RECONNAISSANCE SOIL SURVEY OF SOUTHEAST PAHANG

By

DAVID W.IVES, B. SC (N.Z.)

New Zealand Colombo Plan Soil Surveyor

Malayan Soil Survey Report No. 4/1967

WITH THE COMPLIMENTS

OF

THE DIRECTOR OF AGRICULTURE,
WEST MALAYSIA,
KUALA LUMPUR.

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SOIL SCIENCE DIVISION
RESEARCH BRANCH
DIVISION OF AGRICULTURE
MINISTRY OF AGRICULTURE AND CO-OPERATIVES
WEST MALAYSIA
KUALA LUMPUR

Frontispiece: An attempt to stabilize aborigine shifting cultivation practices, Kampong Kuala Rekoh, Ulu Keratong. Rubber, bananas and sugar cane have been planted and tapioca, sweet potatoes and corn are being grown as food crops. Dry rice is still grown by shifting cultivation methods within the environs of the village. In the background, riverine forest along the Sungei Keratong.

CONTENTS

PART I

INTRODUCTION

The Reconnaissance Soil Survey of South East Pahang was undertaken as part of an ambitious programme to complete a reconnaissance survey of the soil resource of West Malaysia by the end of 1967. The author was attached to the Soil Science Division of the Division of Agriculture in March 1965 for the specific purpose of undertaking this survey. Field work was conducted during the periods of May - October 1965 and March - October 1966. This report presents the results of these investigations.

1. Location

The region discussed in this report, the south-eastern corner of the State of Pahang, encompassing some 2710* square miles, is situated between 2^{0} 30' and 3^{0}30' north latitude and 102^{0} 45' and 103^{0} 40' east longitude (Figure 1). The area is bounded to the south, east and north respectively by the State of Johore, the South China Sea, and the Sungei** Pahang. To the west, the area is bounded by the Sungei Mentiga and the watershed of the Sungei Rompin and its tributaries, excluding the upper valley of the Sungei Jeram. The outlying island of Pulau Tioman and Pulau Sri Buat in the South China Sea, administered by the State of Pahang, have also been covered in this report.

2. Access

The main east coast highway parallels the eastern extremity of the region between Pekan and Endau. On the northern boundary a new road between Pekan and Kuala Chini follows the south bank of the Sungei Pahang. Approximately 50 miles of metre-gauge railway bisect the region, connecting the mining township of Bukit Ibam with Kuala Rompin. These lines of communication afforded only limited access, and while it was possible to utilise the Sungei2 Bebar, Rompin and Endau, timber extraction roads in the Kuala Mentiga, Batu Gong, Ulu*** Serai and Ulu Sungei Rekoh areas, as well as aborigine tracks in various places, it was found necessary to establish some 575 miles of cut traverse lines (rentis2)**** in order to complete a survey at reconnaissance level.

3. Population and Settlement

According to the 1957 Census (Department of Statistics) only 9% of the population of the State of Pahang lives within the South East Pahang region. Of this total of approximately 24,000 people, (excluding indigenous people) more than 90% are Malays, the remainder being predominantly of Chinese and Indian extraction. They are confined almost exclusively

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* 1,734,000 acres (approx.)

** Sungei - (Malay) = river (pl. Sungei2)

*** Ulu - (Malay) = headwaters

**** Rentis - (Malay) = traverse line on a fixed compass bearing (pl. rentis2)

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FIGURE I

MAP OF MALAYA SHOWING POSITION OF AREA SURVEYED

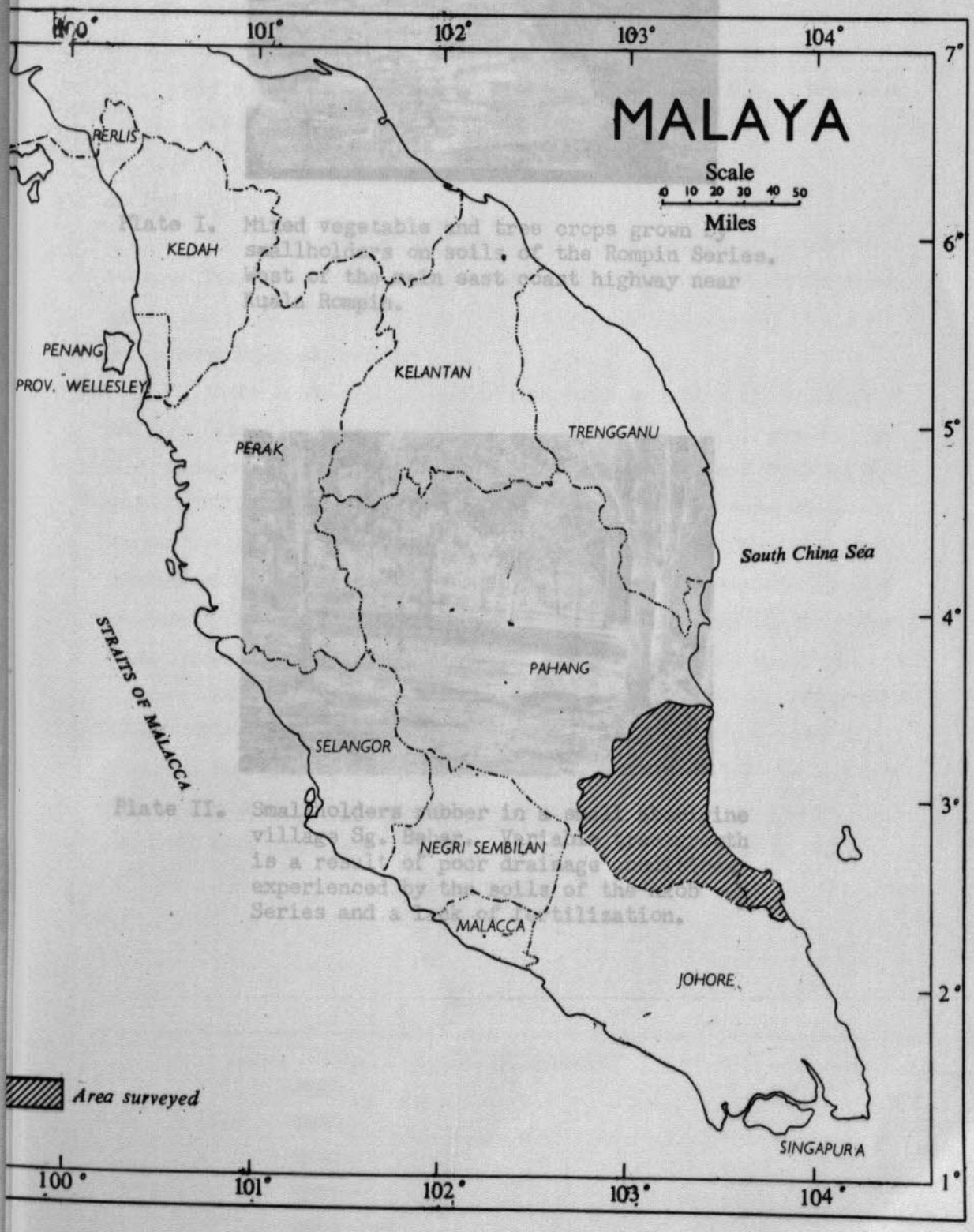

Plate I. Mixed vegetable and tree crops grown by smallholders on soils of the Rompin Series. West of the main east coast highway near Kuala Rompin.

Plate II. Smallholders rubber in a small aborigine village Sg. Bebar. Variable tree growth is a result of poor drainage conditions experienced by the soils of the Akob Series and a lack of fertilization.

to the narrow areas adjacent to the Sungei Pahang and Pekan - Endau highway, and, while there is a fairly even scattering of settlement throughout these areas, larger concentrations are found adjacent to the mouths of the main rivers at Pekan, Nenasi, Merchong, Kuala Rompin and Pontian, these latter four town being based primarily on the fishing industry.

Inland, the township of Bukit Ibam has been established by a large mining concern This industry has afforded considerable employment for many, including the indigenous people. Lanjut on the north bank of the Sungei Rompin opposite Kuala Rompin serves as the marshalling yard, stockpile and lighter loading point for the iron ore from Bukit Ibam. A large number of people in both areas are dependent, either directly or indirectly, on this mining industry for their livelihood.

4. Agriculture

Agriculture and animal husbandry are practised in the small strips adjacent to the Sungei Pahang in the north and the main highway between Pekan and Endau on the eastern border. Small areas under aborigine shifting cultivation and semi-permanent cultivation are scattered throughout the region.

Rubber in smallholdings, padi and some coconut are grown on the flood-plain of the Sungei Pahang. Along the coast, coconuts are the major crop. Padi is grown in blocks of various sizes in the swampy swales between beach strand lines. Citrus fruits and vegetablesare crops of some significance in the Rompin - Endau area. In the interior, small acreages of rubber are grown at many places, kampong2* Kuala Aur, Buloh Nipis, Lubok Batu, Batu Gong and Gambir being worthy of mention. Padi, vegetables and fruit trees are being encouraged at Bukit Serok, Kampong Kedaik and Kampong Mentelong. In addition 300 acres of coconuts have been recently planted at Kampong2 Jong, Mempelam, Sembayan and Mentelong.

All together, there are approximately 7000 acres under coconuts, 5000 acres in rubber, 2500 acres predominantly in wet padi, and small acreages of citrus, cashew nut, fruit trees and vegetables. Some 2500 buffalo and oxen, 2000goats and 1500 sheep have free range to graze on the poor grasses of the coastal padang and the weeds and sedges of the padi fields during the off-season (Source: Department of Agriculture, Pahang; 1965).

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* Kampong - (Malay) = village - (pl. Kampong2).

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Plate III. Dry rice planted by aborigines under shifting cultivation practices on soils of the Harimau Family at Kampong Kuala Rekoh in the Keratong Basin.

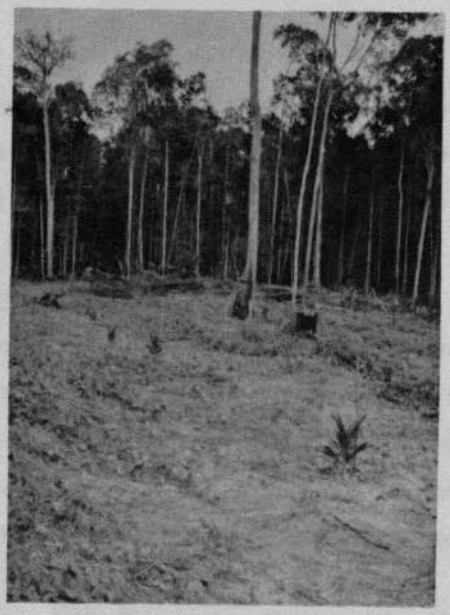


Plate IV. Young oil palm in a field trial on soils of the Durian Series at Bukit Ibam.

PART 2

THE ENVIRONMENT

Soils are the expression of the interaction of the passive and active forces of the environment. It may be generally stated, that the soils formed over a particular landform are a result of the influences of climate and biological activity (including both floral and founal influences) on a particular rock type over a certain length of time. All of those factors have a role to play in the formation of the soils of South East Pahang, but perhaps the greatest influence is that of parent rock or parent material (Leamy and Panton, 1966), Topography exerts a strong influence, as does the climate although a more accurate picture of soil genesis could be obtained from a study of palaeoclimates. Biological activity, both on and within the soil, also plays a significant part in soil formation, and the present distribution of vegetation types is a useful guide for soil mapping. The influence of the time factor is significant in separating soils developed on alluvia, but due to limited observations, it's influence on the sedentary soils is not discussed in more detail.

5. Physiography

The South East Pahang region has been subdivided into fifteen sub-regions on a physiographic basis. Although these physiographic regions are composed of many geomorphic units, they are capable of being isolated topographically and having the genesis of their landscapes discussed separately (Figures 2.).

a) Coastal Sand Ridge Country

This region stretches in an unbroken line from Pekan to Endau and varies from a quarter of a mile to 5 miles in width. It is composed of a series of discontinuous strand lines, of varying width, which are separated by swampy swales. The strand lines are narrowest in the central part of the region and widest in the south. They owe their origin to a northward longshore littoral drift, the periodic influence of heavier seas during the monsoon and a retreating shoreline.

b) Inland Swamp Basin

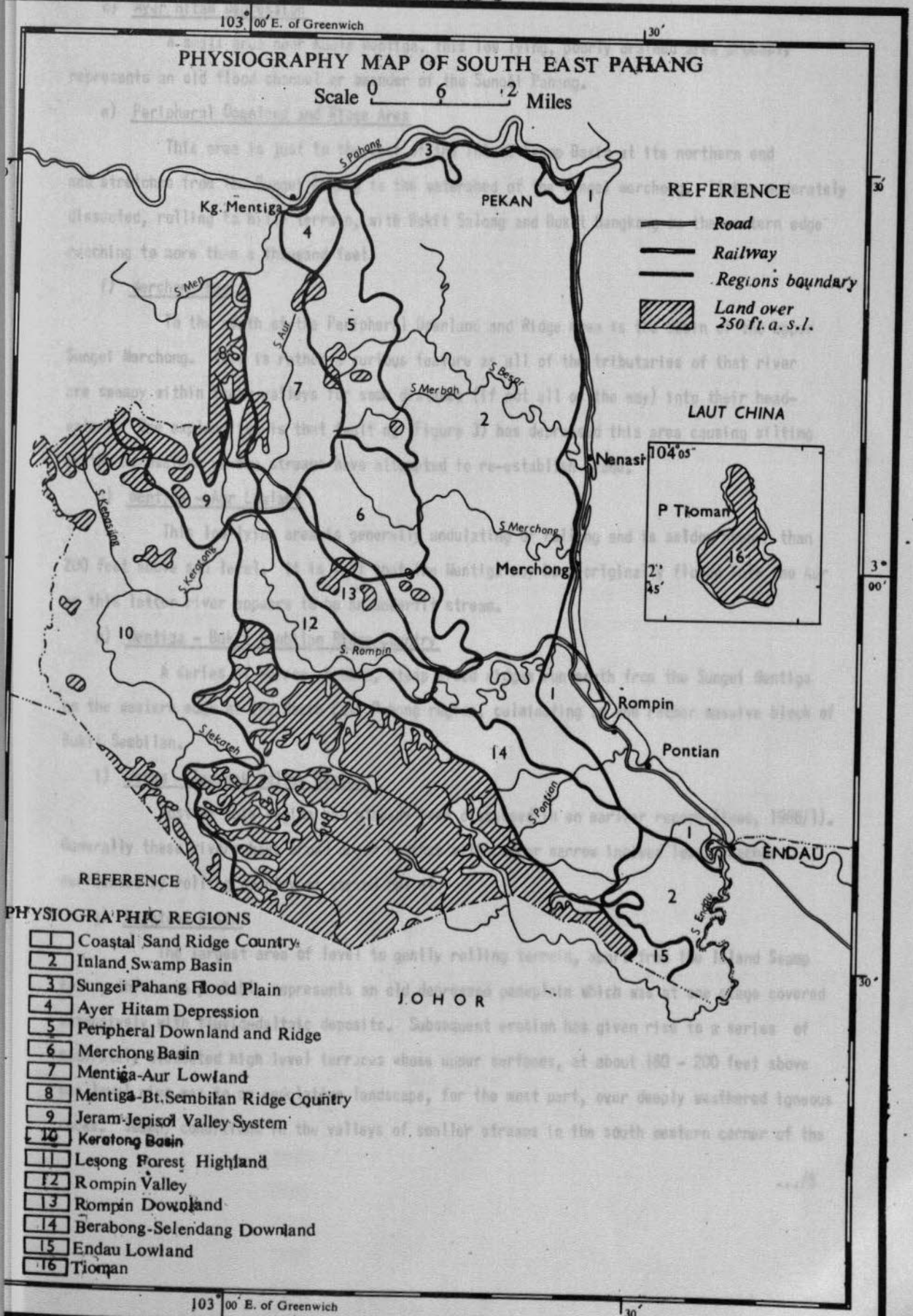
A succession of old lagoons behind sand spits, formed during the later Pleistocene gave rise to this very extensive area which parallels the coast and varies considerably, but generally averages about 12 miles in width. Subsequent drop in sea level encouraged the development of deep peat deposits over most of this area.

