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MAORI MODIFIED SOILS OF THE UPPER WAIKATO

Alan Clarke

INTRODUCTION:

Stereoscopic examination of aerial photographs of the Waikato Basin taken in 1943 reveals a number of large pits on the low terraces and old natural levees which flank the present course of the Waikato River, and on a few well-drained areas within a kilometre of its banks in the Horotiu district (i.e. between Ngaruawahia and Piarere). They can also be seen in similar situations but in smaller concentrations and numbers at odd places on the banks of its major tributary, the Waipa River. Some are round and others irregular, but most are oval-shaped, varying in density from 1 - 3 per hectare. While they are generally connected in a loose chain, some are grouped together in a cluster. Field surveys indicate that they are about 2 - 4 metres deep, though some are much deeper (Taylor, 1958: 71-77). Such pits also feature in other parts of New Zealand, particularly Aotea Harbour, Southern Taranaki, the Wairarapa, D'Urville Island, Kaikoura and the Waimea Plain, including Nelson and Motueka (Watson, pers. com; Buist, 1976; Fleming, 1953:94; Yate, 1835:156; Stack, 1893; Best, 1925; Bishop, 1924: 317-20; E.J. Wakefield, 1908) and have been called "quarry pits" by archaeologists (N.Z. Site Recording Handbook, 1970: 31-32). In reviewing the various interpretations placed upon their origins, D. Pick (1968) has mustered considerable evidence from the records of early missionaries, artists and other travellers throughout different parts of the country in the 1830 - 40's, together with recorded observations made much later, to support the hypothesis that they owed their origins to the quarrying activities of the Maoris who excavated pumiceous gravel or sand from the pits, frequently with the addition of burnt vegetable material, in order to improve the natural humified surface profile (the 'A' horizon) of soils to make them more suitable for growing kumara.

The work of the pedologist N.H. Taylor (op. cit) has revealed that adjacent to these pits there are indeed large areas of "gravelly topsoil" which he considers forms an almost perfect kumara soil from the physical viewpoint (i.e. drainage, heat retention, fertility) ranging in area from about 0.2 hectare to over 20.23 hectares. Taylor has mapped about 832.28 ha of such modified soils in the northern Waipa County and southern Waikato County but estimates that there are over 2020 ha all told in the Waikato Basin because his soil maps do not include areas of metropolitan Hamilton and Cambridge and Ngaruawahia where cultivations are known to have existed in the 1840 - 60's (F.W. McKenzie M/s 1853; Ashwell, Journal: 18/1/1849; Taylor M/s 1848; Isaac Coates M/s in Norris, 1963: 8-10; Weekly News, December 1866; ibid, February 1867; Daily Southern Cross; 13/8/1863; Gorst, 1864: 17n, 60n; Graham, 1864 Map), and where quarry pits are indicated on the 1943 aerial photos. G. Law (1968) has also reported about 89.03 ha of modified soils, and some possible quarry pits, on the better-drained, higher parts of the Rangiriri-Huntly flood plain.

While Taylor (1958: op cit) tends to emphasise the physical properties of the soils, S. Edson (pers. com.) distinguishes between physical and chemical modification: i.e.

"A. The Addition of Gravel/Pebbles to improve 1) friability, 2) the

balance between moisture retention and drainage, 3) the significant raising of soil temperature, and 4) improvement in temperature constancy. (See Aidan Challis, Auckland University, forthcoming Publication in N.Z. Journal of Science, on kumara soils in Motueka, Nelson. His results indicate that the addition of gravel raises soil temperature by as much as 2°C enabling an earlier planting-out and consequently improved yield).

- B. Nutrient Enrichment. There is increasing evidence that pre-historic Maori gardening techniques were more sophisticated than we thought. Both in Nelson (Ibid) and on Mayor Island (see McCraw and Whitton, N.Z. Journal of Science, 1971: 1015 - 16) qualitatively and to a lesser extent quantitatively similar results obtain from soil analysis, i.e. modified soils, when compared to unmodified parent soils tend to possess a slightly higher pH value and base saturation (particularly calcium), a slightly higher retention, and a higher tamm's oxalate extractable aluminium value, and a much higher proportion ($\times 10^{-15}$) of NH_2SO_4 ."

