indications are that the introduction of a green manure crop into Native subsistence gardening would be adequate.

(c) A third factor, probably of little significance, is the effect of the buried profile, particularly when this occurs at shallow depths. There is no indication at present that any effect can be expected. While the soil is less fertile than the pumice, it is still adequate in all respects other than phosphorus. On the other hand, the effects of the abrupt textural change and the possibility of perched water-tables are two unknown factors.

In regard to the type of development in the area there are two principal forms :—

(*a*) European style plantation development;

(*b*) Native settlement.

Neither is mutually exclusive and a combination of both forms will probably eventuate. It would be desirable to group Native producers, assuming they would operate peasant sized holdings, in order that advantage could be taken of central processing facilities.

Part II.—By S. C. BASEDEN.

Chemical characteristics of the Warangoi soils.

The typical soil profile of the Warangoi series is a shallow (10 inch to 20 inch) layer of sandy loam, developed on a volcanic ash layer of depth varying from 2 feet to 8 feet.

The soil colour merges from dark brown at the surface, through a yellowish-brown zone, to the light grey zone of the unweathered ash. The Munsell colours for the profile of a shallow ash layer (25 inches) overlying a weathered andesitic tuff layer (25 inches to 100 inches +), and of a deep ash layer (54 inches), are given in Table 1 together with mechanical analysis and organic matter content (%C x 1.73). At the base of the ash layer occurs a thin layer of pumice pieces of about 1 inch diameter which suggests that there was an early fall out of large particles when the ash was deposited. This is also indicated by the regular increase with depth of the sand fraction as shown in Table 1 and Figure 4.

Samples examined.

Profiles 1234-1243, 1244-1250, 1251-1256, 1257-1264, 1265-1271, 1280-1286, are representative of the main soil type.

Profile 1294-1299 is from a slope where the ash layer had been removed by erosion, exposing the weathered tuff. Profile 1273-1278 is an alluvial soil from the Nengmutka River.

The last two profiles are from sites of minor agricultural importance.

Influence of the depth of the ash layer on the profile development.

Deep ash layer.—

Ash layers 5 feet to 8 feet deep are characterized by a deep and gradual development of organic matter and clay—the result of the free drainage conditions which exist. An example is shown in Figure 4, profile 1251.

Shallow ash layer.—

Ash layers 2 feet to 3 feet deep are subjected to some lateral water movement where slope occurs, since underlying the ash layer is a weathered tuff which is much less permeable (50 per cent. to 70 per cent. clay). The tendency for subsurface lateral flow is probably an important factor in effecting the rather shallow development of clay and organic matter in the shallow ash layers (see also Figure 4, profile 1234).

A comparison of the development of organic matter in a series of four profiles in ash layers of varying depths is illustrated in Figure 5.

Factors dependent upon the organic matter and clay content, e.g., exchange capacity and exchangeable bases follow a similar pattern of distribution in the profile (see Figure 6).

Organic Matter.

As is typical of forest soils, the bulk of the organic matter is close to the surface, the content in the first few inches being about

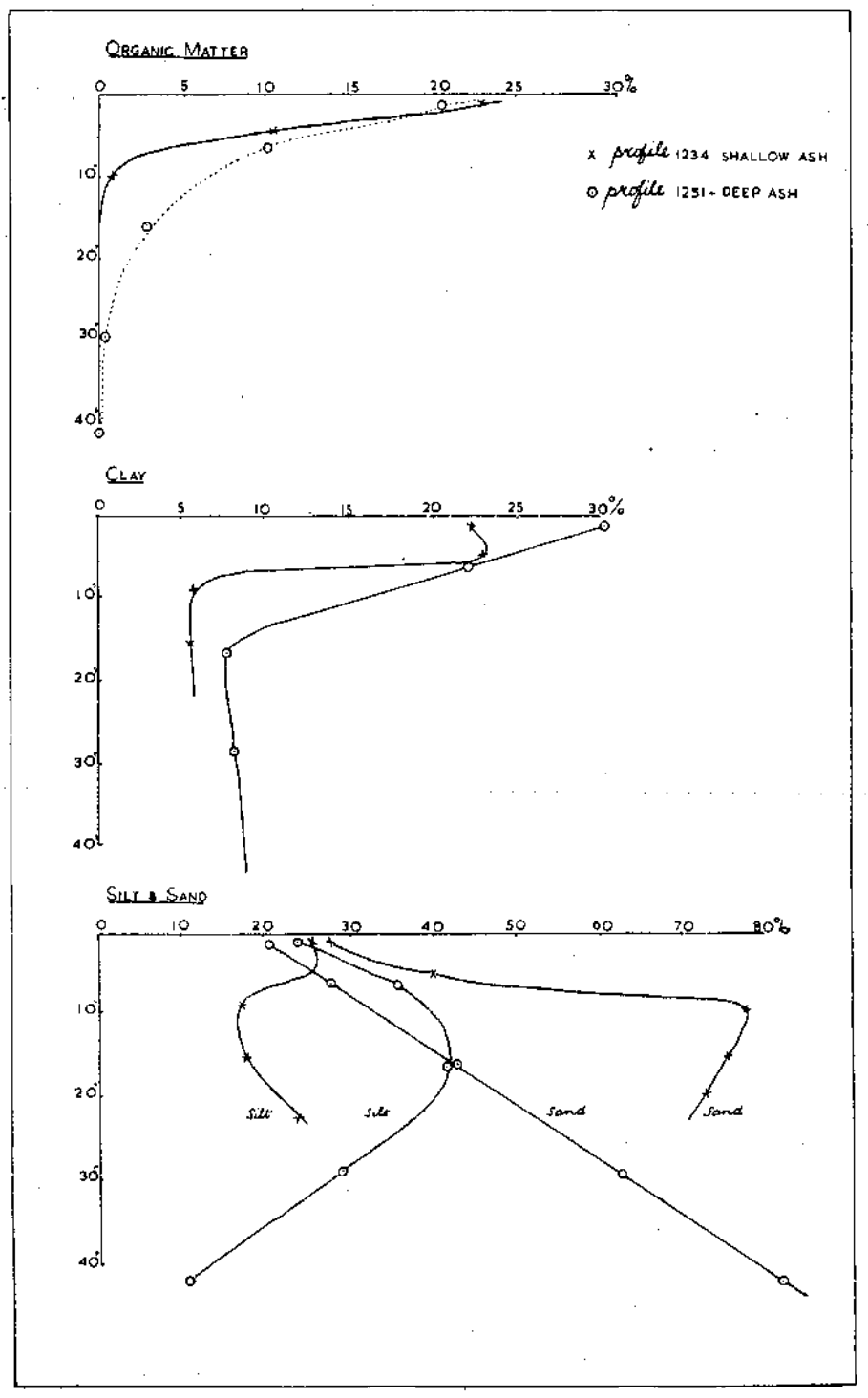
ORGANIC MATTER
0 5 10 15 20 25 30%
10
20
30
40
x profile 1234 SHALLOW ASH
o profile 1251 - DEEP ASH
CLAY
0 5 10 15 20 25 30%
10
20
30
40
SILT & SAND
0 10 20 30 40 50 60 70 80%
10
20
30
40
Silt
Silt
Sand
Sand

Fig. 4

23 per cent. and rapidly decreasing to nil at 15 inches and 40 inches in shallow and deep ash layers respectively.