c) Sungei Pahang Flood Plain

This region is a very narrow strip of flat land which is immediately adjacent to

.../4

FIGURE 2


103° 00' E. of Greenwich
30'
PHYSIOGRAPHY MAP OF SOUTH EAST PAHANG
Scale 0 6 12 Miles
S. Pahang
Kg. Mentiga
PEKAN
S. Mep
S. Aur
S. Merbah
S. Besar
LAUT CHINA
Nenasi
104° 05'
P Tioman
2° 45'
3° 00'
S. Kepasing
S. Kertang
S. Merchong
Merchong
S. Rompin
Rompin
Pontian
S. Lekateh
S. Pontian
ENDAU
S. Endau
JOHOR
REFERENCE
Road
Railway
Regions boundary
Land over 250 ft. a. s. l.
REFERENCE
PHYSIOGRAPHIC REGIONS
1 Coastal Sand Ridge Country
2 Inland Swamp Basin
3 Sungei Pahang Flood Plain
4 Ayer Hitam Depression
5 Peripheral Downland and Ridge
6 Merchong Basin
7 Mentiga-Aur Lowland
8 Mentiga-Bt. Sembilan Ridge Country
9 Jeram-Jepisol Valley System
10 Keratong Basin
11 Lesong Forest Highland
12 Rompin Valley
13 Rompin Downland
14 Berabong-Selendang Downland
15 Endau Lowland
16 Tioman
103° 00' E. of Greenwich
30'

the Sungei Pahang, and which may be inundated at times of flooding.

d) Ayer Hitam Depression

A small area near Kuala Mentiga, this low lying, poorly drained area probably represents an old flood channel or meander of the Sungei Pahang.

e) Peripheral Downland and Ridge Area

This area is just to the west of the Inland Swamp Basin at its northern end and stretches from the Sungei Pahang to the watershed of the Sungei Merchong. It has moderately dissected, rolling to hilly terrain, with Bukit Salong and Bukit Bangkong on the western edge reaching to more than a thousand feet.

f) Merchong Basin

To the south of the Peripheral Downland and Ridge Area is the basin of the upper Sungei Merchong. This is rather a curious feature as all of the tributaries of that river are swampy within their valleys for some distance (if not all of the way) into their headwaters. One explanation is that fault ng (Figure 3) has depressed this area causing silting in the headwaters as the streams have attempted to re-establish grade.

g) Mentiga - Aur Lowland

This low-lying area is generally undulating or rolling and is seldom higher than 200 feet above sea level. It is felt that the Mentiga may have originally flowed into the Aur as this latter river appears to be an underfit stream.

h) Mentiga - Bukit Sembilan Ridge Country

A series of narrow, broken, steep sided ridges run south from the Sungei Mentiga on the western edge of the South East Pahang region, culminating in the rather massive block of Bukit Sembilan.

i) Jeram - Tepesok Valley System

Most of this region has already been discussed in an earlier report (Ives, 1966/1). Generally these rivers have broad upper reaches with rather narrow incised lower reaches surrounded by rolling country of varied relief.

j) Keratong Basin

The largest area of level to gently rolling terrain, apart from the Inland Swamp Basin, this area probably represents an old depressed peneplain which was at one stage covered extensively with fluvio-deltaic deposits. Subsequent erosion has given rise to a series of moderately dissected high level terraces whose upper surfaces, at about 180 - 200 feet above sea level give way to an undulating landscape, for the most part, over deeply weathered igneous rocks. Swampy conditions in the valleys of smaller streams in the south western corner of the

.../5

area are strong evidence for river capture in this region. In fact it is very likely that the Sungei Juram and SungeiTepesok flowed south into the Keratong Basin and had their outlet through Tasek Bera or the Sungei Palong into the Sungei Muar. Fluctuations in base level, possibly associated with some regional tilting were probably responsible for these rivers now making their exit via the Sungei Rompin.

k) Lesong Forest Highlands

An area characterised by steep and very steep slopes and narrow valleys. It is almost completely over 1000 feet in altitude. Gunong Beremban on the Pahang/Johore border reaches 2751 feet. Some larger valleys, such as the valley of the Sungei Kinchin, do penetrate this block, but because of their isolation they can be considered as part of this sub-region.

l) Rompin Valley

The Sungei Rompin meanders for more than 40 miles through this sub-region and in that time undergoes a loss in height of some 20 feet. The course of the river reflects a strong degree of lithologic control, and this feature, associated with the swampy nature of the areas immediately adjacent to the river is probably indicative of the superpositioning of a much larger river in an old river course. Beyond the swampy fringe, moderately dissected, undulating and rolling country charactertises the edges of this region.

m) Rompin Downland

This is an area of gently to moderately strongly dissected country with a general summit accordance at about 150 feet above sea level and with a scattering of isolated higher, steep sided, hills reaching elevations of 500 to 1000 feet. There appears to be a present phase of still stand in the geomorphic cycle which was previously the rejuvenation of a mature landscape. The higher features exist as such because of the more resistant nature of their rocks.

n) Berabong - Selendang Downland

An area characterised by narrow valleys and broad ridges varying between 100 and 200 feet above sea level, this area forms a peripherhal fringe to the Lesong Forest Highland on it's north-eastern side. The landscape indicates an identical stage in the geomorphic cycle to that shown by the terrain of the Rompin Downland.

o) Endau Lowland

This is only a small portion of a more extensive, somewhat imperfectly drained, level, lowlying area which extends between the Sungei Endau and the Sungei Kahang in Johore State.

p) Pulau Tioman

Pulau Tioman may be considered as a distinct and separate unit because of its isolation. It is almost entirely steepland, reaching 3406 feet above sea level in Gunong Kajang.

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Isolated pockets of level to moderately slop ng land are found in the heads of small bays scattered around the coastline.

6. Geology

The surface geology of the South East Pahang region is dominated by the large continuous extent of 'younger' or recent alluvia which occupy the flood plains and valleys of the present rivers an the area designated as the 'Inland Swamp Basin'. To the west these alluvia give way to arenaceous and argillaceous sediments of varying ages which are in turn bounded to the west and south by th eroded surfaces of the basement granite. Along the western and southern boundaries of the region the granites are overlain by sediments and minor occurrencesof acid and intermediate effusives. Numerous small outcrops of intermediate igneous rocks occur throughout the region and crustal deformation is evidenced by the presence of several areas of quartz prophyry rocks near the centre of the region (Figure 3).

Table 1 summarises the dominant lithologic types occurring in this region and outlines briefly the nature of the environment at the time of their formation. The oldest rocks encountered appear to be part of the Raub Group (Alexander, 1962) which is of Upper Carboniferous - Permian age and was previously designated as the 'Calcareous Series'. As they occur in this region these rocks are principally rhyolites and rhyo-dacites and associated intermediate extrusives - the latter group having been called the 'Pahang Volcanic Series ' (Fitch, 1952 p. 16) in the past and generally considered to be younger than the more acid effusives.

A gradual deepening of the seaway covering the region in late Permain and Triassic times resulted in the deposition of a great thickness of sediments which have been allied to the Malaysian geosyncline (MacDonald Personal comm.) and are divided into three separate lithologic groups. These are the Argillaceous Group which is predominantly siltstones, shales and mudstones, the Arenaceous Group of quartzites, greywacke and tuffaceous sandstones and the Rudaceous Group composed principally of conglomerates and conglomeratic grits. While it is generally assumed that the Argillaceous Group is the older of the three there is considerable interfingering and interbedding of components of all three Groups. Consequently the Geological Map (Figure 3) serves as only a general indicator of the extent of each Group, and bands and lenses of the others may and do occur within the areas shown as each particular Group.

During Jurassic times these sediments were uplifted and folded and there was contemporaneous intrusion of a large mass of granite (Alexander, 1962) below the sediments and probably into the cores of the anticlines. Locally the sediments were altered to quartzporphyry, quartzites, hornfels and schists by the proximity of the igneous material and associated minor

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FIGURE 3

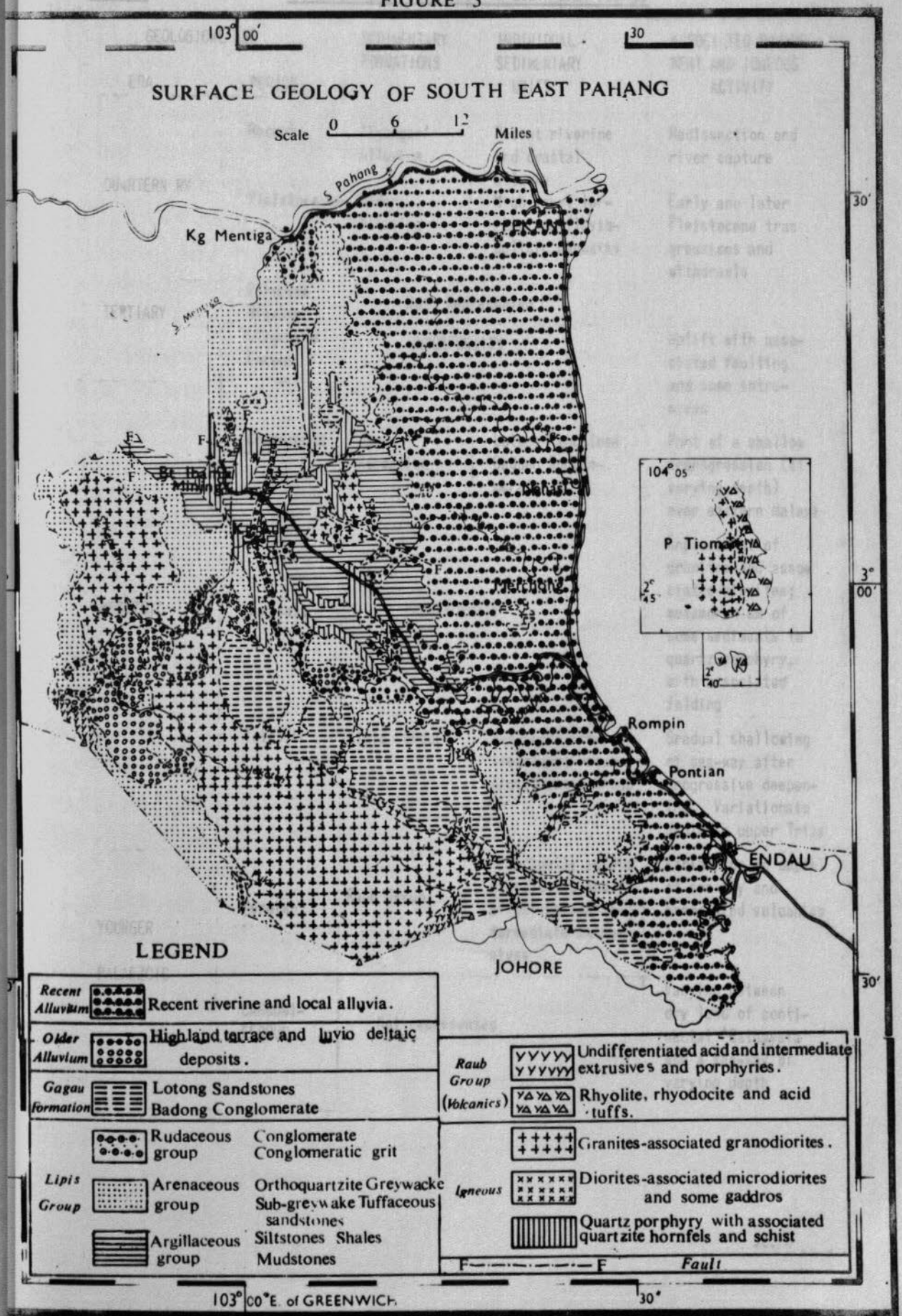
SURFACE GEOLOGY OF SOUTH EAST PAHANG
Scale 0 6 12 Miles
103° 00'
30'
S Pahang
Kg Mentiga
PKNS
Bt Ibu Mining
104° 05'
P Tioman
2° 45'
2° 40'
3° 00'
Rompin
Pontian
ENDAU
JOHORE
LEGEND
Recent Alluvium
Recent riverine and local alluvia.
Older Alluvium
Highland terrace and luvio deltaic deposits.
Gagau formation
Lotong Sandstones
Badong Conglomerate
Lipis Group
Rudaceous group
Conglomerate
Conglomeratic grit
Arenaceous group
Orthoquartzite Greywacke
Sub-greywake Tuffaceous sandstones
Argillaceous group
Siltstones Shales
Mudstones
Raub Group (Volcanics)
Undifferentiated acid and intermediate extrusives and porphyries.
Rhyolite, rhyodocite and acid tuffs.
Igneous
Granites-associated granodiorites.
Diorites-associated microdiorites and some gaddros
Quartz porphyry with associated quartzite hornfels and schist
Fault
103° 00' E. of GREENWICH
30'

TABLE 1 STRATIGRAPHICAL SEQUENCE IN SOUTH EAST PAHANG

GEOLOGICAL AGE ERA	PERIOD	SEDIMENTARY FORMATIONS	INDIVIDUAL SEDIMENTARY UNITS	ASSOCIATED ENVIRONMENT AND IGNEOUS ACTIVITY
QUARTERNARY	Recent	'Younger' Alluvium	Recent riverine and coastal alluvia	Redissection and river capture
	Pleistocene	Older Alluvium	High level terrace and fluvio-deltaic deposits	Early and later Pleistocene transgressions and withdrawls
TERTIARY	Pliocene Miocene	Not Represented		
	Oligocene Eocene	UNCONFORMITY		Uplift with associated faulting and some intrusives
	Cretaceous	Gagau Formation	Lotong Sandstone Badong Conglomerate	Part of a shallow transgression (of varying depth) over eastern Malaya
MESOZOIC	Jurassic	UNCONFORMITY		Enplacement of granites and associated diorites; metamorphism of some sediments to quartz porphyry, with associated folding
	Triassic	Lipis Group	Rudaceous Group Arenaceous Group Argillaceous Group	Gradual shallowing of sea-way after progressive deepening. Variationsin depth in upper Trias
YOUNGER PALAEZOIC	Permian	Raub Group	Principally acidic pyroclastic and effusives and intermediate extrusives	Variations in depth of sea-way and associated volcanics
	CARBONIFEROUS	Not represented		Varying between dry land of continental 'Cathaysia' and a sea-way of varying depth