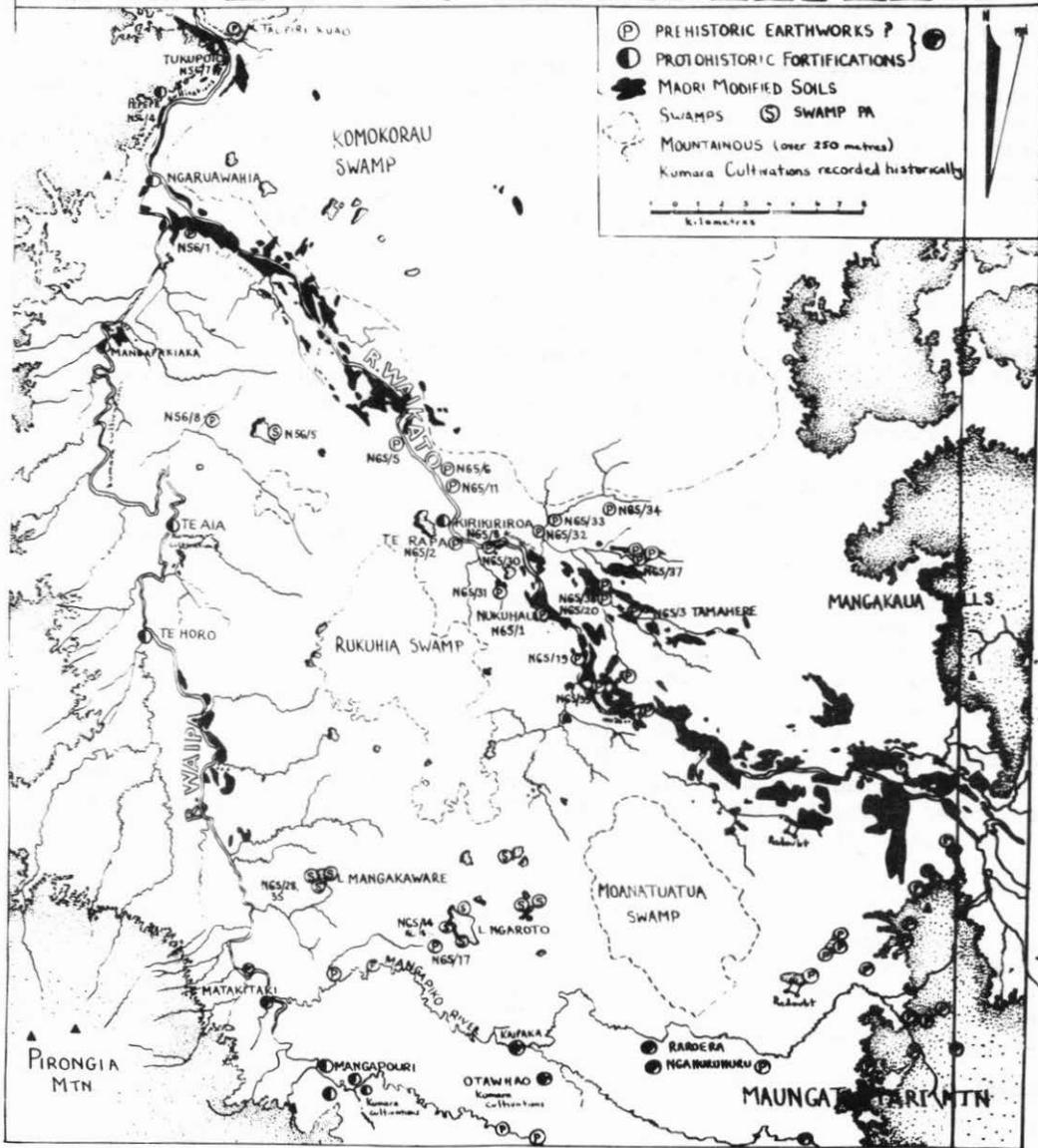
How these differences are translated into events of archaeological significance is open to interpretation (Leach, 1976 mimes), but so far as phosphorus and nitrogen enrichment are concerned, an explanation for the former may be found in the burning of manuka, mahoe and makomako, and for the latter the growth of tutu, leguminous kowhai and ngutukaka as some of the first nitrogen replenishing species to become established in forest regeneration (ibid).

It is the intention of this paper to present the ethnographic evidence from the Waikato in detail and thereby demonstrate that the soils were in fact utilised for agricultural purposes, and specifically for the cultivation of the kumara. It also attempts to assess the relationship of the archaeological site distribution and nineteenth century settlement pattern to the distribution of the modified soils.

Environmental Setting:

The Horotiu district is bounded in the north by the Taupiri Gorge and the Komokorau Swamp, in the east by the Maungakaua Hills, and in the west by the once extensive Moanatuatua and Rukuhia Swamps. It is some 48 kilometres in length and extends inland for about 8 kilometres on either side of the Waikato River. Flat to gently undulating it consists of young Pleistocene and recent gravels, sands, clays and peats, the occasional long clay ridge breaks its surface around Hamilton and Cambridge. There are isolated hillocks to the north and south of Hamilton which are the eroded elements of a system of terraces formed on Pleistocene deposits Selby (1967); McCraw (1967); de Lisle (1967). Like the Waipa, the Waikato River above Ngaruawahia has cut its bed to form a deep channel about 17 metres below the general level of the surrounding terrain, and this has resulted in the area being dissected by steep-sided stream valleys and a low water-table in places. On Hochstetters 1858 map of the Waikato (Waikato University Library) many of these streams are shown as rivers, which they were then but today are clogged by willows and blackberries. The discontinuous terrace about 8 - 10 metres above the river level and up to 20 metres wide which flanks the course of the rivers is

UPPER WAIKATO



generally devoid of cultural features (possibly because of the danger of flooding or because they were within musket range from the terraces above), and it is on the upper terrace that the sites of former habitation and defence, the quarry pits and modified soils are found.

The extremely complex soil patterns follow closely the parent material and vegetative cover (N.Z. Soil Bureau Maps). A thorough examination of Taylor's kumara soil maps, together with a reading of the historical estimates of soil fertility and the gross elements of settlement and cultivation location indicates that almost without exception the areas of modified soils are found on the alluvial flood plains and deltas of the Waikato and Waipa Rivers, on recent stream terraces or on surfaces covered by the basic volcanic materials of relatively recent geologic age. One exception in the proto-historic period was kumara production at Otawhao (Te Awamutu) and Mangapouri where kumara were grown on friable, easily worked yellow-brown loams and silts without the apparent necessity of modifying the soil profile (Stack, Journal: 13-15/8/1835, 8-12/12 1835, 22/11/1834: 17, 1-11/11/1834: 20-21, 11/12/1834: 23). A number of zonal mature soils on flat or undulating areas of the Waikato and the Waipa where cultivation of tropical root crops might have been carried out were relatively stable but were low or very low in fertility (Gorbey, 1970), cold and overwet or were subject to flooding, and it was the lighter, well-drained, heat-retaining (but moist in summer) interzonal and azonal alluvial soils or yellow-brown loamy soils on water-spread pumice which were selected as the most suitable for kumara cropping. Edson's (1976) fieldwork on the west coast of Coromandel and the offshore islands (1973) points to the critical importance of recent alluvial soils, volcanic ash deposits and yellow-brown sandy earths and loams for understanding settlement patterns in these areas also.

