found near the bottom of the fill of Pit 2 on the Upper Terrace in Area D. It is made from a mammal tooth, now unidentifiable to species, and has been ground and polished on all surfaces so that much of the original tooth has been removed. It could be a much larger tooth that has been worked to resemble a human incisor, rather than an actual human incisor, as originally thought. It has been drilled from two sides.

The other pendant was found in the fill of Pit D on the Upper Flat in Area A. It is part of a ray spine shaped to a blunt point at one end and perforated at the other (Fig. 34B). The perforation has broken and a slight notch on one outer edge of the pendant may indicate an attempt to repair it sufficiently to secure a suspension cord.

Two flat valves of the scallop (*Pecten novaezelandiae*) with rough perforations were found in Area D, one in the fill of Pit 7 and the other in the complex overlapping fills of Pits 5 and 6. In each case the perforation is roughly central and about 2 cm in from the hinge. The perforations are not drilled but roughly pierced, with maximum diameters of 13 mm and 19 mm. The edges of the shells are weathered and rough. It is possible that these were simple breast ornaments.

Points and other worked bone

Three perforated bone points, thought to be needles, were recovered during the excavations in Area D. The smallest, only 23 mm long but with a relatively large eye, was found with the partly exhumed burial on the Lower Terrace (Fig. 33E). It is made from a long bone, probably of a bird. The longest needle (Fig. 33A), which is also probably made from a long bird bone, came from the fill of Pit 4 on the Upper Terrace. The third needle (Fig. 33B), from immediately above the surface of the Lower Terrace in square O12, sealed in by later deposits on the scarp at the back of the terrace, has been so thoroughly ground and polished to a lenticular section that the original bone cannot be determined with certainty, although it was possibly from a bird.

A sawn piece of human cranium was found deep in the fill of Pit 1 in square L11 in Area D.

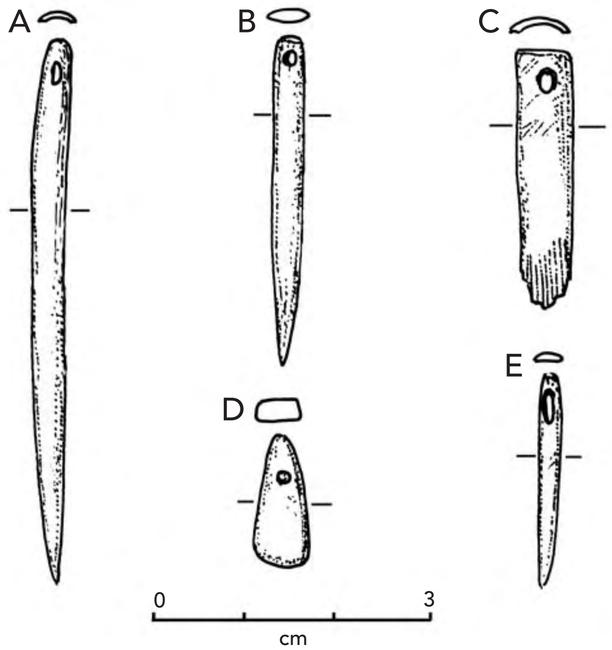

Fig. 33 Bone and tooth artefacts from Area D. A, needle AR4039; B, needle AR4040; C, tattooing chisel AR4038; D, perforated tooth pendant AR3983; E, needle AR4042.

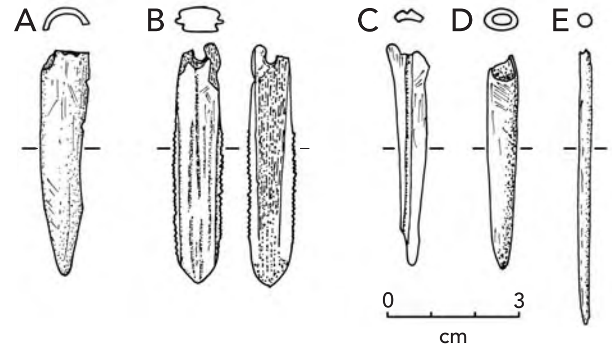

Fig. 34 Worked bone items from Area A. A, possible awl MW039; B, ray spine pendant MW040; C, grooved long-bone-shaft fragment MW041; D, broken bone point MW042; E, broken bone point, probably a needle, MW043.

Four pieces of worked bone were found in Area A in 1960. Two fragments came from the poorly documented Upper Terrace. One is the distal part of a bone point (Fig. 34D); the other is a shaft fragment of a long bone in the process of being divided by sawing, presumably into long, thin tabs for making needles or other fine points (Fig. 34C). Both could be either mammal or bird bone. They are catalogued as being from squares H10 layer 5 and H9 layer 6, respectively. Two broken points came from inside the crater. One, from layer 6 in square E4, is a large sliver of long bone, probably from a bird, filed to a blunt point, and is possibly an awl (Fig. 34A). The other is a long, narrow point, probably a needle, although it has broken below the eye, if any existed (Fig. 34E). It came from layer 8E in the baulk between squares E2 and E3 on the Lower Terrace, which is the same context as a broken adze described below.

The stone assemblage

During the 1971–72 excavations, workers were asked to collect not only artefacts, but also any examples of what appeared to be foreign stone (i.e. not scoria) from the midden and fill deposits. Unfortunately, no samples were taken of stone that was obviously associated with cooking areas, or of the 'pavement' on the Lower Terrace in Area D. However, some heat-shattered rock was collected from other deposits. The stone assemblage has not been studied petrographically, but since all foreign stone in the deposits has been carried up to the site by people in the past, proper identification of all stone resources is a worthwhile project for the future.

The artefacts include a small number of adzes, most of which are unfinished or fragmentary; hammerstones, grindstones and cutters; and flakes and cores of various kinds of stone. The stone resources used by the people of Maungarei for tools include obsidian imported from beyond the Auckland area. Most of the rest of the artefactual stone appears to be greywacke and chert derived from the Waipapa series of rocks, readily accessible on Motutapu and adjacent islands quite close to Maungarei. The Waipapa series was mapped and described in detail by Mayer (1968, 1969), who defined the term greywacke in this case to mean 'a texturally and/or compositionally immature sandstone with a high degree of induration' (1968: 217). Mayer found the cherts to range widely in colour, including white, cream, grey, green, red, buff and black, and to be extremely hard, breaking with a conchoidal fracture (1968: 218). The chert most commonly found in Auckland archaeological sites is green, although two orange/black chips in the Maungarei assemblage may also be chert.

Adzes

A complete adze, a broken one, and part of a small adze or chisel were found during the 1960 excavations, and four adze segments, two of which are part of one tool, were found in 1971–72.

The complete adze is a small, wedge-shaped blade of irregular, almost circular section (Fig. 35, right). Its context is not recorded and it may have been a surface find. It is partly ground on the front and back surfaces and hammer-dressed elsewhere.

The broken adze comprises the butt and central section of a tool that has a typically triangular section at the poll but is more plano-convex at the break (Fig. 35, left). It was found in the baulk between squares E2 and E3 in Area A in layer 8E in the fill of the deep feature at the back of the Lower Terrace. This is presumably the item described by Golson (1960: 34) as a 'broken hog-backed adze found amongst the scoria boulders of one of the layers of the crater scarp'. It has some hammer-dressing on what is assumed to be the front. Traces of what may be haft polish on the sides and back suggest that this tool was actually used when complete, rather than being just a broken preform. It is not unlike a complete adze from Taylor's Hill (Leahy 1991: Fig. 7).

A spall consisting of the back and parts of the sides of a very small adze or chisel of rounded quadrangular section (not illustrated) was found in fill in the baulk between squares F6 and F7 in Area A. It is fully ground apart from what appears to have been the butt end, where the grinding is incomplete. The fragment is about 40 mm long and 22 mm wide. Neither the cutting edge nor poll is present but this tool is unlikely to have been more than 50 mm long or to have had a cutting edge wider than about 16 mm.

The butt end of a flaked preform with only slight signs of hammer-dressing was found in the stony soil of square M4 in Area E in 1971 (Fig. 36C). It has an irregular section, probably intended to be elliptical rather than quadrangular.

The butt and blade sections of another unfinished adze were found quite close together deep in square U18 on the scarp below the Lower Terrace in Area D (Fig. 36A). This tool appears to have been close to completion, with an elliptical section and an extensively hammer-dressed body; the bevel and cutting edge were still to be formed when it broke in two places. Turner has shown that 'Motutapu preforms were very susceptible to transverse fracture, especially where length was disproportionate to thickness' (Clough & Turner 1998: 27); this is exemplified here.

The butt end of an adze, which appears to have been recycled as a hammerstone, was found in a rubble layer immediately above the old ground surface in square U21 on the scarp below the Lower Terrace in Area D (Fig. 36B). It is hammer-dressed and has extensive areas of 'haft polish', some of which probably derive from its use as an adze. However, some polish is also present on ridges between flake scars that must date from after the adze broke, and there is pecking on the poll, suggesting that the fragment may have been used as a hafted hammerstone.

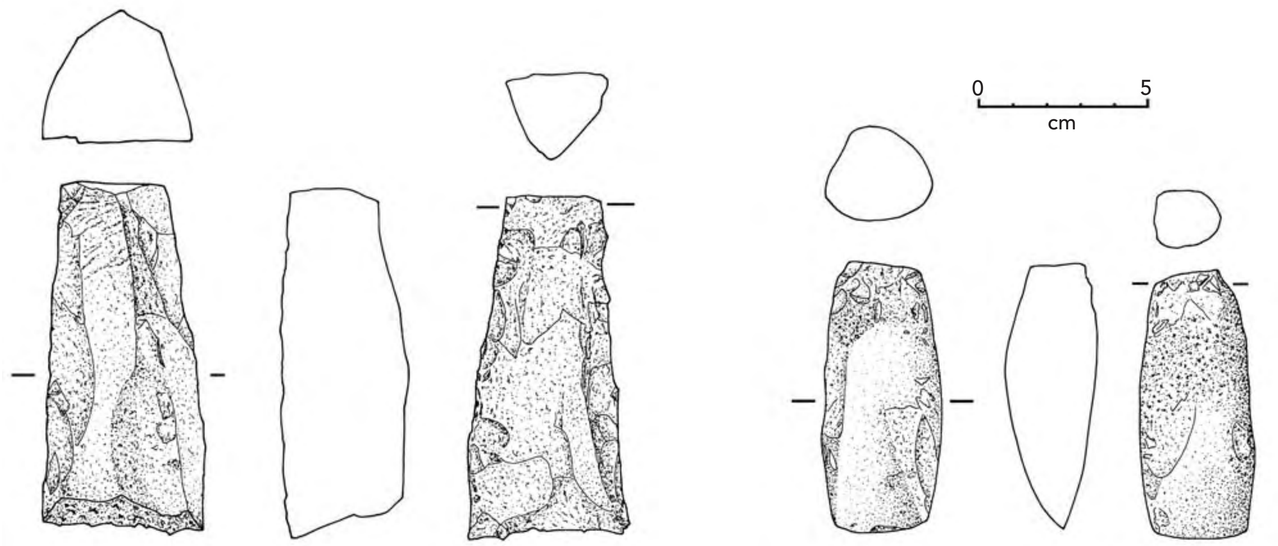

Fig. 35 Adzes from Area A. Left, the butt of a triangular-sectioned adze MW044; right, a small complete adze MW045.

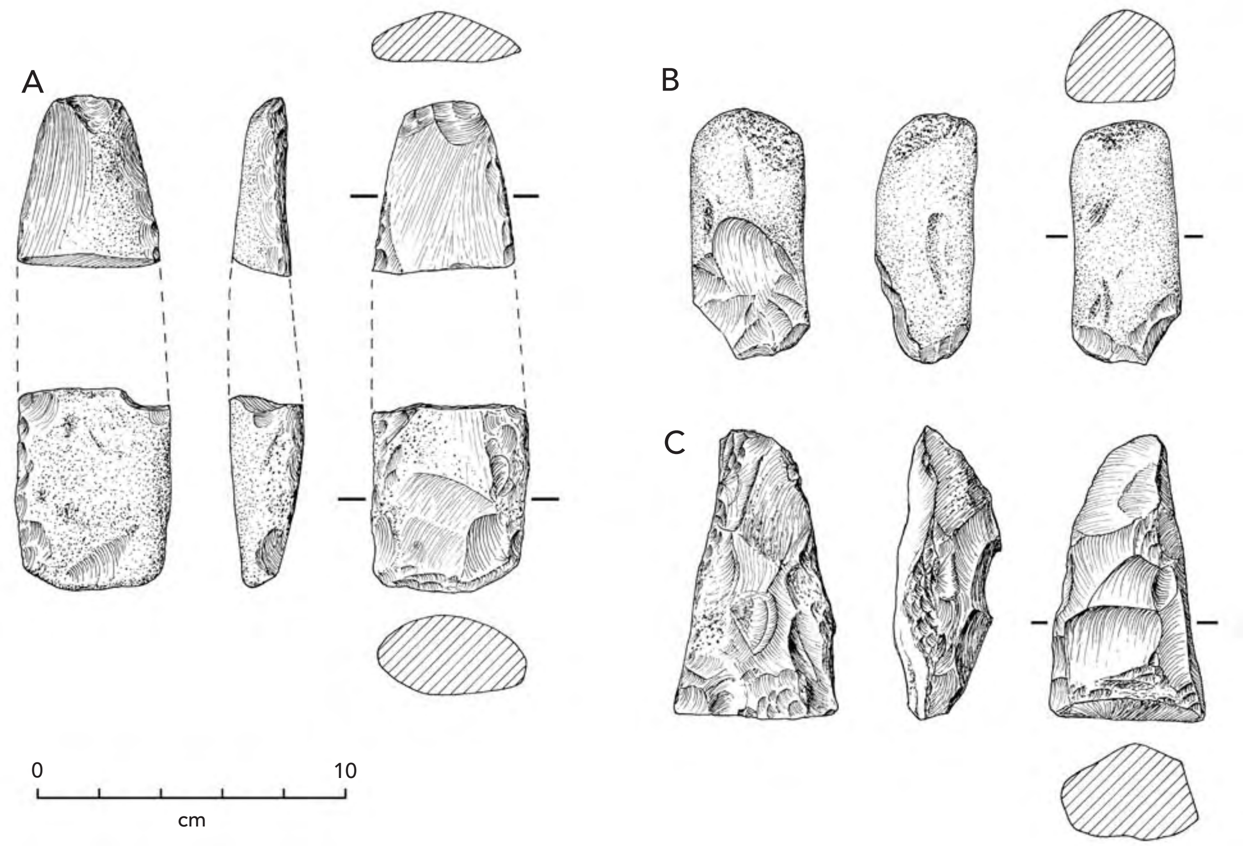

Fig. 36 Adzes from Areas D and E. A, two parts of a broken preform from Area D AR3993; B, part of an adze reused as a hammerstone from Area D AR3952; C, broken preform from Area E AR4047.

Although most of these adze pieces appear to be made from Waipapa greywacke, the broken 'hog-back' and the fragment from Area A are a darker grey colour rather than grey/green and may not be of Waipapa stone.

Adze manufacture or finishing was obviously carried out at Maungarei, in view of the broken preform recovered from Area D, although the example from Area E, where there is no other evidence of tool working, might have been recycled as some form of hoe or digger in the garden. A fragment (MW102, not illustrated) from just below the turf in the baulk between squares R14 and Q14 on the Lower Terrace in Area D is possibly the butt of a blank similar in size and shape to that of the broken preform from square U18. Half a split greywacke cobble from the upper fill of square Q14 in Area D may be a discarded piece of raw material for a small adze: Turner (Clough & Turner 1998: 28) has shown that a common way to begin adze manufacture using Motutapu greywacke was to split a beach cobble in half longitudinally by throwing it at an anvil. This served the dual purposes of testing the stone and providing two blanks.

Adze use and/or maintenance are reflected by small chips and flakes from finished adzes. Seven tiny fragments from ground adzes were found in Area A. Five, which may all have been from the same tool, were found with two apparently unworked spalls of greywacke and a small chip of obsidian on the interface between two fill layers in Pit D. Perhaps someone sheltered from the wind in the disused and partly filled pit and did a little work of some kind. The other two were from the fill of Pit C. A small chip from a ground adze came from square D1 in Area C; a larger piece from a highly ground quadrangular-sectioned adze and another probable small chip came from below the topsoil in square R12 on the Lower Terrace in Area D; and other probable adze chips came from the upper midden in square J11 and a fill layer in square L9. A flake with hammer-dressing from the upper pit fills in the baulk between squares M11 and M12 on the Upper Terrace of Area D could be from manufacture, remodelling or use.

Hammers, grindstones and cutters

Two grindstone pieces, from the upper fill layers of square U16 below the Lower Terrace, suggest some finishing or regrinding of adzes and the working of long, narrow items. They are both relatively small pieces of larger slabs. One has evidence of grinding on only one surface; the other is dished on two surfaces. Both also have signs of grooving across the dished surface (Fig. 37D).

Several small water-worn pebbles, all from the Lower Terrace, show evidence of use as hammerstones. A small, elongated pebble with evidence of pecking on one end was found just below the turf in square Q14 and exemplifies this kind of tool (Fig. 37B). A similar, slightly larger pebble from near the base of the deposit in square O11 has no sign of use, but is presumably a hammerstone waiting to be used. Also from square O11, but of uncertain context, is a still larger, less regular pebble with some wear on one end (Fig. 37C). The broken end of a similar pebble, with extensive pecking, came from the base of square U18 (Fig. 37A). All of these hammers could have been used in adze manufacture or maintenance.

Two small pieces of greywacke from the Upper Terrace in Area D have a polished edge compatible with use as a cutter or saw. The larger, from the fill of Pit 2, has a straight edge about 26 mm long with polish evenly distributed but more obvious on one side than the other. The second, from the upper midden fill of Pit 1, is a tiny chip only 15 mm long; it has a slightly curved edge 12 mm wide with marked wear on both sides. This small object would have been used for very fine cutting work, during which only part of the edge would be used at one time and the tool could be rotated slightly to make smaller and deeper cuts. Both of these items might have been used in bone working, the larger perhaps to cut bone into preforms for needles and points, as seen in the grooved bone from Area A (Fig. 34C). Clough & Turner (1998: 30–31) suggested that similar cutters from the Waipuna site might have been used for cutting sandstone, whereas examples with 'nibbled edges' would be used for sawing bone artefacts. The Maungarei examples, particularly the small one, are too small for cutting sandstone.

Flakes and cores

The obsidian is described separately below. The remainder of the stone assemblage contains relatively few flakes and cores, and more spalls and shattered items.

Two unusually large stone items were found in Area D. A discoid core (Fig. 38, left) came from a thick orange fill layer in square T16 on the Lower Terrace, and a large flake (Fig. 38, right) with no evidence of use or further modification came from the midden in square J11 on the scarp above the Upper Terrace. On the surface opposite the flake scar there is clear evidence of the prior removal of a hinge flake from what must have been a larger core. These two items reflect the adze-making technology that is typical of early sites in many parts of New Zealand but continued in use on

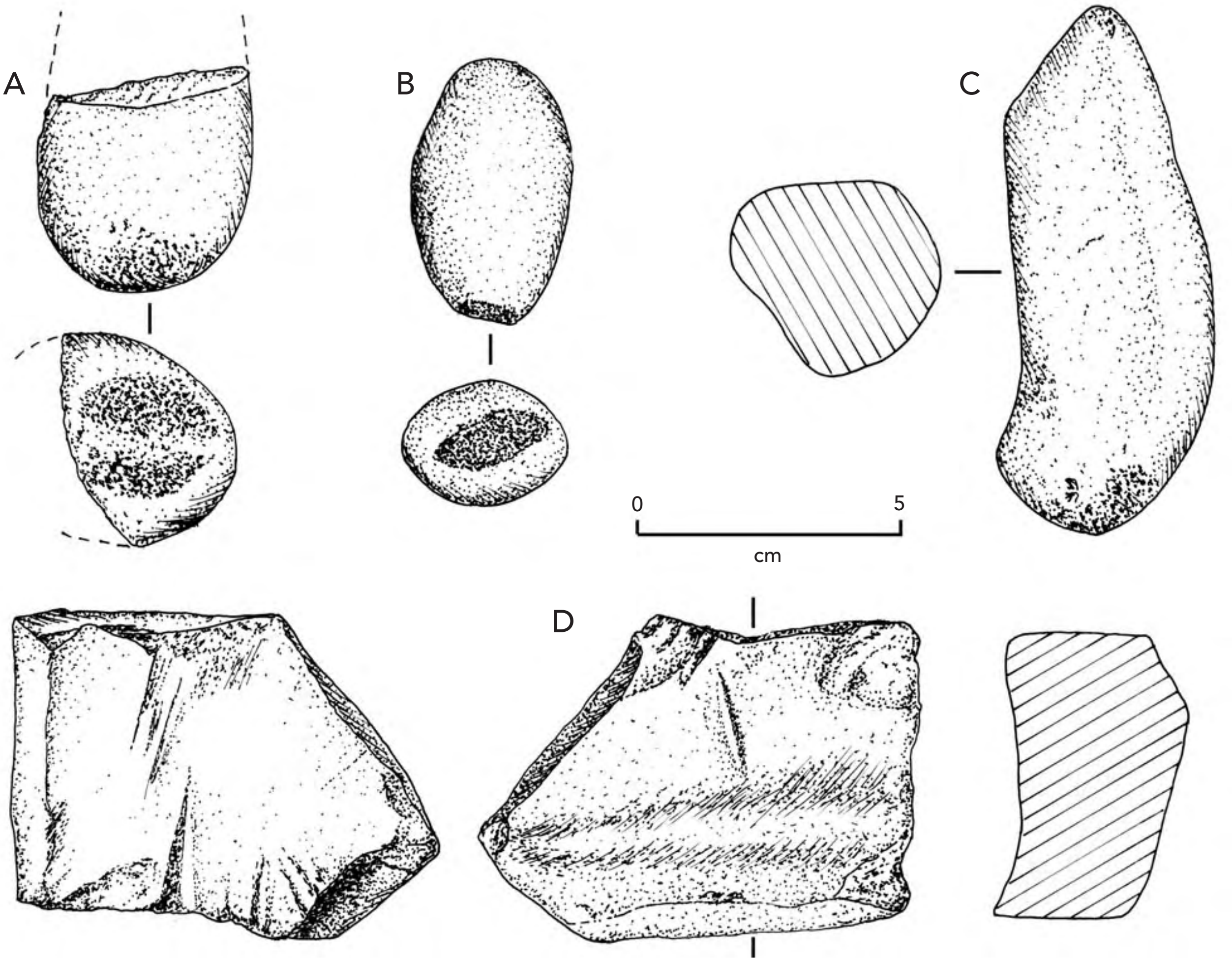

Fig. 37 Hammers and part of a grindstone from Area D. A, MW053; B, MW052; C, MW054; D, MW056.