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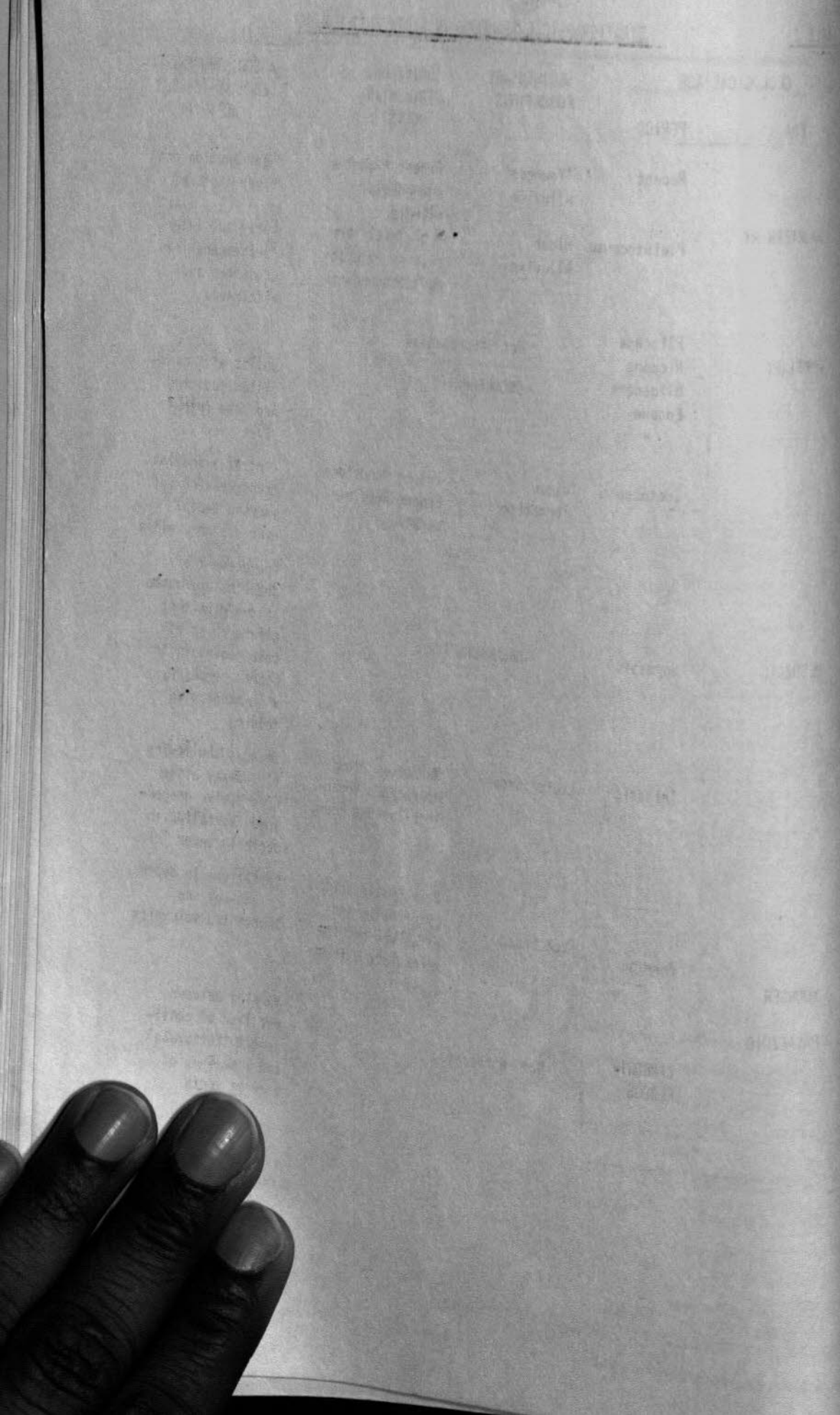

shearing (MacDonald p. 22 & 23). At about the same time minor intermediate differentiates from the granitic magma were intruded into the sediments. This period of orogeny was followed by a long period of erosion with gradual subsidence below sea level.

During the late Jurassic and early Cretaceous a thick sequence of predominantly arenaceous sediments were deposited over the area. These are the beds of the Gagau Formation which have been described in detail by Rishworth (Personal comm.). Essentially this sequence consists of the Badong Conglomerate comprising conglomerates with minor bands of siltstones and shale, and sandstones, which lies on the eroded surface of the granites and is overlain by the Lotong Sandstone. This latter bed comprises sandstones and massive siltstones. In the type area, in southern Trengganu volcanic rocks are found to occur immediately below the Badong Conglomerate and overlying the eroded surface of the granites. In the Lesong Highlands of South East Pahang a similar sequence has been observed, but Rishworth noted that the relationship of these volcanics to the overlying Badong Conglomerate is not as clear as that observed in southern Trengganu. In fact the granites appear to have intruded the volcanic rocks, and as a consequence in Figure 3 these volcanics have been shown as part of the Raub Group and not the Gagau Formation. The Gagau Formation in this region is characterised by gentle dips to the north or north west and resultant mesa-like geomorphic expression (Plate X).

In the early Tertiary this area was uplifted and some minor displacements occurred. In adjacent areas there is evidence for some igneous intrusive activity at this stage (Fitch p. 17). A long period of erosion then followed during which a considerable volume of material was removed and deposited in a shallow seaway to the east of the region. Pleistocene marine transgressions into many parts of the area and consequent terrace formation resulted in the deposition of large areas of high level alluvium or Older Alluvium (Burton p. 30) adjacent to the Keratong Basin. It would appear that at this time the Sungei2 Jeram and Keratong flowed west and south-west into the headwaters of the Sungei Muar.

An emergence of the land relative to sea level and the subsequent down-cutting to re-establish grade in the later Pleistocene and Recent times has been responsible for the present drainage pattern including the capture of the Sungei2 Jeram and Keratong by the Sungei Rompin in the Kampong Aur area. The sea was gradually pushed out to the present coastline and the old shallow shelving sea was infilled with recent flood sediments and an extensive organic accumulation giving rise to the vast 'inland swamp basin' (Figure 2). Flood deposits druing this time were responsible for the large areas of sub-recent and recent alluvia which occur adjacent to the major rivers.

Perhaps the most significant feature influencing the pedogenesis of the soils of South East Pahang is the length of time (the whole of the Tertiary and Quarternary eras)

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that these sedentary soils have been subjected to the processes of soil formation. The consequent leaching associated with formation has given rise to the very low supply of available nutrients in these soils. Variations in base level during the Pleistocene and later Tertiary may have been repons ble for the gley characteristics often exhibited by the heavier textured sedentary soils.

7. Climate

The equable, tropical climate experienced by lowland Malaya is not sufficient to produce marked differences between soils throughout the country. As pointed out by Panton (1965), the influences of high temperature and rainfall give rise to many distinct morphological features; especially soil depth, colour and presence of plinthite, as well as being responsible for the moderately and strongly leached nature and consequent low nutrient status of most Malayan soils.

The rainfall pattern (Figure 4) reflects the influence of the north-east monsoon, but this is moderated to some extent by the effect of the south-west monsoon on the western edge of the region. In the eastern and central parts of the region, maximum rainfall comes during the months of November to January when approximately half the annual total can be expected. Not every day during this period is a 'rain-day' but few days are rain free. During the remainder of the year May, June, July and August are the driest months when it is not uncommon to have periods of two to three weeks without rain. Towards the western margin, two distinct wet periods are experienced. These are in March and April and in October, November and December, the latter period being the wetter of the two. Neither of the intervening drier periods are as dry as that experienced further east.

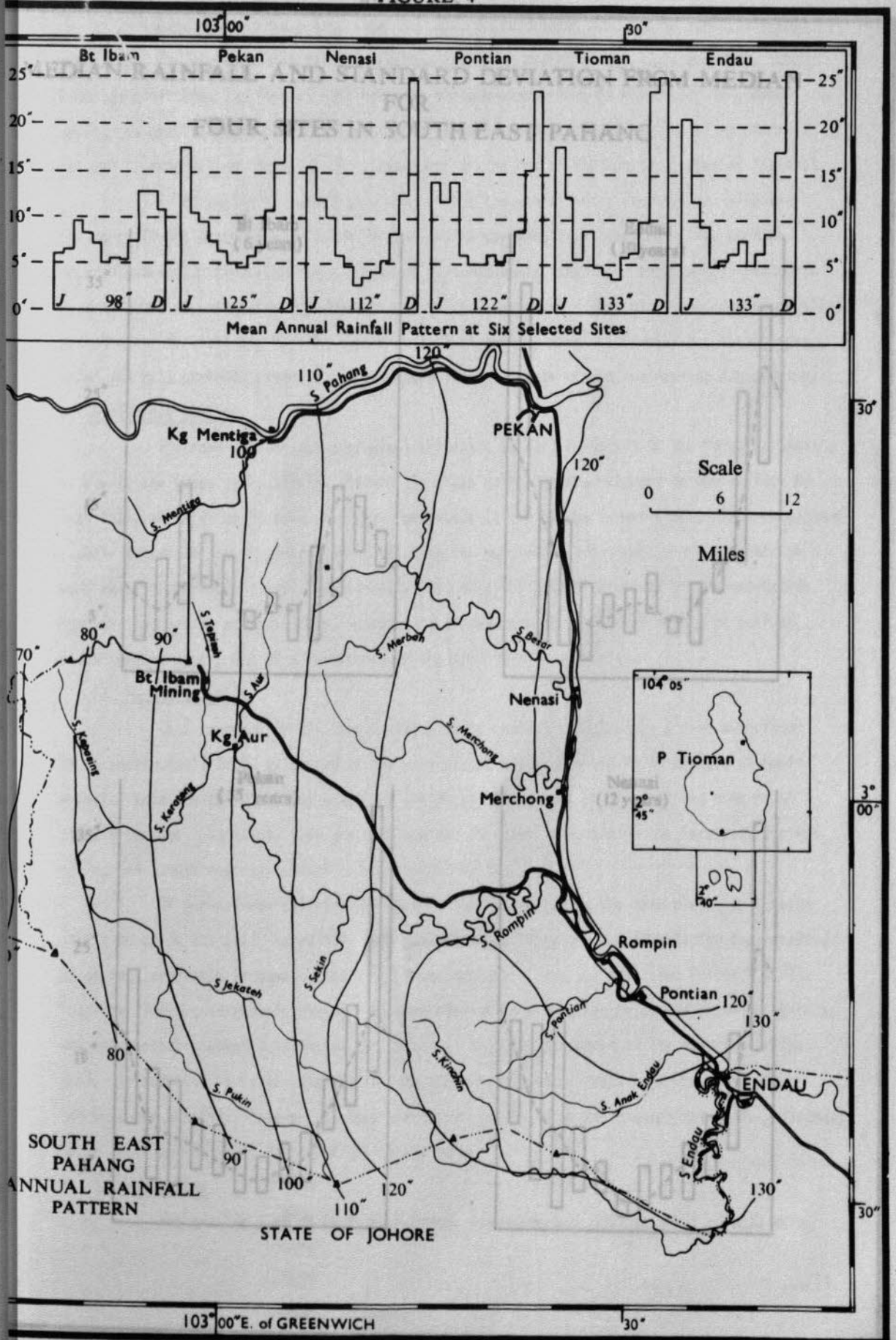
Often, mean rainfall figures do not give a particularly accurate indication of the monthly rainfall pattern; consequently,(Figure 5)showing median rainfall and the deviation from the median of four selected sites over a number of years is included for comparison. It can then be seen that while the expected range in precipitation during the drier months is relatively narrow, a considerable range of precipitation, during the wetter months, may be experienced from year to year.

Day temperatures show little variation throughout the year. Temperatures are generally of the order of 85° - 91° F during the day, dropping to 71° - 76°F at night, with a generally wider range of temperatures inland. Dale (1963) notes that the hottest days and nights are in May and the coolest days are in January with the coolest nightsduring September.

As a result of high temperatures and high rainfall, humidity is generally high, averaging 60% - 70% during the major part of the year but frequently fluctuating between 35% and 100% over short periods. During the monsoon, humidity may remain at or near 100% for days

.../10

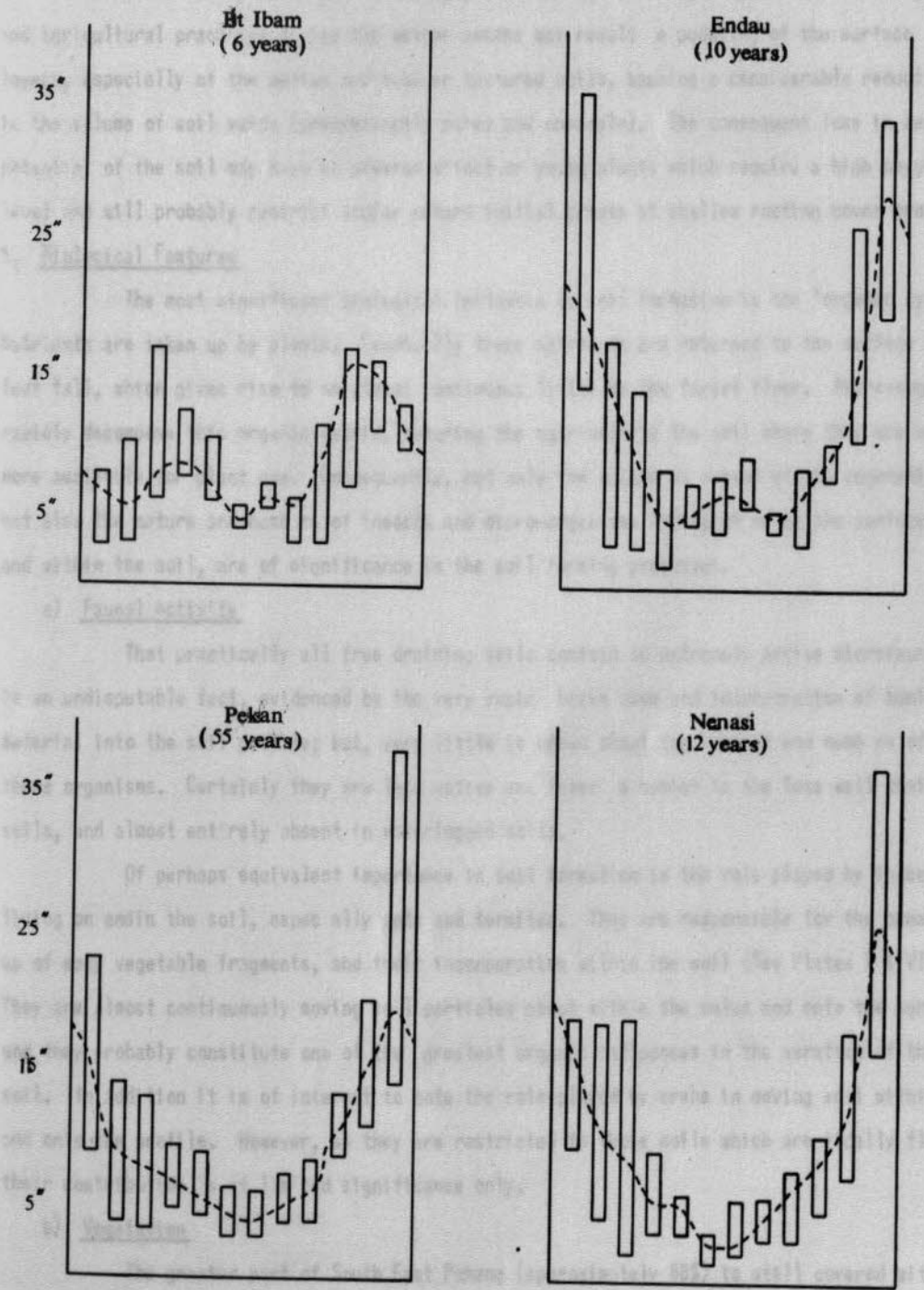
FIGURE 4



Sources: D.I.D. Hydrological Data Rainfall Records 1961. Rompin Mining Co. 1966.