The natural vegetation of the area has been greatly modified by the interference of both Maori and European, but from pollen studies and relict vegetation, coupled with the earliest historical records, it would appear that in prehistoric times much of the area not in swamp or bog was covered with a mixed forest dominated by rimu and tawa, with kahikatea in the swampy hollows (Shortland, M/S Book 4:3/10/1842:104-105; McKenzie op cit; Stack, op cit; Norriz, 1963; Taylor and Pohlen, 1958; Cranwell, 1939). While yellow-brown earths and loams are derived from mull-forming trees, mor-forming trees such as rimu and kauri produce acidic and leached podzolic soils, but soils that are under a cover generally tend to be loose, soft, permeable and easily croppable when initially cleared of the wild cover and very little formal tillage is required to prepare them for cropping (Spencer, 1966). Why then was it necessary to modify the soils utilised for kumara production? Has it any relationship with the practice of swidden agriculture and the extensive areas of fernland described by the European visitors to the Waikato in the 1850 - 60's? What was the relationship of the soils to the pattern of settlement and site distribution? Were pa sites located in the immediate vicinity of the kumara fields? What cultigens were being grown on unmodified soils and why? The answers to some of these questions may be contained in the ethnographic literature of the Waikato and prompted this paper.

Site Distribution and Morphology:

The advent of mechanised farming in the Waikato and the rapid and extensive urbanisation that has characterised the Horotiu area since 1947 has resulted not only in

the disappearance of hundreds of quarry pits and the disturbance of the "Maori modified soils", but also the destruction of most of the earthwork fortifications. This has helped to create the impression today that the seemingly intensive use of the modified soils was not paralleled by a concentration of pa, not to mention a wide range of component sites (Law, 1968; Gorbey, op cit: 95). In fact the under-representation of pa reflects the state of the Waikato file records rather than the true ground situation and the 1943 aerial photos show quite clearly several very large river terrace pa defended by transverse ditch and bank systems on the immediate banks of the Waikato and Waipa Rivers, and many small river terrace or promontory pa together with the occasional hill-top and ridge pa situated on smaller navigable tributaries, which have been subsequently recorded. Few of the latter sites are heavily defended and none exhibit conspicuous surface evidence of frequent intermittent or a long continuous occupation. However, there is spatial cointiguity between these earthwork pa and the modified soils and quarry pits in nearly all cases.

Investigation of the relationship of the quarry pits and soils to the overall pattern of nineteenth century settlement also shows a significant spatial correlation, but the historical records of the 1830 - 50's clearly indicate that stockaded enclosures mostly devoid of earthworks were the dominant structure in the settlement pattern. Palisaded swamp pa have made their appearance in the archaeological record of the Waikato, dated to the sixteenth century (Bellwood, 1969, 1970, 1971: 113-126; Peters, 1971) the Thames and other North Island areas (Shawcross and Terrell, 1966; Adkin, 1948; Guthrie-Smith, 1953; Best, 1927), but have not received the same attention that earthwork fortifications have had because of their poor survival rate. There is a strong possibility that the stockaded enclosures of the protohistoric period with their specialised features adapted to musket and cannon defence are a development of the prehistoric swamp pa.

Historical Evidence:

In view of the extent and depth of the modified soils one would expect a considerable time in their formation, but K. Gorbey (Law, 1968) has suggested that they date from the historic period before the Maori-European Wars of the early 1860's when an extensive agricultural trade developed with the Auckland and Tauranga markets (Hargreaves, 1959; 1963). Certainly the protohistoric period in the Waikato extended well into the 1850's, but direct European contact and serious commerce did not begin in the Waikato until 1829 - 30, and religious conversion until 1834 - 35 (Clarke, June 1973; December 1974a; June 1975) and before these dates there was a period of over twenty years of change resulting from Hongi Hika's musket raids from 1822 on (ibid) or from indirect European influences, technology and agricultural items and methods diffusing from primary innovation centres in the Bay of Islands and Thames districts. For this period there is very little record, yet an understanding of what took place in these intervening years is important because of the way features which appeared in Waikato Maori culture and society at this time have coloured thinking about the Waikato's truly prehistoric period.

Taylor's (op cit) map of the so-called Maori kumara soils and quarry pits shows one of the largest continuous stretches of modified soils to be found in the Waikato is

around the confluence of the Waikato-Waipā delta at Ngaruawahia though Edson's field work indicates that the incidence of quarry pits on the old river terraces is consistently high between Ngaruawahia and Cambridge (pers.com.). The Rev. William Yate (1835: 208) wrote of the Waikato in the 1830's that:

"..Here, as in other parts of the island, when the natives are not living in fortifications for security, they were found to be residing in detached villages; at a few miles distant from the other; their cultivations being still more scattered..."

