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Problems of Site Interpretation in Archaeology:

PEDOLOGY

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It can be assumed that in an archaeological site the soil has been largely modified by man and may even be man-made. To estimate the degree of disturbance the pedologist has to refer to the natural soils in the vicinity and, better still, possess a knowledge of the soils of the region. No worthwhile opinion can be offered on a mere spot examination.

Furthermore, it could be said that the pedologist and the Holocene geologist trespass on each other's ground; the pedologist, however, can move easily within the framework of surfaces and parent materials provided by the geologist.

The archaeologist is not interested in soils as such but rather in the information they will yeild him in respect of the age of the site, whether it was occupied recently or a long time ago. Nevertheless, some pedological theory is necessary to understand the way in which soils are examined scientifically. The pedologist believes that the soil is a natural organised body, the upper weathering layer of the earth's crust commonly differentiated into horizons and forming a continuum called the 'pedosphere'. In its broadest sense the soil embraces not only the lifeless medium of organic and inorganic materials but also the living organisms within it, including roots and other underground parts of plants. The lifeless medium is called the 'soil body' and it is this part of the soil which the pedologists examine and describe.

The soil body has area as well as depth and, in the field, is never quite uniform. To allow for variation, the range of which has to be determined by the pedologist, the smallest unit or block for study is the 'pedon'. A vertical slice through the pedon is known as the soil profile. In a pit, or pits, excavated by archaeologists only a part of the profile may be examined.

The profile is described for purposes of anatomy or morphology of the soil body and, in New Zealand, it is the macro-morphology that is recorded ie. features that can be seen by the eyes and by a hand lens. As yet there is no systematic micro-morphology as practised by Kubiena and Dalrymple.

Profile examination is both descriptive and interpretative: description includes the number of horizons(A,B,C) and the colour, texture, consistency and porosity, structure, organic matter and soluble salts of each horizon; interpretation involves the genesis of each horizon and the relationship of one to another. The interpretive aspect of the soil profile differentiates pedology from geology in that the geologist may explain the origin of parent material and the manner of its emplacement whereas the pedologist is required to explain the genesis of horizons within the soil body. For example, the parent materials of some yellow brown pumice soils are layered in the form of volcanic ash-fall beds. The A horizon may embrace both the Tarawera ash and

the Kaharoa ash, and the B horizon the Taupo pumice.

Soil horizons occur best on stable land where no inorganic material is added to or taken away from the soil and, over a long time, may be said to illustrate the balance between weathering, leaching by rainwater and return of elements by plants. Good examples include podzolised yellow brown earths and podzols in North Auckland and yellow grey earths in Otago and Southland. Where, however, there are periodic additions such as sediment from flooding rivers, ash from volcanic eruptions or wind-blown dust from river beds, or where there is accelerated erosion, no more than an A horizon(A/C) or perhaps an embryonic B(A/B) may be formed. Because of shortness of time, horizons are not well expressed and such soils are regarded as immature. Examples include yellow brown sands from coastal beachlands, recent soils from alluvium on valley floors and coastal lowlands, and some yellow brown pumice soils on upland parts of Rotorua, Taupo, Hawkes Bay and Gisborne districts. Skeletal soils on steeplands have A horizons only. As the foregoing situations were also among the most favoured for Maori settlement, it can be assumed that immature soils provide the natural setting around most archaeological excavations.

The broader soil pattern has been introduced purposely to provide another angle to 'change of climate' views fashionable in some parts of the world. In the author's opinion, the effects of other natural agencies over-ride the importance of climate, particularly in the North Island.

Natural Soils: All immature soils have a well-marked A_1(mineral) horizon and, with age, may have a B_1 horizon. The A_1 horizon is characterised by its common thickness of 7-9in., its colour(shades of black and brown), consistency(manner in which primary soil particles are aggregated) as well as by visible organic matter and live plant roots. The B_1 horizon is characterised by its colour(shades of yellow), consistency and structure. The A_1 is the horizon of maximum soil life but only the activities of soil animals such as worms and insects can be observed in the field. In this paper little heed is taken of the A_0 horizon(organic - fresh litter, dead litter, humus) because of likely disturbance of the surface by man.

Parent materials are commonly layered and include ash-fall beds in yellow brown pumice soils and flood layers in recent soils from alluvium. Where such layers can be named and dated they form valuable time planes for the archaeologist. In particular, Kaharoa and Taupo pumice beds are of particular importance because they can be recognised over a wide area.