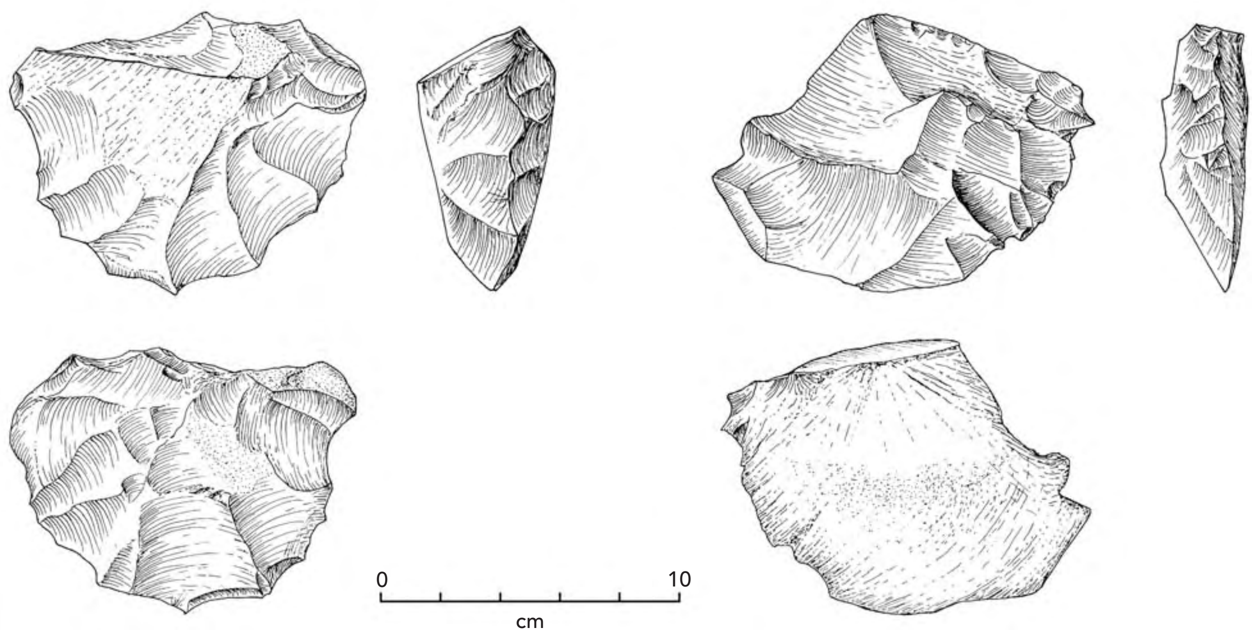

Fig. 38 Large flaked items from Area D. Left, discoid core AR4037; right, large flake AR3982.

nearby Motutapu Island and in the Auckland area generally into the time when Maungarei was occupied. They reinforce the idea that large pieces of greywacke raw material, as well as preforms and adzes, were occasionally brought to the site.

A large pebble of what appears to be red and white chert, which weighs 450 g, was found in the uppermost midden layer in square V22 below the Lower Terrace. It has extensive areas of water-worn cortex and has had a number of small flakes removed from one side. The only other partial core is a greywacke piece from square E7 in Area A.

Only 42 other possible flakes were identified among the much larger quantity of spalls and pieces collected, predominantly from Area D. None of these shows signs of use. Most appear to be greywacke, and two may be chert. There were six flakes from three contexts in Area A, three from Area C, twenty-one from the Upper Terrace in Area D, six from the Lower Terrace, five from the Midden Squares and one with no context. The small number from the Lower Terrace contrasts with the relative abundance of obsidian in that area (Table 2).

Obsidian

One hundred and eighty-nine pieces of obsidian were recovered, consisting of cores, flakes, slivers and pieces, many of which are tiny. Although obsidian was recovered from all kinds of contexts, a relatively high proportion came from the Lower Terrace in Area D, perhaps reflecting activities that were actually carried out there, whereas most of the rest was from fill layers. The distribution is given in Table 2.

The great value of obsidian compared with other stone materials that were available to pre-European Māori was its ability to form extremely fine, sharp edges. Obsidian blades made by pioneering experimental archaeologist Donald Crabtree in the United States and used for open heart surgery have been shown to cause less tissue damage than normal surgical scalpels. At 10,000× magnification, a razor blade edge appears flat whereas an obsidian flake still appears as a cutting edge at about 30 angstroms width (Buck 1982: 266). A disadvantage of obsidian is that it is very brittle, so it is not suitable for heavy work. However, the stone is unrivalled as a material for cutting hair or flesh. Experimental research has shown that even a tiny obsidian flake is very effective in skinning an animal and removing meat from bones. Although this quality of sharpness is its main advantage, pieces of obsidian that have higher edge angles, such as 45–90°, make very effective scrapers on harder materials like wood.

The size of pieces of obsidian in a site can reflect how valuable this material was to the people inhabiting the site.

Table 2 Distribution of obsidian at Maungarei.

Area A		
Pit fills		9
Lower flat and scarp		6
	Sub-total	*15*
Area C		
Early pit fill		2
Terrace surface		5
Late pit fill		4
	Sub-total	*11*
Area D		
Scarp above Upper Terrace		8
Upper Terrace surface		3
Upper Terrace pit fills		8
Scarp between terraces		39
Lower Terrace northeast surface		31
Burial pit		4
Lower Terrace pit fills		4
Hāngi area		30
Other terrace surface		1
Scarp below Lower Terrace		10
Midden Squares		21
No context and surface find		4
	Sub-total	*163*
	Total	**189**

If the supply of obsidian was abundant, then the average size of pieces discarded and not reutilised may be expected to be somewhat larger than if access to the source of supply was more difficult. However, distance from source was not the only determinant of value, since social factors were involved too. A strong trading link may have existed between two communities separated by a considerable distance, decreasing the value of this commodity. Another community quite close to the source of supply may have been denied access to it because of inter-group hostility. In such a case, the short supply of obsidian makes it very valuable. It is therefore useful to examine the size as well as the number of obsidian pieces in a site. Each piece from Maungarei was weighed on a Sartorius model BA310S top-loading balance to 1 mg precision. Similar data are available for the Whangapoua site on Great Barrier Island (Aotea Island),

Table 3 Maungarei obsidian mass (g) statistics compared with obsidian from a selection of other sites.

Site	No.	Min.	Max.	Mean	SD	Skewness		Kurtosis	
						g1	w1	g2	w2
Maungarei	189	0.02	13.1	1.3 ± 0.2	2.1 ± 0.1	3.2	10.1	14.6	33.9
Whangapoua	464	0.01	41.8	1.1 ± 0.1	2.7 ± 0.1	8.8	26.2	117.2	510.5
Kauri Pt	5733	0.02	135.2	3.8 ± 0.1	6.1 ± 0.1	5.1	69.6	59.8	879.2
Pahia	1573	0.10	1591.1	5.1 ± 1.7	66.5 ± 1.2	22.8	77.5	525.7	4252.2

the swamp excavation at Kauri Point in the western Bay of Plenty, and a surface collection from Pahia, west of Riverton in Southland (B.F. Leach, unpublished data). Statistics of this information appear in Table 3.

All of these collections display expected non-normal characteristics. Significant positive skewness reflects the presence of a few larger cores of obsidian amongst abundant small pieces. Significant positive kurtosis reflects a very strong peak in abundance at the smaller end of the size range, corresponding to the size of tools used by people. Note the much larger mean size at Pahia. This almost certainly reflects preferential selection during surface collecting on the site. The other three samples are less likely to suffer from selective bias, so the mean sizes probably do reflect the relative value of obsidian to the people at these sites. The pieces of obsidian at Maungarei were quite small compared to these other collections and the largest specimen was only 13 g.

The 189 pieces of obsidian were carefully examined with low-power binocular microscope[5] for evidence of use as tools. Not a lot of previous research of this kind has been carried out on New Zealand obsidian assemblages, but studies by Morwood (1974), Turner (Clough & Turner 1998: 32–33) and Holdaway (2004) provide a useful starting point. It is important to avoid making interpretations about functional use unless they can be thoroughly justified. With this in mind, some simple descriptive terms that are linked to function should be used.

For example, micro-flaking along an edge can be on one or both sides. Use of the edge of a piece of obsidian as a knife (to and fro sawing action) leaves damage on both sides, either scratches or micro-flaking or both. Use of an edge as a scraper in one direction leaves micro-flaking on one side and, in the case of heavy work such as scutching a piece of flax (*Phormium* spp.), scratches on the other. The micro-flaking occurs on the opposite side of the edge to the direction of the scraping. The same tool could then be turned 180° to scrape in the same direction as previously. This would produce micro-flaking on the other side of edge as well. In other words, a uni-directional scraper can have micro-flaking on both sides of the edge. However, most flakes are more conveniently held in one way only, and micro-flaking on both sides of a uni-directional scraper is therefore likely to be uncommon. A bi-directional scraper (held in one position but used to scrape in two directions) will also leave micro-flaking on both sides.

In any assemblage of obsidian there are usually numerous pieces displaying flaking that is not the result of using the object as a tool. The dividing line is not always clear. For example, item AR4008 from Maungarei shows small flake scars all around its edges in a neat pattern, but these are not thought to be edge damage from use as a tool. Micro-flaking and scratch marks are a better indication of such use. Given the obvious complexities, description of edge wear may be reasonably certain, while interpretation of function is much less so.

Twenty-eight pieces of obsidian from Maungarei showed edge damage that could be described as use-wear:

MW007b Use-wear occurs along an acute-angled edge of this piece of obsidian. A photomicrograph clearly shows this bi-directional damage (Fig. 39, right). The flake scars are minute and reflect light use. This object qualifies as a knife/cutter.

AR3986 Two edges on this piece of green obsidian show clear edge damage associated with use. One edge is concave, qualifying as a spokeshave form, with uni-directional micro-flaking. The other edge is acute-angled and has bi-directional micro-flaking, such as occurs during action as a knife.

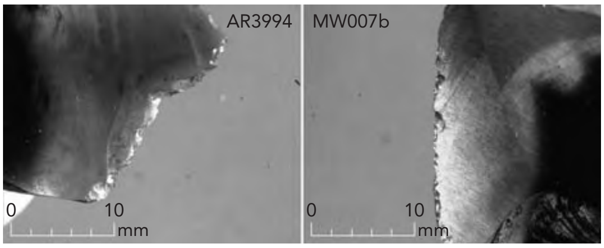

Fig. 39 Two obsidian flakes with use-wear interpreted as knives/cutters.

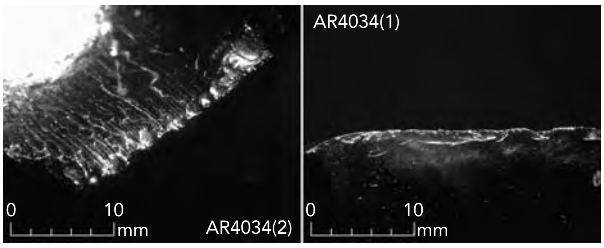

Fig. 40 An obsidian core or nucleus with use-wear on two edges. One edge is interpreted as a spokeshave and the other as a steep-edged scraper.

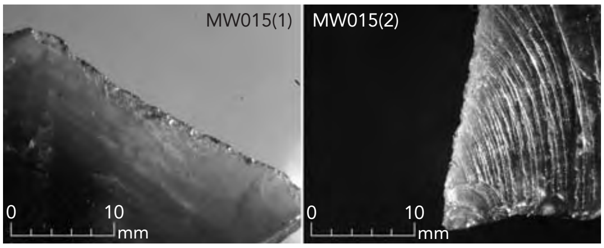

Fig. 41 An obsidian flake with an acute-angled edge showing considerable use-wear. This has been used as both a knife/cutter and a sharp-edged scraper, possibly for scutching flax.

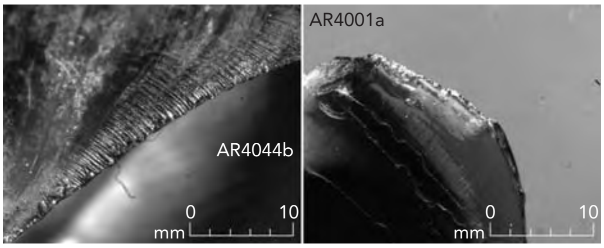

Fig. 42 The acute-angled flake on the left has considerable edge damage. It has been used as both a knife/cutter and as a sharp-edged scraper, possibly for scutching flax. The piece on the right has been used as a steep-edged scraper.

Spokeshave scrapers are very useful for scraping shafts of spears and similar objects that have round cross sections.

AR4018b This piece of green obsidian has a protruding piece about 15 mm wide with a convex end bearing considerable edge wear. This convex edge has uni-directional flaking around it. Such a form is sometimes referred to as a nose-scraper. Such implements are useful for scraping along a concave groove, for example during wood carving.

MW014g This is a very small chip of obsidian with a maximum dimension of 10 mm and is probably the tip of a broken tool. An edge with a 90° angle has minute uni-directional flake scars along it, suggesting that the original tool was used as a scraper for some purpose.

MW016 This is also a small, pointed chip of obsidian, and quite thin. Again, it appears to be part of a broken tool, possibly a drill point since there are bi-directional flake scars along both edges. If it was a drill point, it must have been used for very fine work, because this flake would be very brittle. Alternatively, it is the tip of a sharp implement used as a knife.

MW008b A somewhat larger piece than most, with uni-directional micro-flaking on one straight, high-angled edge. This has been used as a scraper for heavy work.

AR3994 An acute-angled flake with minute bi-directional flake scars. Part of the original edge of this flake has been broken away and the new edge also has use-wear on it. This suggests considerable use as a knife/cutter (Fig. 39, left).

AR4034 This is a core or nucleus with several high-angled edges. One edge is concave and has been used as a spokeshave, indicated by heavy uni-directional micro-flaking (Fig. 40, left). Another straight edge was clearly used as a steep-edged scraper, as it has minute uni-directional flake scars (Fig. 40, right). Several edges and surfaces of this piece show micro-channels and ridges, which could be confused with use-wear. However, this is minute flow-rippling from when the obsidian was molten. Cracks appear in some of these ripples.

AR3990 An acute-angled flake with minute bi-directional flake scars, suggesting light work as a knife/cutter.

MW020a This is shaped like a drill, with acute angles along both edges. The small flake scars along both edges are uni-directional and along the same side, showing that this tool was used as a scraper, not a drill.

AR4027a An acute-angled flake. The working edge is convex and some has broken away. What remains shows mainly uni-directional flake scars, so use as a scraper is indicated.

MW021 An acute-angled flake with minute bi-directional flake scars. This was probably a knife/cutter.

AR4030i This is shaped like a drill and has minute bi-directional flake scars, suggesting use as a drill.

MW025 An acute-angled flake with minute bi-directional flake scars. This was probably a knife/cutter.

MW015 An acute-angled flake. This is a most interesting piece. One edge shows use-wear, with minute bi-directional flake scars (Fig. 41, left), and one of the sides shows very severe scratching up to 4 mm wide (Fig. 41, right). This suggests that this implement was used as a knife/cutter as well as a uni-directional scraper for sustained heavy work, possibly scutching flax.

AR4033b There is minute uni-directional flaking along the acute-angled convex edge of this flake, suggesting use as a scraper.

AR4035 An acute-angled flake. The minute flake scars are uni-directional, so this implement was used as a scraper for fine work.

AR4016d There is uni-directional edge damage along a convex edge of this flake, suggesting use as a spokeshave.

AR4025a This is a drill-shaped flake with steep edges and minute bi-directional flake scars, which suggest use as a drill.

AR4019 An acute-angled flake with minute bi-directional flake scars. Use as a knife/cutter is indicated.

AR4033a Quite a large flake with a hinge fracture 60 cm long. In the centre of this edge over a distance of 10 mm there are minute uni-directional flake scars, suggesting use as a high-angle scraper.

AR4044b This small flake has an acute-angled edge with minute bi-directional flake scars along it. On one side there are intense scratch marks that have formed grooves on the surface from a scraping action (Fig. 42, left). This implement may have been used as a knife/cutter and for heavy scraping, perhaps during scutching of flax, as with MW015 above.

AR4050a One acute-angled edge of this item has minute bi-directional flake scars, suggesting use as a knife/cutter.

AR3979 Two concave edges on this implement have minute uni-directional flake scars, suggesting use as a spokeshave.

AR4049 One concave edge on this core tool has minute uni-directional flake scars, suggesting use as a spokeshave.

AR4016e One acute-angled edge on this tool has very fine bi-directional flake scars, suggesting use as a knife/cutter on some relatively soft material.

MW009 This flake has been heated in ash, giving it a frosted appearance. There is considerable uni-directional flaking along the nose-shaped end of this flake, suggesting heavy work as a scraper. The flaking is fresher than the rest of the flake surface, so either the flake was retrieved and used after it was heated, or the edge was damaged during excavation. Distinguishing between these two options is not easy.

MW4001a One edge of this implement has considerable minute uni-directional flake scars, suggesting heavy work as a scraper (Fig. 42, right).

This small collection of 189 pieces of obsidian from Maungarei is mainly of detritus, left over after useful implements broke during use and were no longer serviceable. However, 28 have sufficiently clear evidence of edge damage from use as tools for their purpose to be identified. The most common use was as scrapers of various kinds (10 items), some for relatively heavy work and others for lighter tasks. Two of these show severe use marks, possibly sustained during scutching flax. Others would have been used for debarking pieces of flat wood or scraping wood into shape. Knives/cutters were about equally common in the collection (nine items). It is hard to know what these implements were used for, but given that obsidian flakes can have extremely fine edges, they could have been used for a range of tasks, from trimming hair, cutting cordage and preparing flax fibre, to skinning dogs and cutting up meat. Four items can be interpreted as spokeshaves. These could have been used for smoothing the shafts of spears or wooden paddles. There are only two implements that could be interpreted as drills, but this is not surprising given the brittleness of obsidian – there are other rock types that are more suitable for this purpose. Finally, there are three multi-purpose tools, two serving as both knife/cutter and scraper, and one as a spokeshave and scraper.

Sources of obsidian

To identify the sources of the obsidian found at Maungarei, the assemblage was sent to Mark McCoy at the University of Otago, who established X-ray fluorescence (XRF) spectra with a Bruker AXS hand-held XRF (McCoy *et al.* 2010). Spectra from the artefacts were compared with those obtained from source material from the North Island to arrive at an assessment of the geographic origin of each artefact. Sixty-eight pieces were too thin for reliable spectra

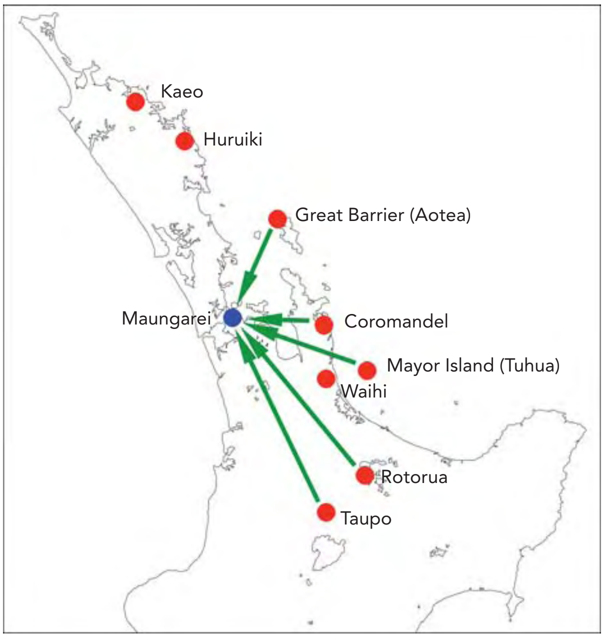

Fig. 43 Obsidian at Maungarei was derived from most of the main sources in New Zealand except those in Northland.

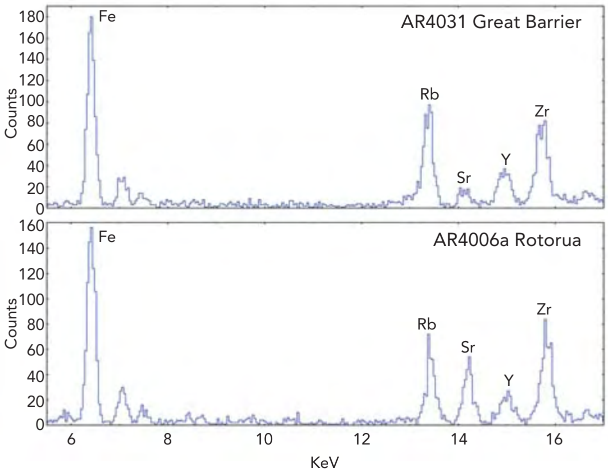

Fig. 44 X-ray spectra of two of the Maungarei obsidian artefacts. Upper, from a source on Great Barrier Island (Aotea Island); lower, from a source at Rotorua.

to be obtained. By far, the bulk of the remaining 121 pieces was shown to be derived from sources on Great Barrier Island (Aotea Isaland), with smaller numbers from Mayor Island (Tuhua), Rotorua and Coromandel sources, respectively (Fig. 43). Typical spectra are shown in Fig. 44, and the source allocations are given in Table 4.

Table 4 Source of origin of Maungarei obsidian (M.D. McCoy, pers. comm. 2010).

Origin	Number
Great Barrier Island (Aotea Island) (Te Ahumata)	90
Mayor Island (Tuhua)	15
Rotorua	6
Great Barrier Island (Aotea Island) (Awana)	2
Cooks Bay/Purangi	2
Hahei	1
Central North Island (similar to Maraetai)	1
Unknown A (similar to Awana)	2
Unknown B (similar to Coromandel or Taupo)	2
Total	**121**

Baked clay

A piece of baked clay with a partial fingerprint impression was found in the fill of Pit 3 in Area C. It looks as if it resulted from a person rolling or fiddling with a piece of clay to produce an elongated object similar in size and proportion to a finger bone, which then became fired. Two other amorphous fragments, which could have been parts of small balls, were also found in the fill of this pit. Baked clay items, including flutes and objects with incised decoration, have been reported from sites in Auckland and the Hauraki Plains (Furey 1986: 17, 1996: 148; Foster & Sewell 1999: 17). The Maungarei pieces are unimpressive in comparison.