FIGURE 5

MEDIAN RAINFALL AND STANDARD DEVIATION FROM MEDIAN
FOR
FOUR SITES IN SOUTH EAST PAHANG



at a time.

Evaporation from a free water surface ranges between 5.5. inches and 7.75 inches per month. The highest rates occurring during the drier months of May, June and July. Under forested conditions the loss of soil moisture through evaporation is relatively low, even during the drier months, but on clearing prior to development, a large volume of moisture is removed by evaporation resulting in a consequent drying out of the surface layers of the soil.

It is worthy of note at this stage, that the use of heavy machines for clearing and agricultural practices during the wetter months may result in puddling of the surface layers, especially of the medium and heavier textured soils, causing a considerable reduction in the volume of soil voids (predominantly pores and channels). The consequent loss in aeration potential of the soil may have an adverse effect on young plants which require a high oxygen level and will probably restrict and/or retard initial growth of shallow rooting cover crops.

8. Biological Features

The most significant biological influence in soil formation is the 'organic cycle'. Nutrients are taken up by plants. Eventually these nutrients are returned to the surface by leaf fall, which gives rise to an almost continuous litter on the forest floor. Micro-organisms rapidly decompose this organic debris, returing the nutrients to the soil where they are once more available for plant use. Consequently, not only the nature of extent of the vegetation, but also the nature and numbers of insects and micro-organisms living at or on the surface, and within the soil, are of significance in the soil forming processes.

a) Faunal Activity

That practically all free draining soils contain an extremely active microfauna is an undisputable fact, evidenced by the very rapid break down and incorporation of humic material into the soil profile; but, very little is known about the habitat and numbers of these organisms. Certainly they are less active and fewer in number in the less well drained soils, and almost entirely absent in waterlogged soils.

Of perhaps equivalent importance in soil formation is the role played by insects living on and in the soil, especially ants and termites. They are responsible for the breaking up of many vegetable fragments, and their incorporation within the soil (See Plates V & VI). They are almost continuously moving soil particles about within the solum and onto the surface, and they probably constitute one of the greatest organic influences in the aeration of the soil. In addition it is of interest to note the role played by crabs in moving soil within and onto the profile. However, as they are restricted to those soils which are tidally flooded, their contribution is of limited significance only.

b) Vegetation

The greater part of South East Pahang (approximately 88%) is still covered with

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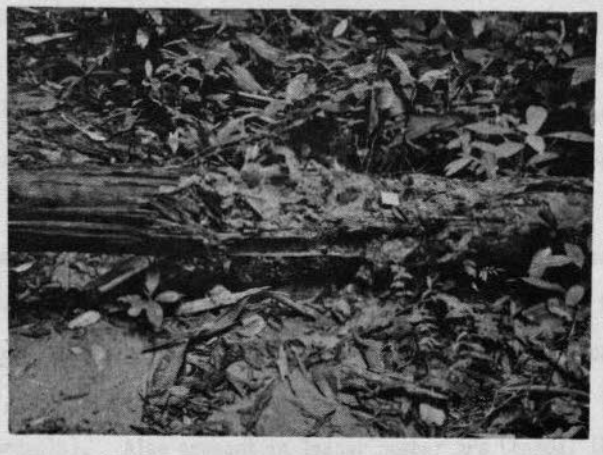

Plate V.

Plate VI. Two stages in the building - up of a humus enriched topsoil as a result of ant activity in decaying timber. Plate V shows the accumulation of soil in a hollow log. Plate VI illustrates the next stage in the process when the log has collapsed and has almost completely rotted away leaving a long semi-circular mound of soil.

primary forests or mature secondary forests. The nature and extent of the various forests has been discussed by Chong (1965) and Lee (1966). They have indicated that Lowland Dipterocarp and Freshwater Alluvial Swamp Forests cover the major part of the region, and that Hill Dipterocarp Forests, Edaphic Hill Forests, Inland Riverine and Seasonal Swamp Forests, Marine Alluvial Swamp Forests and Coastal Forests play only minor roles in the vegetation pattern (Figure 6).

The dominant member of the Lowland Dipterocarp Forests is the Red Meranti - Keruing Forest which is characterised by Meranti melantai (Shorea macroptera), Keruing kerut (Dipterocarpus sublamellatus), Keruing belimbing (D. gradiflorus), Keruing kipas (D. costulatus), Keruing gondol (D. Kerrii), Meranti langong (Shorea lepidota), Meranti kepong (S. ovalis) and Meranti tembaga (S. leprosula). Also present in lesser number are Chengal (Balanocarpus heimii), Balau merah (Shorea collina), Merbau (Instia palembanica), Nemesu (Shorea pauciflora) and Kempas (Koompassia malaccensis), In less well drained areas Keledan (Dryobalanops oblongifolia) and Keledang (Artocarpus lancefolius) appear. In certain areas Keruing or Chengal become dominant and on some lower ridges, especially in the north, Balau kumus hitam (Shorea maxwellliana) and Perah (Elateriospermum tapos) are dominant.

Lee (1966) notes that the forests of the Inland Swamp Basin are variable and range from almost pure Mengkuang (Pandanus atrocarpus) (indicative of sandy horizons at shallow depth below the peat) through forests of Kelat (Eugenia sp.), Nyatoh ketiau (Ganua motlevana), Mempisang (Annonoceae) with scattered larger trees of Kempas, Terentong simpoh (Campnosperma macrophylla) and Durian (Durio spp.), to higher forests of Pulai basong (Alstonia spathulata), Durian and Kempas with occasional Meranti paya (Shorea platycarpa) and Geronggang (Cratoxylon spp.). The swampy areas in smaller valleys inland, and adjacent to larger rivers, designated as Inland Riverine and Seasonal Swamp Forests, are characterised by an upper storey containing Merbau and Keruing gombang (Dipterocarpus cornutus), above the smaller Kelat (Eugenia spp.), Nyatoh (Sepotaceae) and Bintangor (Calophyllum spp.), and with Mengkuang, Rassau (Pandanus helicopus) and Kelubi (Zalacca conferta) as an understorey (Plate VIII).

Above 800 feet above sea level, the Lowland Dipterocarp Forests give way to the Hill Dipterocarp Forests. Balau Forests are similar to the Red Meranti - Keruing Forests but have higher percentages of Balau (Shorea sp.), especially Balau laut (Shorea glauca) and Seraya (S. curtisii). Seraya Ridge Forests, which are found capping sandstone and shale ridges, are characterised by the dominant emergent Seraya (S. curtisii), Kapur Forests, often considered as part of the Lowland Dipterocarp Forests, occur up to 1300 feet and contain, Kapur (Dryobalanops aromatica), Chengal, Balau bukit (Shorea foxworthyi), Balau tembaga (S. elliptica), Keruing sendok (Dipterocarpus concavus) and others. Within the same association are the Edaphic Hill Forests which are found particularly on the rocks of the Gagau Formation (Plate X),

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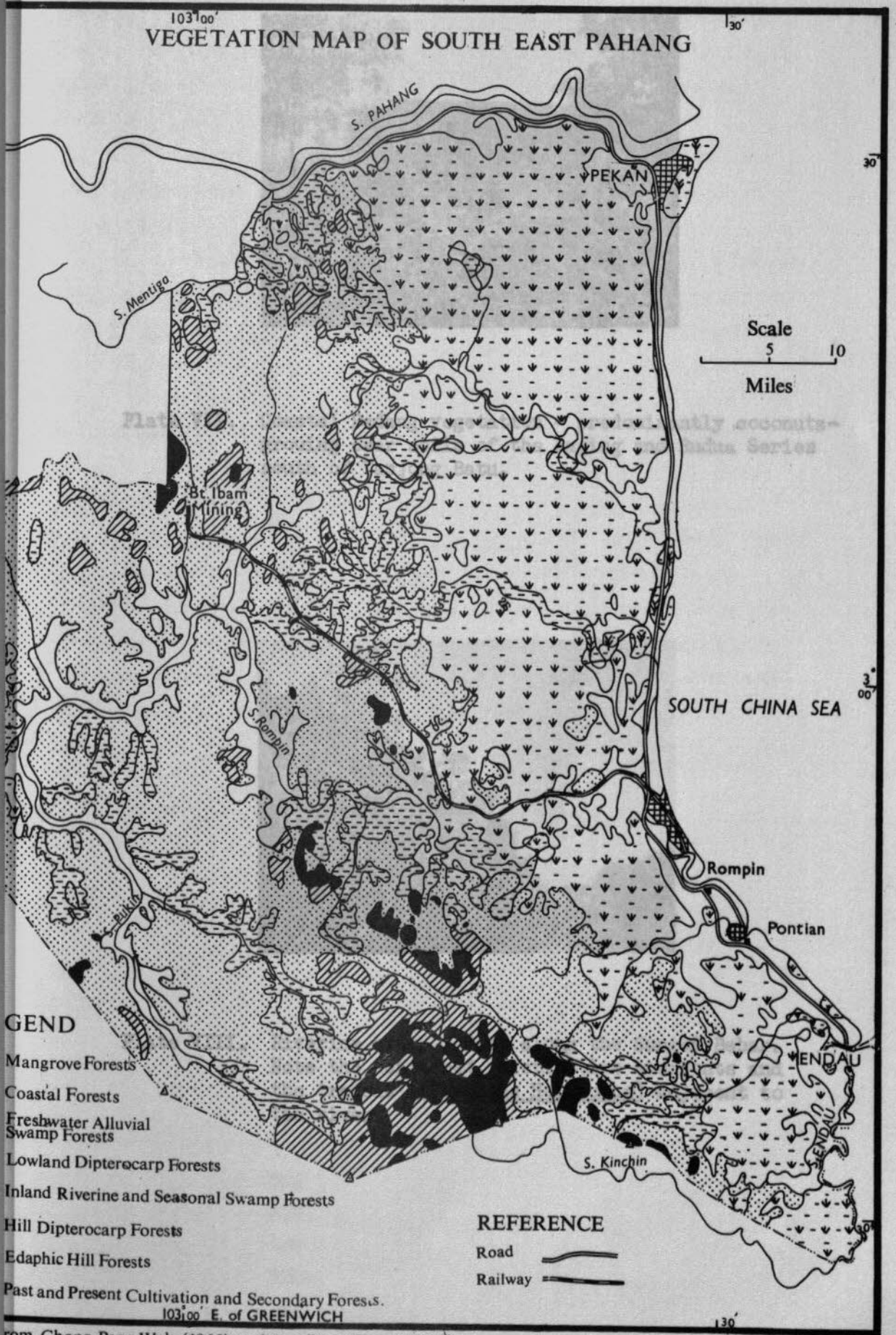
FIGURE 6



rom Chong Peng Wah (1965) and Lee Peng Chong (1966).

Plate VII. Coastal Padang vegetation - predominantly coconuts-growing over soils of the Baging and Rudua Series south of Tanjong Batu.

Plate VIII. Riverine swamp forest along the Sungei Bebar. Note the scattered, distinctive emergents and the 'rassau' (Pandanus Helicopus) adjacent to the river.

The dominant trees are Kelat, Rengas (Anacardiaceae), Kedodong (Bursenaceae) and a stunted Seraya, as well as the Serdang palm (Livistonia tahanensis) which is prevalent in the Lesong Highlands. This assemblage is particularly indicative of very shallow sandy and stony juvenile soils.

The Mangrove Forests (Plate IX), found adjacent to the estuaries of the larger rivers, are characterised by Bakau (Rhizophora spp.), Tumu (Bruguiera, spp.) and Api-api (Avicennia spp.).

True coastal Forests are of very limited extent and are characterised by Casuarine (Casuarina equisetifolia) along the coast and with Balau pasir (Shorea materialis) and Keruing kertas (Dipterocarpus chartaceus) inland. The poorly drained swales between the sandy ridges support Durian and Pulai basong.

Large areas adjacent to the main lines of communication have been cleared and in many cases have been allowed to revert to secondary forests. Adjacent to the coast this makes up the Coastal Padang vegetation and contains Kemunting (Rhodomyrtus spp.), Tembusu (Fragea fragrans), Sendudok (Melastoma malabathricum), Gelam (Melaleuca leucodendron), Resam (Gleichenia linearis) and Lalang (Imperata cylindrica). In addition, coconut (Cocos nucifera) and cashew nut (Anacardium occidentale), are scattered throughout this area (Plate VII). Inland, aborigine shifting cultivation practices have given rise to many areas of secondary forests of varying age. Sendudok, Resam and Lalang are the commonest plants which appear during the early stages of the reversion of these areas to forest. Later appearing forms depend to a large extent on the nature of the surrounding forest.

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Plate IX. An almost pure stand of 'api - api' (Avicennia sp.) on soils of the Kranji Series, in a tidally flooded location at Nenasi.

Plate X. Mesa-like topography formed by the eroded remnants of the Gagau Formation. The capping is a gently dipping quartzite which overlies softer sandstones, grits and conglomerates, which inturn have an unconformable contact with the underlying granites. Photograph shows the western and southern slopes of Gunong Kinchin in the Lesong Forest Highlands.

PART 3

SOIL SURVEY METHODS AND CLASSIFICATION

9. Soil Survey Method

As pointed out by Leamy and Panton (1966), soil surveying under forested conditions is a time consuming process which calls for considerable attention to logistics. To overcome these difficulties it was necessary to travel by Landrover, boat, rail, native dugout, logging truck, helicopter and on foot. Some 575 miles of rentis were cut, across the maximum number of geological and topographical boundaries whilst at the same time it was necessary to bear in mind logistic problems. Rentis2 were generally cut between two and three miles apart in east - west directions and at much greater distances in north south directions (See Traverse Plan on Soils Map). In many places oblique rentis2 were utilised in order to save time and money.

All roads, the Bukit Ibam railway line, most logging tracks and many aborigine tracks were traversed by the Soil Surveyor and Agricultural Assistant. In addition about 25% of the rentis2 were covered by the Soil Surveyor and Agricultural Assistant and boat traverses were made along the Sungei2 Mentiga, Bebar, Rompin (including the Kertong and Jeram) and Endau.

All rentis2 were sampled with a 6 inch post-hole auger at a quarter of a mile intervals, samples from 0-6", 6-12", 12-24" and 24-36" being brought back to the Soil Survey Office for examination. In addition 120 profiles were examined either in pits or cuttings and these formed the basis for the classification of the soils of the region.

All samples brought from the rentis2 were examined and recorded in Field Records along with traverse notes made by Junior Agricultural Assistants and Mandors.

10. Nomenclature

The nomenclature employed in site and profile descriptions is based on the terminology recommended by Leamy and Panton (1966). The terrain classification proposed by Leamy and Panton is peculiar to West Malaysia and is reproduced herein for the convenience of the reader:-

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TABLE 2

SLOPE AND TERRAIN CLASSES

Angle of Slope	Terrain Classes	
	Single Slopes	Complex Slopes
0 - 2°	Level or nearly level, A_1	Level or nearly level, C_1
2 - 6°	Gently sloping, A_2	Undulating, C_2
6 -12°	Strongly sloping, A_3	Rolling, C_3
12 -20°	Moderately steeply sloping A_4	Hilly, C_4
20 -25°	Steeply sloping, A_5	Steep, C_5
Greater than 25°	Very steeply sloping, A_6	Very steep, C_6

The horizon nomenclature employed is also restricted to West Malaysia and is described fully in Leamy and Panton (1966). The terminology employed in the description of roots is taken from Ives (1965, p.25).