The C/N ratios indicate that the organic matter is well humified. The averages of five profiles are :—

Depth.	C/N
0-2"	11.1
2-8"	9.7
8-14"	8.5

The distribution of the individual values is given in Figure 5.

Nitrogen.

The total nitrogen in these soils is high, and associated with C/N ratios in the range 8-12. Mineralization processes can be expected to release adequate available nitrogen for the initial crops. The conservation of the high nitrogen reserves of these soils is of first importance. Under conditions of management which permit the depletion of organic matter, nitrogen is likely to be the first major nutrient to become limiting to plant growth.

Calcium Carbonate.

Although there are no detectable amounts of free calcium carbonate in the parent ash material, substantial amounts were found in the organic horizon. This was noticed when investigating the source of calcium removed by normal ammonium acetate which was in excess of that required to saturate the exchange complex.

The presence of a high concentration of carbon dioxide in the surface soil atmosphere, abundance of calcium ions from the humified litter and the weathering of the volcanic ash and a pH environment of greater than 7 are the conditions prevailing which have assisted in the formation of calcium carbonate. A high correlation exists between the calcium carbonate and organic matter contents, as shown in Figure 7.

The calcium carbonate values account for only a part of the NH_4Ac soluble, non-exchangeable calcium.

Exchangeable cations and exchange capacity.

The exchange complex throughout the profiles is saturated with bases. In the topsoil where organic matter accounts for the larger part of the exchange capacity, calcium ions dominate the exchange complex. Below the organic horizon where the exchange capacity is due only to minerals in the clay and silt fractions, potassium ions occupy a high percentage of the exchange positions.

The ratio of divalent to monovalent cations is more than five times greater at the surface than in the subsoil.

The topsoils have a high exchange capacity, due to the presence of over 20 per cent. organic matter with an exchange capacity of approximately 200 m.e.% and the presence of over 20 per cent. clay with an exchange capacity of about 70 m.e.%

It is evident from the exchange data that it is very unlikely that calcium, magnesium or potassium will become factors limiting to plant growth. Details of the exchange characteristics of a deep and shallow ash profile are given in Table 2 and represented graphically in Figure 6.

Ignition loss proved to be unsatisfactory as a method for approximate determination of organic matter. This has been found to be partly due to the high moisture retention capacity of the clay at 103° C., and partly to a moisture loss by the parent material. Pumice lumps and sands from the bottom of the ash profile consistently lose 2 per cent. to 3 per cent. on ignition. In the organic horizons, ignition losses are a regular 5 per cent. to 6 per cent. higher than organic matter calculated from carbon by the combustion method.

Carbon determined by the Walkley-Black wet combustion method, provides a reasonably accurate and quick method of assessment of organic matter. A consistent recovery of about 75 per cent. of the carbon determined by the dry combustion method was obtained for samples throughout the profiles (see Figure 7).

Phosphorus.

Phosphorus determinations were carried out on profiles 1234-1243, which includes a buried profile (see Table 4 for a summary of analysis for phosphorus).

The total phosphorus figures indicate a high surface accumulation, there being four times as much in the 0 inches-2½ inches layer, and three times as much in the 2½

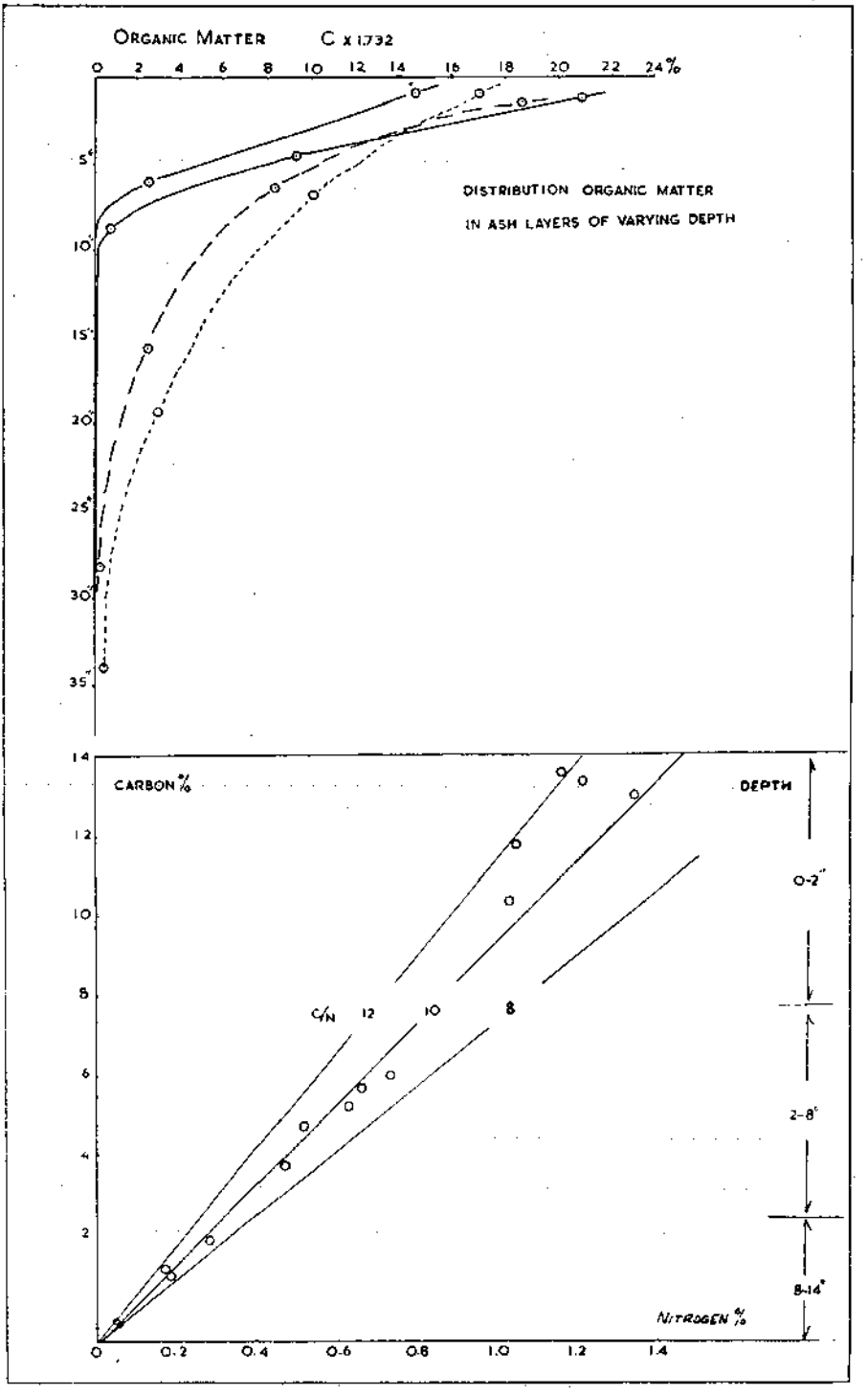
ORGANIC MATTER C x 1.732
0 2 4 6 8 10 12 14 16 18 20 22 24%
5"
10"
15"
20"
25"
30"
35"
DISTRIBUTION ORGANIC MATTER
IN ASH LAYERS OF VARYING DEPTH
CARBON %
14
12
10
8
6
4
2
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
C/N 12
10
8
DEPTH
0-2"
2-8"
8-14"
NITROGEN %