Unworked stone

The remainder of the stone assemblage consists of pebbles, spalls, shattered pieces and fragments of a variety of stone types. There is a significant amount of greywacke; a small amount of mostly green chert; some obviously volcanic pieces, probably from the immediate vicinity; and several other kinds of stone, some heat-shattered. As noted above, at least some greywacke was brought to the site as raw material. Unused pebbles, almost certainly intended for use as hammerstones, were also present. There is an intriguing group of other pebbles, some possibly intended for use as hammerstones but others almost pea-sized. Some of the smallest may have arrived in the deposits, like the inedible shells (discussed below), as by-products of mass harvesting of cockles; others, particularly pretty coloured ones, may have been brought in as curiosities.

Several small pieces of what appeared to be kōkōwai were collected, although there may have been many similar-sized pieces missed among the ubiquitous scoria gravel. Two pieces came from the slope layers in squares S15 and T15 in

Area D, and a tiny fragment from the fill of Pit 3 in Area C. A less certain piece was found in square M9 in Area E. Kōkōwai from the burial pit on the Lower Terrace was not retained.

European artefacts

The use of the Mt Wellington Domain for grazing and recreation is reflected in the faunal remains of cattle, sheep and pig, described below. Not surprisingly, artefactual evidence of recreational and other activities was also found in the surface and turf layers of Areas C and D.

From Area C came two pennies, dated 1940 and 1947, and a few fragments of clear, rather thick bottle glass. Area D yielded a glass marble; a flat metal plate measuring 100 × 70 mm with two small perforations; some tangled, rusty wire; and a piece of brown glass, probably from a beer bottle. Concrete fragments, probably dating from reservoir construction, were scattered about in several places.

Of greater interest, from Area D, were nine brass shells and the remains of a Yale RKB18 padlock, which had been heavily battered on both narrow sides, presumably in an attempt to force it open. The RKB18 was a standard lock used in low-security situations by the Auckland City Council water department and its successor, the Auckland Regional Authority water department, into the late 1970s at least, and this example presumably dates from the period of reservoir construction on the mountain in 1960.

Fig. 45 Nine .22 long shells from the excavations in Area D at Maungarei.

Table 5 Rim-fire shell dimensions from Maungarei excavations.

Cat. #	Rim width (mm)	Case length (mm)
MW30	6.89	15.31
MW31	6.88	15.36
MW32	6.89	15.47
MW33	6.88	15.72
MW34	6.96	15.59
MW35	6.80	15.53
MW36	6.88	15.38
MW37	6.85	15.46
MW38	6.97	15.36

Brass rim-fire shells

Eight of the brass shells came from just under the turf in square M11 and the baulk between M10 and M11 on the Upper Terrace. One (MW034) was from the turf layer in square R13. They all appeared to be .22 long-calibre rim-fire shells. Although rim-fire was patented as early as 1831, the .22 long did not appear until 1871. Some of the shells in the excavations could be of nineteenth-century age, and it is considered useful to describe these formally for future reference. The nominal specifications of various manufacturers of the .22-calibre cartridge are given by Barnes & McPherson (2000) as having a rim diameter of 0.275 in (7.0 mm) and case length of 0.590 in (15.0 mm). The dimensions of the nine shells from the excavation are given in Table 5.

There are three types of head-stamps on the shells (Fig. 45). These were identified by the Chief Armourer at the National Forensic Services of the New Zealand Police. The top row in Fig. 45 shows the head-stamps on shells MW038, MW030, MW031 and MW036. These are all brass shells and belong to ammunition manufactured by Imperial Chemical Industries in England between about 1926 and 1962. Ammunition with this head-stamp was loaded in New Zealand throughout this period. Items MW032, MW034 and MW037, in the middle row of Fig. 45, are nickel-plated brass, and were manufactured by Remington Arms Company USA between about 1934 and the late 1950s. The bottom row, MW038 and MW035, are brass shells. This head-stamp was in existence from 1886 until 1978. It was initially used by the Dominion Cartridge Company of Canada from 1886 to 1927. The company then became Canadian Industries Ltd and used this head-stamp from 1928 to 1976. Valcartier Industries Inc. of Canada used it from 1976 to 1978.

All but shell MW036 show firing-pin marks, and the impressions appear to be consistent within each group and different from one group to another, suggesting three different rifles. The general preservation of these shells was different from one group to another. The nickel-plated shells were the freshest in appearance, and the two on the bottom row were the most corroded, suggesting greater age.

We cannot be certain what activity is reflected by the shells. However, as rabbits were still present on Maungarei at the time of the excavations and rabbit burrows had disturbed the deposits in several places, rabbiting is a distinct possibility.

Discussion

The small Māori artefact assemblage from Maungarei is not unlike that recovered elsewhere in the Auckland region, including the sites at Station Bay on Motutapu Island. However, it falls short of sites such as the smaller volcanic cone of Taylor's Hill, where a much larger assemblage of adzes and greater diversity of bone artefacts were recovered (Leahy 1991); Waipuna (R11/1436), an open site further up the west bank of the Tāmaki Estuary, which yielded a larger assemblage of greywacke artefacts (Clough & Turner 1998); R10/497 on Motutapu Island, a small terraced site, from which a range of bone and stone items was recovered (Watson 2004); or Westfield (R11/898), an open settlement site further up the west bank of the Tāmaki Estuary beyond Waipuna, adjacent to the now destroyed cone of Te Apunga ō Tainui (McLennan's Hills) (Furey 1986).

The stone assemblage appears to reflect the use of predominantly local stone resources, with the important exception of obsidian. The adze technology is entirely compatible with what is known of the history of stone working in the Auckland area. Golson (1959: 46) described the material culture of the Pig Bay site on Motutapu as 'Archaic throughout'. However, Turner (Clough & Turner 1998: 27–28) has shown that people in the Auckland area chose to continue using this important local resource and working it with the technology most suited to it, after people in many other regions had turned to other stone resources that required different working methods, as shown by Best (1977).

Faunal analysis

Little or no midden was found on the southeast part of the crater rim or in the garden area on the western side, but there were large quantities of predominantly shell midden in the other three areas investigated. Content varied from small amounts of fragmentary redeposited shell in fill layers that consisted mainly of scoria rubble and grit, to primary midden deposits of fresh shell. Even the latter, however, usually contained significant amounts of scoria, making sieving difficult or impossible.

Methodology

No shell has survived from the 1960 excavation in Area A. Bone hand-picked during excavation was retained. In the 1971–72 excavations, workers were asked to pick out bone and unusual stone (i.e. not scoria) where possible, together with examples of unusual shells. Some bulk samples were taken, often from sections after excavation of a square was completed. A few were sieved in the field, but most were true bulk samples. The samples ranged in weight from less than 1 kg to 25 kg, with the majority in the 1–3 kg range.

The laboratory study distinguished between the 'small bags' containing hand-picked items, and the bulk samples. All the small bags were examined. Stone and examples of unusual shells that might not be represented in the bulk samples were extracted. If any identifiable bone was present, all bone was extracted and given a catalogue number.[6] If there were only a few unidentifiable fish spines, these were returned to the bag with the remaining shells. These bags were subsequently discarded.

Cockles had been extracted from six bulk samples for radiocarbon dating. The remainders of these samples were catalogued and retained but not further investigated. The intact quantitative samples were catalogued and retained, and about half were sorted, while the rest were kept for future study. Initially, the samples to be studied were sorted without sieving and all residue retained. Later, the remaining samples were sieved through ⅛ in (3.175 mm) mesh and the residue retained unexamined.

The bulk samples consisted largely of scoria grit and rubble, and cockle (*Austrovenus stutchburyi*) shells. Almost all samples also contained pipi (*Paphies australis*). Any bone, all whole cockles and pipi, and fragments with a complete hinge were extracted, along with all identifiable pieces of other shells. A bivalve species such as a scallop (*Pecten novaezelandiae*) might be represented by one fragment, not including a hinge, while a gastropod such as the cats eye (*Lunella smaragdus*) or mudsnail (*Amphibola crenata*) might be represented by one or more recognisable fragments that did not include the operculum, protoconch or aperture rim.

Cockles were divided into left and right valves. The right valves were counted to generate MNI values (minimum number of individuals). Both left and right valves were

Table 6 Summary of quantitative midden samples from Maungarei, listing minimum number of individuals (MNI).

Cat. #	Context	Shell	Rat	Fish
AM028	C/E5 Upper fill Pit 3	516	—	1
AM030	C/E5 Lower fill Pit 3	117	—	—
AM273	C/D2 Upper fill Pit 4	158	—	—
AM018	D/J11 L3 south face (upper midden)	383	—	—
AM020	D/J11 L3 shell lens	444	—	—
AM341	D/J11 L4 (loose midden)	911	—	3
AM019	D/K11 L3 centre of square	262	—	—
AM014	D/K11 L3 south face	147	—	—
AM015	D/K11 L3 west face	75	—	—
AM092	D/L11 Upper part pit fill	159	—	—
AM274	D/L11 Upper midden in north face (sieved in field)	498	—	—
AM016	D/K11 L4 south face	136	—	1
AM017	D/K11 L4 west face	81	—	—
AM021	D/K10 Base of Pit 2	119	—	1
AM271	D/N10 Top of midden northeast corner	101	—	—
AM272	D/N10 Top of midden northwest corner	68	—	—
AM344	D/R12 Yellow and orange midden bag 1	813	—	—
AM345	D/R12 Yellow and orange midden bag 2	643	7	—
AM343	D/S13 Between darker fill and orange fill	81	—	—
AM340	D/T15 Basal midden	157	—	—
Total		**5869**	7	6

retained. For other bivalves, where numbers were very small, minimum numbers were maximised by counting both left and right valves, then taking the larger number and also taking account of obvious size mismatches. Thus, three small left valves and one much larger right valve would give an MNI of 4.

Twenty-two samples were analysed. One, deliberately taken from a pipi lens within a larger midden layer, contained 99 pipi, one cockle and one gastropod (*Cominella* sp.). Another small sample proved to consist largely of scoria, ash and shell fragments, and gave an MNI of only six shells. These two samples are not considered further.

The 20 remaining samples studied are listed in Table 6 with their contexts and a summary of their contents. It can be seen that there are four cases where two samples are from one square and layer, and one case where three samples were taken from different parts of the same layer.

Almost all the bone material was hand-picked during excavation. Fish bones were analysed using the comparative collection in the Archaeological Laboratory at the Museum of New Zealand Te Papa Tongarewa. Mammal and bird remains were analysed in the archaeological laboratories at Otago University's Department of Anthropology and Archaeology by Sarah Mann and Ian Smith (Appendix 1).

Shellfish

The 20 shell samples all consist largely of cockles, which is by far the dominant species. Details of the shell analysis are given in Table 7 and a summary is provided in Table 8.

The mussel shells are very fragmentary. Some have been identified as blue mussel (*Mytilus galloprovincialis*),[7] but the green mussel (*Perna canaliculus*) may also be present. The shellfish deemed too small to be edible are mostly the gastropods *Zeacumantus lutulentus*, *Zeacumantus subcarinatus*, *Zeacolpus pagoda*, *Xymene plebeius* and *Cominella glandiformis*. In some cases the decision over what is too small to be edible was fairly arbitrary and was made in the context of the generally small size of other gastropods in the midden,

Table 7 Minimum number of individuals (MNI) values of shell species at Maungarei from quantitative samples.

Cat. #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
AM028	453	31	1	1	1	1	—	2	4	7	1	3	—	—	11	516
AM030	100	8	—	1	1	—	—	—	1	1	—	—	—	1	4	117
AM273	139	2	—	—	—	—	—	—	—	—	—	—	—	—	17	158
AM018	365	7	2	—	—	—	—	—	—	1	—	—	—	—	8	383
AM020	427	8	1	—	—	—	1	—	—	—	—	1	—	1	5	444
AM341	882	13	—	—	—	—	—	—	—	2	—	4	1	—	9	911
AM019	257	2	—	—	—	—	—	—	—	1	—	—	—	—	2	262
AM014	141	5	—	—	—	—	—	—	—	1	—	—	—	—	—	147
AM015	72	1	—	1	—	—	—	—	—	1	—	—	—	—	—	75
AM092	157	—	—	—	—	—	—	—	—	1	—	1	—	—	—	159
AM274	497	1	—	—	—	—	—	—	—	—	—	—	—	—	—	498
AM016	135	—	—	—	—	—	—	—	—	—	—	—	—	—	1	136
AM017	78	1	—	—	1	—	—	—	—	—	—	1	—	—	—	81
AM021	95	3	—	1	1	2	—	—	1	3	—	10	—	1	2	119
AM271	92	4	—	1	1	—	—	—	—	1	1	1	—	—	—	101
AM272	65	2	—	—	—	—	—	—	—	1	—	—	—	—	—	68
AM344	799	5	—	—	—	—	—	—	—	2	—	1	—	1	6	814
AM345	633	4	1	—	1	—	—	—	—	—	—	—	—	1	3	643
AM343	75	2	—	2	—	—	—	—	—	1	—	1	—	—	—	81
AM340	128	14	7	—	—	—	—	—	—	—	4	1	—	—	3	157
Total	**5590**	**113**	**12**	**7**	**6**	**3**	**1**	**2**	**6**	**23**	**6**	**24**	**1**	**5**	**71**	**5870**

1, *Austrovenus stutchburyi*; 2, *Paphies australis*; 3, *Cyclomactra ovata*; 4, *Pecten novaezelandiae*; 5, mussels (see text); 6, *Paphies subtriangulata*; 7, *Ruditapes largillierti*; 8, *Macomona liliana*; 9, *Ostrea chilensis*; 10, *Lunella smaragdus*; 11, *Amphibola crenata*; 12, *Cominella* spp.; 13, *Amalda australis*; 14, *Diloma zelandica*; 15, several species too small to be eaten (see text).

notably the cats eye, and of the main components, cockles and pipi, as described below. Also too small to be eaten are a few specimens of the bivalve *Nucula hartvigiana*, tiny examples of both *Ostrea chilensis* and rock oyster (*Saccostrea glomerata*), and one very small chiton, represented by several plates.

Edible examples of shellfish species not represented in the quantitative samples but hand-picked during excavation include the bivalves toheroa (*Paphies ventricosa*), *Dosina zelandica*, *Tucetona laticostata* and rock oyster and gastropods *Dicathais orbita*, *Alcithoe arabica*, *Melagraphia aethiops* and *Penion sulcatus*.

All the identified shells except the single toheroa and perhaps the tuatua (*Paphies subtriangulata*) could probably have been collected in or near the Tāmaki Estuary. All are recorded in the comprehensive list of mollusc species observed in the intertidal zone of the estuary and around its mouth by Hayward & Morley (2005: 58–63), although some were represented in that study only by dead shells. Despite the emphasis on cockles, the range of species present suggests that Maungarei people were gathering from more than one zone – from the mouth of the estuary up at least as far as the Panmure Basin, and from both the intertidal flats and the adjacent rocky areas.

In the 1990s, the densest cockle beds in the Tāmaki Estuary were at Farm Cove, northeast of Maungarei on the other side of the channel (Clark 1997: 35), although cockles were present throughout the estuary. In their more recent study, Hayward & Morley (2005: 27) show restricted occurrences of pipi from fairly close to the entrance to well above the Panmure Basin. The bivalves *Macomona liliana* and *Cyclomactra ovata* are likely to be found in the same places as

Table 8 Minimum number of individuals (MNI) values of Maungarei shells, all samples combined.

Taxon	MNI	%
Principal species	5590	95.2
Austrovenus stutchburyi (cockle)		
Secondary species	113	1.9
Paphies australis (pipi)		
Minor edible species	96	1.6
Cominella sp.	24	
Lunella smaragdus (cats eye)	23	
Cyclomactra ovata	12	
Pecten novaezelandiae (scallop)	7	
Amphibola crenata (mudsnail)	6	
Ostrea chilensis	6	
Mussel species*	6	
Diloma zelandica	5	
Paphies subtriangulata (tuatua)	3	
Macomona liliana	2	
Ruditapes largillierti	1	
Amalda australis	1	
Tiny inedible species	71	1.2
Total 5870	**99.9**	

*See text.

cockles and pipi, but are deep burrowers and require much greater effort to gather. *Amalda australis* is also an estuarine species, as is the carnivorous *Alcithoe arabica*, now rare in the estuary but thought to have been formerly abundant (Hayward & Morley 2005: 33). The mudsnail is particularly associated with mangroves in northern New Zealand (Morton & Miller 1968: 554) and is today confined to the parts of the Tāmaki Estuary inland from Maungarei, from the Panmure Basin south (Hayward & Morley 2005: 26).

The cats eye is common on rocky outcrops in the estuary and around its mouth but is also found grazing on large brown low-tidal seaweeds (Hayward & Morley 2005: 14). Both species of mussel and the indigenous rock oyster, along with the predatory *Dicathais orbita*, would also have been found in the rocky parts of the estuary or its entrance, although the New Zealand rock oyster has now been replaced throughout the estuary by the Pacific oyster (*Crassostrea gigas*). *Diloma* and *Melagraphia aethiops* are boulder- or stone-dwellers, which would also be found in rocky areas.

Ruditapes largillierti and *Dosina zelandica* were reported from the mouth of the estuary as 'offshore bottom communities' (Morton & Miller 1968: 583, citing Powell 1937), but Morton and Miller also describe *Ruditapes* as sometimes found on *Zostera* flats (1968: 543) and *Penion sulcatus* as preying on *Dosina* on patches of sand among low tidal rocks (1968: 162). According to Hayward & Morley (2005: 2), *Zostera* (seagrass) disappeared from the Tāmaki Estuary in the 1950s and 1960s but is now making a comeback.

The single fragment of toheroa could not have been collected nearby and, judging from modern distributions, is likely to have come from an Auckland west coast beach such as Muriwai or South Kaipara, either as part of a gift of food or, perhaps, as a tool. The southern end of Muriwai Beach is about 40 km from Maungarei as the crow flies and considerably more for anyone travelling by canoe and on foot. Similarly, the tuatua would not have been found within the estuary. The nearest source today would be Takapuna or Milford beaches on the North Shore, about 20 km away by canoe.

Scallops raise an interesting question. They inhabit shallow sand banks as well as deeper waters, and are 'mobile and somewhat migratory' (Morton & Miller 1968: 548). They have been easily gathered from shallow waters in the Manukau Harbour in recent times and Hayward & Morley (2005: 38) report that two live specimens were found at Bucklands Beach, east of the Tāmaki Estuary, in 1991. However, in view of the intense gathering of shellfish by the people of Maungarei, it seems unlikely that scallop beds would have survived very long in the vicinity. Two flat valves from Maungarei appear to have been worked (described above). It therefore seems likely that scallops were brought to the site from further afield, either as part of a gift of food, or as dead shells for other purposes.

Similarly, it seems unlikely that examples of the large, relatively deep-water bivalve *Tucetona laticostata* were items of food. They may have reached the site either as curiosities or, like the curved valves of scallops, for some use, such as scraping tools or small containers for pigment or other small items.

The shellfish described above as too small to be edible require explanation. Similar small shells (and sometimes also clearly dead shells) have been found in other sites in this part of Auckland and have usually been interpreted as incidental products of gathering practices (e.g. Fredericksen & Visser 1989: 98). Both *Cominella glandiformis* and *Xymene plebeius* are scavengers on cockle beds (Morton & Miller 1968: 398,

490) and the tiny bivalve *Nucula hartvigiana* occurs in quantities on *Zostera* flats and in association with pipi and cockles (Morton & Miller 1968: 490, 535, 543). The most numerous of the small shells are the two species of *Zeacumantus*, which are vegetarian browsers, present in large quantities on mudflats and, in the case of *Zeacumantus subcarinatus*, also in rockpools. *Zeacumantus lutulentus* is particularly typical of mangrove areas, in association with the mudsnail, but there is no clear association with mudsnails at Maungarei. It does therefore seem likely that these shells are a by-product of the gathering of pipi and cockles. As there are likely to have been huge quantities of *Nucula* in the vicinity of cockle and pipi beds, the presence of only three individuals in the quantitative samples from Maungarei suggests that gathering practices usually filtered them out. Single examples of small *Ostrea*, *Saccostrea* and *Zeacolpus pagoda* are probably shells from already-dead animals; *Zeacolpus pagoda* is an open-shore and deep-water species.

The results of the shell analysis are similar to those from other sites in the vicinity, such as Taylor's Hill to the north (Leahy 1991: 62–63), and Westfield (Furey 1986: 12), the Tamaki River pā (Foster & Sewell 1999: 16) and Waipuna (Clough & Turner 1998: 24) to the south. Cockles dominated in all these sites, although only at Westfield did they constitute more than 95% of the samples, as at Maungarei. Pipi are somewhat more significant in other sites. However, at Cryers Road, further up the Tāmaki Estuary and on the eastern side, cockles made up 98% or more of all samples analysed (Fredericksen & Visser 1989: 99).

Since cockles are by far the most important shellfish at Maungarei, some comments should be made about their food value. Vlieg provides useful nutritional information on this species per 100 g of wet weight (Vlieg 1988: 47, 80):

Protein	8.2 g
Oil/fat	0.9 g
Soluble carbohydrate	0.6 g
Moisture	87.8 g
Ash	2.5 g
Energy	43 kCal

These values can be compared with those for some other marine foods available to Māori in the Auckland area (Fig. 46). There is not much to choose between cockles and pipi as far as food value is concerned; of the marine foods compared, these two shellfish have by far the lowest values for protein and lipids. At a level of energy consumption of about 2000 kCal/day, a person living only on cockles would have to consume about 4.7 kg of wet cockle meat per day. The average amount of wet meat per kg of total shell weight harvested is 109 ± 3 g. For a person to obtain this daily amount of 4.7 kg of cockle meat, about 42.7 kg of cockle shells would have to be harvested and, in this case, carried up the slopes of Maungarei. A group of 100 people would need 4.3 tonne per day. This shows that cockles are a very poor-quality food, and could only ever be considered a garnish at best. It is well known that a person attempting to live on cockle meat alone would soon die of starvation (Leach 2006: 234).

Cockle size

A noticeable aspect of the midden deposits on Maungarei is the apparently small size of almost all the shells. This is most obvious in the numerous small cockles and pipi. It appears to be true of most of the gastropods as well, although they are too few and too fragmentary to measure. Mt Wellington Borough Council workmen who visited the excavation in 1971 volunteered the information that small pipi in the excavations were comparable in size (*c.* 30 mm) to those present in the Tāmaki Estuary at that time.

