NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION NEWSLETTER

MAORI SOILS IN THE LOWER WAIKATO

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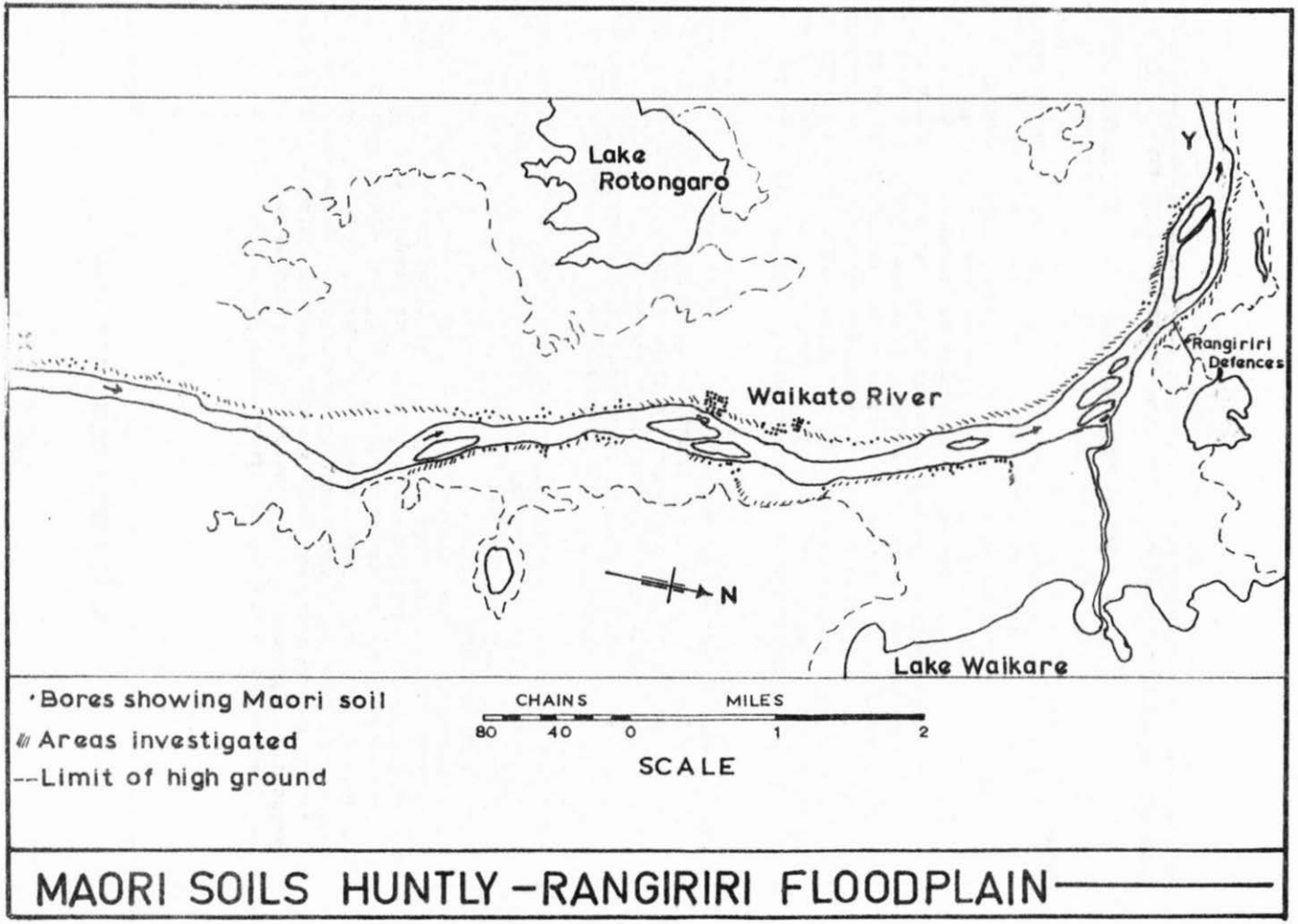
For a period of several years Tonkin and Taylor, consulting engineers, Auckland, have been employed by the Waikato Valley Authority to undertake foundation investigations for stopbanks along the Lower Waikato River. The author was engaged in this work for the consultants during the summer of 1966-1967 on the Huntly-Rangiriri flood plain. The investigation involved deep machine drilling at 20 chain intervals and shallow hand augering at more frequent intervals along predetermined stopbank locations. During the logging of bores it was observed that the natural humified surface profile of these pumiceous soils, particularly in the areas where silt formed the topmost layer, had been altered to a depth of up to two feet by the addition of sand and gravel, and, furthermore, in several exposures inspected by the author these profiles contained lenses of charcoal to similar depths and clear stratigraphic evidence of disturbance.