Fig. 5

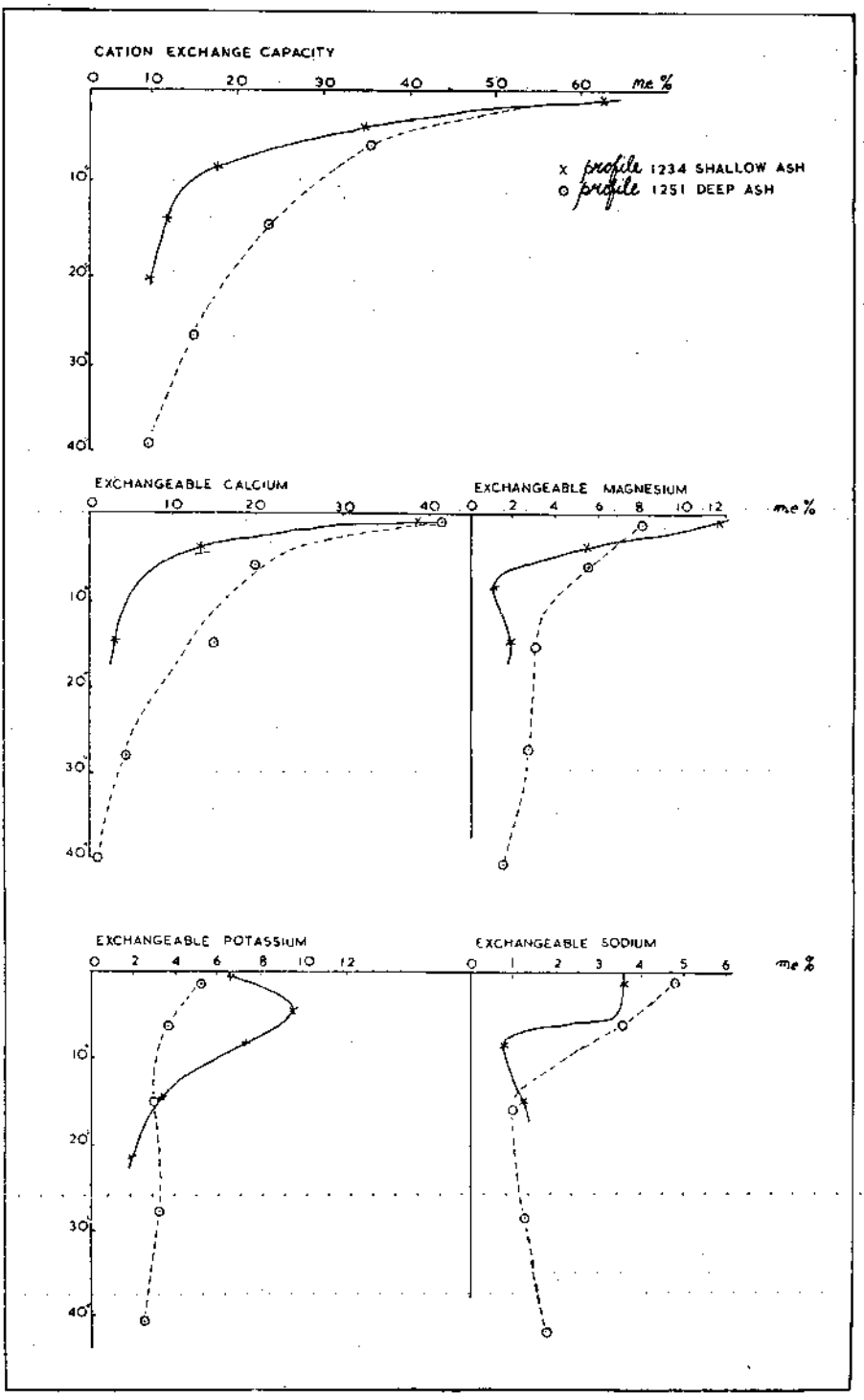
CATION EXCHANGE CAPACITY
0 10 20 30 40 50 60 me %
x profile 1234 SHALLOW ASH
o profile 1251 DEEP ASH
10
20
30
40
EXCHANGEABLE CALCIUM
0 10 20 30 40
EXCHANGEABLE MAGNESIUM
0 2 4 6 8 10 12
me %
EXCHANGEABLE POTASSIUM
0 2 4 6 8 10 12
EXCHANGEABLE SODIUM
0 1 2 3 4 5 6
me %