Hayward & Morley (2005: 45), citing their own work and that of Stewart (2004), state that modern cockles in the Tāmaki Estuary have a smaller mean size than those elsewhere in Auckland, although they also claim (with no references) that they are 'much smaller than old shells in middens'. Pollution of the Tāmaki Estuary and siltation are seen as likely reasons for the small size of modern cockles. A study of cockles in the estuary in the 1990s (Clark 1997) showed a strong correlation between high levels of fine silt and small cockle size, although the interrelationships of size, density and environmental factors were complex.

Measurements of individual cockle shells in six of the analysed quantitative samples from Maungarei were taken with digital callipers and captured electronically in a database for analysis. There is some confusion in publications relating to cockle measurements, with the term 'length' having several definitions. The parameters used by Williams *et al.* 2008 are used here (Fig. 47), with definitions as follows:

SL (shell length) Maximum shell dimension parallel to the direction of movement in cockles, approximately along the axis through anterior and posterior adductor muscles, and perpendicular to any axis passing through the hinge (umbo).

SH (shell height) Maximum dimension from dorsal hinge (umbo) to the most extreme edge of the ventral shell margin.

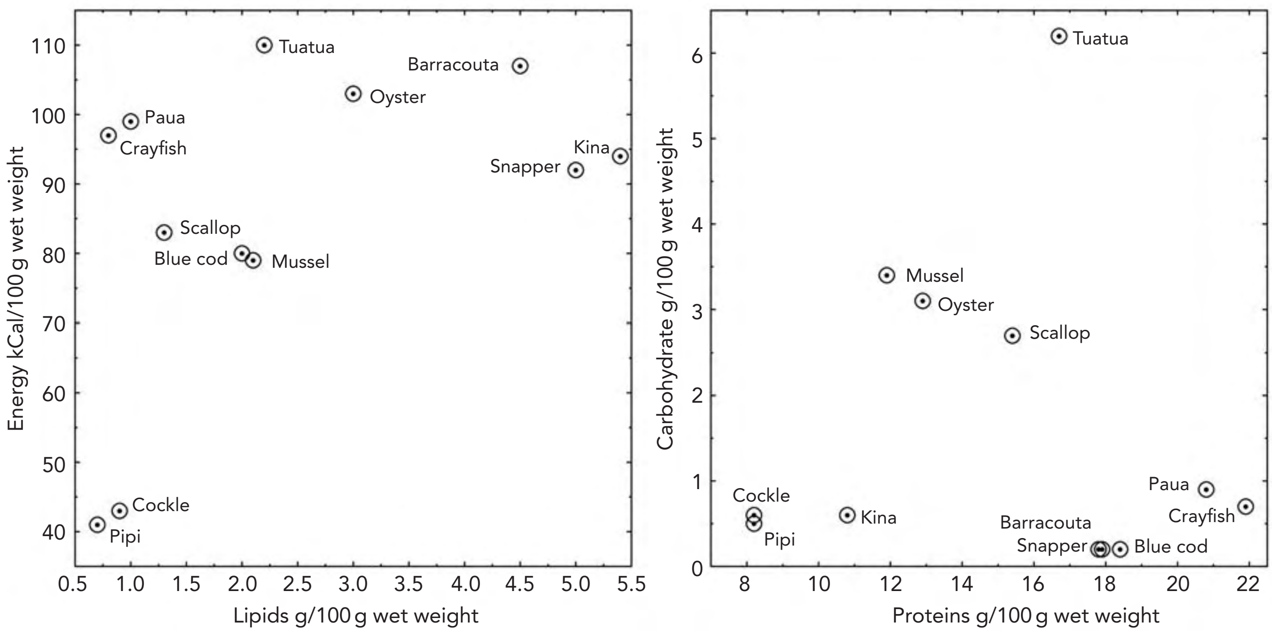

Fig. 46 Nutritive values of cockles compared with other commonly available marine foods (reproduced from Leach *et al.* 2001: 09–10).

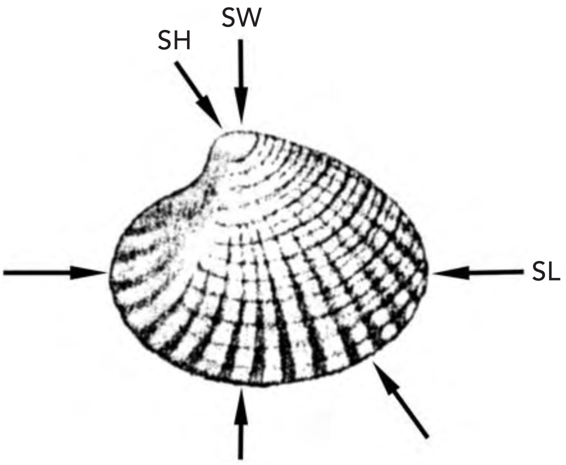

Fig. 47 Cockle measurements. SL, shell length; SH, shell height; SW, shell width.

SW (shell width) Axis perpendicular to the shell length dimension, from dorsal hinge (umbo) to ventral shell margin.

Regression equations are available linking these parameters together (Williams *et al.* 2006). The measurement taken on cockles from Maungarei and other sites discussed here is the SL dimension. Basic dispersion statistics were calculated for the six samples. These results are compared with those for two archaeological samples from Kauri Point Pā on Tauranga Harbour in the Bay of Plenty, and archaeological and modern samples from Pauatahanui Inlet north of Wellington (Table 9). Size-frequency histograms for the Maungarei samples are given in Fig. 48.

At first glance it appears that the Maungarei size-frequency histograms are all very similar and the statistics not particularly different. However, closer scrutiny reveals some interesting differences and features. The first notable feature is that all these cockles are small. This is a well-known feature of Auckland archaeological cockles, probably first noted by Best (1927: 221) and regularly commented on by archaeologists, although usually without documentation, from the 1950s to the present.[8]

Modern fisheries management of cockle biomass is based upon current understanding of the biology of this species:

> Maori and recreational fishers prefer cockles of 30 mm shell length and greater whereas commercial fishers currently prefer cockles of 25 mm and greater. … As cockles become sexually mature at around 18 mm, using a size of recruitment between 25 mm and 30 mm should provide some protection against egg overfishing under most circumstances. However, using the smaller size of recruitment to estimate yield will confer a great risk of overfishing. (Annala *et al.* 2003: 116)

The comments about harvesting preferences are not supported by any evidence, and are somewhat naive. Recent

Table 9 Maungarei cockle length statistics compared with those from Kauri Point Pā and Pauatahanui Inlet.

						Skewness		Kurtosis	
Site	**No.**	**Min.**	**Max.**	**Mean**	**SD**	**g1**	**w1**	**g2**	**w2**
AM345	243	16.73	31.68	22.10 ± 0.15	2.33 ± 0.11	0.50	4.57	4.19	3.98
AM344	354	10.32	29.75	21.90 ± 0.14	2.70 ± 0.10	-0.43	5.05	5.05	8.10
AM341	561	11.17	42.97	20.84 ± 0.12	2.71 ± 0.08	1.13	10.35	10.83	38.43
AM018	365	10.73	31.60	19.92 ± 0.16	3.14 ± 0.12	0.55	5.83	4.11	4.48
AM028	429	11.50	36.70	19.59 ± 0.17	3.59 ± 0.12	1.32	9.76	5.44	10.55
AM030	97	15.13	29.82	20.28 ± 0.32	3.16 ± 0.23	1.09	4.33	3.90	2.10
Kauri – 11	310	15.00	34.50	22.38 ± 0.27	4.71 ± 0.19	0.94	7.05	2.77	0.78
Kauri – 6	813	11.00	42.00	23.11 ± 0.17	4.84 ± 0.12	0.30	6.35	2.76	1.38
Paua – Old	5753	15.10	66.00	38.45 ± 0.07	5.44 ± 0.05	0.69	25.73	4.39	21.65
Paua – Mod.	27288	2.00	56.00	21.54 ± 0.04	6.52 ± 0.06	-0.01	6.27	3.09	3.04

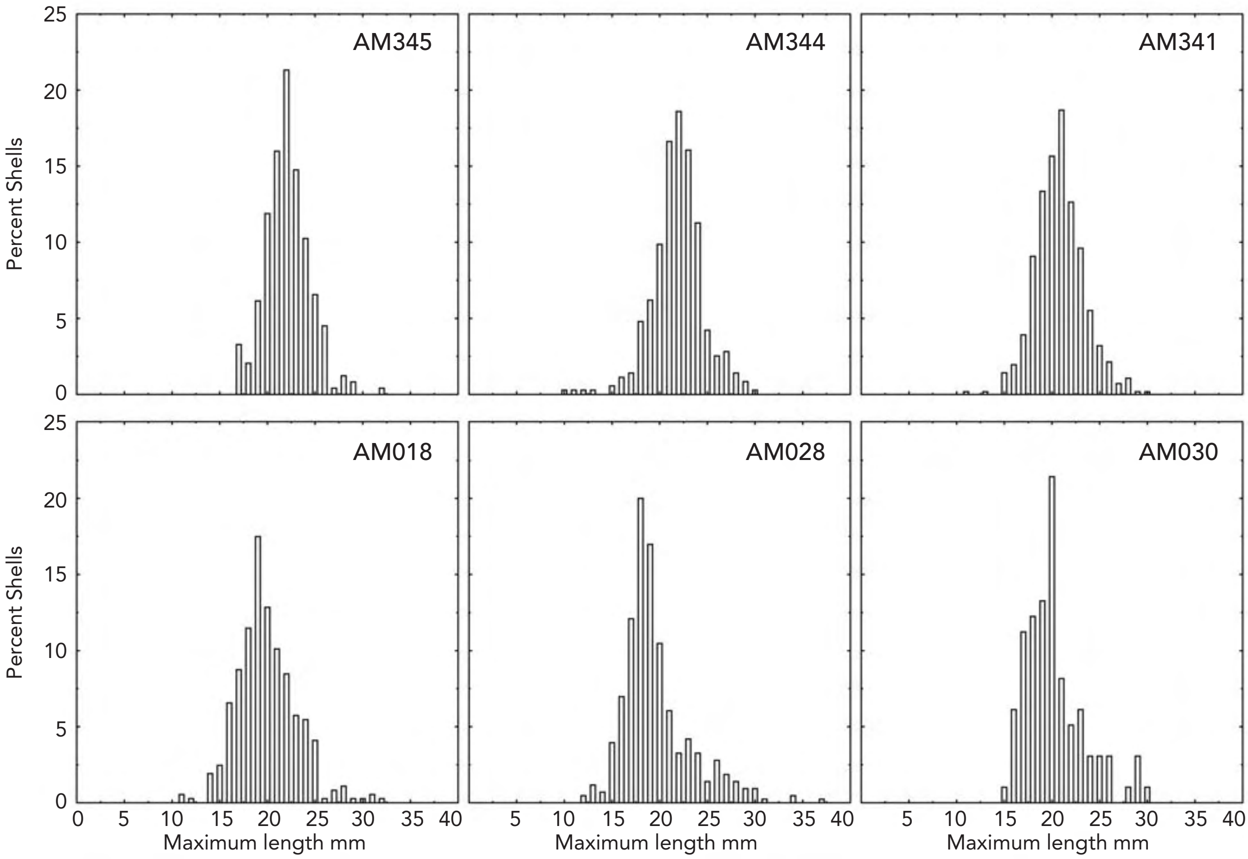

Fig. 48 Size-frequency histograms of cockle shell length (SL) from Maungarei. See Table 9 for statistical data relating to these histograms.

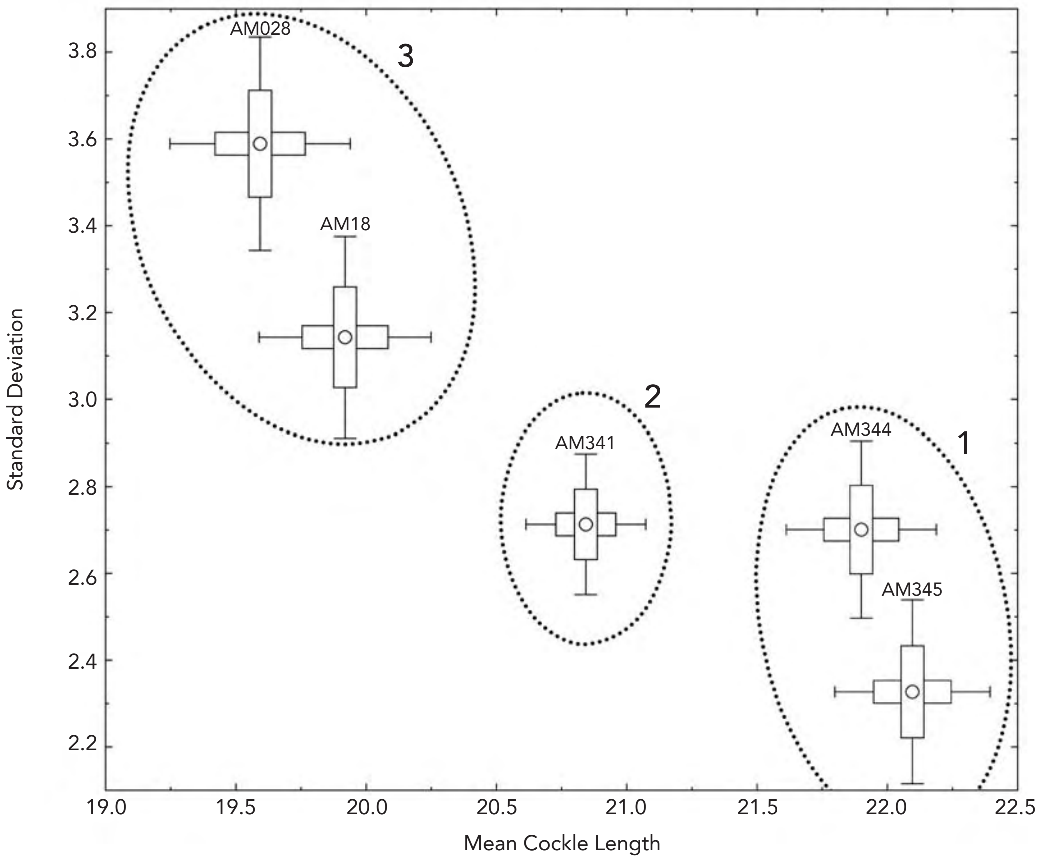

Fig. 49 Cockle mean sizes and standard deviations for three time periods at Maungarei. Those circled are not significantly different from each other. See Table 9 for statistical data relating to these plots.

research suggests that sexual maturity is closer to 20 mm (Williams *et al.* 2008: 14). This puts the Maungarei cockle sizes in sharp relief, indicating that the people of this site were harvesting very small cockles indeed. If the 20 mm figure is accepted, more than 42% of the total catch is sexually juvenile. Such a harvesting strategy would certainly have a dramatic effect on population dynamics in a fairly short period and, if sustained over a long period (hundreds of years), could easily result in rapid evolution in favour of a change in growth rate for the species, possibly a slowing down to avoid capture. Such rapid evolution has been documented for other marine species subjected to size-selective harvesting pressure (Leach 2006: 301–302).

All but one of the size-frequency histograms from Maungarei display significant positive skewness (g1>0 and significance above $p = 0.05$, i.e. w1>1.96), which certainly indicates that people were harvesting as many larger specimens as they could find. Sample AM345 (from relatively early in the site's history) shows significant negative skewness, which is curious. The only other sample that is similar in this respect is the modern population sample from Pauatahanui. The latter is not surprising because this sample was deliberately taken to include every shell down to the tiniest. At Maungarei, cockles as small as 10.3 mm were being harvested and taken up to the site to be consumed as food. This is remarkable, as the amount of food in such small specimens could hardly be worth the effort of capture and transport. This suggests mass harvesting without taking much notice of size. It is not necessary to use a wooden-pronged shell-rake to achieve this. One common way of gathering cockles is to use both hands with fingers spread a little open, pushing them through the sandy substrate; the fingers act as a rake and capture all shells down to the size that will not pass through the gap between them. The two hands are then put together and shaken in the water to remove sand and grit, and all shells are placed in a container. If large cockles are readily available, the fingers can be opened up wider apart so that small specimens slip through.

Close scrutiny of the mean and standard deviation figures for Maungarei reveals some surprising indications of the effects of people on the nearby cockle population over time. A student's t-test was carried out on all pairs of the six samples (15 tests). Of these, only pairs AM345/AM344, AM341/AM030, AM018/AM028, AM018/AM030 and AM028/AM030 proved not to be significantly different. When the means and standard deviations are plotted out, together with their appropriate standard errors, these patterns of significance and lack of it are more readily observed (Fig. 49).

There are three clusters in Fig. 49. The samples are arranged in chronological order from earlier to later, as follows:

AM344, *AM345* Two samples from one layer below the Lower Terrace in Area D, preceding terrace construction.

AM341 One sample from a lower midden layer on the scarp above the Upper Terrace in Area D, post-dating construction of the terrace and its use for pit storage.

AM018 One sample from an upper midden layer on the scarp above the Upper Terrace in Area D, post-dating construction of the terrace and its use for pit storage.

AM028 Upper fill of Pit 3, part of the late occupation in Area C on the crater rim.

The largest cockles are in the two early samples labelled 1, which are not significantly different from each other. The most recent samples are those labelled 3. These last samples cluster together as not significantly different. They are the smallest cockles. The sample labelled 2 is intermediate in size between these two clusters and is significantly different from both. Unfortunately, the sixth sample, AM030 from the lower fill of Pit 3, was very small ($n = 97$) and not so easily distinguished from other nearby samples. It falls within the cluster labelled 3, but has been omitted from Fig. 49. AM341/AM030 narrowly fails the significance test ($t = 1.96$, $p = 0.05$) with $t = 1.66$.

Thus, there is evidence here that the average size of cockles in the harvest was declining over time from small to even smaller. It is interesting to see that the standard deviation also appears to have been changing through time. The later samples had larger standard deviations than the earliest ones. This suggests that whatever selective harvesting behaviour was being practised earlier on had to be abandoned in favour of gathering everything possible later in time, perhaps by narrowing the gap between fingers.

The earliest cockle samples from Maungarei are highly unlikely to date before AD 1450, so it is important to recognise that they do not represent harvesting from a population of virgin biomass. Just what the original cockle population in this area looked like is unknown; to shed any light on this requires earlier archaeological samples to be found and examined.

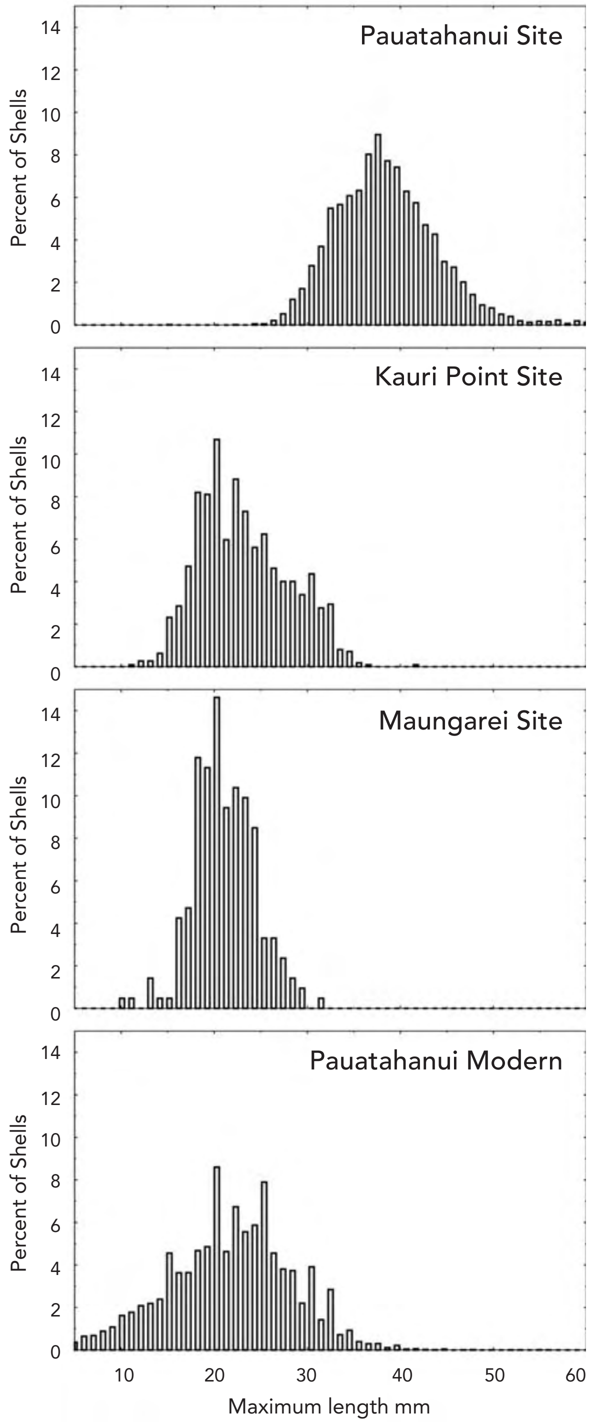

Fig. 50 Comparison of the Maungarei cockle shell lengths with others from New Zealand. See Table 9 for statistical data relating to these histograms.

A clue to the possible extent of change from virgin biomass to that which prevailed during the period of occupation at Maungarei is provided by a comparison of archaeological and modern cockles at Pauatahanui (Fig. 50). At this site, which was occupied between about AD 1450 and 1550 (Leach *et al.* 2009: 23), people were harvesting cockles that, compared to those at Maungarei, seem enormous. No doubt this was the result of selective harvesting behaviour, but such large cockles must have been present to be gathered. It can be seen from Fig. 50 that such large cockles simply do not exist in the Pauatahanui Inlet today. In fact, the mean size of cockles today is strikingly similar to that of archaeological cockles from Maungarei and Kauri Point. Such a dramatic change is thought to be a combination of human predation and deteriorating water quality over time, exactly the same causes in place in the Tāmaki Estuary, albeit with much larger human populations, both prehistoric and historic, at the latter. Whether earlier archaeological samples of cockles from the Tāmaki Estuary will prove to be like those from the Pauatahanui site remains to be seen, although there is no obvious environmental reason why this should not be so.