These features are consistent with the Maori practice of improving drainage and lightening soil recognised elsewhere in the Waikato Basin (Taylor 1958: 71). The extent of the investigation and the bores in which these profiles were recognised, are shown in Fig. I (Tonkin and Taylor 1964-1967). The Huntly-Rangiriri flood plain is a classic geomorphological example of the sedimentation of the main stream exceeding that of its tributaries and the valley (Cotton 1949, p. 197), (see Fig. 3).

As a consequence of the morphology of the valley and the position of the defined stopbank lines close to the best transportation route, namely the river, and the concentration of the bores on areas of difficult foundations or high head, this survey cannot be regarded as an adequate sample of the flood plain as a whole. However, the higher, better drained, less flood-prone ground adjacent to the river, and thus with better access, is likely to be the only area of the flood plain used for agriculture by the Maori, particularly in the light of the published plan (Taylor 1958: 77) showing areas of Maori soils adjoining the Waikato and Waipa Rivers. Some undoubted borrow pits exist in this area as they do higher up the river, but as many more dubious examples may merely be former channels blocked by the slips and bay mouth sedimentation they have been excluded from this paper. An analysis of the depth of admixture of the soils is shown in Fig. 3 together with a histogram for the heights of the step on the museum examples of ko (digging sticks).

The centre lines and cross sections of the proposed stopbanks had been sufficiently well surveyed for estimates of the level to the nearest 0.5 of a foot to be assigned to most of the bores. There was no tendency for the soil depth to vary with the elevation above the river.