Fig. 6

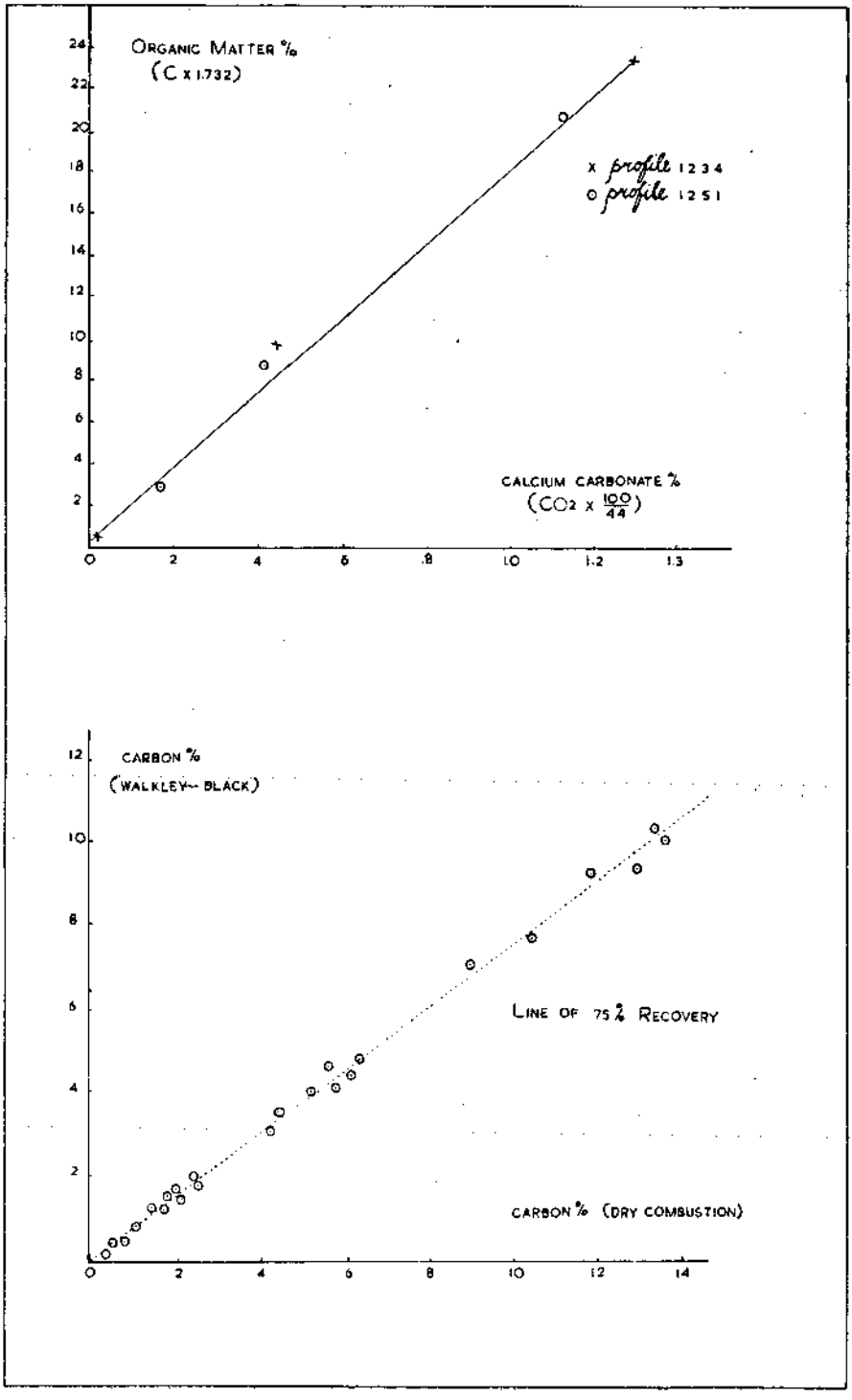
ORGANIC MATTER %
(C x 1.732)
x profile 1 2 3 4
o profile 1 2 5 1
CALCIUM CARBONATE %
(CO2 x 100/44)
CARBON %
(WALKLEY— BLACK)
LINE OF 75% RECOVERY
CARBON % (DRY COMBUSTION)

Fig. 7

inches to 7 inches layer as in the 7 inches to 25 inches unweathered ash layer. Pumice lumps in the 20 inches to 25 inches layer contained 500 p.p.m. P. The buried profile is relatively poor in total phosphrous.

Soluble phosphorus.—Dilute acid, alkaline and neutral extractants were used to obtain an idea of the solubility of the phosphorus.

The alkaline extractant, 0.5M $NaHCO_3$ pH 8.5, removed more phosphorus from the organic phase of the profile.

Water removed almost as much as the above extractant.

The dilute acid extractant, 0.01N H_2SO_4, removed substantial amounts of phosphorus throughout the ash profile, but very little from the buried profile.

About 1/3 of the total phosphorus in the unweathered ash was extractable with .01N H_2SO_4, indicating its high solubility under acid conditions.

An extractant of 0.2N H_2SO_4 removed practically all the phosphorus from the unweathered ash.

Organic Phosphorus.—An assessment of the organic phosphorus content was made by determining the phosphorus extractable with 0.2N H_2SO_4 before and after ignition of the sample, and taking the difference as being a measure of the organic phosphorus. As the figures in Table 4 show, there is a strikingly high accumulation of organic phosphorus at the surface.

The C : N : P (org) ratios are :—

1234	0-2½″	62 : 6 : 1
1235	2½-7″	61 : 6 : 1
1236	7-11″	53 : 6 : 1

Available Phosphorus.—The fairly low total phosphorus of the parent ash and the insolubility of phosphorus minerals under the prevailing pH conditions, suggest that a minor portion of the available phosphorus will come from this source.

The large accumulation of organic phosphorus associated with the low C : N : P (org.) ratios, most likely will be the major source of available phosphorus, supplied through a process of mineralization, similar to and possibly associated with nitrogen mineralization.

Phosphate Mineral.—Separation of the mineral fraction of specific gravity greater than 2.9 with bromoform, from the coarse and fine sand fractions of sample 1237, resulted in a fourfold concetration of the phosphorus in the heavy fraction.

A reaction between the phosphate mineral and ammonium molybdate acidified with nitric acid, carried out under the microscope, showed the development of colonies of phosphomolybdate crystals around inclusions in some of the heavy minerals. It seems evident that the phosphate mineral occurs as an apatite inclusion, which obtains some degree of resistance to weathering due to the resistant nature of the occluding minerals.

The Clay Fraction.

The judgment of texture in the field fails to indicate that nearly 30 per cent. of the soil of the first few inches of the profile is in the clay fraction. This is due to the considerable resistance to dispersion shown by the clay and the finer silt fractions. Only slight dispersion can be achieved with dispersing agents and prolonged mechanical stirring. Complete dispersion is possible only after final destruction of the organic matter. It seems likely that a strong organo-clay bond is largely responsible for the marked stability of the clay fraction in the organic horizon. A contributing factor is undoubtedly the calcium saturated nature of the exchange complex near the surface. Dispersibility increases significantly down the profile, as the organic matter content and the Ca^{++}/K^{+} ratio decrease. This is shown below for a profile on a deep volcanic ash layer.

Lab. No.	Depth (inches)	Less than 2μ fraction	Carbon %	Ca^{++}/K^{+}
1251	0-3	30.3	9.06	7.9
1252	3-10	23.2	3.90	5.3
1253	10-22	8.7	1.35	4.7
1254	22-36	8.2	0.17	1.3
1255	36-48	8.9	0.03	0.3
1256	48-54	5.3	0.04	0.4

(Carbon determination by Walkley-Black method. Values are approximately 75 per cent. of the values by ignition method.)

The instability of the sub-humic horizon is apparent in the field where lateral water movement over the buried tuff causes tunnel erosion. The undermining of the crust leads finally to the collapse of the organic horizon and gully formation.

Analysis of the Clay Fraction.

Clay fractions of less than 1.5*u* were separated from soil sample 1260, which was pretreated with hydrogen peroxide, and from the bulked soil sample 1248, 1249, 1250, which was not pretreated. The clay fraction was dispersed with ammonia at pH 10, made just acid with acetic acid, flocculated with calcium chloride, and washed with alcohol. Deferration was omitted, and the clay fraction kept at 50 per cent. humidity.