11. Soil Classification

The soil classification utilised in this report (Table 3) is based on that proposed by Leamy (1966/2). This classification is an attempt to harmonize the 7th Approximation System (Soil Survey Staff, 1960), as well as some modification (Haantgens, 1965), with Malayan soils and environmental conditions, as outlined in previous classifications of Malayan soils (notably Panton, 1964; Leamy, 1966/1; and Ng, 1966)*.

The broadest scale of sub-division is the 'Soil Order'. Each order is a grouping of soils which have experienced similar kinds and relative strengths of processes responsible for giving the soil body its horizons and properties. Orders have been divided into Sub-Orders, that have the greatest genetic similarities. Sub-Orders in turn are separated into Great Soil Groups. At this level considerable attention has been paid to the morphology of the soils and divisions are broadly based on the presence or absence ofdiagnostic horizons. At this stage, the Malayan Classification deviates from the 7th Approximation with the application of colour ranges, in the names of almost all Soil Groups (e.g. Red Brown Oxisols). Subgroups have been established to illustrate the central concept of each Group and the variations within it. Subgroups have not been shown on Table 3 or used in the discussion of the Soils of South East Pahang. Subgroups are divided further into Families which embrace Series having similar parent materials, a similar arrangement of genetic horizons within the soil profile and similar mineralogy.

*The amendments to the 7th Approximation have not been used in this report.

TABLE 3 STRUCTURE OF THE TECHNICAL CLASSIFICATION OF THE SOILS OF SOUTH EAST PAHANG

ORDER	SUB-ORDER	GREAT SOIL GROUP	FAMILY	SERIES
OXISOLS	ARGOX	RED BROWN OXISOLS (NORMARGOX)	KAMPONG	Jerangau
			KOLAM	Katong
			JEMPOL	Jempol
				Jeram
			MUNCHONG	Munchong
	ACROX	YELLOW RED OXISOLS (NORMACROX)	SEGAMAT	Segamat
	PETROX	CONCRETIONARY OXISOLS (NORMIPETROX)	MALACCA	Malacca
			TAVY	Tavy
ULTISOLS	UDULT	RED YELLOW ULTISOLS (TROPUDULT)	RENGAM	Rengam
			SERDANG	Serdang
				Kedah
			HARIMAU	Harimau
				Tampoi
				Kawang
		YELLOW GREY ULTISOLS (PLINTHUDULTS)	DURIAN	Durian
				Bungor
			KULAI	Kuala Brang
				Penyabong
			BATU ANAM	Batu Anam
				Marang
	AQUULT	LIGHT GREY ULTISOLS (TROPAQUULT)	RUSILA	Rusila
SPODOSOLS	HUMOD	PODZOLS (TROPHUMOD)	RUDUA	Rudua
ENTISOLS	UDENT	BROWN ENTISOLS (HAPLUDENT)	TELEMONG	Telemong
			BAGING	Baging
				Rompin
	AQUENT	BROWN GREY ENTISOLS (HAPLAQUENT)	BRIAH	Briah
				Akob
			SEROK	Serok
		DARK GREY ENTISOLS (HYDRAQUENT)	KRANJI	Kranji
				Linau
	ACRENT	GREY YELLOW ENTISOLS (NORMACRENT)	RASAU	Rasau
			HOLYROOD	Holyrood
			BUKIT TUKU	Lunas
HISTOSOLS		ORGANIC SOILS	PEAT	
			ORGANIC CLAY & MUCK	

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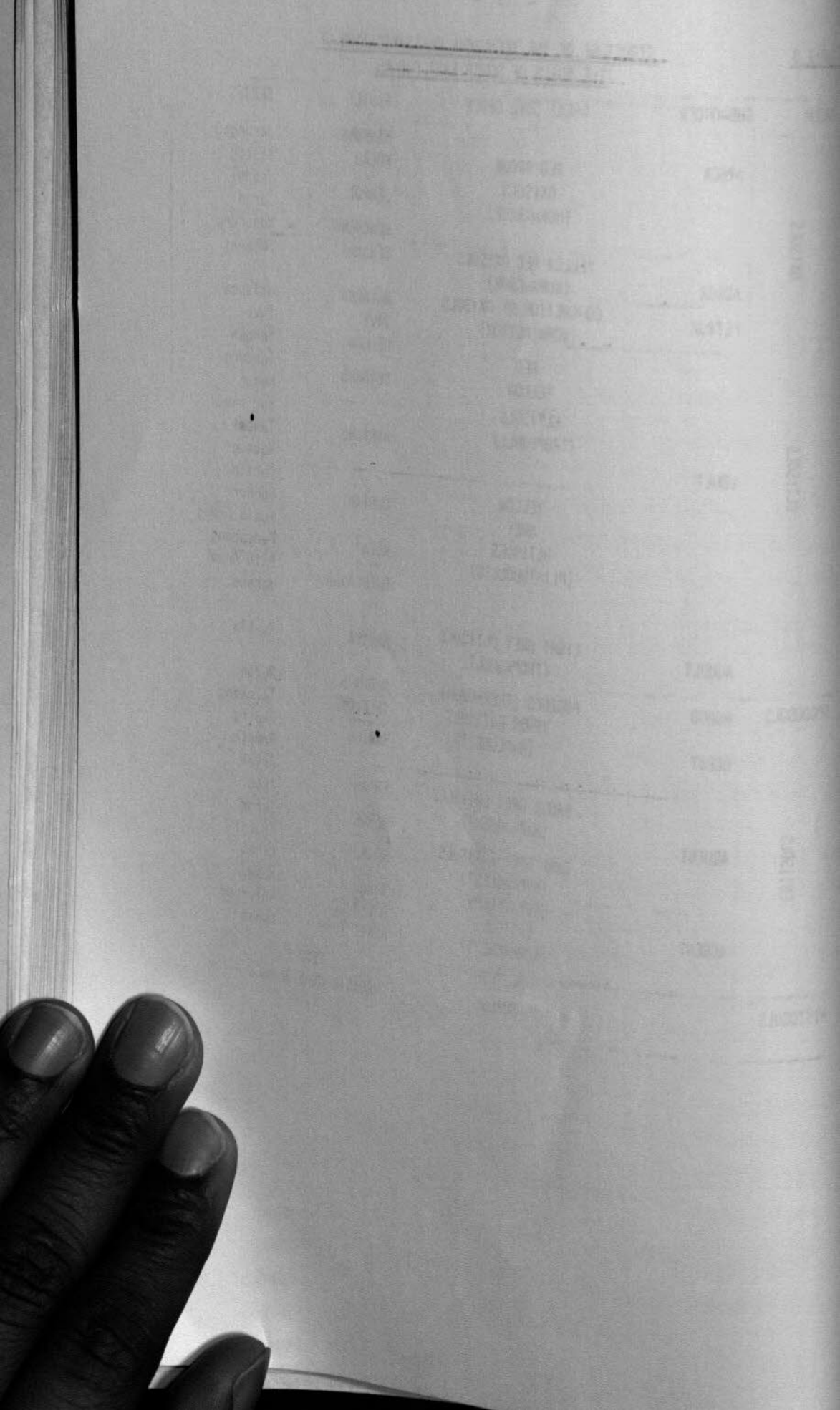

Classification units then, may be considered as convenient pigeon holes for grouping similar soils at various levels. Such groupings are essential before broad generalisations may be made regarding soil formation and utilisation potential. The most convenient units are the Great Soil Groups which are used in the production of regional soil maps; and the Soil Family. From the point of view of the soil user, Series grouped into a single Soil Family are envisaged to have similar potential for agricultural development, and, under cultivation, react in a similar fah on.

12. Mapping

The basic unit of soil mapping and soil classification used in Malaya is the soil series, which is defined as:-

"A grouping of soils with similar profiles, similar temperature and moisture regimes, and the same or very similar parent material" (Leamy and Panton, 1966). Wherever possible individual series were separated. Where, due to the small local occurrence of series, it was impractical to map at this level, the series have been grouped into Soil Families. While the Soil Family (Leamy 1966/2 p. 9) is strictly a classification unit, it was felt that the utilisation of this grouping as a mapping criterion would have a greater practical application in respect of soil suitability and large scale regional mapping, than the geographic grouping, the 'soil association' (Leamy and Panton 1966 p. 66) which has been utilised in previous reports.

Additional, convenient groupings, designated as 'miscellaneous land units' were utilised to show distinct landscape types generally of low agronomic potential, and at the scale of mapping, impractical to subdivide into individual families.

All auger profiles from rentis2 were recorded on clip cards. These cards were then sorted in accordance with the established classification of Leamy (1966/2). Rentis2 and traverses were plotted on a two inch to one mile (approximately) photostat enlargement of a 'new series' one inch to one mile sheet, or on a 1:25,000 'new series' sheet and the appropriate identification marked for each site. Soil boundaries were marked in on each rentis and traverse line and were then extrapolated in the inter-rentis areas on a landform/vegetation/geology basis. These extrapolated boundaries were then compared with air photographs and were relocated if necessary. The base maps were then reduced, by the use of an Saltzman projector to a scale of four miles to one inch. This map was rechecked against existing data from this and adjacent regions before final printing at four miles to one inch.

It is felt that the accuracy achieved by this method is sufficient to place boundaries along rentis2 and traverses to within less than 1/8 of a mile and in the inter-rentis and inter-traverse areas to $\frac{1}{4}$ mile, a level of accuracy acceptable at the scale of mapping.

It will be apparent, that, while it has been possible to delimit and map Soil

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Families and in certain cases to indicate the extent of individual series it has been found convenient to generalise in some areas. In this respect, while an area may be indicated on the Soil Map as a specific family, related soils may occur in a few places within that area. In particular, narrow strips of recent alluvia on the floors of small valleys give rise to areas of soil which are too small to be shown on the Soil Map as 'Minor Valley Alluvial Soils' and consequently are incorporated with the adjacent soils. Table 4 shows the mapping units, the major soils which may be encountered within each unit, and the associated soils of minor importance, usually occupying less than 10% of the area mapped which may also be encountered. On the Soil Map each unit is indicated by a colour and a number e.g. for the Durian Family - 10. Where one particular series within a Family tends to dominate in a certain area, its presence is indicated by a small letter, e.g. 10b - meaning that within an area of Durian Family soils, while all members of the Family may be encountered the soils of the Bungor series tend to dominate.

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TABLE 4 TABLE SHOWING MAPPING UNITS (FAMILIES) EMPLOYED, AREA OF EACH AND SERIES CONSTITUTING EACH UNIT

FAMILY/UNIT	SYMBOL	SERIES	SYMBOL	OTHER SERIES INCLUDED*
Kampong Kolam	1	Jerangau		Segamat
		Katong		
		Jempol	2a	
Jempol	2	Jeram	2b	Munchong, Durian
Munchong	3	Munchong		Jeram, Serdang, Bungor
Segamat	4	Segamat		Katong
Malacca	5	Malacca		Tavy
Tavy	6	Tavy		Serdang, Bungor
Rengam	7	Rengam		Harimau, Family
		Serdang	8a	
Serdang	8	Kedah	8b	Tavy, Bungor
		Harimau		
Harimau	9	Tampoi		Rengam
		Kawang		
		Durian		
Durian	10	Bungor	10b	Serdang, Tavy and
		Kuala Brang		Batu Anam
Kulai	11	Penyabong		
		Batu Anam	12a	
Batu Anam	12	Marang	12b	Durian
Rusila	13	Rusila		Linau
Rudua	14	Rudua		Rusila, Baging
Telemong	15	Telemong		Akob
		Baging	16a	Rudua
Baging	16	Rompin	16b	
Briah	17	Briah		Organic Clay and Muck
		Akob		and Telemong
Serok	18	Serok		Minor Valley Alluvium, Akob
		Kranji		
Kranji	19	Linau		Rusila
Rasau	20	Rasau		Holyrood
Holyrood	21	Holyrood		Rasau, Lunas
Bukit Tuku	22	Lunas		Holyrood
Peat	23			Organic Clay and Muck
Organic Clay and Muck	24			Briah
Minor Valley Alluvium	25			Telemong and Akob
Steepland	26			Varies
Disturbed Land	27			

*These soils may or may not be present, but if they do occur they do not occupy more than 10% at the whole.

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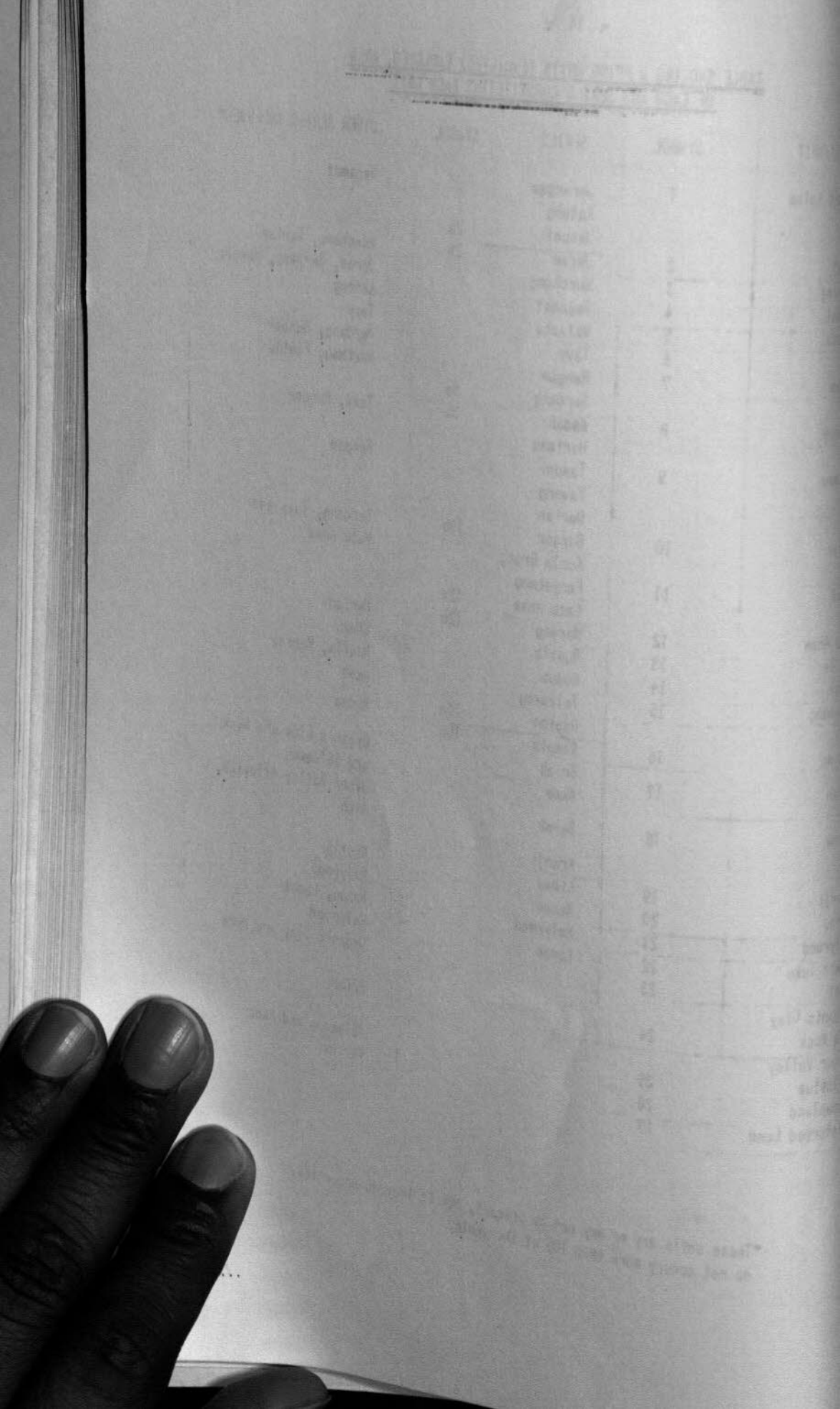

PART 4

DESCRIPTION OF THE SOILS

13. RED BROWN OXISOLS (NORMARGOX)

Previously called 'reddish brown laterite soils', these soils have a moderately well expressed oxic horizon overlain by a weakly formed eluvial A horizon. Consistence is generally friable throughout the A and B horizons and colours are of 7.5YR hue or redder. Clay content in the oxic horizon should be between 45% and 75% and total Fe_2O_3 (soluble in 6N HCl) between 2.5% and 11%. They normally have few to many pores, only weakly expressed clayskins and horizons boundaries are diffuse to indistinct.