The Rev. William Williams (Journal, 3/1/1834: 349) maintained that the banks of the Waikato River were "...the place of general rendezvous of the Waikato tribes in the planting season..." and also stated (ibid, 21/8/1834: 382) that:

"...the banks on either side of the river for about fourteen miles from Ngaruawahia pa are lined with cultivations for nearly the whole distance, though for the most part they have few inhabitants except in the planting season"

Unfortunately his or any other accounts fail to record the types of crops grown at Ngaruawahia (though potato clamps in the indigenous style were reported in the 1860's). Ngaruawahia pa was the most important fortification and political centre of the Waikato tribes in the 1830's through to the 1860's (Hamlin, Diary: 28/1/1834: 15; Stack, op cit: 30/6/1835; Rogers, 1961: 428; Gorst, 1959; Wade, 1842: 110; Shortland, M/S Book 4: 10/4/1842; Taylor, 1966: 345). Located at the confluence of the two most important canoe waterways in the Waikato (Memorial Park), it was obviously sited from the point of view of defensive requirements primarily but could also control the flow of canoe-borne trade from the Lower Waikato through the Taupiri Gorge. The pa was Te Wherowhero's principal fort and general seat of residence once his people began to return from the hills around Te Kuiti and Otorohanga where they had retired after Hongi's 1822 invasion (Kelly, 1931: 35-38; ibid, 1949: 365; ibid, 1938: 144-152; Clarke, 1973: 44). Three important chiefs - Te Kati (Te Wherowhero's teina), Te Pura and Toha - were generally to be found there and exercised nominal proprietorship. The settlement was described as "large" by Williams (op cit: 17/8/1834:381-382; Taylor M/S 1848), a judgement to be respected since he was acquainted with the size and distribution of Maori settlements in several heavily populated New Zealand areas (e.g. the Bay of Islands and Tauranga). According to the early Waikato trader, Charles Marshall (St. John, 1873), when it was reported that another northern expedition was intended against the Waikato tribes toward the end of 1833 to avenge the deaths of the northern chiefs Pomare and Pukerangi (Rogers op cit: 246-8, 257; Williams, op cit: 26/6/1832, 18/8/1832: 254);

"...all the Waikato tribes conjointly erected a large pa at Ngaruawahia occupying many acres".

(see also Hamlin, op cit: 30/5/1835: 21; Rogers, op cit: 428; Williams, op cit: 3/7/1826: 50, 16/8/1834: 279-280; Kelly, 1949: 366). Stack (op cit: 22/4/1836) reported that Te Wherowhero was still expecting reprisal raids as late as 1836. The pa may have had earthworks comparable to those of Matakītaki and Te Horo (Clarke, June 1974b), but it certainly was surrounded by a palisade of strong hardwood posts which were dismantled when Te Wherowhero was elected Maori King in 1858 (St. John, op cit). Only 200

people assembled in the pa to meet Williams when he first visited the Waikato in August 1834 (Journal: 17-18/8/1834: 381) as many of its inhabitants were residing in small undefended settlements in the Upper Waipa Valley collecting fern-root, the winter white potato crop and eeling (Hamlin, op cit: 14/2/1834; Clarke, December 1973: 44-58; *ibid*, June 1974: 2-11), but another 120 who came down the Waipa later also regarded Ngaruawahia as their residence. Most of the important meetings that were held in the Waikato region between 1834 - 60 took place at Ngaruawahia, the "Council - of - Chiefs" (komiti) representing the views of the leading chiefs and warriors from both the inland and coastal districts of the Waikato as well as the Upper and Lower Waikato Basins (Hamlin, op cit; 28/4/1834: 100; Williams, op cit: 17/8/1834: 381, 3/1/1834:349; Rogers, op cit: 427-428; Gorst; op cit). At such times the population of the pa undoubtedly increased, but at other times it contained only a few families and old people (Hamlin, Diary: 28/4/1834: 101; *ibid*, Journal: 30/5/1835: 21; Stack, op cit: 30/4/1834: 144; 21/8/1834: 27, 27/6/1835; Wade, op cit). This decrease in population occurred principally between January - April and appears to have been associated with the harvesting of the kumara, potatoes, maize and occasional wheat crops from distant plantations.

Second only to Ngaruawahia in political importance in the Waikato by 1844 was the large palisaded enclosure of Tukupoto, situated on the west bank of the Waikato River at Taupiri where the river leaves the Upper Waikato Basin on its northward passage to the sea. Here a range of hills crosses the course of the river obliquely from northeast to southwest and the river flows by a short and narrow gorge through clayey hills. Sheltered towards the south by the Hakarimata Range is a flat alluvial terrace some 3.219 kilometres long and 109 - 820 metres wide on which were Tukupoto and other settlements. Tukupoto is one of the very few settlements in the Waikato from which it is possible to infer the protohistoric pattern of Waikato settlement, largely as a consequence of G.F. Angas's (1850; 1847, Plate XV) sketches and description. He stated that:

"Kaitote (Tukupoto) pah consists of an open quadrangle, with houses ranged on either side in the primitive style, the whole surrounded by a lofty palisade of wooden posts, having an entrance at each end."

It was inhabited by the Te Ngaungau section of the Ngati Mahuta under their old chief Wesley Te Paki, who was next in importance to Te Wherowhero in the district (Buddle, Diary: 2/11/1840; Ashwell, Journal: 21/10/1841: 80). As paramount chief of the Waikato tribes, however, Te Wherowhero exercised nominal ownership of the pa which was the largest of a number of stockaded enclosures along the Taupiri flats collectively known as Kaitotehe, and in the Lower Waikato (Ashwell, op cit: 31/3/1842; 8/2/1851: 219; Meurant, Diary: 12/10/1845; Johnson in Taylor, 1959: 134). Of the other smaller settlements on the west bank, two miles upstream there was Kahumatuku pa inhabited by the Ngati Whauroa a population of 80 in 1840 (Fenton, 1859: 3; Johnson, "the New Zealander": 3/11/1847); Patutaka pa, another settlement of Te Paki's about three miles up the river towards Ngaruawahia and several undefended hut clusters (e.g. Pepepe). On the opposite bank was a small stockaded village called Tarake, also occupied by the Ngati - Whauroa. (Ashwell, op cit: 29/12/1845: 85; A.J.H.R., 1860: B - No 9).