Analysis of the two clay fractions is given below. All analyses are calculated to an oven dry basis (103° C.).

Lab. No.	1248-50	1260
SiO_2	49.1	47.2
$Fe_2O_3+TiO_2$	10.0	10.6
Al_2O_3	26.6	28.7
H_2O (100-1000° C.)	13.5	12.2
Molecular ratio SiO_2 Al_2O_3	3.1	2.8
Exchange Capacity m.e.%	75.0	64.0

Titration Curve.—The calcium clay fractions were converted to the hydrogen form by washing with 100 ml. of 0.004N HCl and 2000 ml. of 0.001N HCl and then with alcohol.

Figure 8 shows the titration curve for a 1 per cent. aqueous suspension of the hydrogen clay fraction of sample 1248-1250.

Dehydration Curve.—A dehydration curve of the calcium clay fraction of sample 1248-1250 is shown in Figure 8, together with curves for an allophane, kaolinite and a montmorillonite (10). The clay fraction of sample 1260 gave an almost identical curve.

Points on the curve were determined by heating of samples in a furnace for one hour at constant temperatures, cooling and weighing. Although the equipment and method were not particularly satisfactory for this type of investigation, repeated determinations failed to reveal any marked flexure in the dehydration curve.

Discussion.

Earlier work was carried out on the recent volcanic deposits and volcanic soils of New Britain by Hosking (1) who later (2) investigated the clay minerals present in the clay, silt and sand fractions of a light yellow grey subsoil of volcanic ash near Rabaul. Differential thermal and X-ray analyses showed that halloysite was the only clay mineral present, and the diffuse nature of the X-ray pattern indicated the presence in the soil of a large amount of amorphous clay.

The exchange capacities of the colloid, coarse clay and silt fractions (using 1N NH_4Ac at pH 9.0) found by Hosking (3) were 89, 58 and 33 m.e. per cent. respectively. Exchange capacities of the less than 1.5*u* clay fractions from two subsoils of the Warangoi series, 75 and 64 m.e.% (using 1N NH_4Ac at pH 7.0) are of the same magnitude as the above. It is possible that halloysite and an amorphous clay will be found also in the Warangoi soils, and that the latter clay may prove to be allophane.

The presence of allophane could account for the pattern of the dehydration curve which resembles those described by Ross and Kerr (4), Nutting (5) and Aomine and Yoshinaga (6). It could also account for the absence of flexure in the titration curve which is similar to that described by Birrell and Gradwell (7).

The unusual ability of the Warangoi and other ash soils of New Britain to accumulate organic matter and organic phosphorus under conditions of high temperature and rainfall, with a texture and base status favouring rapid oxidation of the organic matter, may be due to an allophanic nature of the fine mineral fractions (8).

General Conclusions.

The data accumulated from the investigation of the Warangoi soils indicate clearly their high nutrient status, and crops in this area can be expected to perform at least as well as they do on volcanic ash soils of other parts of New Britain.

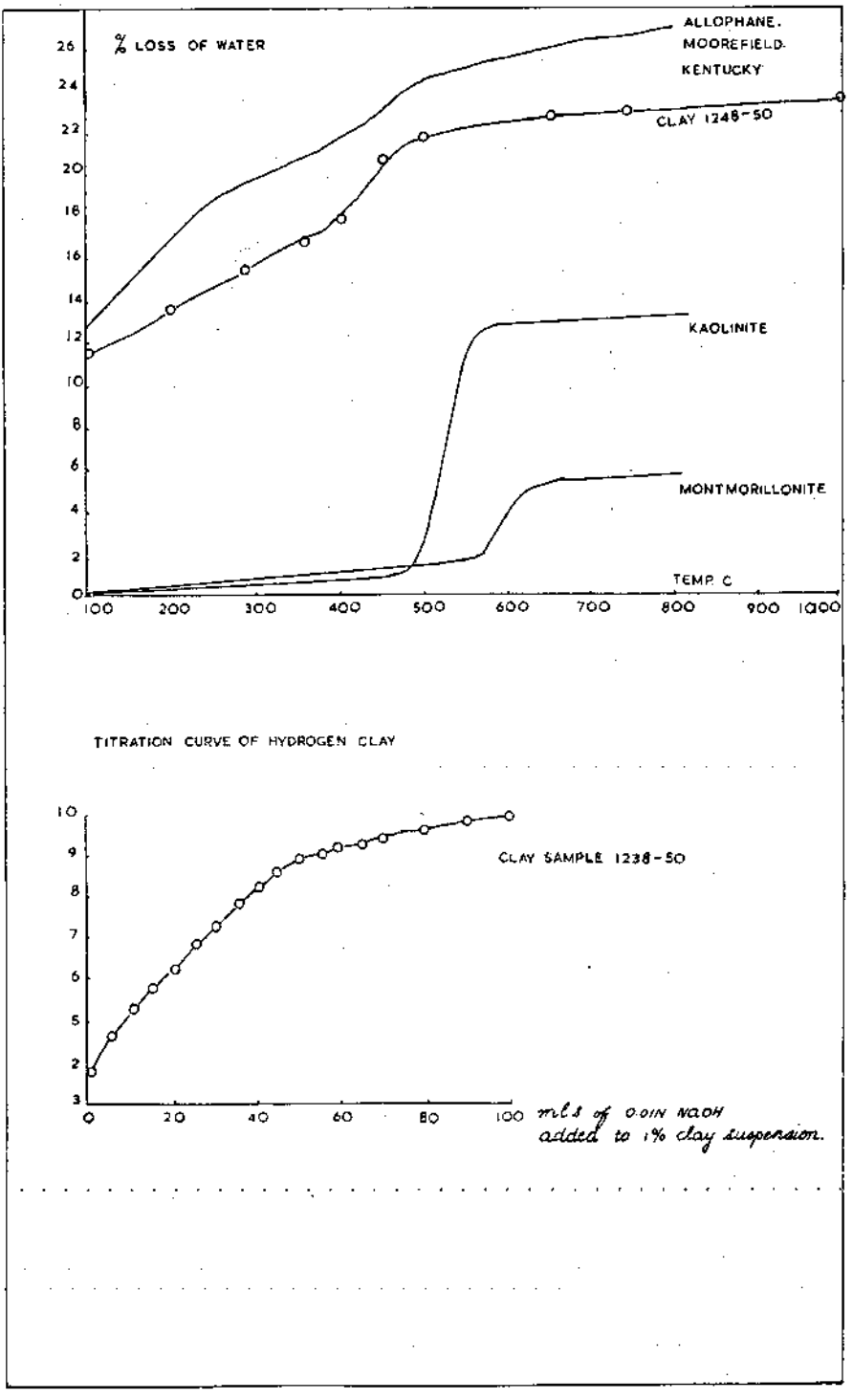
% LOSS OF WATER
ALLOPHANE.
MOOREFIELD.
KENTUCKY
CLAY 1248-50
KAOLINITE
MONTMORILLONITE
TEMP C
26
24
22
20
18
16
14
12
10
8
6
4
2
0
100
200
300
400
500
600
700
800
900
1000
TITRATION CURVE OF HYDROGEN CLAY
CLAY SAMPLE 1238-50
10
9
8
7
6
5
2
3
0
20
40
60
80
100
mls of 0·01N NaOH
added to 1% clay suspension.