The Kauri Point samples are both from the early part of the sequence at that site as described by Ambrose (n.d.) and are broadly dated by radiocarbon sample ANU 25, calibrated as AD 1330–1570 (2σ)(Green 1978: 43). It would appear that here, too, there must have been heavy prior exploitation of cockle beds, and/or siltation of the harbour following forest clearance. In her pioneering study of shellfish-gathering in pre-European New Zealand, Swadling (1972, 1977) identified the cockles from the early site at Mt Camel in the far north as being close to an unexploited population, while those from later sites in the vicinity showed effects of human harvesting. The size range at Mt Camel was 26–48 mm and the average size 36.4 mm. These measurements are similar to those of the archaeological cockles from Pauatahanui.

Fish

The study of fish bones followed the procedures outlined by Leach (1986). Number of identified specimens (NISP) and MNI values were calculated. Tables 10 and 11 show the distribution of fish according to area. The relative abundance of each species in the total assemblage is given in Fig. 51. There are no significant differences between areas.

As noted above, fish bones were hand-picked by excavators from the deposits in Areas A, C and D, and this unsystematic collection provides the main body of fish remains from the site. However, fish remains were identified from three of the bulk samples. An MNI of one snapper was present in each case, together with an elasmobranch, a kahawai and a gurnard in sample AM021. This total of six fish from the relatively tiny volume of the combined bulk samples suggests a higher presence of fish in the site than is reflected by the size of the existing collection of hand-picked bones.

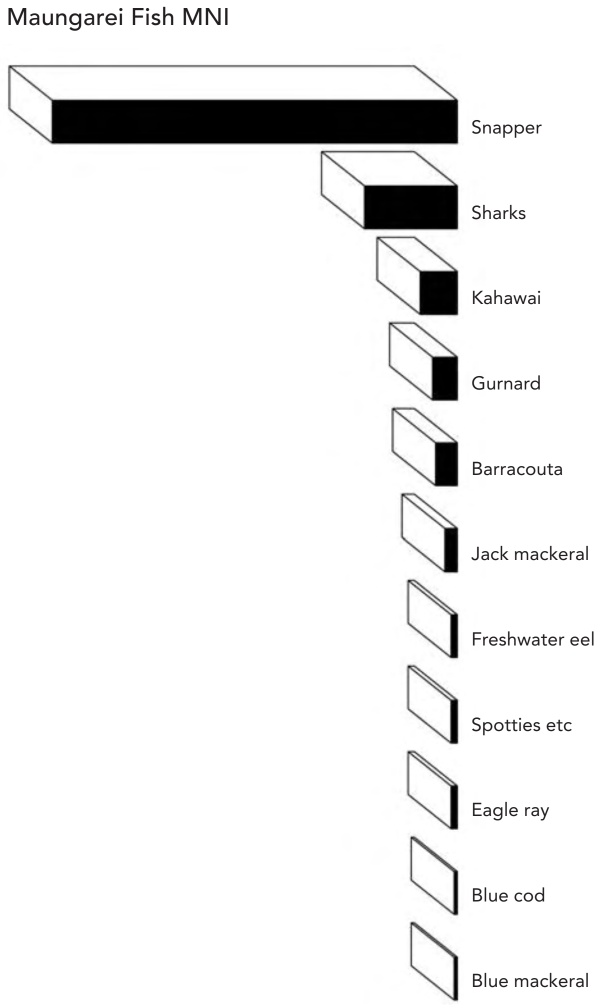

Fig. 51 The relative abundance of fish species at Maungarei. The total minimum number of individuals (MNI) value is 200.

Although some of the fish found at Maungarei could have been taken in the Tāmaki Estuary, it is highly unlikely that all of them were. The Maungarei people would have been travelling by canoe to more distant fishing grounds, probably around the nearby islands of Rangitoto, Motutapu and Motuihe (Fig. 2). The southern tips of Rangitoto and Motuihe are only about 5 km by canoe from the mouth

Table 10 Maungarei fish: minimum number of individuals (MNI) and number of identified specimens (NISP) values by area.

Family/Class	MNI								NISP
	1	2	3	4	5	6	Total	%	Total
Sparidae: snapper	26	5	61	14	25	—	131	65.5	224
Chondrichthyes: sharks, rays	1	1	17	3	8	—	30	15.0	106
Arripidae: kahawai	1	1	6	—	4	—	12	6.0	16
Triglidae: gurnard	—	—	7	—	1	—	8	4.0	10
Gemphylidae: barracouta	1	1	1	—	4	—	7	3.5	7
Carangidae: jack mackerel	—	—	2	—	1	1	4	2.0	6
Anguillidae: freshwater eel	—	—	2	—	—	—	2	1.0	2
Labridae: spotty, etc.	1	—	1	—	—	—	2	1.0	3
Myliobatidae: eagle ray	—	—	2	—	—	—	2	1.0	2
Mugiloididae: blue cod	1	—	—	—	—	—	1	0.5	1
Scombridae: blue mackerel	—	—	1	—	—	—	1	0.5	1
Totals	**31**	**8**	**100**	**17**	**43**	**1**	**200**	**100**	**378**

1, Area A; 2, Area C; 3, Area D Upper Terrace; 4, Area D Lower Terrace; 5, Area D Midden Squares; 6, context unknown.

Table 11 Maungarei Fish: minimum number if individuals (MNI) percentage and standard error by area.

Family/Class	1	2	3	4	5	6
Sparidae: snapper	83.9 ± 15.0	62.5 ± 45.0	61.0 ± 10.2	82.4 ± 22.4	58.1 ± 16.3	—
Chondrichthyes: sharks, rays	3.2 ± 8.1	12.5 ± 32.7	17.0 ± 7.9	17.6 ± 22.4	18.6 ± 13.1	—
Arripidae: kahawai	3.2 ± 8.1	12.5 ± 32.7	6.0 ± 5.2	—	9.3 ± 10.1	—
Triglidae: gurnard	—	—	7.0 ± 5.6	—	2.3 ± 5.8	—
Gemphylidae: barracouta	3.2 ± 8.1	12.5 ± 32.7	1.0 ± 2.5	—	9.3 ± 10.1	—
Carangidae: jack mackerel	—	—	2.0 ± 3.3	—	2.3 ± 5.8	100 ± 50
Anguillidae: freshwater eel	—	—	2.0 ± 3.3	—	—	—
Labridae: spotty, etc.	3.2 ± 8.1	—	1.0 ± 2.5	—	—	—
Myliobatidae: eagle ray	—	—	2.0 ± 3.3	—	—	—
Mugiloididae: blue cod	3.2 ± 8.1	—	—	—	—	—
Scombridae: blue mackerel	—	—	1.0 ± 2.5	—	—	—
Totals	**100**	**100**	**100**	**100**	**100**	**100**

1, Area A; 2, Area C; 3, Area D Upper Terrace; 4, Area D Lower Terrace; 5, Area D Midden Squares; 6, context unknown.

of the Tāmaki Estuary. This raises an important question about the extent of the harvesting territory of Maungarei people and their relationships with neighbouring groups, considered below.

As discussed below, the size range of snapper brought to the site suggests the use of several kinds of nets. Although no items of fishing gear were found in the excavations, fish such as kahawai, barracouta and jack-mackerel were often taken on lures. Larger snapper were often taken with baited hooks. However, the absence of any durable items of fishing equipment at the site means it is quite possible that all these fish were taken by netting. There is abundant ethno-historical information from the time of Captain Cook onwards about the widespread use of large seine nets in the northern half of the North Island (Leach 2006: 109–113). Eagle rays frequent inshore waters, especially during summer months, and play havoc with nets when they are caught.

The Maungarei fish assemblage is typical of northern North Island assemblages, which are dominated by snapper (Leach 2006: 163, 164). Leach (2006: appendix 1) provides MNI for 26 assemblages from the northern North Island, studied using the standard methodology: two small assemblages from the Tāmaki Isthmus, six from four sites on nearby Motutapu Island, six from Northland, two from Great Barrier Island (Aotea Island), two from the Hauraki Plains and eight from the Coromandel Peninsula. Snapper were present in all except one very small Northland assemblage and dominant in most; kahawai, labrids, barracouta, gurnard and blue cod were also well represented in sites, although in much smaller numbers. Jack mackerel are not distinguishable in this list from other Carangidae, notably trevally. Blue mackerel occur in few sites. Species numerous in some sites but not present at Maungarei include tarakihi, leatherjacket (typical of rocky shore habitats of the Coromandel) and yellow-eyed mullet.

The presence of only two eels at Maungarei, despite the proximity of extensive wetlands, is not surprising, as eels are absent from most of the assemblages considered above and, if present, usually represented by very few individuals. There is an MNI of three eels from Hot Water Beach on the Coromandel Peninsula and one from each of five other sites. Irwin (2004: 242) comments that eels were 'anomalously absent' from the late Māori lake village of Kohika in the Bay of Plenty, but this is in fact typical rather than anomalous in sites where fish bones have been studied.

One of the interesting features of the Maungarei assemblage in this comparison is the relatively high proportion of Chondricthyes. It could be argued that the MNI is inflated, since the identified specimens are nearly all vertebrae, but their very wide distribution through a diversity of contexts suggests that this is not so. Seasonal shark fishing is said to have been important in the middle Waitematā Harbour in the vicinity of Kendall Bay and Kauri Point (Graham 1910), and sharks caught there may have been dried and taken elsewhere for later consumption (Davidson 1990: 13). Murdoch (n.d.: 16) notes that the use of important shark-fishing grounds between the Waitematā Harbour and Kawau Island was a cause of dissension between the people of Tāmaki and Hauraki.

Fish bones have been less systematically identified in small assemblages from a number of salvage excavations in the vicinity of Maungarei. Again, snapper predominate when numbers are given, as at Taylor's Hill (Leahy 1991: 62), Westfield (Furey 1986: 13), and one excavation at Hamlins Hill (Pearce 1975: 196). Ten species of fish are reported from Fisher Road (Foster & Sewell 1988: 63, 1989: 20) but only by presence. The Fisher Road assemblage includes all the species found at Maungarei except eels, labrids and eagle rays, plus trevally, stargazer and yellow-eyed mullet. It should be noted that the amount of fish remains recovered from these sites is very small.

Snapper size

Live fork lengths of snapper were estimated from the bones using the method described by Leach & Boocock (1995). Statistical data are presented in Table 12 with comparative data from seven other New Zealand sites. Size-frequency diagrams are given in Fig. 52. Several things are notable about the snapper caught by the people at Maungarei. First, some were tiny, the smallest being a mere 128 mm long and 43 g in weight. The size-frequency diagram shows that there were notable numbers of these small snapper as a separate node. They are in the age range of only one to three years, and could have been caught only by some trapping method, presumably a very small mesh net. There would be little food on such small fish. None of the small bones shows signs of gastric erosion, so they are not from the stomach contents of larger fish.

Second, the people at Maungarei also had access to very large snapper. The biggest had a fork length of 903 mm, and is estimated to have weighed 14.1 kg. This is at the extreme end of the size range of snapper in New Zealand, and

Table 12 Maungarei snapper live fork length statistics compared with a selection of other sites.

						Skewness		Kurtosis	
Site	**No.**	**Min.**	**Max.**	**Mean**	**SD**	**g1**	**w1**	**g2**	**w2**
Maungarei	145	128	903	428.6 ± 13.3	160.6 ± 9.4	0.12	1.74	2.78	0.46
Houhora	8847	218	1010	490.5 ± 0.9	81.6 ± 0.6	0.33	22.07	3.79	15.28
Twilight	1914	176	994	532.0 ± 2.3	102.5 ± 1.7	0.37	10.85	3.64	5.73
Galatea	212	246	799	464.2 ± 7.1	103.2 ± 5.0	0.52	4.36	3.35	1.15
Cross Creek	997	146	782	400.0 ± 3.0	94.9 ± 2.1	0.28	6.86	3.27	1.80
Foxton	1080	239	953	471.5 ± 3.0	100.0 ± 2.2	0.48	9.32	3.44	3.04
Mana Island	527	266	939	463.7 ± 5.1	116.1 ± 3.6	0.70	7.92	3.17	0.84
Rotokura	824	138	870	575.0 ± 3.3	93.5 ± 2.3	-0.38	7.21	4.87	11.09

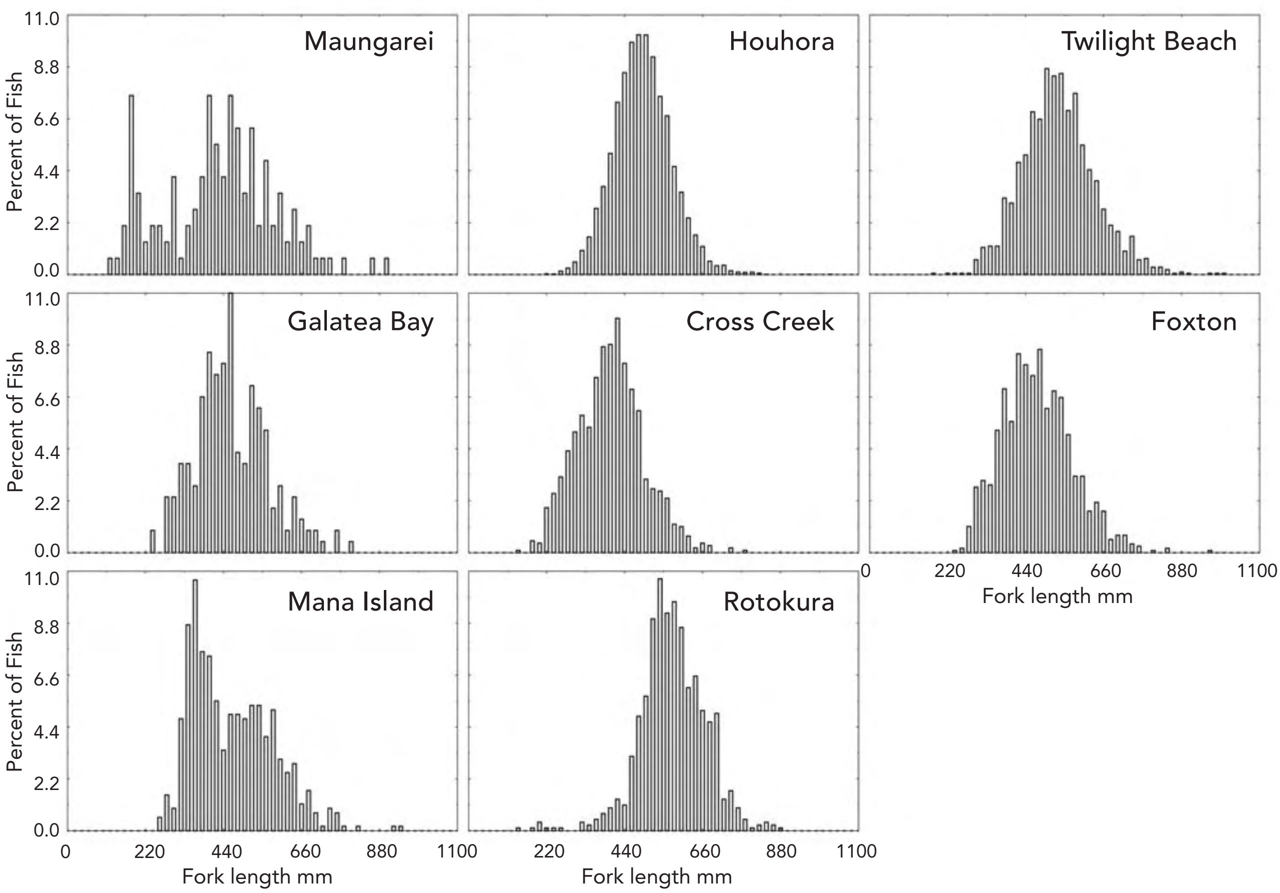

Fig. 52 Size-frequency histograms of snapper fork length from Maungarei and several other sites for comparison. See Table 12 for statistical data relating to these catches.

whenever a fish of such a size is caught today it is likely to make the national news. In Table 12 it will be seen that such monsters also occur in other archaeological sites.

Third, the shape of the Maungarei snapper size-frequency curve is clearly multi-nodal, something not seen with such clarity in other archaeological catches. This suggests that the Maungarei people were harvesting shoals of specific age cohorts that entered the estuarine waters from the Hauraki Gulf and were mass captured at these times. Juvenile shoaling snapper are known to have visited the upper reaches of estuaries in the Auckland area in former times. After about four years of age, snapper tend to become more independent of their age cohort. The larger specimens in the snapper catch may have been taken with baited hook and line despite the lack of evidence of fishhooks in the site.

Most archaeological sites have snapper size-frequency distributions that display significant positive skewness with values of g1 greater than zero in Table 12. Values of g1 are significant if their associated normalised deviates (w1) are greater than 1.96 ($p = 0.05$). Although the value of g1 for Maungarei is positive, w1 is less than 1.96 and is therefore not significant. The only site that displays significant negative skewness is Rotokura and, like Maungarei, this site also had some extremely small snapper.

The kurtosis values are also interesting. Archaeological snapper catches sometimes have a pronounced leptokurtic character, or positive kurtosis (a narrower peak than the shape of a normal distribution). This is indicated by a value for kurtosis (g2) that is greater than 3.0. Significance is again indicated by the associated value of w2 being greater than 1.96. It is thought that this leptokurtic shape is due to the use of gill nets, which are selective by size, so that both larger and smaller specimens escape. Leptokurtosis is therefore a fairly good indicator for the use of gill nets. Five of the sites in Table 12 have this feature to a significant degree. Maungarei, on the other hand, stands out with a value of g2 less than 3.0 (platykurtic), although w2 is not significant. This odd result reflects the multi-nodal shape of the size-frequency curve. The most likely interpretation is that several kinds of net were being used by the Maungarei people.

As has been seen above, the snapper MNI for Maungarei was 131 fish. The mean live weight of these fish is estimated to have been 2177 ± 184 g. One way of calculating the total weight of fish this represents is the mean weight × MNI, which would be 285,150 g. An alternative way of calculating the total weight is adding up the weight of each individual fish represented by bones that can be measured. This estimate is 315,624 g. The two values are reasonably close together, representing a fish catch of about 300 kg. It should be remembered that this probably represents a minuscule sample of the total catch of snapper carried up to the site.

Mammals and birds

The mammal and bird study is described in detail in Appendix 1.

European-introduced mammal remains identified include sheep, cattle and pig, all from near the surface, and rabbits from surface contexts and burrows. The sheep and cow would have been animals grazing in the Domain. The single pig bone, however, found in the turf layer in square E2 inside the crater in Area A, shows numerous knife cuts resulting from carving and is presumably the discarded remains of a relatively recent picnic.

A human tooth, patella and skull fragment could have derived from inadvertent disturbance of earlier burials during later terrace construction. A cut piece of human skull, however, indicates the use of human bone for artefact manufacture.

Rat bones were not assigned to species but, on the basis of size and context, it is thought that most, if not all, are the Pacific rat (*Rattus exulans*), introduced in pre-European times. Relatively few dogs are represented, and bones of individual dogs appear to have been widely scattered in the site. As argued in Appendix 1, the relative scarcity of the main limb bones of dogs may be due to the detachment of limbs and their removal for consumption elsewhere. This has also been suggested for Taylor's Hill (Leahy 1991: 68).

The few identified bird remains seem to reflect opportunistic capture, as most are not species that would normally be targeted. Both the definite and possible kiwi bones are from early contexts – the slope deposits pre-dating the formation of the lower terrace in Area D – as is the weathered piece of moa bone. This last may have been a curiosity, perhaps found in one of the lava tubes in the vicinity, as lava tubes have been a source of natural moa finds elsewhere in the Auckland volcanic field. The pūkeko is interesting, as these birds are seldom found in archaeological sites. In this case, the bone is from a definite and apparently secure midden context in the fill at the base of one of the pits on the Upper Terrace in Area D. The European-introduced red-legged partridge is a puzzle; it is from an apparently pre-European fill layer in one of the midden terraces, unassociated with any other faunal remains and therefore presumably intrusive.

Rat, dog and bird remains have been found in other sites in the area but generally in very small amounts, and bird bones have often been too fragmentary for identification. Where dog remains have been fully reported, there are both similarities and differences with Maungarei. At Fisher Road (Foster & Sewell 1989: 20) and Westfield (Furey 1986: 12–13), all body parts were represented. The largest assemblage is from Taylor's Hill, where an MNI of seven dogs, including a pup, was found. All body parts were represented, although here too there was an indication that some meat-bearing parts might have been detached and taken elsewhere. The most interesting feature of the Taylor's Hill dog remains, however, was the working of mandibles, presumably for fishhook point manufacture (Leahy 1991: 61). Taylor's Hill is also the only nearby site where bird bones have been identified:[9] pūkeko, harrier, little blue penguin, grey duck, teal and kākā (Leahy 1991: 62). The pūkeko is thought to be a recent arrival in New Zealand (Worthy 1999: 133). However, it was clearly established in Auckland by the time Maungarei and Taylor's Hill were occupied. It has recently been reported from a relatively early site on the Auckland west coast, just north of the Manukau Heads, in association with moa bone, which may, however, be industrial (Turner *et al.* 2010: 207–209).

The relatively large size of the Maungarei bird and mammal assemblage compared with other sites in the vicinity is partly a reflection of the extent of the midden deposits on the site, and is a further clear indication that Maungarei was a place where people were living and eating, not merely a storage facility or refuge.

Landsnails

No attempt has been made to extract landsnails from the various soil samples and residues of quantitative midden samples. However, landsnails large enough to be noticed were found in small concentrations and hand-picked from a number of layers in squares U16, U18 and U21 in Area D. These are almost all an introduced species of *Oxychilus*. However, one example of a native landsnail of the genus *Climocella* (not determined to species) was found amongst these introduced snails.

Landsnails, including both indigenous and introduced species, have been identified from several sites in this part of Auckland: Westfield (Furey 1986: 13), Fisher Road (Foster & Sewell 1988: 60) and Cryers Road (Fredericksen & Visser 1989: 114). The indigenous species in these sites indicate a mostly scrubby environment, but with some bush or rotting logs in the vicinity.

Discussion

The various excavations on Maungarei were concerned primarily with the chronology and structural history of this large and complex site. Nevertheless, the faunal material collected in 1960 and 1971–72 and retained for many years has provided useful insights into aspects of the economy of the people of Maungarei. Advances in faunal analysis since the excavations took place, particularly in the study of fish remains, have enabled old samples to provide interesting results.

The study of relative abundance of shell species at Maungarei has merely added to an already consistent picture of shellfish-gathering in the vicinity of the Tāmaki Estuary, developed by several previous researchers, in which there is a major focus on cockles and a secondary focus on pipi. It is clear that in sites like Maungarei, relatively small bulk samples (1–3 kg) will usually give an adequate picture of the relative abundance of shells brought to the site.