Although Te Wherowhero is reputed to have resided on the alluvial margins at Taupiri prior to the battle of Matakaitaki pa in 1822 (Kelly, 1940: 158-159), none of the travellers up the Waikato from 1834 on make reference to habitations on the river flats until 1840. When the Rev. W. Wade made his night quarters at Taupiri in January 1838 (1842: 110) it was on:

"...an unsheltered plain on the opposite side of the river to Taupiri."

That is to say the site of Tukupoto pa. It is possible, therefore, that Te Wherowhero's pa was the deserted earthwork fortification of Taupirikua (Kelly, 1940: 158) which appears in the right hand side of Angas's sketch of Tukupoto (1847: Plate XV) and described by him as "... an ancient fortification." Site 56/1 just south of Ngaruahia pa is reputedly also an ancient fortification known as Pukeiahua - Kelly, 1949). In November 1840 however, the Rev. Thomas Buddle (op cit: 2/11/1840) while in search of a site for a second Wesleyan mission station, encountered a small party of Taupiri who told him that they had put up dwellings for two European traders who had never arrived, and now planned to build a pa there. These were the Te Ngaungau section under Te Paki (ibid). Buddle wrote that:

"They say.....that there will be 400 fighting men among them, so that we may calculate on 700 - 800 souls, men, women and children in the valley."

By the beginning of 1841 the pa had been completed and the vicinity was so well - populated that it was here that a mission was established, though a Church Missionary Society settlement. Angas (1850, Vol. II: 35) implies that the pas known as Kaitotehe had a population of between 1000 - 2000 in 1844, a figure which may appear to have been exaggerated but which was probably a reflection of the coming together of some or all of the tribes recognising Te Wherowhero's authority for the communal planting of the kumara, or when danger threatened or arose between sections of the tribes as it did between 1842 - 46 (Ashwell, op cit: 31/3/1842, 3/9/1845: 98-99; Morgan, Vol I, 1846: 256; Shortland M/S Book 4:7/11/1842: 83; Wily and Maunsell, 1938).

The site of Tukupoto and the other settlements has been the scene of maize plantations and dairying activities since 1860's and has not been mapped by Taylor (1958: 77), but there are still about thirty eroded quarry pits recognisable along the flats, which also show pedological signs of having been modified by the addition of gravelly pumice and burnt vegetable material to create a friable blackened soil. Reminiscing at Tukupoto about the ancient gods to Ashwell (op cit: 8/12/1851: 219) Te Paki stated:

"My friends.....Eels, Fish, Mussels were worshipped by us and our inland gods were similar - Rats, Owls and Kumeras. Our tapus (sacred places) were numerous."

His friend, Mokorau (ibid: 280) likewise declared:

"Our kumaras were very sacred and if our tapus were infringed wars followed these things were very sweet to us."

Both these chiefs were observed attending to the communal planting of the kumara in the 1840's. Ensign Best (Taylor, 1966: 343-345) was one of several European visitors to remark upon the:

"...much fine land in the neighbourhood and considerable plantations of Corn Potatoes & Kumaras"

Angas (op cit: 34) stated that:

"The district around Kaitote is famous for its fine kumara grounds, the soil being composed of a rich alluvial mould, and the native cultivations exhibit an unusual degree of care and attention"

He also implies that the generally light dry soils of the river terrace were a fruitful source of the large edible fern-root rhizome. Elsewhere (ibid: 35) he wrote:

"Kaitote is famous for its fine kumara grounds. The banks of the river are low, and the fern extends to the water's edge, with about three or four feet of light vegetable soil or sand, through which the roots of the fern extend, thickly matted together...Numerous whatas or elevated repositories, are scattered about this district, and the natives have extensive cultivations of potatoes, kumaras, Indian corn and occasionally wheat"

Accompanying Ashwell on a 3 kilometre walk across the flats to Pepepe Angas noted:

"...large piles of bushes in stacks amongst the kumara grounds through which we passed; they were used for sheltering the tender plants when young. Great care is required in rearing this precious vegetable owing to its susceptibility to frosts and severe winds".

The burning off of these piles of brushwood over the years could be a further factor accounting for the blackened nature of the soils. Dr J. Johnson ("The New Zealander", 30/10/1847) likewise declared that the whole of the ground around Tukupoto pa was under crops of kumara, potatoes and maize varying from 8 - 20 ha in extent, the smaller-sized cultivations being in kumaras. Though the kumara and maize crops were in excellent condition, the potatoes were in a very poor state as the result of a long drought. These and other cultivations along both sides of the river between Taupiri and Ngaruahia were semi-permanent cultivations, only portions being allowed to fallow by reverting to fern or scrub (Ashwell, op cit: 7/11/1853) and were still being cultivated over a decade later, in contrast to swidden agriculture of the white potato which was usually grown in new swiddens burnt out of the forest or scrub each year (Johnson, op cit: 29/11/1847, 6/10/1847, 20/10/1847, 13/11/1847, 22/12/1847; Best, 1930; Felton Mathew M/S 1841-44; Morgan, Journal: 141; Wade, 1842; Dieffenbach, 1843). The cultivations do not appear to have been associated with other such archaeological features as walls, drains or boundary markers. Other elements in the diet of the Maoris at Tukupoto (and elsewhere in the inland Waikato) in the 1840's were mentioned by Ensign Best (Taylor, op cit: 344):