Fig. 8

The present mechanical stability and fertility of these and other New Britain ash soils appears to depend to a large extent upon the organic phase, and management practices should aim at organic matter conservation.

Analytical Methods.

Mechanical Analysis.—The fractions were separated according to the International System described by Piper (9).

pH and Specific Conductivity.—Determinations made on a 1 : 5 soil/(CO_2 free) water suspension, after shaking for 1 hour. Measurements made with a Phillips conductivity bridge and glass electrode.

Echangeable Bases.—A technique which has been shown to give satisfactory results over the past few years in these laboratories was employed. Briefly the soil is treated as an exchange column; 5 gm. of soil is supported on a glass wool plug in a 20 × 1 cm. glass tube and 100 ml. of 1N NH_4Ac is poured into a funnel connected to the tube and allowed to percolate through the column overnight. The exchangeable bases contained in the effluent are determined flame photometrically with a Beckman DU.

Exchange Capacity.—The soil column above is eluted with 60 per cent. alcohol, approximately 75 ml., until excess NH_4Ac is removed, transferred to a Kjeldahl flask and distilled with MgO, the exchanged ammonia released being collected in a standard acid solution.

Carbon.—The Walkley-Black and dry combustion methods described by Piper (9) were used.

Total Nitrogen.—Kjeldahl method.

Total Phosphorus.—Samples were ignited with $Mg(NO_3)_2$, precipitated as the phosphomolybdate which was titrated with a standard acid solution.

Extractable Phosphorus.—Phosphorus in the extraction solutions was determined colorimetrically.

Clay Fraction Analysis.—Silica and sesquioxides were determined according to the method described by Piper (9).

Clay Exchange Capacity.—Samples were leached with IN Ammonium Acetate followed by elution with 60 per cent. alcohol until excess NH_4Ac was removed. The clay column was then transferred to a Kjeldahl flask and distilled with MgO as usual.

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(7) Birrell, K. S. and Gradwell, M. (1956). Ion Exchange Phenomena in Some Soils containing Amorphorus Mineral Constituents. Aust. J. agri. Res. Vol. 7, No. 1., 130-143.

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(9) Piper, C. S. Soil and Plant Analysis. Univ. of Adelaide, Adelaide, Australia.

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TABLE 1

MECHANICAL ANALYSES

(Values as percentages on oven dry basis)

Lab. No.	Depth inches	Coarse sand	Fine sand	Silt	Clay	Solution loss	Total	Organic matter	Munsell Colour	
									Sample dry	Sample wet
1234	0-2½	8.5	19.1	25.3	22.2	24.4	99.5	23.2	Dark Brown .... 10 YR 3/3	Black .... 2.5 Y 2/0
5	2½-7	11.1	28.8	25.9	23.2	10.5	99.6	9.70	Brown .... 10 YR 5/3	Dark Greyish Brown 10 YR 3/2
6	7-11	35.0	42.7	17.5	5.8	1.5	102.5	0.61	Pale Yellow .... 5 Y 7/3	Dark Yellowish Brown 10 YR 4/4
7	11-20	24.4	51.5	17.7	5.2	0.3	99.1	0.09	Light Grey .... 5 Y 7/2	Greyish Brown .... 2.5 Y 5/2
8	20-25	38.3	32.5	24.2	5.8	1.1	101.9	0.06	Light Grey .... 5 Y 7/2	Greyish Brown .... 2.5 Y 5/2
9	25-30	17.2	29.0	28.8	25.0	1.3	101.3	1.23	Brown .... 10 YR 5/3	Very Dark Brown 10 YR 2/2
40	30-48	7.0	9.7	24.2	57.9	1.3	100.1	0.59	Yellowish Brown 10 YR 5/4	Dark Reddish Brown 5 YR 3/3
1	48-69	5.0	7.6	11.1	77.0	0.7	101.4	0.20	Yellowish Brown 10 YR 5/4	Dark Reddish Brown 5 YR 3/4
2	69-101	9.4	20.9	36.1	36.5	1.0	103.9	....	Very Pale Brown 10 YR 7/4	Brown .... 7.5 YR 5/4
3	101+	5.1	18.4	30.9	46.7	0.7	101.8	....	Pale Brown .... 10 YR 6/3	Dark Brown .... 7.5 YR 3/2
1251	0-3	4.2	16.2	23.7	30.3	23.1	97.5	20.5	Dark Brown .... 10 YR 3/3	Black .... 2.5 Y 2/0
2	3-10	4.9	22.3	35.5	23.2	11.7	97.6	8.9	Brown .... 10 YR 5/3	Dark Reddish Brown 5 YR 2/2
3	10-22	7.4	35.0	42.0	7.7	4.3	96.4	2.9	Pale Yellow .... 2.5 Y 7/4	Dark Brown .... 10 YR 4/3
4	22-36	18.0	44.8	28.2	8.2	1.9	101.1	0.4	Pale Yellow .... 5 Y 7/3	Dark Yellowish Brown 10 YR 4/4
5	36-48	33.3	48.8	10.6	8.9	0.8	102.4	....	Light Grey .... 5 Y 7/1	Greyish Brown .... 2.5 Y 5/2
6	48-54	43.0	39.3	11.0	5.3	0.8	99.4	....	Light Grey .... 5 Y 7/1	Greyish Brown .... 2.5 Y 5/2
1294	0-12	10.0	19.0	17.0	42.7	11.0	99.7	9.85		
5	12-18	10.4	19.0	22.2	44.9	3.1	99.6	3.54		
6	18-34	17.4	21.8	23.1	37.4	0.5	100.2	0.9		
7	34-42	15.9	21.2	28.1	35.4	1.0	101.6	....		

Profile 1234-1243 Shallow ash layer (25 in.) over weathered tuff (25 in. to 101 in +).

1251-1256 Deep ash layer (54 in.).

1294-1297 Old profile exposed after removal of ash by erosion (10 per cent. slope).