The colour of the A horizon is imparted by the pigment of the organic matter so that, in general, brown coloured soils appear under forest, black under manuka and fern, and greyish brown under grasses. Yellow brown pumice soils under pasture and with a high content of Taupo pumice, however, possess a special mechanism in which an organic matter 'allophane complex' resistant to microbial decomposition which confers organic matter stability to the soil. This explanation may account for the persistent blackness of yellow brown pumice soils in the Gisborne district, even when they have admixtures of other mineral matter. Thus any disturbance by man would be reflected in the thickness of the A horizon.

In general, yellow brown pumice soils are characterised by (1) layeredness, (2) conspicuousness of organic matter in the A horizon and (3) a paucity of

casting fauna(earthworms) whereas recent soils from alluvium are characterised more by their granular structure, especially (worm) cast granular structure.

Finally, the hallmark of a natural immature soil is the measure of the 'verticality' imparted to the profile principally by plant roots and the structure of the B horizon.

Man-made Soils: Having set up a standard with which to compare man-made soils, we can now mention a few examples with confidence.

(1) Soils with a thick A horizon.

C.G.Vucetich reports that, in the Rotorua and Taupo districts, many Maori garden soils and sites of pa are easily recognised because the A horizon is deeper than usual. Such sites show up well in road cuttings along the shore of Lake Rotorua, particularly through points and promontaries. On Mokoia Is. in the lake itself, old garden soils on a sinter terrace are 12in. deep and well mixed, so much so that the ash-fall bed sequence Rotomahana mud/Kaharoa ash/Taupo ash/Mamaku ash, which usually occurs in distinct layers, is not evident.

There are as well, numerous middens contributing shells and, on the slopes, are many earthworks of considerable age judging by the overall mantle of black A horizon. The entity of ash layers has been destroyed by soil mixing, including downslope movement of soil. There have also been many fires.

Thick topsoils must not be confuesd with mineral accretions such as Tarawera ash and Rotomahana mud which,-after further darkening by organic matter, merge with the black Kaharoa ash beneath. An example is found near Lake Rotoehu where these ash beds are not very thick.

At Muriwai, near Gisborne, man-made soils are as thick as 24ins., are of very black colour(Munsell Soil Colour Chart notation 5Y2/1) and numerous burnt stones can be uncovered. These features are quite out of keeping with the natural soils of setting.

(2) Truncated soils.

At Orongo Bay, near Gisborne, there is a buried soil in which the A horizon does not belong to the B horizon. The former topsoil had been removed by the prehistoric Maori ,replaced by other material and, after an interval of time, a new A horizon began to form. The two horizons are now so welded together as to create the impression of the old B being related to the new A.

At the Pakotore pa site the natural topsoil has been truncated to a thickness of 3in. and, from furrows, there is artificial filling to a depth of 18ins. Truncation appears to have been done recently for worms are now active in the subsoil at 6ins. from the surface. Eventually worms will help to form an A horizon 9ins. thick. In other pits the soil structure suggests at least two periods of settlement for Pakotore.

(3) Disturbed soils in the forest.

In the Urewera country there are old pa sites well within the forest and some of these have been recognised both by soil disturbances and by patches of unusual forest composition. In a forest clearing by Te Whaiti is an old pa deserted about 1830 but the soil has been much disturbed and dug over by amateur archaeologists. In the kumara patch is tall manuka and a fine-looking rimu tree. The topsoil is 12ins. deep and the roots of the rimu tree are well

distributed through it; as yet no sign of podzolisation is evident and it will be interesting to note the rate of this soil process since we know the age of both the tree and the soil. Soil formation has been introduced deliberately at this stage to show that really old pa sites in the forest cannot always be recognised merely on soil evidence alone.

(4) Colour.

C.G.Vucetich elucidates principles on the colour of soils which deserve close attention. He observes that where the forest is logged by the European, and there is no burning, second growth, including wineberry, is sufficiently vigorous to restore the canopy quickly and there is no black A horizon. Where however, the cut-over forest is burned the new growth is principally bracken and the A horizon becomes distinctly black. There would thus seem to be an association of black topsoils and bracken, but there is an exception - under tall bracken on a forest edge, and with partial canopy, the topsoil is brown. C.G.Vucetich is of the opinion that the black colour is a function of organic matter break-down when the soil is exposed to the sun.

He is also of the opinion that the manuka-bracken vegetation was largely fire induced and that without intermittent fires the black would soon give way to the brown of normal forest soils. For example, in the Waiotapu district are 'young' pole forests of rimu and matai growing in a soil with brown A0 and A1 horizons: when the previous forest was burned the soil colour would have been black for a time but has since changed to brown. Black A horizons are normal during a period of intermittent fires when the vegetation was probably set alight by man.