Kampong Kolam Family

The soils of this Family have moderately deep or deep profiles, which are friable and well structured throughout. Soil colours are 7.5YR hue or redder. They are developed over igneous rocks of intermediate composition and consequently are relatively rich n plant nutrients. Despite moderately high levels of iron, indurated plinthite concretions are rarely encountered. These soils are generally found over undulating or rolling terrain in the west centre, and south west of the region, and they may be considered as suitable for a wide range of crops. Where individual slopes exceed about 14^{0} care should be exercised in their cultivation due to their moderately high susceptibility to erosion in steeper regions. Two series belonging to this Family have been located in the South East Pahang region.

Jerangau Series

The soils of this series occur over rolling to hilly terrain in localised areas only, mostly in the west in the Sungei Tepeso - Sungei Aur, Sungei Keratong and Sungei Jeram areas. They are formed over igneous rocks of acid-intermediate composition, predominantly diorites and granodiorites, and are characterised by very little colour and textural differentiation between the A and B horizons, and with an oxic horizon in the position of a B horizon below 9 to 12 inches.

A thin humus enriched brown clay loam topsoil is normally underlain by a transitional horizon of about 6 to 10 inches thickness. This transitional horizon passes into a yellowish red to strong brown oxic horizon (Leamy 1966/2 p. 10 - 21) which exhibits, clay texture, friable consistence and moderately to a strongly developed, medium, fine and very fine subangular blocky structures. Clayskins are relatively common in this horizon being located on some ped faces and as pore linings, and fine angular quartz grains are usually present. Below three feet, this horizon often gives way to a weakly structured clay containing some nodular indurated plinthite gravels. The depth and occurrence of this horizon varies with site and aspect. Roots are well distributed throughout the upper three feet of this soil and the even distribution of pores and channels allows for good

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internal drainage and maximum aeration.

These soils, are generally considered to be amongst those with relatively better nutrient status of Malayan sedentary soils. They have been cultivated in oil palm and cacao in other areas and consequently may be considered as being suitable for a wide range of tree crops. In some areas, the steepness of the terrain may be a minor limitation, but due to its rapid internal drainage, erosion is not considered as a major limitation in the steeper regions.

Katong Series

This soil, which occurs over undulating and rolling terrain near the Pahang-Johore border in the south west corner of the region, is found to overlie igneous rocks of intermediate composition, often containing an abundance of free quartz. They are characterised by a more distinct eluvial horizon than is shown by the Jerangau series, over an oxic horizon.

In general, a thin, brown, humus enriched, clay loam overlies a strong brown to dark yellowish brown eluvial clay loam to clay horizon which has friable consistence and moderately developed fine and medium granular structures and extends to below three feet. There is good rooting to about this depth and pores are common. Clayskins, however, are only weakly expressed. The oxic horizon passes into a yellowish red or reddish brown, weakly structured, firm clay which usually contains decomposing fragments of the parent rock.

This is a younger soil than the Jerangau series and usually contains higher nutrient levels, especially of potassium and magnesium. Due to the relative abundance of nutrients, its friability and moderately strong structures, as well as its occurrence in areas of easy rolling country, this soil may be considered as being suitable for a wide range of tree crops, including oil palm.

Jempol Family

In the South East Pahang region the soils of this Family almost invariably present shallow profiles which are seldom more than three feet in depth. The other unifying factor of this Family is that the members display colours of 5YR hue or redder. They have friable, eluvial A horizons over firm illuvial B horizons. The oxic horizon is in the position of a B horizon but it is not a particularly good oxic horizon when compared with the other members of the Oxisol Order. Due to their occurrence over strongly rolling and hilly terrain and their consequently shallow profiles, they are more suited to crops with a wide range of soil tolerance. Two series have been located within this Family.

Jempol Series

Soils of the Jempol series occur over quartz and sandstone pebble conglomerates with a tuffaceous shaley matrix. They are confined to moderately steep sided discontinuous ridges, especially in the northern and central portions of the region. These soils are

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characterised by yellowish red and reddish brown colours and sandy clay loam and fine sandy clay loam textures.

A thin, humus enriched eluvial horizon, showing reddish brown colours, sandy clay loam texture, very friable consistence and moderately developed fine subangular blocky and crumb structures overlies a reddish brown or yellowish red illuvial horizon. This latter horizon may vary in texture from a fine sandy clay loam to a clay, generally of friable to firm consistence, and exhibiting only weakly to moderately developed subangular blocky structure. These two diagnostic horizons are usually separated by up to 12 inches of transitional horizon, normally designated as either on AB or a juvenile B horizon. Normally, this soil becomes increasingly stony, with angular fragments of shale, rounded quartz stones from weathering conglomerate and nodular indurated plinthite gravel, below 30 or 36 inches. Clayskins are moderately developed in the B horizon. Roots are seldom found below 24 inches.

The Jempol series contains an average supply of nutrients by Malayan standards. The moderate to moderately heavy textures, friable consistence and moderately developed fine structures are conducive to its use for a wide range of tree crops. However, due to the occurrence of this soil on moderately steep and steep topography, and the general shallowness of the solum, it is better to treat it with caution. Consequently it has been relegated to Class 3 in the Soil Suitability Classification.

Jeram Series

These soils occur over red (iron rich) shales in rolling, hilly and steep terrain. They are scattered throughout the northern and central portions of the region but are most extensive in the region of the Sungei Jeram. They are characterised by reddish brown or red colours, firm consistence and stony subsoils. They exhibit a weak eluvial A/illuvial B sequence, but show prominent B horizon clayskin development.

Soils of the Jeram series have a humus enriched, reddish brown, friable, clay loam topsoil, overlying a transitional layer to a distinct illuvial B horizon. This latter horizon is a reddish brown or red clay, having firm consistence and moderate to strongly developed coarse, medium and fine subangular blocky structures. Clayskins are well developed, but few roots penetrate this horizon, Angular fragments of red shales, often with an iron impregnated crust appear below 24 inches and rapidly increase in number with depth.

In general, by Malayan standards, nutrients levels in this soil are below average. In a few areas of limited extent, this soil may prove suitable for a more specialised crop, such as oil palm, but, in most areas, because of the hilly nature of the terrain, their shallow depth and firm subsoil, they should be cultivated with crops having a wide range of tolerance.

Munchong Family

Developed over shales with a high iron content, the soils of this Family are

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characterised by strong brown or reddish yellow colours of 7.5YR hue, clay textures, friable consistences and moderately or strongly developed fine structures. In some places weakly developed plinthite may be encountered at depth, and indurated plinthite, in non-compacted layers is sometimes present. These soils, which intergrade to the Ultisols, usually have a more distinct eluvial A/illuvial B sequence than that found in the other Oxisols. Only one series within this Family has been located in South East Pahang. These soils are suitable for a wide range of tree crops including oil palm.

Munchong Series

This soil occurs over a variety of slopes ranging from gently sloping to moderately steep, but usually over rolling terrain. It is sporadic in occurrence, occupying small areas in many parts of the region and is generally associated with either the Bungor or Serdang series. It is characterised by moderately developed fine structures, friable consistence, strong brown colour and very fine sandy clay loam texture, and is normally found to overlie shales containing gritty bands of fine arenaceous material.

Topsoils vary from dark yellowish brown to light yellowish brown in colour, depending upon the amount of incorporated humus. This horizon has a fine sandy clay loam texture, very friable consistence and moderately to strongly developed fine crumb and subangular blocky structures. Below 12 inches the topsoil merges into a deep B horizon which has strong brown colour; becoming yellowih red with depth; very fine sandy clay loam, silty clay loam or clsy textures, friable consistence and moderately developed fine crumb and subangular blocky structures.

A thin fragmental indurated plinthite layer may be present between 30 and 36 inches, but parent rock rarely appears below a depth of four feet.

Unfortunately, due to the rather sporadic occurrence of this soil, it was not sampled and so analytical data from this region are not available*. However, in adjacent regions, (Dumanski & Ooi 1967, Nul et al 1965), these soils have been found to be suitable for a wide range of tree crops, especially oil palm. Where they occur on terrain with slopes in excess of 14^{0}, care should be exercised, since such friable and loosely structured soils as these will present an erosion problem.

14. YELLOW RED OXISOLS (NORMACROX)

These soils are characterised by deep uniform profiles with colours of 5YR and 2.5YR hue. Textures are usually clays, (invariably greater than 70% clay) and they have friable and very friable consistences, abundant pores and strongly developed fine fitting and non-fitting aggregates. Dumanski & Ooi note that acid soluble Fe_2O_3 (6N HCl) is usually present in quantities greater than 18% of total sample. One Family has been recognised in

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*Analysis data from another region are included in Appendix A.

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this Group.

Segamat Family

Developed over volcanic rocks of intermediate composition, the soils of this Family are amongst the most fertile sedentary soils in Malaya. They are deep, strongly structured, friable, clays with colours usually of 5YR hue. They have excellent potential for most tree crops demanding high nutrient levels. Unfortunately, they are restricted to a very small area in the south west of the region, but as this is continuous with areas in North Johore (Smallwood pers. com.) and the Temerloh - Gemas Region the development of these areas should be accorded high priority. Only one series has been located in this Family during the present survey.

Segamat Series

This soil occurs in undulating to hilly terrain over andesites. It has an oxic horizon which underlies an eluvial A horizon, usually below about 12 inches depth.

Colours are uniformly yellowish red in the eluvial horizon, and yellowish red or red in the underlying oxic horizon. The topsoil ranges between clay loam and clay in texture while the subsoil is invariably a clay. Consistence is very friable near the surface gradually becoming firm and very firm with depth, but throughout, the peds have friable consistence. Structures are moderately or strongly developed throughout and are usually fine or medium subangular blocky in nature, modified to some extent by fine crumb and granular structures in the eluvial horizon. Clayskins are not distinct, and there is good root penetration to below three feet. Usually, in this region, a non-compacted layer of nodular indurated plinthite gravels is present below three feet and with depth this merges into weathering andesite.

Nutrient levels, by Malayan standards, are relatively high for a sedentary soil. The generally friable nature of this soil and its occurrence over areas of easy topography make it suitable for a wide range of tree crops, including oil palm.

15. CONCRETIONARY OXISOLS (NORMIPETROX)

Formed over arenaceous and argillaceous sediments, these soils are found to occupy the highest positions on ridges and hills, indicating the presence of an old peneplain or erosion surface which has been moderately to strongly dissected, if not completely eroded, during the present cycle. They are characterised by the presence of a petric horizon (Leamy 1966/2 p. 10) which occurs within 36 inches of the surface and which is invariably underlain by non hardened plinthite in the form of a compacted mottled clay. Two families occur within this Group.

Malacca Family

The chief factor in the identification and characterisation of this Family is the occurrence of the petric horizon, within 24 inches of the surface, which is of greater

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than 36 inches thickness. In many areas, especially in Malacca, the soils of this Family support economic stands of rubber, and Dumanski & Ooi have noted that even oil palm has been successfully cultivated in some places. It is almost definitely evident that the current suitability assessment of these soils needs re-investigation, but until something concrete is available it would be advisable to restrict such soils to the more tolerant crops.

During the South East Pahang Survey only one series, the Malacca series, was located; however, considerable variation from the central concept of this series was encountered. In effect, future detailed surveys will probably be able to separate massive indurated plinthite and fragmental indurated plinthite phases and strong brown (similar to the Gajah Mati series of Kedah - Joseph 1966), and yellowish red variants within this series.

Malacca Series

This is the most widespread soil in South East Pahang. It is found to overlie a variety of sedimentary rock types, but occurs chiefly on shales, quartzites and sandstones. It is almost invariably found on the more level tops of ridges and hills in rolling, and hilly terrain, although it is not uncommon to find a colluvial variant in low lying locations. The true parent material of this soil is either the petric horizon which invariably occurs within 24 inches of the surface or the underlying non hardened plinthite.

The topsoil is a humus enriched eluvial A horizon with yellowish brown colour, clay loam to sandy clay loam textures, friable consistence and moderately developed fine structures. This overlies a thin weakly expressed oxic horizon with yellowish brown or strong brown colour, sandy clay loam to clay textures, friable to firm consistence and weakly to moderately developed subangular blocky structure. A petric horizon of either, broken massive, or fragmental indurated plinthite occurs within 24 inches of the surface; often within 12 inches; and is invariably thicker than three feet. It has either strong brown or reddish yellow colour, has clay or sandy clay textures of the fine earth fraction and is either slightly or moderately compacted. This horizon is underlain by plinthite (mottled clay), which is variegated in yellow or white and red, has clay texture and is moderately or strongly compacted. This latter horizon gradually merges into the underlying weathered rock.

Despite moderate levels of nutrients, the shallowness of the soil overlying the petric horizon and the semi-compact nature of that horizon, are serious limitations to cultivation. In many parts of Malaya rubber has been extensively cultivated on these soils. However a sensible and use policy would be to develop these soils in strong rooting crops, such as rubber, and then, only after more suitable soils had been developed.

Tavy Family

Similar to the Malacca Family in basic morphology, the Tavy Family usually has a greater depth of solum (2 - 3 feet) over the top of a thinner (less than 3 feet in thickness)

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petric horizon, which is almost invariably, completely fragmental indurated plinthite. Generally, the soils of this Family tend towards the Ultisols in general morphology and this is borne out by the presence of a rather distinct illuvial B horizon. The soils of this Family may prove suitable for a wide range of tree crops but until more information on them is available, it may be advisable to limit this Family to the more tolerant crops. One series has been located within this Family during this survey.

Tavy Series

Soils of the Tavy series are of sporadic occurrence in South East Pahang and are found mainly in the northern and western parts of the region, although minor occurrences have been found in association with Malacca and Bungor series. They are formed over interbedded shales and sandstones in undulating to rolling terrain. They have a distinct petric horizon normally below 24 inches.

The surface soil is usually a yellowish brown or brownish yellow, sandy clay loam with friable consistence and moderately developed crumb and subangular blocky structures. This overlies a strong brown, or reddish yellow sandy clay loam to clay textured horizon with friable consistence and moderate to weakly developed subangular blocky structure. A petric horizon of thickness varying between 6 and 24 inches occurs below 2 foot depth in the profile and is composed of fragmental indurated plinthite. This horizon in turn overlies, non hardened plinthite, similar to that described for the Malacca series. This latter horizon passing into weathered parent rock between 4 and 8 foot depth. Clayskins are moderately distinct in the B and underlying horizons. Roots seldom penetrate the petric horizon.