"...the Mauries presented us with some little delicacy such as a Bundle of Eels a handful of Pokoto a basket of Kumeras or Mauku. This last the root of a shrub called by the Mauries Ti is of extraordinary sweetness when dressed which operation I believe consists in steaming and beating with a stone it has the appearance of Oakum plentiful sprinkled with brown sugar the flavour is remarkably agreeable something resembling Licorice. Pokoto are a small fish said by some to come down from Lake Taupo to spawn in a lake called Whangape they are caught and dried in great numbers and as well as dried Eels are much esteemed."

The edible fern-root was an important staple in the diet of the Waikato Maoris until well into the 1840's when it gradually came to be replaced by the white potato and maize or wheat (Johnson in Taylor, 1959; Ligar M/S 1846). Places (whai) where fern-root could be gathered by travellers were established along the river (Taylor, 1966: 343).

As paramount chief of the Waikato tribes, Te Wherowhero could be found residing at any one of a number of settlement types throughout the 1830-40's, ranging from the large pas at Ngaruawahia and Taupiri, the Waikato Heads and at Honipaka (Onepaka) at the base of Kakepuku Mountain in the Waipa Valley, to the numerous lightly palisaded villages along the Lower Waikato and the Waipa or the undefended hut clusters on the slopes of Pirongia and the eeling lakes of Pokomuaia, Waikare and Whangape (Ashwell, op cit: 27/10/1839: 47; Meurant, Diary 1845; Ligar, op cit; Hamlin, op cit: 8/2/1834: 19; Stack, op cit: 27/9/1835, 2/11/1834: 113, 16/11/1834: 17, 11/10/1835: 35; Dieffenbach op cit: 317; Meurant, op cit: 17/5/1845; Angas, 1850: 16-35, Taylor, 1959: 124-134; Shortland, M/S Book 4: 225). Similar mobility has been recorded for Te Waharoa, the principal chief of the Ngati Haa, living between Hamilton and Matamata and Maunga-tautari mountain. Not a single Maori was at Tukupoto pa when Angas was there in October 1844. In the company of Te Wherowhero they were at their extensive kumara grounds at Whatawhata on the Waipa, another area of modified soils and quarry pits (N 56/27) Whatawhata was an important centre of Maori agricultural activities throughout the 1840 - 50's (Gorst, op cit: 68-69, 186-187, 224) and cultivations were situated all around it along the banks of the river (Angas, op cit: 42-43). Visiting the "... settlement and potato grounds" at Whatawhata two days after visiting Tukupoto pa Angas found a small but strongly fortified pa called Te Aia standing on a knoll overhanging the eastern bank of the Waipa in a curve of the river. In the 1840's it was occupied by two sections of the Ngati Mahuta - the Ngati Hourua and some of the Te Ngaungau and had a perennial population of about 200 (Taylor, 1959: 137); Ashwell, op cit: 5/7/1840, 13/3/1846, 20/2/1849; Shortland, op cit: 2/11/1842). The pa was not mentioned in any of the resident missionary accounts between 1834 - 36 and was probably built after 1836. Angas (op cit: 49 - 50) observed Te Wherowhero superintending the planting of the kumara in the rich, but generally light gravelly soil. Again there were numerous whata in the neighbourhood but no explicit reference is made to underground storage structures, which are also absent in the archaeological record. Although he did not record the number of people working in the cultivations at this time, when he returned a month later Angas found the Maoris still occupied in their plantations and estimated

that about a thousand people of all ages were assembled at the kumara grounds. Not all these people were from Kaitotehe, however, as a number were related Ngati Ruru from Orawahao pa, Te Awamutu (Those people left behind in the pa at Te Awamutu were collecting Freycinetia Banksii or kiekie), under their chief Mokorau. Another "important chief" was present implying that a further tribal section was helping to plant and weed the kumara which were being grown for a large "hui hui" or feast which Te Wherowhero intended giving in the following season.

There were kumara grounds and settlements on the Waikato islands of Wakatupuhina and Tarahanga in the vicinity of Rangiriri, and around the numerous pa and hut clusters along the higher, better drained levels of the Huntly-rangiriri flood plain where Law (op cit) has located an estimated 80 ha of modified soils and some quarry pits (Ligar, op cit; Mainwaring, 1863 in A.J.H.R. E No 5-D; Angas, op cit). In October 1845, Edmund Meurant (Diary: 17/5/1845 - 24/12/1845) accompanied Te Wherowhero from the kumara gardens at Whatawhata to the plantations near Rangiriri and had to wait a week while the kumara were planted in a sacred ceremony before he could continue on his journey. The Rev. J. Whiteley (Journal, 1839: 6) likewise declared that when a person commenced planting kumara both he and the cultivation ground were tapu because of the kumara in it:

"The kumara ground must not be defiled by food, the persons on it must not prepare food for themselves nor touch it with their hands.....they work together in perfect silence and other persons not engaged in this employment must not pass near them, but find their way by some circuitous route through the bushes."