MAORI SOILS HUNTLY – RANGIRIRI FLOODPLAIN

FIG. 1

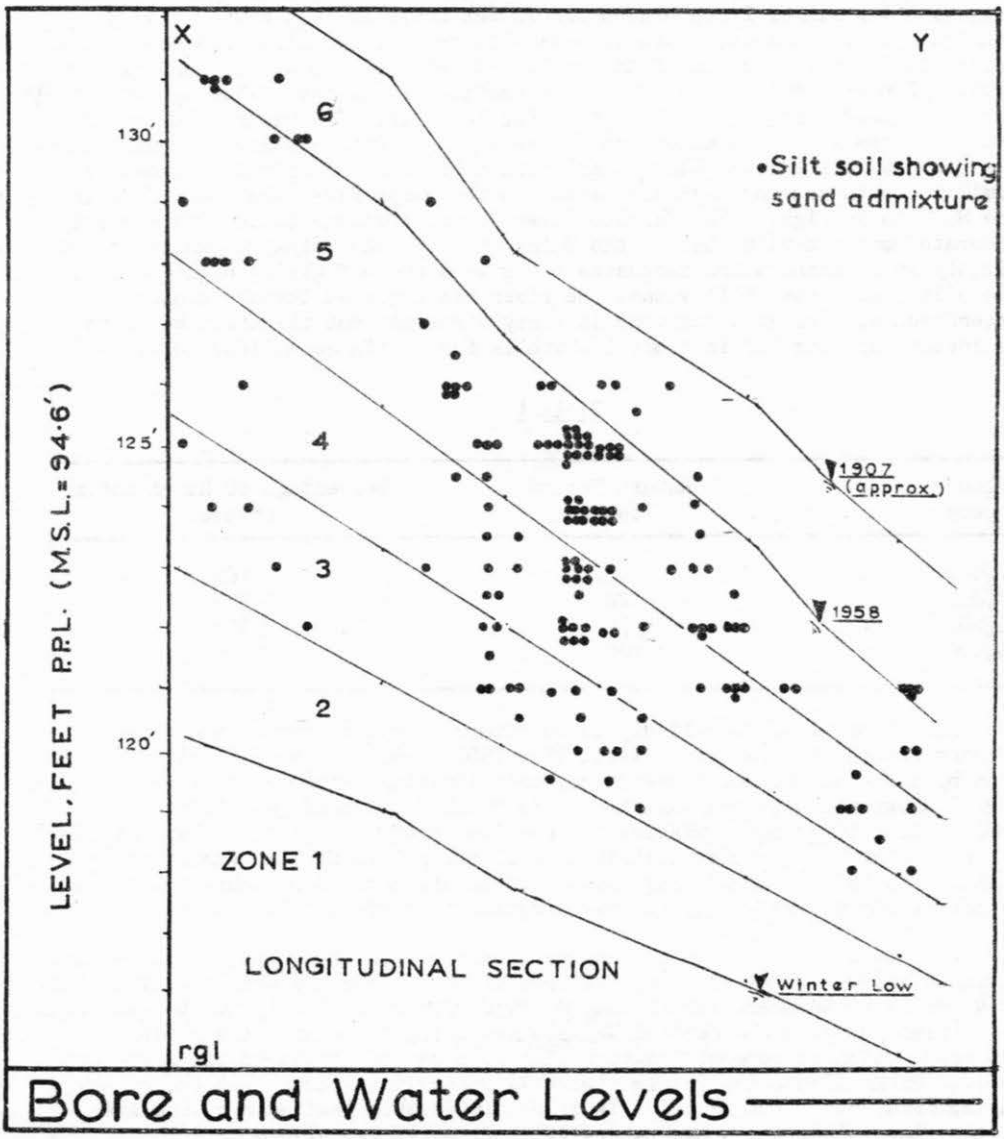

X
Y
130'
125'
120'
LEVEL, FEET P.R.L. (M.S.L.=94·6')
6
5
4
3
2
ZONE 1
•Silt soil showing sand admixture
1907 (approx.)
1958
Winter Low
LONGITUDINAL SECTION
rgl
Bore and Water Levels

FIG .2

The Waikato Valley Authority has undertaken considerable hydrological work with the aim of flood prevention in the Lower Waikato River. As a consequence, considerable data is available on flood profiles and recurrence intervals for this section of the river and catchment in its modern state (W.V.A. Report 1959). Fig. 2 shows a profile of the river showing two historic floods and a typical profile for low flow. The extrapolation of these figures to the catchment and river in its former condition is difficult. High floods in the lower Waikato are caused by summer tropical cyclones or similar events causing high discharges in the Waipa River when base flow in the Waikato is high. The Waikato River flood discharge is delayed and only moderate compared with that of the Waipa River. The Waipa catchment is now largely in farmland which increases and speeds run off giving higher peaks. There is also a possibility that the river has aggraded through human interference. Flood conditions in early times may not therefore be quite as serious as made out in Table 1 which is for modern conditions only.

Table 1

Flow cusecs	Return Period Years	Percentage of Maori soils covered
31,000	10	16%
37,000	20	38%
50,000	50	97%
65,000	100	100%

All these floods are likely to be summer floods or during the kumara growing season of November to April (Yen 1961: 340). The destruction of the crop by flooding must be a severe economic limiting factor to this area. Fig. 3 shows the data from all the bores drilled on the flood plain rationalised into zones relative to the river profile at low flow and flood. It shows that the vertical distribution of the points of sand admixture is cultural in that it avoids high water tables and more flood-prone areas and is not merely determined by the distribution of surface silt layers.

At a conservative estimate giving each bore 100 ft square, or the minimum distance between bores squared, the area of soil proven by this investigation is 41 acres. However, Taylor (Taylor 1958: 77) states that five to ten acres is a common size in the central Waikato and using five acres the total is 220 acres which at several locations includes several bores in one five-acre area. Banks (Banks ed. Beaglehole: 417) stated that gardens at Anaura Bay varied from one to two acres. It is not impossible that much of the area of the flood plain which has naturally sandy soils was also used for agriculture, but this is difficult to establish.