Nutrient levels are generally lower than those encountered in the other Oxisols, although, the easily soluble phosphorus level is much higher than that normally encountered in soils developed over sedimentary rocks. While Smallwood (1965 p. 14) has noted that a large area of these soils in North Johore have been developed in oil palm, they should be treated with caution because of the existence of the semi-compact petric horizon at relatively shallow depth.

16. RED YELLOW ULTISOLS (TROPUDULT)

In soils of this Group, as with all Ultisols, the key factors differentiating them from the Oxisols, are "... the presence of an argillic horizon, and the absence of a petric horizon, together with the presence of non-hardened plinthite ..." (Leamy 1966/2, p. 18). In this particular case, these soils have a distinct argillic horizon which is generally separated from the overlying eluvial A horizon; or in some cases albic horizon, by an abrupt textural change. A thin band of fragmental plinthite may be present at the base of the argillic horizon. Colours of the argillic horizon range between yellowish brown and reddish yellow.

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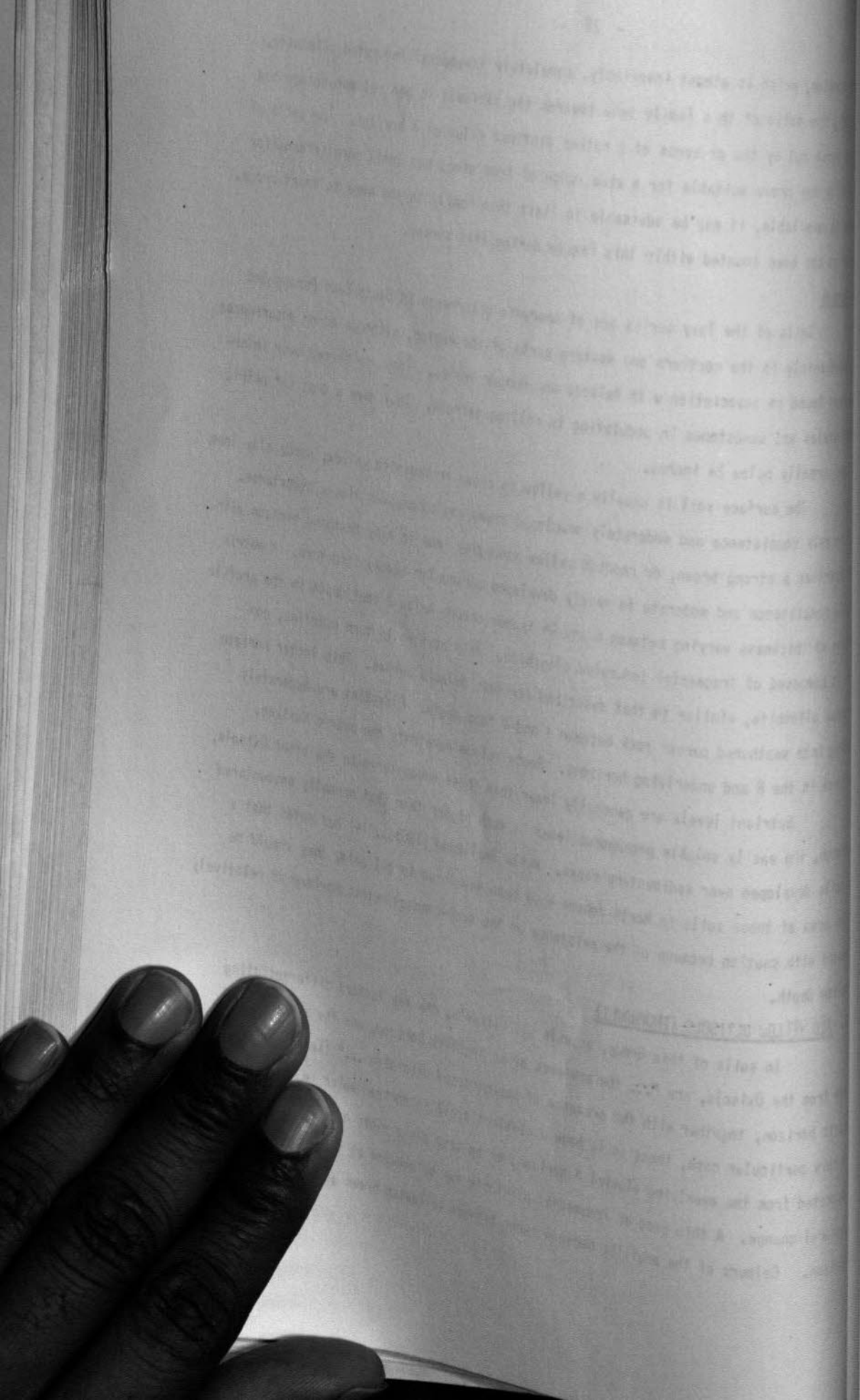

Consistences are friable, becoming firmer with depth, pores are few and structures are only weakly to moderately weakly developed. Three Families are recognised within this Group.

Rengam Family

Formed on acid igneous rocks of plutonic origin, the soils of this series exhibit sandy clay loam to sandy clay textures with an abrupt textural change between the eluvial A horizon and argillic B horizon. Colours gradually become redder with depth, giving way eventually to non-hardened plinthite. Their friable to firm consistences and great depth of solum make these soils suitable for a wide range of tree crops. Although only one series has been located within this Family, locally, small occurrences of the stony Bukit Temiang series may be encountered on steeper terrain.

Rengam Series

One of the most widespread soils in West Malaysia, the Rengam series is found to occupy an extensive area in the Keratong Basin, as well as smaller areas around Bukit Ridan and east of the Lesong Forest Highlands. It occurs over igneous rocks of granitic composition on undulating to rolling and rarely hilly terrain. It is often associated with the soils of the Harimau Family, which are developed over older alluvium and due to many similarities between these two it is often difficult to determine where the one ends and the other begins.

Colours are generally uniform throughout the profile except for a gradual reddening in hue with depth. There is usually an abrupt textural change between the A and B horizons. The topsoil is generally a yellowish brown or brownish yellow, friable, sandy loam or sandy clay loam with moderately developed subangular blocky structure. This gives way to a brownish yellow to reddish yellow, friable to firm sandy clay loam or sandy clay, with moderately d developed subangular blocky structure and moderately expressed clayskins. This horizon becomes gradually redder with depth, passing through yellowish red to red in colour. Consistences become firm and structural development becomes retrogressively weaker. With depth a horizon of non-hardened plinthite is usually encountered before reaching parent rock. The sand fraction is usually in the medium or coarse sand size range. In low-lying locations, some pale yellow mottles may appear in the subsoil, but normally this is a free draining soil. Similarly in some areas a thin, loosely compacted, band of nodular indurated plinthite may be present. Rooting is good to about four feet.

Nutrient content is considered to be average by Malayan standards. Panton (1958) noted that phosphorus and calcium and possibly magnesium are in short supply (although in South East Pahang, magnesium levels are generally above average for West Malaysian sedentary soils). As would be expected, for a soil derived from acid igneous rocks, potash levels are above average for Malayan soils (Ng, 1965). In other regions of West Malaysia this soil has been

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found to be suitable for a wide range of tree crops, including oil palm, hence, the soils of this series in South East Pahang will have a similar wide range of crop suitability.

Serdang Family

Despite their development over arenaceous rocks (of a predominantly acidic nature) these soils display similar characteristics to those described for the Kengam Family. They are however, usually redder in colour, (7.5YR & 5YR hue), but do display an abrupt textural change between A and B horizons, have moderately weakly developed structures and non-hardened plinthite at depth. Two series are recognised, the Kedah series being a shallow, juvenile equivalent of the Serdang series which occurs on the easier terrain. The nature of the terrain is the chief factor in limiting the use of these soils for a wide range of tree crops.

Serdang Series

This is a deep well developed soil which displays an eluvial A horizon over a weakly developed argillic horizon, generally with a thin transitional horizon between. It is found in rolling and hilly terrain over arenaceous rocks, predominantly sandstones, conglomerates and quartzites. It is normally very well drained, but the sandy textures and loose consistency make it particularly susceptible to erosion after clearing.

The topsoil is generally a yellowish brown, friable, sandy loam or sandy clay loam with weakly to moderately developed crumb and subangular blocky structures. Below 12 - 18 inches this gives way to a friable, strong brown, sandy clay loam or sandy clay, with weakly to moderately developed subangular blocky structure and moderately developed clayskins. With depth this becomes reddish yellow or yellowish red in colour, firmer in consistence and usually of sandy clay texture. Mottles may be present in this horizon but rarely in the argillic horizon. Rooting is well developed to below four feet .

These soils, although considered as suitable for a wide range of tree crops, including oil palm, are of a lower than average nutrient status by local standards, and are especially deficient in potash. As mentioned above, its susceptibility to erosion is another limitation which should not be overlooked.

Kedah Series

Occurring over hilly and steep terrain, these shallow, juvenile soils overlie arenaceous rocks which are predominantly quartzites, sandstones and conglomerate. They are generally associated with either the Serdang series or the Bungor series, but located on steeper slopes than these two soils.

The Kedah series exhibits a weak Ae/Bt sequence, these two horizons normally separated by a transitional horizon. The topsoil is usually a very friable brown, sandy loam, with weakly to moderately developed subangular blocky and crumb structures. Below about 6 inches the soil becomes a friable, brown, sandy clay loam, tending to a sandy clay with depth

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The subangular blocky and crumb structures are only moderate to weakly developed, but clay skins are moderately well expressed. This horizon usually gives way to weathering rock fragments below about 18 inches. Clayskins are only weakly expressed and roots seldom penetrate below two feet. If this soil occurs adjacent to soils of the Malacca Family, fragmental indurated plinthite as creep debris may be present at the base of the B horizon.

Where this soil occurs on moderately steep slopes it may be considered as of Suitability Class 3 and may be utilised for a limited range of tree crops under a high standard of management. On steeper slopes it shallowness and susceptibility to erosion make it suitable for protective forest only.

Harimau Family

Soils of this Family are formed over Older Alluvial deposits of Pleistocene age. Generally a transitional horizon separates the argillic B horizon from an eluvial A horizon. Perhaps the chief morphological differentiating criterion in these soils, is the occurrence of only a narrow, incipient, non-hardened plinthite horizon over the bedded, predominantly quartzose gravels which constitute their parent materials. Chemically, they have lower values of available basic nutrients than the other members of this Group, and are especially lacking in trace elements (Ng, 1966). These low nutrient levels and trace element deficiencies will have to be corrected when crops with a narrow range of tolerance are considered.

Harimau Series

This soil is of widespread occurrence over level to rolling terrain in the south western part of the region. It is developed over older alluvial parent materials of riverine origin. It is characterised by an eluvial A horizon over an argillic horizon; the two usually separated by a transitional horizon of 6 to 10 inches thickness.

The topsoil is a very friable to friable, yellowish brown or brownish yellow, sandy loam or sandy clay loam with weakly to moderately developed subangular blocky and granular structures. A friable yellowish brown or brownish yellow, sandy clay loam transitional horizon passes into a brownish yellow, friable, sandy clay loam with weakly to moderately developed subangular blocky structure and moderately expressed clayskins below about 18 inches. This horizon is normally underlain by a slightly compacted, brownish yellow to reddish yellow, sandy clay loam which in turn overlies rounded quartz gravels and stones at depths greater than six feet. Yellowish red and pale yellow mottles are present throughout the B horizon and are dominant in the underlying horizons. Rare nodular indurated plinthite gravels may be present, but these are almost certainly derived from the parent material.

These soils have been found to be particularly low in most of the major crop nutrients, and also in manganese and are suspected of having other trace element deficiencies.

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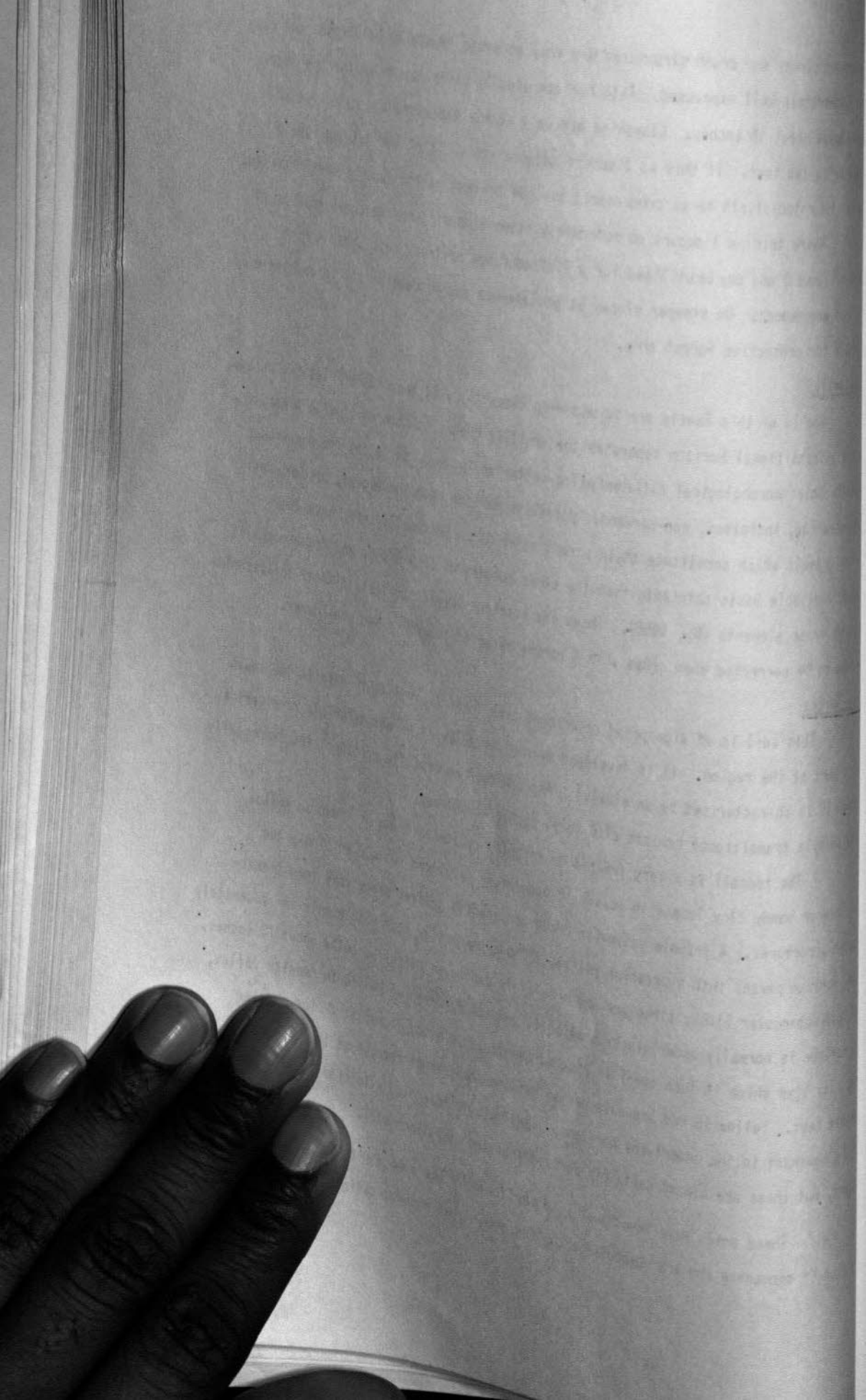

Rubber has been grown on these soils quite extensively in Johore and more recent evidence indicates that with heavy manurial incorporating trace elements as well as soil conservation measures, oil palm can be cultivated successfully on a large scale.