However, samples of this size are not adequate for metrical analysis of the shells. The amount of measurable shell varied considerably in the Maungarei samples: AM344 and AM345, subsamples of one layer, yielded only 617 complete right cockle valves from 9.6 kg of total sample, whereas AM341 yielded 561 from 2.3 kg. Of the samples measured from Maungarei (Table 9 and Fig. 49), the sample of 250 right valves was barely adequate and that of 97 right valves quite inadequate for discerning size differences between one archaeological horizon and another. At Pauatahanui, a minimum of 1000 measurements for each context was considered adequate (Leach *et al.* 2009). The amount of measurable shell per kilogram is actually high at Maungarei, where the shells are so small, compared with sites such as Pauatahanui and Raumati Beach (Leach *et al.* 2000). It is always advisable to err on the side of caution. An unsieved sample of 20 kg would be advisable at Maungarei for adequate measurements to be obtained.

In a site like Maungarei and in a salvage context, even a number of large bulk samples will not provide adequate amounts of fish and other bone, and hand-picking during excavation, unrepresentative though it may be, will always be necessary. No fish at all were identified in the 16.2 kg of bulk samples analysed from the Lower Terrace in Area D, and only five in about 20 kg of samples from the Upper Terrace.

Size reconstructions add an important dimension to our knowledge of the exploitation of shellfish and snapper in this part of Auckland. Measurements of individual shells from relatively large samples provide statistically reliable comparative data and can reveal slight but significant changes, as is the case here. The study documented the small size of Maungarei cockles and identified a trend from small to very small, but the interpretation of these findings is not so easy. The small size of cockles in the Tāmaki Estuary today is not just a result of modern pollution. Both archaeological and modern cockles show the effects of human impact, but still earlier archaeological cockles and better data about vegetation clearance and its possible effects on the Tāmaki Estuary are needed, before the history of cockles and other shellfish in the estuary can be fully understood.

Live fork length reconstruction of snapper from Maungarei has revealed a rather unusual pattern with interesting implications for the fishing methods of Maungarei people. They carried not only a great many small cockles up the hill, but large numbers of very small snapper and some very big ones as well. The small size of much of the protein foods gathered seems to suggest an impoverished environment in the vicinity of the site, with people hard pressed to gather adequate meat. In particular, the gathering of large quantities of shellfish before sexual maturity is a strategy doomed to failure in the long term.

The study of birds and mammals adds considerably to the existing picture in the area. The bird remains are most comparable to those from Taylor's Hill, a site excavated even longer ago than Maungarei and studied and published long after the excavations. Both sites indicate sporadic and probably opportunistic capture of birds of various habitats in a landscape from which significant populations of both colonial nesting seabirds and forest-dwelling species had long disappeared. Maungarei stands out from other sites in the area in the large number of rat bones found. This may be partly due to good preservation and ease of recovery in the loose scoria deposits, but is also rather surprising given the small size of the bones and the salvage nature of the excavations. The rats were presumably brought to the site as food or actually caught there, raising interesting questions, as yet unanswered, about their ecological position in this environment.

There is little doubt that most of the faunal remains reflect exploitation of the adjacent Tāmaki Estuary and readily accessible fishing grounds nearby. There are, however, a few indications of more distant contacts and possible interactions with other communities. The single toheroa shell could not have come from anywhere in the vicinity and must reflect a visit by Maungarei people to the west coast beaches where it occurs, or a gift brought to Maungarei by visitors from afar. Scallop shells and some fish remains, notably of a very large snapper, also hint at possible interactions with other communities. The question of access to resources, including fishing grounds, is discussed below. The differential distribution of the body parts of dogs, not only at Maungarei but at Taylor's Hill and at Pig Bay on Motutapu Island (Smith 1981: 98–99), suggests a particular kind of interaction: not one where an item is sourced from far away, but one where communities sometimes shared meat that was available to all of them, or took meat away with them on trips elsewhere. This kind of information can add to that on the sources of stone found in archaeological sites to develop a picture of community interactions.

Charcoal analysis

The study of charcoal from the excavations was carried out almost 20 years ago by Rod Wallace and is described in Appendix 2. Wallace has updated his report in the light of his more recent research in this field. The samples are grouped in Appendix 2 according to contexts determined by my own recent evaluation of the excavation data.

The charcoal study supports the evidence from faunal analysis in showing that the areas excavated on Maungarei were occupied at a time when the impacts of humans on the local environment were already marked and the vegetation was much modified by human activity. Wallace describes a landscape dominated by bracken and shrubs, and probably kept in this state by repeated burning. Pūriri (*Vitex lucens*) trees were abundant and there may have been a few small stands of forest in the vicinity, but basically this was already a landscape similar to that found by the first Europeans to visit the area.

It is noteworthy that there is more charcoal from large trees in what are thought to be early contexts on the unmodified slopes below the Lower Terrace in Area D and in the crater in Area A. This may suggest that although the landscape was already considerably modified when people first occupied these areas, there was a further reduction in forest trees as occupation of the site progressed. The large quantities of bracken were found in Area A and on the Upper Terrace in Area D, the two parts of the site where burn layers were common, reinforcing the view that there were burn-offs of the surface when these parts of the site were reoccupied after fairly brief intervals of disuse. The almost entire absence of kānuka (*Kunzia ericoides*) in the charcoal samples suggests that periods of disuse, not only of the site, or this part of it, but of the surrounding garden areas were not long. Kānuka was a useful timber, made into various kinds of artefacts (Wallace 1989: 224) and burned as firewood, and should appear in the charcoal from the site if it was available in the vicinity.

It is interesting that the ponga, or tree fern (*Cyathea* sp.), which was often used in the superstructure of storage pits, and kauri, popular for house timbers and beaters, were found only in what appeared to be hāngi contexts, despite the fact that, as Wallace (Appendix 2) notes, ponga burns poorly.

Discussion

This section draws together what has been learned about the life of the people of Maungarei and then considers the wider interpretations and implications that can be drawn from these findings.

The people and their lifestyle

Nothing is known of the health and longevity of the people, or of individual life histories, as the few human remains encountered were reinterred without study. Isolated primary burials were made on the mountain, evidenced by discoveries during reservoir and road construction. One person was buried in a crouched position in a small pit on the Lower Terrace in Area D, and most of the bones were subsequently dug up and taken elsewhere. It is also known that human remains have been found in a lava tube on the western side of the mountain, equated with the traditionally remembered Rua-ā-Pōtaka.

Although evidence of houses was minimal (a stone-edged hearth and traces of a house-like structure on the Upper Terrace in Area D), there can be little doubt that people were living on Maungarei, not just preparing and storing food there. The amount of food refuse is in striking contrast to what may be expected in a specialised food store, as exemplified by Taniwha Pā (Law & Green 1972), and although the artefactual assemblage is small, it shows that people were repairing if not making stone adzes, working bone for artefacts, using obsidian and greywacke tools for a variety of tasks, and carrying out tattooing. The small number of artefacts can be at least partly attributed to the fact that no actual undisturbed house sites or working areas were found.

The people of Maungarei appear to have enjoyed a diet of root crops such as kūmara (*Ipomoea batatas*) and perhaps also taro (*Colocasia esculentum*) and yams (*Dioscorea* spp.), grown in the gardens surrounding the mountain and stored in the numerous pits on the site. This diet may well have been supplemented by fern root – the starchy rhizome of bracken, which apparently grew on parts of the mountain during periods when it was not actually occupied and would also have grown on gardens left fallow. Most of the protein in the people's diet came from shellfish and fish, supplemented by the opportunistic capture of birds, mostly of coastal or open country habitat. The apparently inexhaustible cockle beds in the nearby Tāmaki Estuary were showing signs of human exploitation when people first moved onto the parts of the mountain investigated archaeologically. During the period of occupation, small cockles became even smaller. The main fish caught was snapper, and the fish varied greatly in size from very small to very large. While some fish could have been taken in the estuary, others must have been caught further afield, in the Waitematā Harbour or around the nearby islands of Motutapu, Motuihe and Rangitoto.

The resource zones of Maungarei

The immediate resource zone of Maungarei consisted of the area of fertile volcanic soils at its base, which extended west to Waiatarua, east to the Tāmaki Estuary and beyond the Panmure Basin to the south, just meeting the zone of volcanic soils extending north from Ōtāhuhu/Mt Richmond. To the north there was a gap in fertile soils before the much smaller area around Taurere/Taylor's Hill, while across the estuary, Ohuiārangi/Pigeon Mountain was also surrounded by a small area of volcanic soils. The soils around the Maungarei-Tauomā volcanic complex appear to have been the largest such area associated with a single eruptive centre in the Auckland volcanic field. The Waiatarua wetland, on the edge of the Mt Wellington lava flow, probably also came within the resource zone of Maungarei.

Estuarine resources in the Panmure Basin and along part of the Tāmaki Estuary would also come within the territory of those living on Maungarei. However, the productive shell-fish beds at Farm Cove today are closer to Ohuiārangi/Pigeon Mountain, and those further out towards the entrance are closer to Taurere/Taylor's Hill. There is at present no archaeological evidence to indicate whether these two smaller cones were occupied at exactly the same time as Maungarei, although two radiocarbon dates from Taylor's Hill (Leahy 1991: 65) suggest that it was occupied in the same period; traditions hint that Maungarei was occupied but not attacked by Te Taoū when they took Taurere in the eighteenth century (Graham 1980: 5).

Access to fishing grounds and to Motutapu Island with its stone resources would have been by canoe down the Tāmaki Estuary. This would have been easy if the sites nearer the heads were unoccupied at the time but may not have been contested even at other times. Stone has described how this was thought to have been managed in the period when Maungarei was no longer occupied:

> Tribal leaders, perhaps in a mood of excessively roseate nostalgia, spoke of a tradition of peaceful co-existence in Tamaki during the pre-musket-war era, a tradition that had roots extending deep into the eighteenth century and possibly further. They testified to long-standing, overlapping rights of ownership, to a sharing of fishing grounds with outside hapu, or at least with elements within those hapu bonded with tangata whenua by kinship; they also spoke of uncontested criss-crossing of tribal territories. (Stone 2001: 34)

It is likely that a similar situation obtained during the period when Maungarei was occupied (although, as noted above, there was sometimes dissension over shark-fishing grounds, in particular). But for much of the time, the people of Maungarei could probably have had access to almost all the resources they needed. The outstanding exception for them, as for most pre-European Māori, was obsidian. This they obtained from a number of different sources, although by far the most came from Great Barrier Island (Aotea Island). At the time of the settlements on Maungarei, Great Barrier was occupied by closely related people, some of whom lived both on Great Barrier Island and at Tāmaki (Graeme Murdoch, pers. comm. 2010), so the relative abundance of obsidian from the Great Barrier sources in Auckland mid-sequence sites is not surprising. Murdoch also points out that the Tainui and Arawa connections of people in Tāmaki would have facilitated access to Coromandel, Mayor Island (Tuhua) and central North Island sources. No obsidian from the Northland sources was identified at Maungarei. In contrast, Northland obsidian was present in the much smaller and probably more recent assemblage from Kauri Point, Birkenhead (Davidson 1990: 11–12).

Maungarei as a settlement and as a pā

Maungarei was one of a number of volcanic cones in Tāmaki Makaurau terraced and occupied, according to tradition, by the Waiōhua people. According to Stone (2001: 31), 'it is a commonplace of tribal traditions that Tamaki, in the years of Waiohua ascendancy, was one of the most settled and extensively cultivated regions in Aotearoa, and that it was, in Māori terms, extremely wealthy'. He suggests that its prosperity was sustained by horticulture, primarily of kūmara, and argues that the extensive gardens 'betokened a stable social order' (2001: 33) and, further, that 'what was distinctive to Tamaki, and this in spite of the received wisdom of historians to the contrary, was the fact that tribes enjoyed long periods of relative peace' (2001: 34). This is also the view of Murdoch (n.d.). We may ask then, how can Maungarei be seen, on the one hand, as one of 'three great pa' (Stone 2001: 25), and one which, according to tradition, was sacked at least twice, and on the other, as a prominent feature of the landscape in an often peaceful, golden age of Waiōhua ascendancy? The answer may be that, as Murdoch (n.d.) points out, almost all conflict before the mid-1700s was internal and localised. In other words, it was the result of sporadic bickering amongst relatives. The move to occupy the volcanic cones must surely have had a defensive motive, but this does not mean that a site like Maungarei was a huge fortification. It is more likely that only the two summit areas were actually fortified, giving people living on the slopes below the opportunity to retreat to their citadel when threatened.

As noted above, traditional accounts suggest that when Maungarei was taken, it was by invaders from outside the area of Waiōhua ascendancy: first Ngāti Maru, perhaps in the late 1600s; and then Ngāti Maniapoto, probably in the early 1700s. It was prepared for a possible attack by Te Taoū in the mid-1700s, which did not eventuate. The relatively late remodelling of the crater rim, with its apparent extension of the defended area, may relate to one of these episodes. Irwin (1985: 100, 109) has argued that the three largest pā at Pouto, on the northern head of Kaipara Harbour, reflect a united response by the people of Pouto to external threat, in contrast to the smaller pā in the study area, which would have been built by smaller social groups. The three largest pā at Pouto are all on the boundaries of the settlement area. Although a parallel with Pouto can be suggested, the Auckland case is more complex, with more large sites, not all of them on the peripheries of the Auckland volcanic field. Maungarei is the largest site on the eastern boundary and

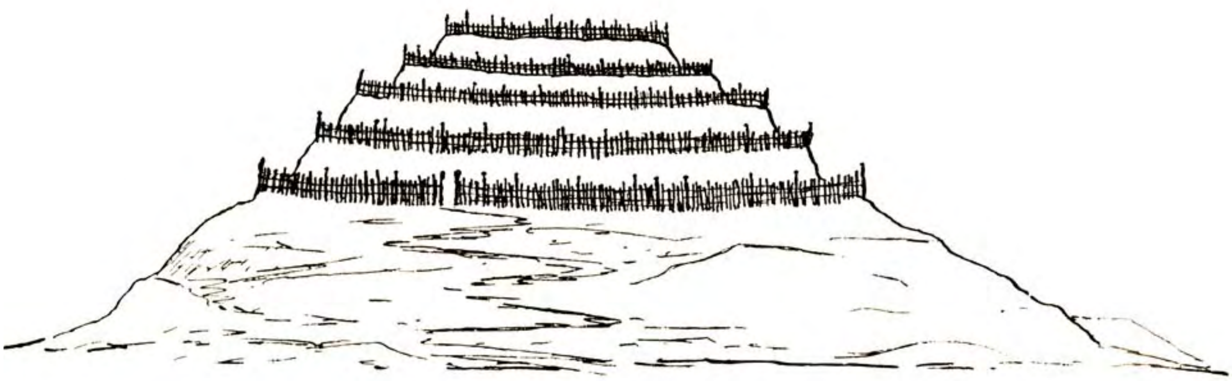

FIG. 84.—THE OLD STOCKADED HILL FORTS MUST HAVE PRESENTED SUCH AN APPEARANCE AS THIS.

Fig. 53 An idealised and an actual terraced hill site. Upper, from Best (1927: 234); lower, the discontinuous terraces on the eastern slopes of Maungarei, which have not been investigated by archaeologists. The line of the road can be seen rising diagonally from left to right (photo: Anthropology Department, University of Auckland).

Māngere Mountain (Te Pane ā Mataaho) the largest in the south, but Mt Eden (Maungawhau) and One Tree Hill (Maungakiekie) are central, with no really large sites on the western and northern boundaries.

The most easily defended areas on Maungarei are the southern part of the crater rim, from the main tihi westward (citadel 1), and the second tihi and its terraces (citadel 2) directly above and to the west of Area A. Both have strong natural defences in the form of very steep slopes around much of their perimeter, and each has a defensive transverse ditch at the weakest point. The easiest approach to citadel 1 is along the crater rim past Areas C and B, where there are what might be described as two outworks. Citadel 1 extends for almost 150 m from the innermost ditch east of the tihi to the outermost terrace at the western tip. It is relatively narrow. This puts it in the same general size category as the fortified area encompassing Areas I to IV and beyond at Pouerua (Sutton *et al.* 2003: 25), and a number of pā that are not on volcanic cones, such as Kauri Point (Tauranga Harbour), which in its earlier defended phase was almost as long as and somewhat wider than citadel 1 at Maungarei. Citadel 1 at Maungarei is thus of a size appropriate for the sort of warfare that might be expected to have been practised in the Auckland area during the Waiōhua era. Citadel 2 is smaller but more easily defended, as it has no long, flat approach from any direction. It would be a suitable refuge for a smaller group of people than would be needed to defend citadel 1.

Maungarei can thus be viewed as comprising two pā in a landscape of living and storage areas. In contrast to most archaeological landscapes, some of the living and storage areas are on the slopes of the hill, adjacent to the pā, and so not as far from refuge as if they were down among the gardens. There is little doubt that there were also living and storage areas down on the flat, but most if not all of these have been destroyed in relatively recent times.

The number and size of the pits on Maungarei suggest that the fields that once surrounded the cone were very productive. The most common use of the terraces seems to have been for pit storage, assumed to have been of kūmara, and many of the pits are both large and deep. But in the areas investigated, nothing was found to suggest that these stores were protected by palisades. No evidence of palisading was found anywhere in the excavations, despite the fact that the Lower Terrace in Area D was clearly the arrival point of a repeatedly beaten access path up to this part of the cone. This all suggests that Maungarei, like Pouerua during much of its history, was not a large-scale fortification, bristling with palisaded terraces, as some previous writers have imagined the Auckland volcanic cones to have been (Fig. 53). Clearly, there was at least one episode, late in the history of the site, when defensive ditches were built across parts of the crater rim, and this may well have obliterated earlier defensive works. However, even without deep trenches and extensive palisades, Maungarei could still have presented a strong statement of power and wealth in the landscape. The highly visible presence of large terraces housing structures containing stored food wealth would make that statement, without the added menace of strong fortifications.

Another way of seeking to understand Maungarei is to examine whether it can be considered as the location of a number of repeated short-term settlements. Walter *et al.* (2006) have extended the earlier ideas of Anderson & Smith (1996a, 1996b) and Smith (1999) about transient villages in southern New Zealand, arguing that this form of settlement was widespread and persistent in New Zealand prehistory. Maungarei certainly meets their criteria (Walter *et al.* 2006: 281–282) for a repeatedly occupied village; it was a place where people lived and worked for a time, adjacent to their gardens, and to which they frequently returned. For Walter *et al.* (2006), the distinction between pā and open settlement is not the primary concern; sites may be undefended at some times and defended at others, although they recognise that pā may reflect community solidarity and make a bold statement in the landscape.

Maungarei in time

The identification of charcoal from the excavations and the study of shellfish size both suggest that occupation of Maungarei, or at least of the various parts investigated, began well after people had made their presence felt in the area with significant impacts on both terrestrial and marine resources. There was little if any forest remaining in the vicinity of Maungarei and the cockle populations in the Tāmaki Estuary were apparently far removed from virgin biomass. The five pooled radiocarbon dates on shell suggest that much of this occupation could have taken place between about AD 1580 and 1660. The three pooled charcoal dates, one of which is from a stratigraphically very early context in Area A, suggest that initial activity could have taken place in the late 1400s, or at the period indicated by the shell dates.

Smith & James-Lee (2009) have grouped a number of excavated sites in what they describe as the greater Hauraki Area into the categories of Early (AD 1250–1450), Middle (1450–1650) and Late (1650–1800), with some described as Early/Middle or Middle/Late. Most of the occupation on Maungarei as revealed by excavation would probably fall into their Middle category. In their study they include several sites in this part of Auckland: Hawkins Hill, the Fisher Road sites, the Tamaki River pā, and some of the Cryers Road sites are Middle; while Hamlins Hill, Westfield, the Tamaki River undefended site and part of Cryers Road are Middle/Late. These sites are all to the south of Maungarei, and most were probably associated with the volcanic cones of Ōtāhuhu/Mt Richmond and Te Apunga ō Tainui/McLennan's Hills rather than with Maungarei. Nevertheless, this shows that undefended occupation and storage sites and a small palisaded pā were present in the same general area during the period when Maungarei was occupied.

The Waipuna site, closer to Maungarei, was not included in the study by Smith and James-Lee. It has shell dates towards the end of its occupation, which fall in their Middle Period; and a charcoal date on tree fern from an early storehouse, which falls in their Early Period (Clough & Turner 1998: 19–20). The possibility that initial occupation of the Waipuna site began before occupation on Maungarei gains support from the fact that much of the charcoal identified at Waipuna is from forest trees. However, apart from a single apparently worked piece of moa bone, there is nothing else about Waipuna to confirm early occupation.

Two radiocarbon dates for Taylor's Hill/Taurere (Leahy 1991: 65) and one from Te Apunga ō Tainui/McLennan's Hills (Sewell 1992: 47) show that these smaller cones were also occupied in the same general time period as Maungarei.

It can be concluded, then, that the main occupation on the northern side of Maungarei took place during the mid-sequence of Auckland prehistory. There is plenty of evidence of contemporary activity along the west bank of the Tāmaki Estuary during this period, including open settlements, a small pā, and use of the smaller cones, but very little indication of what went before. The move onto Maungarei may well have coincided with a perceived need for defence, perhaps as a result of increasing population and periodic quarrels among the various closely related groups of Waiōhua. This was also the time when the idea of earthwork fortification spread rapidly throughout much of New Zealand (Schmidt 1996).

Maungarei in a wider context

As noted above, Maungarei existed in a landscape of undefended settlements, several smaller cones and at least one small palisaded pā along the west bank of the Tāmaki Estuary. However, it also existed in the broader context of many other volcanic cone sites in the Auckland volcanic field, several larger than Maungarei and many smaller. Each of these was also surrounded by garden areas and, presumably, undefended settlements and small pā, as at Pouerua.

Bulmer (1994: 64–66) lists 27 radiocarbon dates from eight other volcanic cone sites in the Auckland volcanic field. Some of these are from rescue excavations of very limited scope (one date each for Te Apunga ō Tainui/McLennan's Hills and Ōtāhuhu/Mt Richmond, and three each from Maungawhau/Mt Eden and Maungakiekie/One Tree Hill). The contexts of the two dates from Taurere/Taylor's Hill, four from Puketāpapa/Mt Roskill and five from Manurewa or Matukutūruru/Wiri Mountain have been described in some detail (by Leahy 1991, Fox 1980 and Sullivan 1975, respectively), but there is little information about the important series of eight dates from Maungataketake/Elletts Mountain. It is not easy to derive a clear picture of occupation of the volcanic cones from these dates; the dates on charcoal, like those from Maungarei, tend to have multiple intercepts on the calibration curve and some, on unidentified wood, may have significant inbuilt age. There appears to be a possible problem of fossil shell mixed with cultural shell at Maungataketake/Elletts Mountain.