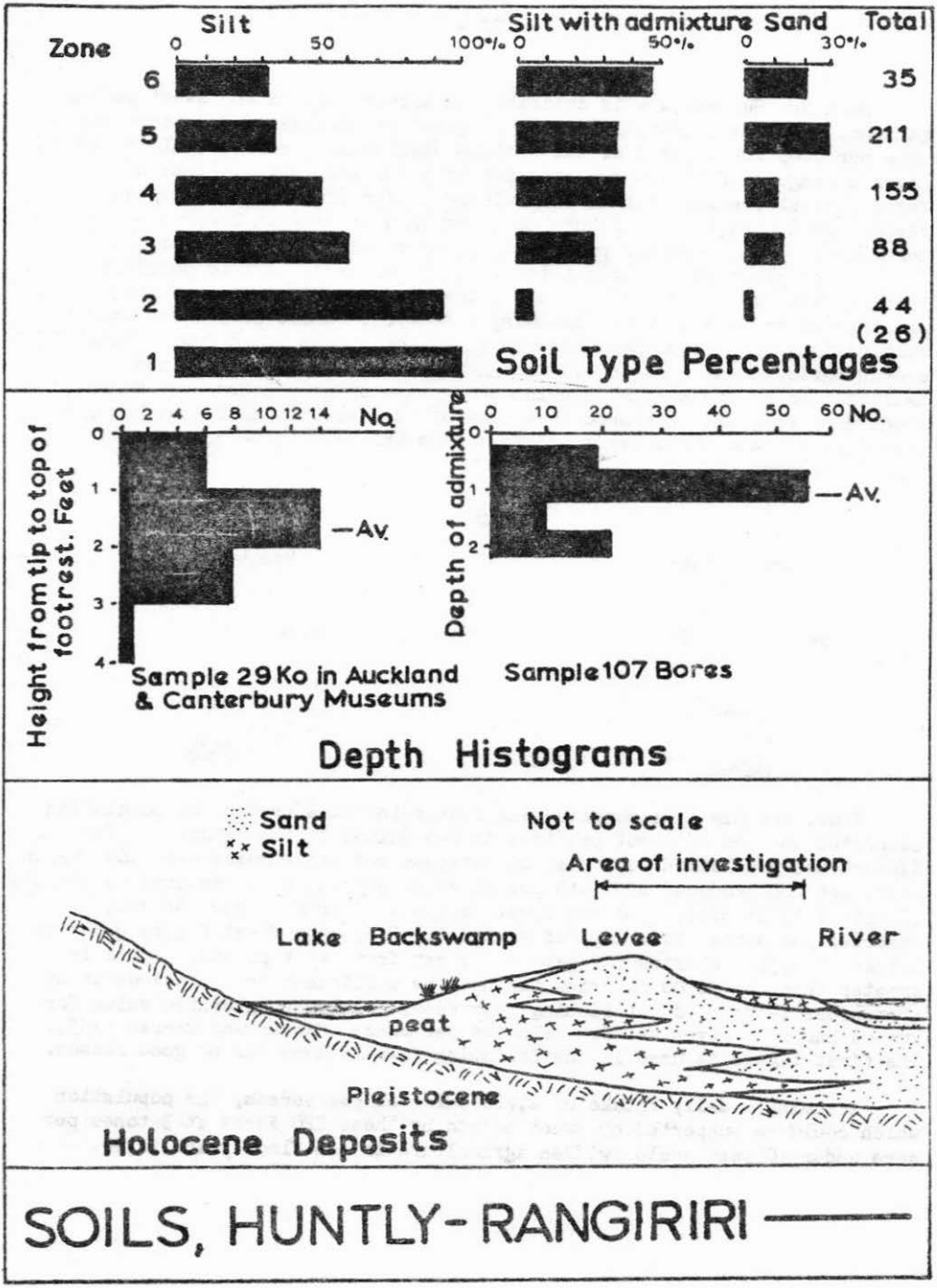
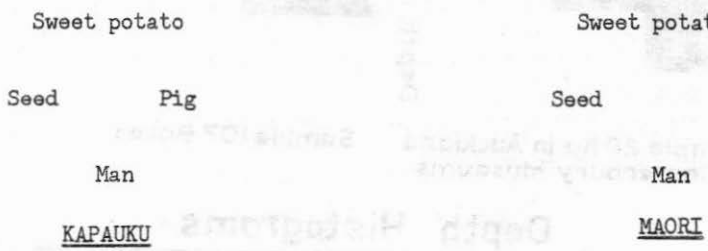

Zone
Silt
0 50 100%
Silt with admixture
0 50%
Sand
0 30%
Total
6 35
5 211
4 155
3 88
2 44
1 (26)
Soil Type Percentages
Height from tip to top of footrest. Feet
0 2 4 6 8 10 12 14 No.
Av.
Sample 29 Ko in Auckland & Canterbury Museums
Depth of admixture
0 10 20 30 40 50 60 No.
Av.
Sample 107 Bores
Depth Histograms
Sand
Silt
Not to scale
Area of investigation
Lake
Backswamp
Levee
River
peat
Pleistocene
Holocene Deposits
SOILS, HUNTLY-RANGIRIRI