TABLE 2

EXCHANGE DATA

(All values on oven dry basis)

Lab. No.	Depth inches	Exchangeable Cations m.e.% †Ca^{++}	Mg^{++}	K^{+}	Na^{+}	Total Cations (=Exch. capacity)	% of Total Ca^{++} Ca^{++}	Mg^{++}	K^{+}	Na^{+}	$\frac{Ca^{++}+Mg^{++}}{K^{+}+Na^{+}}$	$\frac{Ca^{++}}{K^{+}}$	Ca removed by HN_4 Ac	Exchange Ca^{++}	Non Exch. Ca^{++} removed by NH_4 Ac.
1234	0-2½	38.4	11.6	7.1	3.6	60.7	63	19	12	6	4.7	5.4	100.0	38.4	61.6
4	2½-7	13.7	5.5	9.8	3.5	32.5	42	17	30	11	1.4	1.4	32.2	13.7	18.5
6	7-11	5.5	1.1	7.7	0.8	15.1	37	7	51	5	0.8	0.7	6.2	5.5	0.7
7	11-20	3.2	1.8	3.5	1.2	9.7	33	19	36	12	1.1	0.9	3.7	3.2	0.5
1251	0-3	41.2	8.0	5.2	4.8	59.2	70	13	9	8	4.9	7.9	80.5	41.2	39.3
2	3-10	19.7	5.7	3.7	3.6	32.7	60	18	11	11	3.5	5.3	37.5	19.7	17.8
3	10-22	14.7	3.0	3.1	1.1	21.9	67	14	14	5	4.2	4.7	18.9	14.7	2.2
4	22-36	4.5	2.8	3.4	1.4	12.1	37	23	28	12	1.5	1.3	6.3	4.5	1.8
5	36-48	0.9	1.6	2.7	1.8	7.0	13	23	38	26	0.6	0.3	2.9	0.9	2.0
6	48-54	1.0	1.3	2.3	1.6	6.2	16	21	37	26	0.6	0.4	3.2	1.0	2.2

† Exchangeable Ca^{++} obtained by difference, Exchange Capacity $-(Mg^{++} + K^{+} + Na^{+})$

Lab. No.	Depth inches	CO_2%	as Ca CO_3%	CO_2 Expressed in m.e.%	Non Exch. Ca m.e.% removed by NH_4 Ac	Non Exch. Ca m.e.% unaccounted as Ca CO_3
1234	0-2½	0.568	1.29	25.8	61.6	35.8
1235	2½-7	0.193	0.44	8.8	18.5	9.7
1236	7-11	0.009	0.02	0.4	0.7	0.3
1251	0-3	0.495	1.12	22.5	39.3	16.8
1252	3-10	0.185	0.42	8.4	17.8	9.4
1253	10-22	0.069	0.16	3.1	2.2	0

ANALYTICAL RESULTS

(All values on

inches	pH	S.C. mhos × 10^{-5}	Ca removed by NH_4 Ac	Exch. Mg^{++} m.e.%	Exch. K^{+}	C%	N%	C/N	Walkley Black C%	Recovery %	Ignition Loss %	Organic
0-2½	7.30	30.9	100	11.6	7.1	13.4	1.17	11.5	10.0	75	29.1	2
2½-7	7.20	18.5	32.2	5.5	9.8	5.60	0.598	10.4	4.57	81	16.3	9
7-11	7.10	7.0	6.2	1.1	7.7	0.47	0.058	8.1	0.34	72	4.48	0
11-20	6.90	5.2	3.77	1.8	3.5	0.053	....	....	0	....	....	
20-25	6.85	4.9	3.2	1.2	2.6	0.033	....	....	0	....	....	
25-30	6.45	3.6	7.6	3.2	1.7	0.71	....	....	0.52	70	6.90	
30-48	6.30	3.6	7.3	5.1	4.1	0.32	....	....	0.17	50	10.8	
48-69	6.30	4.0	5.6	4.1	3.8	....	....	....	0.11	....	10.9	
69-101	6.20	3.5	4.4	4.8	3.1	....	....	....	0	....	10.9	
101 +	6.15	3.8	5.0	5.5	1.7	....	....	....	0	....	10.2	
0-2	7.1	26.0	76.0	8.6	5.0	10.5	0.990	10.6	7.70	73	24.7	
2-12	7.0	17.4	48.5	4.0	4.6	6.06	0.635	9.5	4.45	73	16.9	
12-28	7.1	9.5	24.2	4.2	4.2	1.84	....	....	1.47	80	8.80	
28-42	7.1	7.0	10.6	1.7	2.4	....	....	....	0.20	....	5.05	
42-54	6.9	6.4	7.0	2.4	2.4	....	....	....	0.09	....	3.88	
54-66	6.9	4.9	6.8	2.3	2.2	....	....	....	0.06	....	3.71	
66-72	6.6	5.2	4.8	2.2	2.1	....	....	....	0.07	....	2.92	
0-3	7.30	36.2	85.5	11.0	5.0	11.9	1.07	11.1	9.06	76	26.6	
3-10	7.20	19.8	44.8	5.0	3.5	5.16	0.501	10.3	3.90	76	14.7	
10-22	7.00	9.3	18.9	3.7	3.3	1.68	0.183	9.2	1.35	80	8.75	
22-36	6.90	6.0	8.2	2.7	3.6	....	....	....	0.17	....	4.56	
36-48	7.10	3.8	4.2	1.6	3.1	....	....	....	0.03	....	2.72	
48-54	7.05	4.6	4.9	1.2	2.4	....	....	....	0.04	....	2.58	
0-1	7.10	29.8	60.4	7.4	4.4	9.07	0.960	9.5	7.17	79	22.2	
1-12	7.00	11.4	23.3	4.2	6.7	1.35	0.17	8.0	1.04	77	9.35	
12-18	7.00	7.0	10.8	2.6	4.4	....	....	....	0.10	....	4.87	
18-24	7.20	3.8	7.4	1.6	2.6	....	....	....	0.06	....	3.57	
24-36	6.90	4.9	6.7	1.2	1.9	....	....	....	0.26	....	5.85	
36-48	6.95	5.2	2.8	0.9	1.6	....	....	....	0.06	....	4.35	
48-54	6.75	7.6	8.7	2.6	2.4	....	....	....	0.35	....	7.08	
54-60	6.70	7.6	11.0	5.6	3.1	....	....	....	0.40	....	8.22	
0-2	7.10	38.0	94.8	6.7	3.6	13.6	1.13	12.0	10.1	74	30.0	
2-6	7.10	15.4	39.2	3.8	2.7	4.21	0.445	9.5	3.12	74	14.0	
6-8	6.90	13.4	28.0	3.1	3.5	2.43	0.280	8.7	1.79	74	10.7	
8-10	6.95	11.3	24.7	2.9	2.8	....	....	....	1.32	....	9.20	
10-14	6.95	8.3	19.2	3.0	4.1	....	....	....	0.39	....	7.17	
14-16	7.20	5.2	11.9	2.8	3.7	....	....	....	0.05	....	4.95	
54	7.50	4.2	3.5	1.9	1.7	....	....	....	0.02	....	2.50	
28-46	6.55	5.5	7.7	3.5	2.0	....	....	....	0.19	....	8.22	
0-2	6.10	9.9	21.3	4.4	0.3	2.42	0.222	10.9	2.01	83	8.55	
2-10	5.70	9.3	14.9	4.2	0.8	1.02	0.127	8.0	0.78	76	6.22	
10-16	5.80	5.2	13.0	3.1	0.4	....	....	....	0.25	....	4.48	
16-24	5.75	7.6	15.0	2.7	0.4	....	....	....	0.20	....	4.65	
24-36	6.10	7.0	17.9	4.4	0.5	....	....	....	0.35	....	6.08	
36-42	6.20	7.6	17.8	4.4	0.7	....	....	....	0.33	....	3.71	
42-72	6.45	6.4	14.7	4.0	0.5	....	....	....	0.09	....	4.75	
0-1	7.00	34.8	81.8	10.4	4.3	13.0	1.29	10.1	9.42	73	28.9	
1-6	7.00	19.0	46.7	5.8	4.2	6.30	0.713	8.8	4.81	76	16.4	
6-12	6.90	14.9	38.3	4.2	4.5	4.38	0.534	8.2	3.49	79	14.1	
12-16	6.90	10.1	19.9	2.5	4.0	1.56	0.188	8.3	1.15	74	8.17	