The best that can be said is that most or all of these sites certainly appear to have been occupied at some point during the 1500s and 1600s, some possibly a little earlier and some into the 1700s, as at Maungarei. Two charcoal dates from Matukutūruru/Wiri Mountain, originally published by Sullivan (1975), and a shell date from Maungataketake/Elletts Mountain have been recalculated and calibrated (95% confidence) and published by Bulmer (1994: 65) as AD 1001–1490 (NZ1888), AD 632–1955 (NZ1909) and AD 977–1179 (NZ6476), respectively. There is also a shell date from Maungataketake/Elletts Mountain with a conventional radiocarbon age of 11 205 ± 138 yrs BP. The currently accepted understanding is that 'humans have been present in New Zealand since 1250–1300 A.D.' (Higham & Jones 2004: 232). This view is reinforced by more recent studies (Wilmshurst *et al.* 2008, 2011). These apparently earlier dates from Auckland cones should not be accepted unless they can be supported by additional dates from the same contexts processed to the latest standards.

More than 100 years ago, Percy Smith guessed the population of one of the most prominent volcanic cone sites, Maungawhau/Mt Eden, as follows: 'It is probable that, in its day, Mt Eden *pa* would hold a population of at least 3000 people' (Smith 1896 & 1897: 78). This comment was cited by Best (1927: 211) and has been influential ever since. Moon, for example, when discussing the traditional story of the capture of Maungawhau/Mt Eden by warriors from Hauraki, cites Best as the authority for the figure of 3000 and goes on to ask 'how was it possible to assemble a force capable of taking a pā containing over three thousand people?' (Moon 2007: 66). The answer may be that there was a much smaller population of people, occupying a much smaller defended area.

Brown (1960) estimated the populations of 34 Auckland pā, including all the major cones, on the basis of 45 persons per chain of defended circumference. He arrived at a population of 2250 for Maungawhau/Mt Eden and 2385 for Maungarei. Fox (1983: 15) estimated the populations of seven pā, including four Auckland cones, using two measures: number of terraces and numbers of pits, assuming a family of six adults occupying a terrace and using two pits. She arrived at 710+ (terraces) and 510+ (pits) for Maungarei compared with 570+ and 510+ for Maungawhau/Mt Eden. She noted that these figures are much lower than previous estimates and that her reassessment 'obliges us "to think small"'. Even so, her figures relate to the final occupation of each site, apparently assuming that the entire site was occupied at the time. Her figures also do not recognise that the complex of Maungarei, Tauomā and the northern tuff ring was much larger than the area shown on the archaeological map of Maungarei. Bulmer (1996: 645) suggested that using a larger family size of 12 to a terrace would give the three largest cones (in her view, Maungakiekie, Maungawhau and Māngere, but not

Maungarei) about 2000 people. This kind of calculation led to total population estimates for Auckland in the eighteenth century of 13,400–14,000 (Brown 1960: 22) and 15,000–20,000 (Bulmer 1996: 645). How this large population was overcome and dispersed by invaders from the north is not explained. It seems more likely that considerably fewer than half the cones, and only parts of each, were occupied at any one time.

Pool (1991: 57), after a thorough review, concluded that 'the population [of Māori in New Zealand] would have reached barely 100,000 before it suffered the shock of European contact'. He considered the population of the Auckland region (a considerably wider area than just the Auckland volcanic field) in 1801 to have been 7% of the North Island Māori population. Based on these figures, the total population of Tāmaki during the period when Maungarei was occupied is unlikely to have reached 5000.

Phillips (2000: 163, 180), in her detailed study of Māori life and settlements along the Waihou River in the Hauraki Plains, argues persuasively that on average, only five of the 49 known pā in her study area would have been occupied at any one time. She suggests an average of 200 people per pā. Some of her sites, such as Oruarangi and Raupa, are comparable in size to the suggested area of citadel 1 on Maungarei; others are smaller and more comparable to citadel 2. The Auckland cones would probably have been occupied more frequently, if for shorter periods, than Phillips suggests for Waihou, with some of the occupations involving fortification and others not. In an apparently optimum area for Māori gardening and settlement, as in Tāmaki, there was probably a larger population over a longer period than along the Waihou.

Marshall reviewed various settlement typologies developed by New Zealand archaeologists and combined them into five classes of settlement, based on criteria of size, complexity, distribution and, to a lesser extent, function (Marshall 2004: 77). She saw Maungarei and other large Auckland cone sites as probably belonging to her Class 5 category of exceptional sites. In the case study areas she considered, Pouerua is the only Class 5 site. This raises the question of whether Maungarei is a 'site' or part of an archaeological landscape containing many 'sites' of different kinds. In the context of whether to lump or split when recording sites, I have previously suggested that when probable garden areas are included, the whole of Motutapu Island could be considered one huge archaeological site (Davidson 1987: 232). The same can be said of parts of the Auckland volcanic field, where archaeological remains continued down the slopes of the cones into extensive garden areas dotted with residential and storage components and occasional small palisaded pā. In this respect, the volcanic cone of Pouerua is also part of a much larger 'site' occupying the whole of the surrounding lava field. Specific components should perhaps be considered 'features' rather than 'sites'.

If Maungarei and the other volcanic cones were transient sedentary villages or settlements of the kind described by Walter *et al.* (2006), occupied and reoccupied by populations numbering a few hundred or less, rather than thousands, the reasons for transience must be examined. It has been widely accepted that kūmara horticulture depleted soil fertility fairly rapidly and gardens could not be used for more than two or three years, after which they would be left fallow for many years (Simmons 1969: 26; Leach 1984: 61; Sullivan n.d.: chapter 4, f. 6). However, recent experimental research has suggested that kūmara yields, while fluctuating from year to year primarily for climatic reasons, do not deplete soil nutrients significantly over a 10-year period (Burtenshaw *et al.* 2003 and authors' subsequent unpublished data). Both Simmons and Sullivan, when discussing garden rotation, cited nineteenth-century sources about gardening practices, which probably related at least in part to white potato gardens and need not necessarily apply to pre-European kūmara gardens. If the population on Maungarei and other volcanic cones was smaller than previous estimates, and gardens could be used for a longer period before being left fallow, what was the impetus to move fairly frequently to other village locations? Walter *et al.* (2006: 282), while emphasising resource depletion as a major cause of transience, also allow for movement 'as a result of political contingencies'. The explanation for movement within the Auckland volcanic field may rest in the complex ebb and flow of hapū growth, decline and constant realignment. But this is beyond the reach of archaeological documentation. Future archaeological research and more precise dating methods may reveal more clearly the pattern of movement from cone to cone and back again.

Although the concept of the transient village can certainly be applied to Maungarei, and by extension to other Auckland sites, the density and size of these sites is dramatically different from those of southern New Zealand, to which the concept was first applied. Does this have implications for our understanding of the social organisation of the people who lived on Maungarei and other large Auckland cones? Do these large sites reflect a more hierarchical kind of organisation? Unfortunately, while we have the big sites, equivalent to Marshall's (2004) Class 4 and 5 sites, we have only a fragment of the total landscape. We can be reasonably certain, however, that the Auckland area had a full range of all classes of sites, from small single-purpose sites, such as the Alberon Park pit site (Law 1970), through larger pit complexes to open settlements and pā. A vast array of archaeological evidence is crammed into a very small area, in contrast to southern New Zealand, where what may be a similar amount of evidence is very widely and thinly spread. Yet there is little in the traditional or historical evidence to suggest the development of a more hierarchical social organisation in Auckland than in other parts of the country where population density was lower and sites more widely distributed.

Conclusions

The various excavations on Maungarei revealed a complex history of terrace construction, the digging and filling of roofed storage pits, and the deposition of various kinds of midden and fill layers on the slopes. The earliest radiocarbon dates are ambivalent when calibrated to calendrical ages; forest clearance may have begun in the crater and on the western toe of the cone in the 1400s or in the 1500s. Repeated episodes of terrace construction and pit-building on the lowest part of the crater rim and adjacent slopes, the locations of the main archaeological excavations, probably took place between about AD1580 and 1660, in what may be described as the mid-sequence of Auckland prehistory. There was activity at this time also on the smaller citadel, above Area A, and the northeast part of the crater rim. Soon after a major remodelling of much of the crater rim, probably in the early or mid-1700s, occupation of the site ceased. No investigations have yet taken place on the more extensively terraced eastern slopes (Fig. 53), and it is possible that an equally complex but more extended sequence of occupation would be found there.

The subsistence economy of the Maungarei people was compatible with what is thought to be typical of Māori life in this part of New Zealand during this period: the growing of plant foods, particularly kūmara; the gathering of bracken rhizomes; fishing, in this case particularly for snapper; and the gathering of shellfish, in this case particularly cockles. A few birds were taken, opportunistically rather than systematically. Dogs and, probably, Polynesian rats, which were numerous in the site, also contributed to the diet.

The limited range of material culture recovered is typical of what has been found in other Auckland mid-sequence sites. Waipapa series greywacke and chert, probably obtained from Motutapu or adjacent islands, was an important local stone resource. Obsidian was obtained from various sources further afield, including Mayor Island (Tuhua), Coromandel, Rotorua and Taupo, but predominantly from Great Barrier Island (Aotea Island).

Maungarei was well placed for access to good garden land, a large freshwater swamp and marine resources. By the time of the main occupation of the cone revealed by the excavations, the environment was already much modified by human presence in the region: there had been extensive forest clearance, presumably for gardens, and impact on shellfish beds was apparent in the small size of most shells gathered.

I have argued that only the two high points or citadel areas were actually fortified; the area of these was appropriate for hapū-level conflicts. No evidence of fortification or fencing was found on any of the excavated terraces, although excavation revealed a series of well-beaten access paths to the lowest of the northern terraces. It is unlikely that most or all of the site was occupied at one time; rather, what we see today can be regarded as the end result of a long series of repeated village- or sometimes hamlet-sized occupations, most of which required the lowering of terrace surfaces and the digging of new pits to allow repeated use of the unstable scoria slopes. Maungarei was thus the location of repeated settlements, which were sometimes fortified, particularly late in the sequence, but often not.

Maungarei is only one of many volcanic cone sites in Auckland and not the largest (although the inclusion of its destroyed sister cone of Tauomā and adjacent tuff rings might bring it up to second place after Maungakiekie/One Tree Hill). It is unlikely that as many as half of these cones were occupied at one time, or that the population of the Auckland area during the mid-sequence was anything like as large as some writers have claimed. Even so, an immense amount of human effort went into the creation of the volcanic cones sites, giving credence to the often repeated claims that Tāmaki some 300 to 400 years ago was a highly populated and wealthy area in Māori terms, just as it is now in modern terms.

Much has been learned from the rescue excavations on Maungarei, but the surface has only been scratched. Its history cannot be fully understood without knowledge of what was happening on the eastern slopes. It is even more important to find evidence of earlier occupation of the area. When did people first step ashore on the banks of the Tāmaki Estuary and how long did it take for them to clear forest, start to affect shellfish beds, take up residence on the mountain and feel the need to defend themselves? In the large metropolitan area that is modern Auckland, most evidence of initial Māori settlement is probably already lost, and any surviving fragments will be precious indeed.

Maungarei and the other surviving Auckland volcanic cones, although they are damaged and battered, and largely deprived of their surrounding settlements and gardens, are still remarkable monuments not only in the New Zealand context but on the world scene. They are of great significance to Māori; they deserve the World Heritage status that has been suggested for them. Protection and appropriate management of what remains should be a top priority.

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Notes

1 The Māori name Maungarei is used throughout this paper for the archaeological site and the volcanic cone on which it is situated. The term Mt Wellington is retained for the former Domain, the former local body that administered it, and the lava field around it.

2 The name means 'the feeding place of Hiku', after the taniwha (mythical monster) who was the guardian of the basin. The full name of the taniwha was Moko ika hiku waru, later shortened to Mokoia (G. Murdoch, pers. comm. 2010) – hence the modern Māori name for the basin, Waimokoia.

3 Tauomā is sometimes given as the name for the entire district on the western side of the Tāmaki Estuary (Stone 2001: 50; Sullivan n.d.: chapter 3).

4 These and other events were previously described by Fenton (1879) and Smith (1896 & 1897), among others; Stone's excellent 2001 account is more readily accessible.

5 Kyowa with 10× eyepiece, 0.5 objective and zoom of 0.7–4.5. The resulting range is 3.5–22.5× magnification. When appropriate, photographs were taken with a ME1300 dig-

ital camera inserted into one eyepiece at 1280 × 1024 pixel resolution and USB output.

6 Faunal material was catalogued in a separate series from artefacts and unworked stone, with the prefix AM. The faunal material is held in the Auckland War Memorial Museum.

7 Although research on contemporary and archaeological specimens of the blue mussel currently suggests that all are best regarded as *Mytilus galloprovincialis*, some specimens from warmer North Island waters exhibit greater affinity to *M. edulis* than to *M. galloprovincialis* and archaeological specimens are significantly different from contemporary populations in New Zealand (Gardner 2004). In addition, nuclear DNA markers suggest that specimens from the Auckland Islands are a hybrid between the two species (Westfall *et al.* 2010; Westfall & Gardner 2010, n.d.; Gardner & Westfall n.d.). Clearly, the last word has yet to be written on the origin and taxonomic relationships of blue mussels in New Zealand and archaeological specimens have an important role in future research on this subject.

8 An exception is the study by Cofman-Nikoreski in Fredericksen & Visser (1989: 93–102), which demonstrated small cockle size by size classes and hinted at a decrease in size through time.

9 It is unclear whether some probable *Diomedea* (albatross or mollymawk) bones from Cryers Road derive from pre-European or historic deposits (Fredericksen & Visser 1989: 103).

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Appendix 1: Mammal and bird remains from Maungarei

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Mammal and bird remains were recovered from excavation Areas A, C and D at Maungarei. These were analysed in the archaeological laboratories of the Department of Anthropology and Archaeology at the University of Otago, using the faunal reference collections housed there.

All specimens were identified to the most precise taxonomic class to which they could be assigned with confidence, the anatomical element represented and portion present, along with any indications of developmental age, taphonomic condition, and presence of cut marks or other notable features. The number of identified specimens (NISP) that the identification represented was recorded and two quantification measures were derived: the minimum number of anatomical elements (MNE) and the minimum number of individual animals (MNI). These measures were calculated initially by aggregating the identification data in terms of the discrete archaeological contexts from which the faunal remains derived. This represents the primary analytical units for reconstructing human activity at the site, but risks inflating counts of vertebrate fauna because anatomical elements from a single individual could be distributed through more than one context. To

Table A1.1 Mammal and bird number of identified specimens (NISP) from Maungarei.

	Area A	Area C	Area D	Total
Mammal				
Sheep (*Ovis aries*)	77	—	—	77
Pig (*Sus scrofa*)	1	—	—	1
Cow (*Bos taurus*)	—	—	2	2
Rabbit (*Oryctolagus cuniculus*)	—	—	29	29
Rat (*Rattus* sp.)	124	34	565	723
Dog (*Canis familiaris*)	72	2	139	213
Human (*Homo sapiens*)	—	—	4	4
Mammal ?sp.	26	—	—	26
Total	**222**	**36**	**739**	**1075**
Bird				
Pied stilt (*Himantopus himantopus*)	1	—	2	3
Kingfisher (*Todiramphus sanctus vagans*)	1	—	—	1
Red-legged partridge (*Alectoris rufa*)	—	—	1	1
Australasian harrier (*Circus approximans*)	—	—	1	1
Black backed gull (*Larus dominicanus*)	—	—	1	1
Common diving petrel (*Pelecanoides urinatrix*)	—	—	1	1
Grey teal (*Anas gracilis*)	—	—	1	1
Pūkeko (*Porphyrio melanotus melanotus*)	—	—	1	1
North Island brown kiwi (*Apteryx mantelli*)	—	—	1	1
Kiwi?	—	—	1	1
Moa ?sp	—	—	1	1
Bird ?sp	3	—	21	23
Total	**5**	**—**	**32**	**36**

Table A1.2 Minimum number of anatomical elements (MNE) and minimum number of individuals (MNI) of mammals aggregated by discrete context and by excavation area.

	Area A		**Area C**		**Area D**		**Total**	
	MNE	MNI	MNE	MNI	MNE	MNI	MNE	MNI
By context								
Rat	90	14	25	7	401	77	516	98
Dog	33	21	2	2	100	68	135	91
Human	—	—	—	—	4	4	4	4
Mammal ?sp	2	2	—	—	—	—	2	2
Total	**125**	**37**	**27**	**9**	**505**	**149**	**657**	**195**
By area								
Rat	77	5	20	2	332	22	429	29
Dog	23	3	2	1	73	3	98	7
Human	—	—	—	—	3	1	3	1
Mammal ?sp	—	—	—	—	—	—	0	0
Total	**100**	**8**	**22**	**3**	**408**	**26**	**530**	**37**

assess the extent to which this may have occurred, data were also aggregated at the excavation area level.

Total NISP of 1075 mammalian bone and tooth specimens, and 36 bird bones were identified (Table A1.1). About 10% of the mammalian assemblage is from species introduced after European contact and likely to have entered the deposits in recent time. The majority are from sheep. Almost half (49%) of these were recovered from the topsoil and layer 2 in squares E2 and E3 of Area A, and are almost certainly parts of a single animal. Another 46% were parts of a second skeleton from layer 1 and the layer 2–3 interface in Area A squares E9 and E10, and two further bones were from layer 1 in Area A square F6. Similarly, the two cow bones were from the topsoil and layer 1 of two squares in Area D, and the single pig bone from layer 1 in Area A. Rabbit bones were found in two clusters: more than half (55%) from the turf of Area D squares R13 and R15, and the remainder from a rabbit hole and adjacent contexts in Area D squares L11 and L12 and M11 and M12. All of these items are excluded from further analysis. Nearly all of the material identified as mammal ?sp appears to be from medium-sized mammals, so could derive from dogs, sheep or pigs.

Rats dominate the remaining fauna, making up three-quarters of the identified items. They have been identified here as *Rattus* sp. because of significant size overlap between kiore (*R. exulans*), introduced to New Zealand by Polynesians, and the European introductions *R. rattus* and *R. norvegicus*. However, all bones complete enough to tell fall towards the smaller end of the size range, making it likely that they are *R. exulans*. When aggregated by discrete archaeological context, a minimum of 516 anatomical elements and 98 individual animals are represented (Table A1.2). These numbers decrease when aggregated by excavation area but, for reasons outlined below, this almost certainly provides a better reflection of the relative importance of rats as by far the most common mammalian species, contributing 78.3% of MNI. More than three-quarters of these are from Area D.

Dogs are the other main component of the mammalian fauna, making up 22% of non-intrusive mammalian NISP, with nearly two-thirds of these from Area D, most of the remainder in Area A and only two items from Area C. When data are aggregated by discrete archaeological context, dogs contribute 20.5% of mammalian MNE, but make up almost half of mammalian MNI (46.7%) (Table A1.2). In contrast, both MNE (18.5%) and MNI (18.9%) are at a similar level when aggregated by excavation area. This comparison indicates that there is a high likelihood that skeletal parts from the individual dogs are distributed through multiple archaeological contexts, so that individual animals are counted multiple times when data are aggregated by minimal units. This is further emphasised when

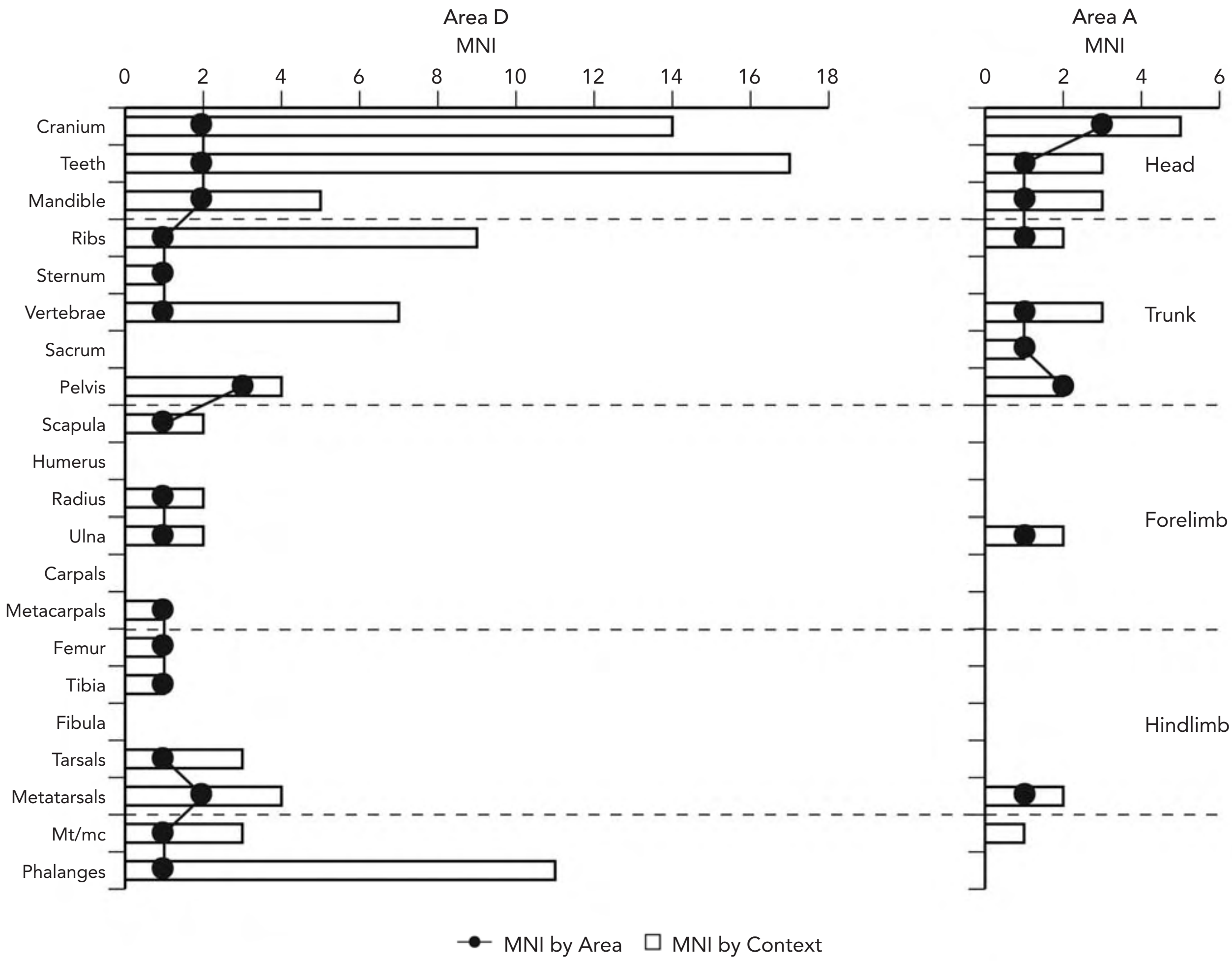

Fig. A1.1 Dog minimum number of individuals (MNI) per skeletal element calculated by archaeological context and excavation area at Maungarei.

comparing what the two aggregation methods indicate as values for the MNI represented by each skeletal element (Fig. A1.1). This shows that the higher MNI values when aggregating by context derive almost exclusively from element classes with numerous members, such as teeth, ribs, vertebrae and phalanges, along with crania, which often fragment into many pieces. It is difficult to imagine that such element classes were separated and distributed around the site for a deliberate purpose, suggesting that their dispersal was post-depositional, presumably as a result of pit-building, terrace construction and other earthworks on the site. These observations suggest that aggregation of data by the larger areal units provides the most reliable indication of the relative abundance of faunal classes.