In the writer's view, it is apparent that archaeologists have yet to come to terms with a further source of evidence that kumara cultivation was an important component of the prehistoric economy of the Waikato - i.e. the socio-economic and socio-religious attitudes of the Polynesians in general and the Maoris in particular to horticulture, the folkways, if you like, revealing ideals, values and ethics preserved in oral tradition and attitudes towards land, some of which survive to the present day.

It is clear that labour patterns associated with the kumara were chiefly cooperative and communal when it came to planting, but there were many variations in the working group structure involved in weeding and harvesting both these and the introduced cultigens. Apart from the utilitarian requisite to preserve food, Angas (op cit: 34) maintained that the law of tapu in connection with the food eaten by a chief rendered it necessary for such food to be kept sacred and apart from that eaten by commoners women and slaves - hence the elaborately carved storehouses he recorded at several of the settlements of the Lower Waikato and elsewhere. He was given some kumara from a raised storehouse at Maurea pa, Rangiriri, and commented that:

"...these are the choicest of the New Zealanders produce and their whatas, or stores for these vegetables are frequently more carved and adorned than the houses they dwell in."

an oft repeated remark by early ethnographers (e.g. Nicholas, 1817, Earle, 1966: 64, Plate VI). The practice of storing crops in raised storage structures could be a

possible explanation for the almost complete failure of isolated or grouped pits to appear in the Waikato file. At the same time, however, this may reflect the incompleteness of the site record file as a result of the concentration paid to the larger, more spectacular sites, and as the ridges are explored well back from the river these undefended pit complexes will be recorded. Two have recently been located at Waerenga (Edson, pers. com.). Most of the pa have had pits within their perimeters, but some of these have been used for the storage of the white potato as well as the kumara, so that their occurrence does not necessarily indicate their association with kumara cultivation (Gorst, Op cit: 21; "The New Zealander": 16/6/1852; "Weekly News": 17/10/1864; Hochstetter, 1867: 319; Morgan, op cit: 24/2/1845: 188).

For the area around Hamilton and Cambridge where most of the modified soils and pa occur there is very little historical material. Several traders and missionaries travelled through the Horotiu district in 1834-36 on visits to either trading depots at Tauranga or to the Mangapouri mission, but encountered only a number of sacked pa. The area was deserted apart from small groups of armed Maories travelling between Nga-ruawahia and Matamata pas and the fortifications on Maungatautari Mountain which was well populated at this time (Fenton, 1879: 64-70; Kelly, 1948; 368-369; Vennell, 1939; ibid, 1951). Some idea of the prevailing state of affairs can be gained from a reading of the Rev. John Morgan's Journal (Vol I, 22/8/1834: 17-20). After crossing the Maungakaua Hills he pitched camp on the banks of the Waikato somewhere near Tamahere and wrote that:

"My native Wahataupoki pointed out to me an old Pa fortification which was formerly occupied by the tribe to which he belongs. They were driven from their possessions some years ago by Waha-roa (Ngati Haua) and his party. The extensive plantations of former days, the numerous potato stores and the native houses now in ruins told a mournful tale and plainly showed what the place had been."

Traditional evidence has this area a zone of conflict between the Ngati Haua, the Ngati Raukawa (who left the Waikato between 1820 - 1829. Carkeek, 1966; Waikato Minute Book No 1: 30/3/1866) and the Ngati Mahuta from the sixteenth century on which reached its climax about the early 1830's (Angas, 1850: 149-151; "The New Zealander": 10/11/1847; Waikato Minute Book No 1; 14/2/1868; Wilson, 1907; Kelly, 1949; 360-370). Kelly (op cit: 369) claims that about 1825 - 26 some of the Ngati Haua, Ngati Maru and Ngati Koroki re-established themselves at the Horotiu, occupying Nukuhau pa (N65/1) and Tamahere, and while there is no historical evidence for this, it is of course possible that these settlements were away from the tracks travelled over by the missionaries and others.

Though it is possible to correlate areas of modified soils and quarry pits with areas where large stockaded enclosures, surrounded by extensive kumara, maize and potato cultivations have been recorded in the nineteenth century records, it is not possible to say with certainty that these agricultural soils had their origins only in the protohistoric and historic periods. In 1842, Edward Shortland, (M/S Book No 4: 3/10/1842: 104-105), Sub-Protector of the Aborigines, made a trip into the Waikato accompanied by two of the most influential Ngati Haua chiefs of the time - Pohepohe,

successor to Te Waharoa as paramount chief when the latter died in 1838 (Brown, Journal: 19/1/1839; 2; Smith, 1910b: 258) - and Tuwhare. They journeyed from the principal Ngati Haua pa at Matamata over the Maungakaua Hills and on reaching the site of present day Hamilton found "Kirikiritoa, a kainga..." At this time some of the Ngati Haua had only recently begun to return to the Hamilton-Tamahere area (Ashwell, op cit: 18/1/1849: 166; Fenton, op cit: 111-120; Shortland, op cit: 18/10/1842). Within a few years Kirikiriroa ("..a long stretch of gravel") was to develop into another large palisaded fortification (N65/8) of considerable size, surrounded by fenced plantations of kumara, maize and potatoes (Taylor M/S 1848; Isaac Coates M/S; Ashwell, op cit: 18/1/1849; McKenzie M/S 1853; "Weekly News", Dec. 1866, Feb. 1867; Daily Southern Cross, 13/8/1863; Gorst, op cit). Prior to the Maori-European wars of the 1860's it was occupied by 300 Ngati Haua (A.J.H.R. 1860, B/9: 147).