TABLE 4

PHOSPHORUS ANALYSES

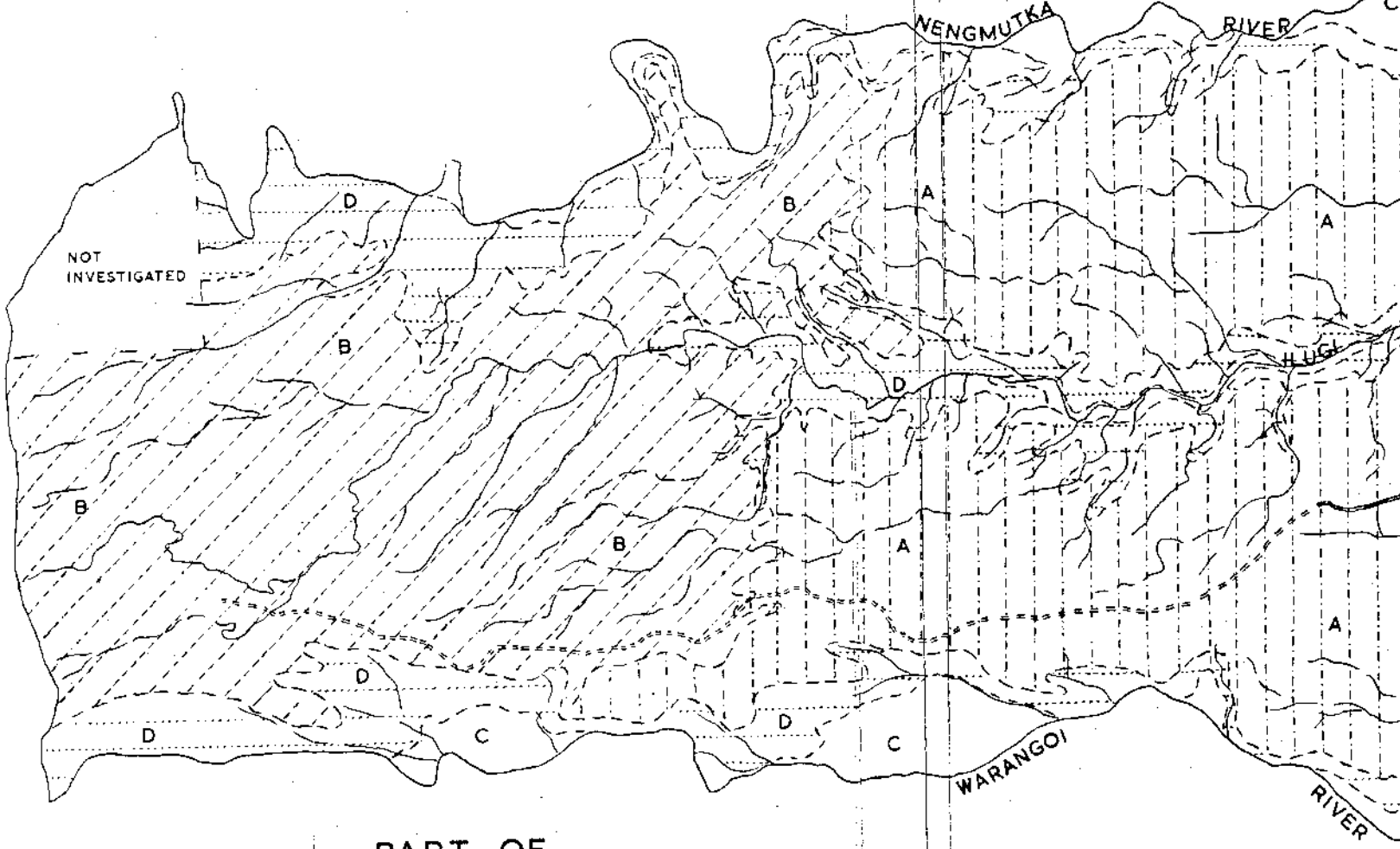
(All values are in parts per million and on oven dry basis)

Lab. No.	Depth Ins.	Total P	P extractable with					Organic P. (by difference)	% Organic P. of total P.
			.5M $NaHCO_3$ at pH 8.5	H_2O	.01N H_2SO_4	.2N H_2SO_4 before ignition	.2N H_2SO_4 after ignition		
1234	0-2½	2860	99	65	288	300 *	2290	1990	70
5	2½-7	1710	44	19	62	285	1200	915	53
6	7-11	585	9	4	162	388	477	89	15
7	11-20	632	3	4	267	640	640	0	0
8	20-25	655	3	4	177	420	470	50	8
9	25-30	320	6	....	11	....	....	....	....
40	30-48	405	13	....	8	....	....	....	....
1	48-69	334	17	....	14	....	....	....	....
2	69-101	356	16	....	7	....	....	....	....
3	101+	262	11	....	5	....	....	....	....

Extraction Solutions :—

0.5M $NaHCO_3$ at pH 8.5 .... 5 gm. sample/100 ml/1 hour shaking time.
H_2O .... 1 gm. sample/100 ml/1 hour shaking time.
0.01N H_2SO_4 .... 1 gm. sample/200 ml/1 hour shaking time.
0.2N H_2SO_4 before ignition .... 2 gm. sample/100 ml/4 hours shaking time.
0.2N H_2SO_4 after ignition .... 2 gm. sample/100 ml/4 hours shaking time.

* 300 ppm extractable with .2N H_2SO_4 before ignition is approximate, since correction was necessary for absorbance due to the substantial amount of organic matter also extracted.



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WARANGOI PURCHASE
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