One notable feature of the dog assemblage, irrespective of how the data are aggregated, is the relative scarcity of the main bones of both forelimbs and hind limbs. In Area D, the humerus, radius, ulna, femur and tibia are together represented by an MNE of 6, which is only 20% of the potential number if three dogs are represented, or 0.9% if there had been 68 dogs. The two ulnae present in Area A are likewise at most 7% or only 1% of the potential number of main long bones. There are two potential explanations for this pattern. Allo (1970: 170–175; Allo Bay-Petersen 1979: 174–175) has suggested that dog long bones are typically underrepresented in sites because they were sought after as raw material for bone tools. This proposition is hard to assess, as it is generally difficult to identify the taxonomic source of completed tools, but it should be noted that a recent study found that where identifications were possible, bird bones were used much more often than dog bones for tools such as awls, needles and all but the heaviest bone points (McPherson 2008). Furthermore, there are now a number of well-studied dog assemblages in which the main

Table A1.3 Minimum number of anatomical elements (MNE) and minimum number of individuals (MNI) of birds aggregated by discrete context and excavation area.

	By context						By area					
	Area A		Area D		Total		Area A		Area D		Total	
	MNE	MNI	MNE	MNI	MNE	MNI	MNE	MNI	MNE	MNI	MNE	MNI
Pied stilt	1	1	2	2	3	3	1	1	2	2	3	3
Kingfisher	1	1	—	—	1	1	1	1	—	—	1	1
Red-legged partridge	—	—	1	1	1	1	—	—	1	1	1	1
Australasian harrier	—	—	1	1	1	1	—	—	1	1	1	1
Black backed gull	—	—	1	1	1	1	—	—	1	1	1	1
Common diving petrel	—	—	1	1	1	1	—	—	1	1	1	1
Grey teal	—	—	1	1	1	1	—	—	1	1	1	1
Pūkeko	—	—	1	1	1	1	—	—	1	1	1	1
NI brown kiwi	—	—	1	1	1	1	—	—	1	1	1	1
Kiwi?	—	—	1	1	1	1	—	—	1	—	1	—
Moa ?sp.	—	—	1	1	1	1	—	—	1	1	1	1
Bird ?sp.	3	3	14	12	17	15	2	—	5	—	7	—
Total	**5**	**5**	**25**	**23**	**30**	**28**	**4**	**2**	**16**	**10**	**20**	**12**

long bones are represented at least as well as, or better than, those from other body parts (e.g. Smith 1981b: 118–119, 1996: 194; Furey 2002: 114). The second possibility is that the fore and hind limbs of dogs were detached from carcasses and removed for consumption and subsequent disposal elsewhere. Similar evidence at Pig Bay on Motutapu Island has been interpreted as indicating the sharing of dog carcasses (Smith 1981a: 98–99). The relative scarcity of major limb bones makes it difficult to assess the age at death of dogs properly, but as far as can be determined all of the animals are osteologically mature.

Human remains are confined to four specimens, all from squares J11 and L11 in Area D. They include a tooth, a patella and two cranial fragments, one of which has been cut along one or possibly two edges, and has striations on the surface, indicating that it was being worked into some form of artefact.

Bird remains are very scarce in comparison to those of mammals. Aggregation by area rather than context has no impact on the number or relative proportions of positively identified species, but it dramatically reduces the total number of birds that appear to be present, by eliminating all the individuals that were not identifiable to species (Table A1.3). One species, the red-legged partridge, is clearly intrusive, having been introduced to New Zealand

Fig. A1.2 Moa long bone shaft fragement from Maungarei, showing extensive weathering on all surfaces.

unsuccessfully in the late nineteenth century and again after 1984 (Heather & Robertson 2005). The remaining species are all native, and thus potentially exploited during the pre-European period. However, none is common, with only the pied stilt being represented by more than one individual. The identified species derive from a diverse range of marine, estuarine, wetland, grassland and forest habitats, and this along with their very low numbers suggests no more than occasional and opportunistic use of avifauna. The single piece of moa bone, a long bone shaft fragment, is extensively weathered on both internal and external surfaces, indicating long periods of exposure to the elements (Fig. A1.2). It almost certainly derives from a period earlier in time than the occupation of Maungarei.

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Appendix 2: Identification of charcoal from excavations on Maungarei, Auckland

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Introduction

Charcoal samples recovered from archaeological excavations in Areas A, C, D and E on Maungarei are identified and the results discussed.

Materials and methods

The charcoal arrived in 120 plastic bags with provenance details written on the labels recording the stratigraphic unit involved. All pieces in the smaller bags were identified but only a representative sample was identified from larger bags. The numbers of pieces of each species identified from each bag are summarised in Tables A2.1 to A2.5. Common and scientific names are listed in Table A2.6. These results provide an estimate of the proportion of each species in each sample bag but are not minimum numbers, as in many cases a single piece of burnt wood may have broken up into many fragments, which are all identified and counted separately.

The charcoal was prepared for microscopic examination by snapping pieces across and cleaving along the grain. They were then mounted on microscope slides so the cleaved/snapped surfaces faced upwards. The cell structure was examined using a Zeiss compound microscope equipped for incident illumination at magnifications of 50, 100, 250 and 500 diameters.

In the nearly 20 years since this material was originally examined, I have made some improvements in species identification. I now realise that pieces originally tentatively identified as patē (*Schefflera digitata*) and rangiora (*Brachyglottis repanda*) are both almost certainly tutu (*Coriaria* sp.). The data have been altered accordingly. Another case is the realisation that pūriri (*Vitex lucens*) branch wood is often thin-walled and develops strongly banded axial parenchyma, both properties making it very similar to kohekohe (*Dysoxylem spectabile*) in its cell structure. In Tables A2.1 to A2.5, these two species show striking covariance, strongly suggesting that only one species is present. I now regard these samples as being almost all pūriri.

Charcoal is the partially combusted remains of woody tissues and is composed of elemental carbon. Although it is not biodegradable, charcoal is rapidly destroyed by weathering if exposed on the ground surface and will be preserved in site sediments only if it is rapidly buried. It can enter deposits as the consequence of several quite different firing events. The most obvious is from domestic fires; we can assume most charcoal found in layers consisting of shell midden and oven stones will derive from domestic firewood. This will have been collected from the local landscape at the time the site was occupied and is likely to reflect the local vegetation quite accurately. Another major source of charcoal is bracken fern (*Pteridium esculentum*) and shrubs that have colonised a recently abandoned occupation area that has been set alight. Repeated firing of such vegetation by Māori was common. Charcoal from such fires will collect in old kūmara pits, hāngi and ditches, etc., and be quickly buried. Such material appears to be a significant component of many archaeological charcoal assemblages, including this one. These post-occupation fires will also burn down the remains of abandoned timber structures such as palisades, fences, houses, cooking shelters, kūmara pit roofs, etc. The species involved here will be dictated by their specific structural uses, but will typically be conifers for dressed timbers and broadleaf tree species for round posts. In only two cases is the inferred specific structural element recorded on the bag label. One was labelled 'Upper terrace – K10 – wooden stake vertical in pit 2 fill'. The charcoal was later identified as rimu (*Dacrydium cupressinum*) or tōtara (*Podocarpus totara*). The other was labelled 'Mt Wellington – 1960 – E9 – Post cut from under L.3' and was found to contain hebe (*Hebe* spp.), coprosma (*Coprosma* spp.) and mataī (*Prumnopitys taxifolia*) charcoal. This sample is clearly not one item, but mataī is potentially the remains of a structural element.

Table A2.1 A summary of the Maungarei charcoal assemblages (ID = individual identifications).

Plant groups	Species	Area D Upper Terrace		Area C Crater rim		Area A		Area D Lower Terrace	
		Species IDs	%	Species IDs	%	Species IDs	%	Species IDs	%
Ferns	Bracken	42	16%	—	0%	45	12.7%	2	0.8%
Shrubs and small trees	Hebe	124	74%	105	83.5%	102	47%	86	50%
	Coprosma	6		24		32		16	
	Tutu	15		3		2		8	
	Mānuka	—		—		—		1	
	Olearia	—		—		1		—	
	Akeake	1		—		—		—	
	Fivefinger	—		3		1		—	
	Pseudopanax	—		—		3		—	
	Kawakawa	1		—		—		—	
	Ngaio	—		—		3		—	
	Pittosporum	—		—		6		—	
	Toro	3		—		—		2	
	Māpau	2		—		7		—	
	Porokaiwhiria	1		1		—		—	
	Kaikōmako	—		—		1		—	
	Māhoe	2		6		7		6	
	Kānuka	42		—		1		—	
Tree ferns	Ponga	—	0%	—	0%	10	3%	4	1.7%
Vines	Vine species	—	0%	—	0%	1	0.3%	4	1.7%
Broadleaf trees	Tītoki	—	8%	4	14.7%	—	32.6%	—	31%
	Taraire	—		—		1		2	
	Tawa	—		—		—		2	
	Rewarewa	—		—		2		8	
	Mangeao	2		—		1		—	
	Tōwai	—		—		2		—	
	Pōhutukawa	—		—		9		3	
	Kohekohe	—		7		30		24	
	Pūriri	19		14		70		36	
Conifers	Tānekaha	4	2%	—	1.8%	—	4.5%	—	15%
	Rimu	—		—		3		5	
	Tōtara	1		—		9		7	
	Rimu/tōtara	1		—		1		1	
	Mataī	—		3		2		7	
	Kauri	—		—		1		16	
Totals		**266**		**170**		**353**		**240**	

Table A2.2 Charcoal identifications from Area A at Maungarei by context.

Species	Early	Pits/ scarps	Hāngi	Late	Upper Terrace	Lower Flat	Totals	Plant type
Bracken	—	36	5	—	4	—	45	Fern 12.7%
Hebe	3	35	51	—	8	6	103	Shrubs or small trees (47%)
Coprosma	4	11	15	—	—	2	32	
Tutu	—	1	—	—	—	1	2	
Olearia	—	1	—	—	—	—	1	
Pseudopanax	1	3	—	—	—	—	4	
Ngaio	—	3	—	—	—	—	3	
Pittosporum	1	3	2	—	—	—	6	
Māpau	—	7	—	—	—	—	7	
Kaikōmako	—	1	—	—	—	—	1	
Māhoe	4	2	—	—	1	—	7	
Kānuka	—	—	1	—	—	—	1	
Ponga	—	—	10	—	—	—	10	Tree fern (3%)
Vine	—	1	—	—	—	—	1	Vine (0.3%)
Taraire	—	1	1	—	—	—	2	Broadleaf trees (32.6%)
Rewarewa	—	1	—	—	1	—	2	
Mangeao	1	—	—	—	—	—	1	
Tōwai	—	2	—	—	—	—	2	
Pōhutukawa	2	—	7	—	—	—	9	
Kohekohe	12	7	—	—	11	—	30	
Pūriri	12	27	7	2	22	—	70	
Rimu	1	—	1	—	1	—	3	Conifers (4.5%)
Tōtara	—	8	1	—	—	—	9	
Rimu/tōtara	—	1	—	—	—	—	1	
Mataī	—	1	—	—	—	1	2	
Kauri	—	—	1	—	—	—	1	
Totals	**41**	**152**	**102**	**2**	**48**	**10**	**355**	

Charcoal from diverse firing events will commonly be inextricably mixed. Five pit fill samples from the Upper Terrace in Area D are labelled ‘burnt layer’ and are dominated by bracken root and stem charcoal. Other pit fill samples from this area are labelled ‘midden fill – not burnt layer’ but also contain large amounts of bracken charcoal that again clearly derive from the burning of the same vegetation type.

Discussion of results

The abundance of bracken fern in the Maungarei assemblage suggests that it was a very important component of the local prehistoric vegetation cover. It is usually absent or underrepresented in most assemblages, as its charcoal is fragile and can be easily destroyed during sieving. The species colonises bare ground after fire or other disturbance. It is very easy to set alight but rapidly regenerates and becomes semi-permanent until repeated firing of the landscape is discontinued.

The establishment of woody species in such fernland is limited by the firing interval. Three woody shrubs – hebe, coprosma and tutu – are typically associated with bracken in the numerous charcoal assemblages from archaeological sites in the northern North Island that I have dealt with over the last 20 years. At Maungarei these four plants between

Table A2.3 Charcoal identifications from Area C at Maungarei by context.

Species	**Early**	**Pit fill**	**Pit fill/hāngi**	**Hāngi**	**Totals**	**Plant type**
Hebe	—	44	17	44	105	
Coprosma	—	11	7	6	24	
Tutu	—	—	—	3	3	
Mānuka	1	1	—	—	2	Shrubs or small trees (83.7%)
Fivefinger	—	—	2	1	3	
Porokaiwhiria	—	—	1	—	1	
Māhoe	2	1	3	—	6	
Tītoki	4	—	—	—	4	
Kohekohe	3	—	3	1	7	Broadleaf trees (14.5%)
Pūriri	12	—	1	1	14	
Mataī	3	—	—	—	3	Conifer (1.75%)
Totals	**25**	**57**	**34**	**56**	**172**	

Table A2.4 Charcoal identifications from the Upper Terrace in Area D at Maungarei by context.

Species	**Early**	**Pit 1**			**Pits**			**Late**	**Totals**	**Plant type**
		bottom	**burn**	**top**	**2/2a**	**4**	**5/6**	**hāngi/ midden**		**(%)**
Bracken	—	2	18	19	—	—	—	3	42	Fern (15.5%)
Hebe	12	10	35	26	17	5	—	18	123	
Coprosma	—	—	—	3	—	2	—	1	6	
Tutu	—	7	—	1	—	—	—	4	12	
Mānuka	—	—	—	—	—	—	—	1	1	
Akeake	—	—	—	—	—	—	1	—	1	Shrubs or
Kawakawa	—	—	—	—	1	—	—	—	1	small trees
Toro	—	—	—	—	—	—	3	—	3	(74.6%)
Māpau	—	1	—	—	—	—	—	1	2	
Porokaiwhiria	—	—	1	—	—	—	—	—	1	
Māhoe	—	—	—	9	1	—	—	1	11	
Kānuka	—	—	—	—	42	—	—	—	42	
Mangeao	—	—	—	1	—	—	—	1	2	Broadleaf
Pūriri	—	—	—	3	5	2	7	2	19	trees (7.7%)
Tānekaha	—	4	—	—	—	—	—	—	4	Conifers
Tōtara	—	1	—	—	—	—	—	—	1	(2.2%)
Rimu/tōtara	—	—	—	—	1	—	—	—	1	
Totals	**12**	**25**	**54**	**62**	**67**	**9**	**11**	**32**	**272**	

Table A2.5 Charcoal identifications from the Lower Terrace in Area D at Maungarei by context.

Species	**Early**	**Slope debris**	**Dump**	**Terrace use**	**Hāngi**	**Pit fill**	**Totals**	**Plant type**
Bracken	—	—	2	—	—	—	2	Fern (0.8%)
Hebe	5	2	24	—	47	8	86	
Coprosma	—	—	2	3	9	2	16	Shrubs or
Tutu	—	—	—	—	6	2	8	small trees
Mānuka	—	—	1	—	—	—	1	(50%)
Toro	—	—	2	—	—	—	2	
Māpau	5	—	1	—	—	—	6	
Ponga	—	—	—	—	4	—	4	Tree fern (1.7%)
Vines	—	—	1	—	3	—	4	Vines (1.7%)
Taraire	—	—	—	2	—	—	2	
Tawa	2	—	—	—	—	—	2	
Rewarewa	—	—	5	3	—	—	8	Broadleaf trees
Pōhutukawa	3	—	—	—	—	—	3	(31%)
Kohekohe	3	1	—	—	20	—	24	
Pūriri	3	—	14	5	14	—	36	
Rimu	—	—	—	—	5	—	5	
Tōtara	—	—	—	—	7	—	7	Conifers
Rimu/tōtara	1	—	—	—	—	—	1	(15%)
Mataī	—	—	4	3	—	—	7	
Kauri	—	—	—	—	16	—	16	
Totals	**22**	**3**	**56**	**16**	**131**	**12**	**240**	

them supplied 47–77% of the charcoal from the four excavation areas (Tables A2.1–A2.5). In fact, hebe alone supplied about 40% of the total assemblage. Combined with all other smaller woody shrubs, this charcoal represents nearly 70% of the total material identified.

Nearly 23% of the charcoal at Maungarei was from large broadleaf trees, the commonest being pūriri. If we assume that most of the material originally identified as kohekohe was, in fact, pūriri branch wood, then 85% of broadleaf tree charcoal was from this one species. Pūriri is a large, long-lived tree strongly associated with the fertile soils sought out by both Māori and early European settlers of the northern North Island (Dykgraaf 1992, 1994). The lowland forests where it originally grew were largely cleared during Māori settlement but, unlike many other species, pūriri has a remarkable ability to survive clearance and to persist on the landscape (Dijkgraaf 1994: 111–113). I have identified pūriri from about 100 charcoal assemblages from archaeological sites in the northern North Island, where it is usually both abundant and one of the only large tree species present in samples otherwise dominated by scrub and shrub species. At European arrival, pūriri was common in most coastal areas, even where bracken fern and scrub otherwise dominated the vegetation. It remains the most common mature native tree on the Auckland volcanic cones today. Other broadleaf tree species are present in only quite small numbers. These are tītoki (*Alectryon excelsus*), taraire (*Beilschmiedia tarairi*), tawa (*Beilschmiedia tawa*), rewarewa (*Knightia excelsa*), mangeao (*Litsea calicaris*), tōwai (*Weinmannia silvicola*), pōhutukawa (*Metrosideros excelsa*) and (probably) some kohekohe. This suggests there were at least some small stands of broadleaf bush in the vicinity.

Only 6% of the charcoal in the assemblage was from conifers. These were tānekaha (*Phyllocladus trichomanoides*), rimu, tōtara, mataī and kauri (*Agathis australis*). All are substantial trees and important sources of timber for

Table A2.6 Common and scientific names of species identified from Maungarei charcoal samples.

Common name	Scientific name
Bracken	*Pteridium esculentum*
Hebe	*Hebe* spp.
Coprosma	*Coprosma* spp.
Tutu	*Coriaria* sp. (probably *C. arborea*)
Kawakawa	*Macropiper excelsum*
Olearia	*Olearia* spp.
Fivefinger	*Pseudopanax arboreus*
Pseudopanax	other *Pseudopanax* spp.
Pittosporum	*Pittosporum* spp.
Mānuka	*Leptospermum scoparium*
Akeake	*Dodonaea viscosa*
Ngaio	*Myoporum laetum*
Kaikōmako	*Pennantia corymbrosa*
Porokaiwhiria	*Hedycarya arborea*
Toro	*Myrsine salicina*
Māpau	*Myrsine australis*
Māhoe	*Melicytus ramiflorus*
Kānuka	*Kunzia ericoides*
Ponga	*Cyathea* sp.
Vine	*Metrosideros* sp. (?)
Tawa	*Beilschmiedia tawa*
Taraire	*Beilschmiedia tarairi*
Rewarewa	*Knightia excelsa*
Mangeao	*Litsea calicaris*
Tītoki	*Alectryon excelsus*
Tōwai	*Weinmannia silvicola*
Pōhutukawa	*Metrosideros excelsa*
Kohekohe	*Dysoxylum spectabile*
Pūriri	*Vitex lucens*
Tānekaha	*Phyllocladus trichomanoides*
Rimu	*Dacrydium cupressinum*
Tōtara	*Podocarpus totara*
Mataī	*Prumnopitys taxifolia*
Kauri	*Agathis australis*

construction purposes. While in most cases it is impossible to determine if this charcoal derived from building timbers, it seems to be a likely scenario given the general composition of the assemblage.

There are small amounts of ponga trunk charcoal in the site. This material burns very poorly so is not likely to have been firewood but may well have been used as construction material for kūmara pits. A vine species, probably a *Metrosideros*, also occurs in the site. Given the numbers of fences and other structures that would have needed to be lashed together, this is not a surprising occurrence.

Some of the most interesting aspects of the charcoal data are the absences from the assemblage. Pōhutukawa is a very common species in coastal Auckland today but is rather rare in the assemblage. If it had been a significant part of the local vegetation, it was no longer so during the occupation of the excavated areas of Maungarei. Its abundance in modern times on Auckland's cones may be due to deliberate planting.

Kānuka is another species that was not common in the assemblage. It is extremely common in native bush in the Auckland area today, where it has the role of the main pioneering woody species, which, as it matures, provides a nursery for regenerating forest. Clearly, forest regeneration was not a feature of the Maungarei landscape at the time the site was occupied. It is suspected that repeated firing of a bracken-dominated vegetation cover suppressed kānuka growth locally.

In summary, the charcoal assemblages from Maungarei strongly suggest that bracken fern and a limited suite of small woody shrubs dominated vegetation in the local area over the period when the site was occupied. While pūriri trees were abundant in the vicinity, only a few stands of bush that could be described as forest seem to have been present locally. It is clear that human modification of the vegetation had resulted in a largely open, non-forested landscape at this time.

References

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