FIG. 3

Much New Guinea data is available on acreage yields for sweet potato gardens. Pospisil (Pospisil 1964: 9) gives an average of 3.2 tones per acre per crop for an area of the Western Highlands. Bulmer (Bulmer 1967) gives a range 2 of 6 tons per acre per crop for the Central Highlands. These figures are for swidden agriculture. Yen (Yen 1961: 340) gives yields for test crops at Otahuhu near Auckland as between 2 and 3.4 lbs per plant. At a recorded planting spacing of around 3 ft (Best: 370) 2.5 lbs per plant is equivalent to 6.2 tons per acre. It is possible that Waikato soils were only used for one season before lying fallow, possibly to be used again. Assuming a ten-year fallow period one season cultivations and 3 tons per acre per crop, the annual yield from a total proven agricultural area is 0.3 tons per acre. The system of food assimilation of the Kapauku Highlanders, whose principal crop was kumara, studied by Pospisil, differed from that of the Maori in that they had pigs (see Fig. 4), and these are a prestige item unlikely to be efficiently reared for food.

Fig. 4



Thus, the pig is a complicating factor in transferring the population supported per ton of sweet potatoes in New Guinea to the Waikato. For the Kapauku the population supported by potatoes and other means was 0.88 person years per ton produced and 1.10 person years per ton on a measured consumption (Pospisil 1963: 376). Giving sweet potato a calorific value of 37.5 calories per ounce (N.Z. Dept of Health N.D.P.5), the first figure gives an intake of 4,570 calories per person per day from sweet potato. This is greater than the 2,700 calories taken to be sufficient in a previous study (Shawcross 1967: p. 8) of fishing resources. A lower calorific value for kumara has been given at 28.4 calories per ounce (Massal and Barrau 1955). The first figure is used in the following calculations for no good reason.

Assuming a daily intake of 2,700 calories per person, the population which could be supported by sweet potato by these 220 acres at 3 tones per acre under 10 year cycle swidden agriculture in non-flood years is 90.

Table 2

Locality	Area of soil, or under cultivation	Tons per year computed	Population supported	
			Recorded	Computed
Lower Waikato	220	66	-	90
Central Waikato	5,000 (1)	1,500	-	2,050
Waipa	1,797 (1)	540	-	730
Waimea	1,000 (1)	300	-	410
Anaura Bay	150-200 (2)	450-600	Less than 100 (2)	610-820

(1) Taylor 1958: 77
(2) Banks ed. Beaglehole 1962: 417.

Table 3 shows some population estimates for New Zealand.

Table 3

Area	Population	Pop./square mile or mile
Whangateau shellfishing	350 (1)	24 persons/mile coastline
Waikato-Waipa agriculture	2,900 (2)	2.1 persons/sq. mile
Waikato-Waipa survey 1858	5,000 (3)	3.5 persons/sq. mile
N.Z. estimate 1774	100,000 (4)	0.87 persons/sq. mile

(1) Shawcross 1967 (b), p. 10.
(2) This paper
(3) Hargreaves 1959, p. 63.
(4) Cook, J., ed. Sparrman, 1953, p. 187.

Shawcross (F. W. Shawcross 1967a) suggested that the Maori soils in the middle Waikato bore an inverse areal correlation with known pa sites. Although this is complicated by the geography of the Waikato with its easy lines of communication along rivers and restricted areas of broken topography suitable for defence, this led Gorbey (K. C. Gorbey 1967) to suggest these may in fact date from the historic period before the Maori wars when extensive agriculture was carried out to trade with Auckland (Hargreaves 1959: 61). Taniwha Pa (Green 1963: 77) is interesting in the light of this as it is situated eight miles to the east of the soils discussed in this article. With its large number of rectangular pits, presumably for kumara storage, it forms a more convincing fellow component (Golson 1959: 31) of these soils than do either the late Maori war pa such as the Rangiriri Defences (Cowan 1922: 91), or the Lake Ngaroto swamp pa and others like it (Shawcross 1968). It is apparent that a large amount of information is available on prehistoric economics in the Waikato but that the areal interpretation of this, with other field evidence should be made with consideration given to the considerable geographic limitations of the Waikato to communications.

The Author acknowledges access to the records of investigations but emphasises that the deductions and opinions in this paper are entirely his own.

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