While blackness can be vegetation-induced during intermittent fires, it may also be induced directly by the products of firing, including charcoal and burnt wood. This aspect of the cause of blackness may explain the dark colour of Waihirere soils when they are buried. In the side of a cut-off channel at Matwhero loop, near Gisborne, are to be seen many buried soils, but one of them, the Waihirere silt loam, is considerably darker than the others. H.W.Wellman suggests that some of the carbon in this soil is from burnt wood and, because of firing, has become 'inhibited to breakdown' by soil organisms. Waihirere soils are thought to be about 500 years old, and were buried 200 to 300 years ago, and it could be that the burning of the forest is associated with Maori settlement, from about 1400 A.D.

This section has been enlarged upon purposely to illustrate the value of regional soil and vegetation knowledge in suggesting the presence of man in a particular area, and when.

Age of Soils: In the author's opinion the age of soil, or better still the age of the soil surface, refers to the date at which sedimentation ceased for a time and a definite A horizon began to form eg. in the Waihirere soils of the Gisborne plains, sedimentation ceased about 1400 A.D., giving an age of 500 years to the soils; the Matawhero were formed from sediments quickly deposited about 200-300 years ago; the Waipaoa soils 30 years ago.

Soils cannot be dated as precisely as a volcanic ash bed, the material of which was erupted in a very short space of time. Nevertheless they are useful datums, the distribution of which can only be determined by a soil survey.

In recent soils from alluvium, on the Gisborne plain, the age of the soils may be roughly indicated by reference to the depth of Taupo pumice from the surface - if shallow, the soil is older and, if deeper, is younger. In lowlands of the Bay of Plenty, soils may be bracketed by the Tarawera ash and the Kaharoa ash, or by the Kaharoa ash and Taupo pumice. A more precise determination requires the aid of 14^C dating. Yellow brown pumice soils in upland parts should be searched for traces of individual ash-fall beds and, at an archaeological site, requires more than ordinary care. For example, at the Pakotore pa studied by the N.Z.A.A. in 1959 a post hole was inspected care fully to see if it was mantled with Kaharoa ash and so prove pre-Kaharoa settlement at the site. At the sides of the hole the Tarawera, Kaharoa, Taupo and other older ashes could be seen but the in-filling of the hole comprised Taupo pumice within Kaharoa ash, and no shower bedding(opinion of C.G.Vucetich). It was later discovered that the (?)posthole is most likely to have been a channel left by a decayed tree trunk. The conclusion arrived at is that settlement took place in post-Kaharoa times.

In the lower Waikato, W.T.Ward points out that the pumice alluvial sequence needs to be related to the eruptions of the central plateau if the archaeologist is to make the most of his sites there. The Taupo pumice alluvium, in particular, is a good time marker as it occurs over much of the flood plains and in the bogs. As the Waikato River swept in, it carried burnt fragments of tussock which were caught in the grass and, later on, the burnt fragments were buried by pumice detritus. In a pit the profile reveals pumice sands overlying a thin carbonaceous band overlying an old soil. While the burnt material is capable of other interpretation, its stratigraphic position fits in with what is known of the Holocene history and therefore the observer may adopt as a working hypothesis the suggestion that the layer of pumice sand is coeval with the Taupo pumice eruptions.

In other parts of New Zealand the age of soils can only be indictaed by recourse to 14^C dating of pieces of charcoal and carbonised wood within the soil. This method is being adopted by J.E.Cox and C.B.Mead for buried alluvial soils of the Canterbury plains. In this instance a date is valuable becau se they have already plotted the distribution of these soils. W.T.Ward offers the comment that in some yellow grey earths and brown grey earths, 14^C dating is not worthwhile where there is evidence of $CaCO_3$ accumulating in the soil.

Pedologists and Field Archaeology: As soils are so variable in the field it is perhaps foolish to lay down principles for the soil profile and its interpretation in field archaeology and, if archaeologists are contemplating a scientific investigation of a site, it is best for them to employ a pedologist in the team rather than undertake the business of soil investigation themselves. Pedologists now live and work in most districts of New Zealand and they would be glad to cooperate with the archaeologist.

While Cornwall's book "Soils for the Archaeologist" is a valuable one, the author would try to make the field archaeologist a 'jack of all trades'. In New Zealand the Archaeological Association has followed the better course of employing specialists for the background work, thus leaving the professional archaeologist free to devote a larger proportion of his time to the interpretation of the site and to the artefacts and non-artefactual material recovered.