Shortland wrote of his journey (op cit) from Kirikiriroa to Mangapakiaka on the Waipa (built in 1843 Morgan, op cit; 5/10/1843; 31) that:

"The land which we travelled the last few days was good, with woods and swamps scattered over it, which latter are highly prized by the natives on account of their eel fisheries. This last day we travelled through several kaingas, which had been in cultivation in Pohipohi's younger day, and the surface of the ground in those places was thickly strewd with gravel, chiefly pumice (punga punga). Several deep pits were pointed out from which this had been dug and mixed with the soil to render it fit for the cultivation of the kumara."

This is the earliest and only first hand observation of the relationship of the modified soils and quarry pits to kumara cultivation and settlement in the Waikato and in the writer's opinion provides strong circumstantial evidence for their prehistoric origins, especially if viewed together with the "ancient" or "old pah" which appear adjacent to the palisaded enclosures on Ligar's map of the Lower Waikato (M/S 1846) and those recorded by Angas (1850) adjacent to Tukupoto and Kelly (1940: 129-133) adjacent to Ngaruawahia pa. Granted that the evidence may be considered slight in that it relies on the heresay of Pohepohe, there can be no reason why the latter should not be telling the truth or be misinformed. What makes Shortland's statement particularly significant is that at this date (1842) Pohepohe was recorded as being not only the most influential of the Ngati Haua chiefs, but was also stated by Ashwell (op cit) and Archdeacon A.N. Brown (op cit: 19/1/1839: 2) to be the oldest chief in the Waikato. They and other missionaries had opportunities of meeting regularly with the leading Waikato chiefs when adjudicating disputes between them, and they and other Europeans frequently mention chiefs who appeared to be in their seventies and eighties. Even allowing for some exaggeration, if Pohepohe's age is conservatively estimated at sixty, this places the cropping of kumara on modified soils well into the Waikato's prehistory (i.e. the 1780-90's).

In a subsequent retrospective review of Maori agriculture which formed part of his book "The Traditions and Superstitions of the New Zealanders" (1856), Shortland elaborated on his manuscript notes:

"The Maories...knowledge of the art of horticulture was considerable for they employed the method of forming an artificial soil by mixing sand with the natural soil in order to render it more suitable to the growth of the sweet potato. In parts of the Waikato district where the kumara was formerly much cultivated, the traveller meets with large excavations from twenty to thirty feet in depth like the gravel pits one is accustomed to seeing in England near the public roads, and in reply to his enquiries he learns with surprise that they were formed by those who resorted there, year after year, to procure sand for manuring the ground in the manner described."

Taken together, these two accounts of Shortland's strongly suggest that in the late prehistoric and protohistoric periods (i.e. prior to about 1845 A.D.) the kumara was the most important indigenous cultigen in the Waikato economy in terms of the value placed upon it by the Maoris, though this is not to deny the great importance of fern root in the diet (K. Shawcross, 1967b). By 1854 kumara were not being grown extensively. Although Shortland doesn't say so, from about 1846 on the introduced cultigens - white potatoes, maize and wheat - and pigs, cattle, sheep and horses on introduced pasture grasses, had begun to play a far greater role in the local economy, with a corresponding decline in kumara production. 1846 marks the beginning of the activities of the agricultural missionaries and a period of extensive contact with the rapidly expanding European population in Auckland which brought about far reaching changes in Waikato Maori culture, a "Golden Age" destroyed by the bitter European-Maori conflict of the 1860's (Hargreaves, 1959: 61-79; Gorst, 1864; Cowan, 1922).

CONCLUSIONS:

What wider implications does this paper hold for late prehistoric settlement in the Waikato? It would appear that the palisaded protohistoric pa of the inland Horotiu district and the Waipa were spatially contiguous to the modified soils and quarry pits, but whether there was contiguity in time as well as space (in the light of the number of deserted earthwork fortifications which occur in the immediate vicinity of these latter features) must be the subject of an excavation programme to determine any stratigraphic connections that may exist. It is apparent that in the protohistoric period a number of pa e.g. Tukupoto, Ngaruawahia, were occupied continuously for over 15 - 20 years, although they were sometimes vacated on a seasonal basis, and from the location of these and the Te Aia pa amongst the kumara plantations at Whatawhata, and the Wakatupuhina and Maurea pas at Rangiriri, it is argued that at least one function of certain types of pa were to protect the growing kumara plants. Two distinct types of agriculture were carried on simultaneously in the protohistoric period i.e. semi-intensive cultivation of the kumara in semi-permanent gardens and swidden agriculture of the white potato. It would seem that it was the latter feature that was coupled with fern-root gathering to bring about the radical restructuring of the environment of the inland Waikato which took place between the 1830 - 50's (Clarke, June 1975, Vol 10, No 1), leading to the conversion of clima forest to fernland over a wide area by 1860.

Many New Zealand archaeologists have tended to assume that the prehistoric Maori practised swidden agriculture, and this assumption has been built into their settle-

ment pattern theories. A. Vayda (1960) has also incorporated swiddening as an essential part of his explanation for Maori warfare. However the extent of prehistoric burning is not known and the picture is complicated by uncertainty about the nature of the pre-human vegetation cover of the country as a whole, the possible effects of prehistoric climatic change on vegetation, and the development and intensity of prehistoric cultivation. In addition to the uncertainty about prehistoric clearance in the Waikato, there is little known about the nature of forest clearance and burning in the protohistoric period; one can postulate a new agricultural revolution at this time as Groube (1965) has done, and agricultural techniques may have been very different from the prehistoric period. All these factors must have a bearing on any assumptions that arise from the presentation of the historical evidence in this paper, and warrant further investigation.

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