Tampoi Series

This soil occurs on level to gently rolling terrain over older alluvial deposits. It is found mainly in the southern part of the Keratong Basin where it s found in association with the Harimau and Kawang ser es.

A thin, yellowish brown (rarely brownish yellow), humus enriched sandy loam to sandy clay loam, with very friable and friable consistence, and moderate to weakly developed, fine subangular blocky, granular and crumb structures, usually overlies the eluvial horizon wh ch varies from yellowish brown to strong brown in colour, has sandy clay loam to coarse sandy clay loam texture, friable consistence an only moderately weakly developed subangular blocky and granular structures. Below 8 to 12 inches a strong brown to reddish yellow, sandy clay to gravelly clay B horizon appears. This horizon has friable to firm consistence, moderately developed subangular blocky structure and only weakly expressed clayskins. Colours tend to yellowish red with depth and pale yellow, brown and pale brown mottles may appear below about 30 inches. Stones in the form of subangular and rounded quartz gravels, and nodular indurated plinthite gravels may appear below this depth. The soil is freely drained and rooting is only moderately developed.

As with other members of this Family the Tampoi series has a nutrient status which is below average for Malayan soils. In addition, because of definite manganese deficiency and probable other trace elements deficits, this soil should be treated with caution and utilised for crops with a wide range of soil tolerance and known to succeed until agronomic field trials indicate otherwise.

Kawang Series

The Kawang series, almost similar to the Harimau series in morphology, has coarser textures and usually a shallower profile. This soil is also found over old riverine alluvial deposits, on level to rolling terrain.

The topsoil, constituting an eluvial A horizon is a light yellowish brown to pale yellow coarse sandy loam with friable consistence and weakly to moderately developed subangular blocky structure. A transitional horizon of between 6 and 10 inches thickness separates the A horizon from a weakly expressed argillic horizon. This latter horizon is a firm, brownish yellow, coarse sandy clay with weakly developed subangular blocky structure and weakly expressed clayskins. This horizon becomes very firm and almost massive with depth before passing abruptly into a reddish yellow stony clay containing abundant rounded quartz gravels and stones and rare indurated plinthite gravels at between three and four feet

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depth. Common red, pale yellow and white mottles are almost invariably present in the B horizon. Root penetration seldom exceeds two feet (Plate XI).

As is the case with the Harimau series, this soil is usually very low in all of the major nutrients and almost definitely suffering from trace element deficiencies. For this reason it should be restricted to crops with a wide range of soil tolerance, until agronomic trials indicate a potentiality for a wider range of crops.

17. YELLOW GREY ULTISOLS (PLINTHUDULTS)

Members of this group are characterised by non-hardened plinthite (variegated clay) which forms a continuous phase within 48 inches of the surface. They have a textural B horizon which satisfies the definition of an argillic horizon. Leamy (1966/2) notes that this horizon is normally overlain by an albic horizon but this is not the usual case in South East Pahang, although an abrupt textural change between the argillic and overlying eluvial A horizon is commonly observable. Dominant subsoil colours range from yellow through brownish yellow to light grey. Clay content is usually greater than 40% but never higher than 80%; consistences are firm and structures are moderately developed, often showing prismatic shape in long exposed cuttings and pits. A thin concretionary horizon of indurated plinthite, often with intermingled angular quartz stones, is commonly present between the argillic horizon and the underlying non-hardened plinthite.

Although soils of the Kulai, Durian, Pohoi and Batu Anam Families have been recognised during the present surveys only the Durian Families and Batu Anam are of any extent. Pohoi Family soils are of only minor, occurrence, and are neither described nor shown on the soil map.

Kulai Family

Developed over rocks of acid igneous composition, these soils show minimal profile development in the South East Pahang region. Three series within this Family, the Kulai, Tampin and Penyabong series were located but all proved to be of extremely restricted extent. Soils of the Kulai series were found to occur in a small area in the southern part of the Keratong Basin where they were characterised by steep slopes and have consequently been mapped as Steepland. Tampin series soils occur as small patches within the areas shown as Rengam Family, but their total extent is so small that they have not been considered significant enough to be mapped or described separately. The Penyabong series is confined to isolated patches on the eastern margin of the region and on the outlying islands and these soils have proved to be highly stony, shallow and juvenile, and, as such, coupled with their occurrence in areas of steeper terrain, are considered unsuitable for agricultural development.

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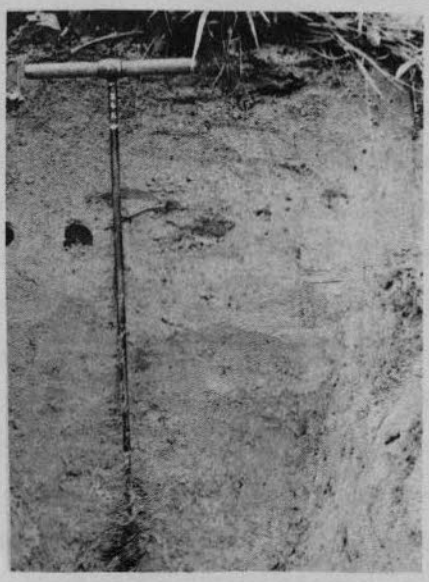

Plat XI. Kawang Series (Harimau Family)-a Red Yellow Ultisol. Subsoil textures are commonly coarse sandy clay loams with rounded quartz gravels appearing below 36".

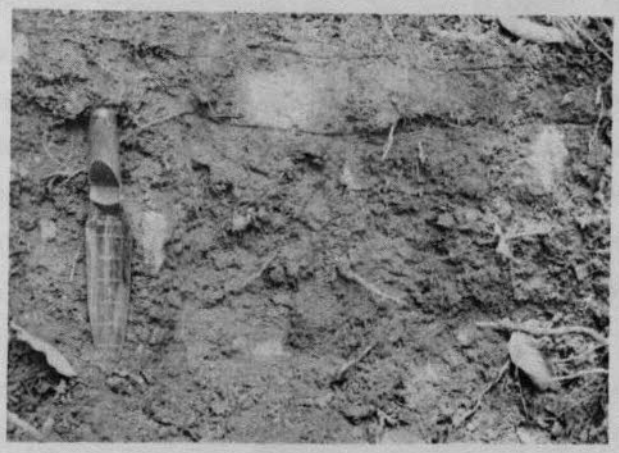

Plate XII. PenyabongSeries (Shallow Phase)- a Yellow Grey Ultisol Which is a member of the Kulai Family.

Penyabong Series (Shallow Phase)

This is a new soil series which was first located in the North Johore region (Smallwood pers. comm.). In South East Pahang it occurs on the outlying islands of Pulau2* Tioman, Sri Buat and Acheh; and over hilly and steep terrain in minor valleys of the eastern and southern parts of the 'Lesong Forest Highlands'. Generally, these soils, which are derived from lithic tuffs or rhyolitic composition, occur above the 'steepland boundary'.

This is a juvenile soil and displays and AC profile with a weakly developed Ae horizon within the surface six inches. The topsoil is a friable, brown, clay loam with moderate to strongly developed very fine subangular blocky, fine crumb and fine granular structures, Rare angular gravel and stones are usually present towards the base of this horizon, and may be coated with thin illuviation cutans. This horizon is underlain by a stony, friable to firm, brown clay loam with moderate, fine subangular blocky and granular structures. The stones increase in number rapidly with depth and give way to solid rock below 12 to 18 inches (Plate XII).

The shallowness of these soils, the steepness of the slopes over which they occur and their susceptibility to severe erosion, make them totally unsuitable for cultivation and are best left in protective forests, or utilised as road metal quarries (e.g. as at Tanjong Batu).

Durian Family

Developed over mixed argillaceous and arenaceous sedimentary rocks, these soils are widely distributed throughout the region. They have an argillic horizon, overlain by an eluvial A horizon. An abrupt textural change may or may not separate the two. They are characterised by a moderately or weakly developed non-hardened plinthite horizon within 48 inches of the surface and may have a distinct stoneline of angular quartz stones and nodular indurated plinthite just above this horizon. Subsoil consistence is usually firm and may present, at least, a minor impediment to root development. Of the three members of this Family, the Bungor series is considered to have the highest agronomic potential, and may actually be considered, on easy terrain, to have a suitability rating of at least Class 2. Current investigations have revealed that the Bungor series should be removed from this Family and either incorporated with the Serdang Family or established in a Family of its own, probably as a Red Yellow Ultisol rather than a Yellow Grey Ultisol (Law,.pers. comm.). At present however, to conform with the classification proposed by Leamy (1966/2) it has been included in this Family with the Durian and Kuala Brang series.

Durian Series

One of the most widespread soils in Malaya, the Durian series is found on un-

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* Pulau - (Malay) - island (pl. Pulau2).

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dulating to hilly terrain over much of South East Pahang. In particular it overlies shales, sandstones and quartz porphyry rocks especially in the western part of the area. It is characterised by a pale coloured, semi-compacted, argillic horizon overlying non-hardened plinthite.

A pale brown or yellow eluvial horizon with textures varying from silty clay loam through clay loam to clay, friable consistence and moderate to strongly developed subangular blocky structure is overlain by a very friable surface layer of humus enriched soil and is underlain by an argillic horizon of brownish yellow or yellow clay loam or clay. The argillic horizon is characterised by firm consistence, often slight compaction, moderately developed coarse, medium and fine subangular blocky structure which tends to coarse prismatic shape on exposure, and distinct cutans coating many ped faces and lining pores and channels. A few light grey or reddish yellow mottles may be present and only the more vigorous roots penetrate into this horizon. At about 24 inches a thin stoneline of nodular, indurated plinthite and angular quartz fragments is almost invariably present. This is underlain by a very firm, weakly structured or massive, variegated red and yellow non-hardened plinthite horizon, which gives way to parent rock below four feet. Variants do occur where the soil colours are generally of a redder hue than normally encountered, but they are of local significance only and consequently are not discussed more fully here.

The Durian series may be considered to be of below average nutrient status by Malayan standards, but in some places it may be found that this soil has higher levels of available potassium than the surrounding sedentary soils. This variation in potassium level is probably directly related to the nature of the parent rock. While it is felt that this soils would be better suited to tree crops with a wide range of tolerance, under a high standard of mangement, it could probably be encouraged to produce quite good oil palms. (See Plate IV).

Bungor Series

These soils differ quite distinctly in texture and colour from the Durian series, but these differences are probably due to a compromise between age and parent rock. These soils, occur over arenaceous shales, sandstones and quartzites, in undulating to hilly terrain. While they exhibit stronger colours and horizonation, cutan development is not as distinct as in the Durian series and only an incipient plinthite layer is present.

A yellowish brown or brownish yellow eluvial horizon with sandy clay loam texture, friable consistence and weakly to moderately developed subangular blocky structure commonly overlies a transitional horizon to a weakly expressed argillic horizon, although, more often than not, an abrupt textural change is present at this level. The B horizon displays brownish yellow to reddish yellow (rarely strong brown) colours, a fine sandy clay to clay

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texture, friable consistence, moderately developed subangular blocky structure and thin clayskin development on some peds and in pores. This horizon overlies a similar horizon with slightly weaker structural development, firmer consistence, a paler colour, and distinct red blotches throughout. Rarely a thin band of fragmental, indurated plinthite, may be found between these latter two horizons but usually below four feet depth. Rooting in this porous, free draining soil, is normally good to below three feet.

Nutrient levels are below average, and slopes are often in excess of 14^{0}, but despite these limitations, this soil may be considered as being suitable for a wide range of tree crops, including oil palm, due to its friable consistence and porous nature which allow deep rooting and good aeration.

Kuala Brang Series

The soils of this series occur over a variety of terrain classes ranging from undulating to steep, but are generally found on moderately steep slopes. They are shallow soils, usually less than four feet deep, occur over sandstones, quartzites and sandy shales and are characterised by yellowish brown or brownish yellow colours and sandy loam textures. There is only a weakly expressed Ae/Bt sequence displayed and generally an abrupt textural change is not present. However, the occurrence of yellowish red and red mottles just above the parent material does ally them with similar, more obvious, Ultisols.

A friable, yellowish brown, humus enriched, sandy loam topsoil with weakly developed subangular blocky and crumb structures usually overlies a transitional horizon to the illuvial B horizon. This subsoil is almost invariably a brownish yellow sandy loam to sandy clay loam with friable consistence and weakly to moderately developed subangular blocky and crumb structures. Clayskins are patchyand only occur towards the base of this horizon and continue in the underlying stony, yellow to reddish yellow sandy clay loam which contains fragments of weathering parent rock, many of these fragments having a red, oxidised, crust. The depth to this horizon depends very much on topography, Roots seldom penetrate to the stony horizon, but the soil is very porous throughout. A clay loam phase of this series may occur locally.

Low nutrient levels, very rapid internal drainage, susceptibility to erosion and the stony nature of the subsoil are limitations to the cultivation of this soil. Consequently, it is best regarded as being suitable for tree crops with a wide range of soil tolerance. Limited areas of this soil, on undulating topography could be planted in oil palm, provided a high standard of management was maintained and observations based on experimental trial plots proved favourable.

Batu Anam Family

Soils of this Family are developed over iron deficient argillaceous sediments.

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They have an argillic horizon which is overlain by a weakly expressed albic horizon, and are underlain at relatively shallow depth by non-hardened plinthite. They commonly have a thin stoneline of angular quartz and nodular indurated plinthite at about 24 inches. Dominant colours are pale yellow, very pale brown and light grey and mottles are often present in the argillic horizon. Nutrient levels are low by Malayan standards and these soil are usually considered to have a suitability only for crops with a wide range of soil tolerance.

Batu Anam Series

This soil which is generally associated with the Malacca and Durian series, especially in the northern and central part of the region, occurs on rolling to hilly terrain over iron poor s liceous shales. Generally it is of local occurrence only in the heads of valleys and gullies where the parent material is an eroded pallid zone which underlies the Malacca ser es on the tops of ridges and the Durian ser es at lower levels (Law & Leamy, 1966).

A thin humus enr ched layer overlies a very pale brown to pale yellow eluvial silty clay loam to clay. Th s eluvial horizon has friable consistence and moderate to weakly developed subangular blocky structure. A narrow transitional horizon gives way to a very pale brown, pale yellow or light gray, firm to slightly compact silty clay to clay with weak coarse subangular blocky structure and moderately developed clayskins. Strong brown or yellowish red mottles are almost invariably present. Below, this horizon is separated from a compact to very firm pale yellow, light gray or white clay with weakly developed subangular blocky structure and moderately expressed clayskins, by a narrow (rarely thicker than six inches) stoneline of nodular indurated plinthite and angular quartz gravels. Roots seldom penetrate the B horizon and internal drainage is somewhat impeded.

This soil, which seldom is thicker than four feet exhibits over all low nutrient levels. In addition, the compact subsoil, is a serious l mitation to cultivation. Generally one would consider that this soil would be best restricted to crops with wide tolerance, but Null et al (p.22) and Dumanski & Ooi (p.41), have indicated that it could also be suitable for oil palm, but prior experimental work whould be conducted before large scale planting is considered.

Marang Series

This soil appears to be developed over sandy siliceous shales in undulating to rolling country, generally of low elevation. It s scattered throughout the western portion of the reg on where it is associated with the Durian, Bungor and Batu Anam series. There is a distinct eluvial A/illuvial B sequence in this so l, which generally has sandier textures and more friable cons stence than the Batu Anam series.

The topsoil is a very friable, pale brown to pale yellow fine sandy loam to very fine sandy clay loam with weakly to moderately developed subangular blocky structure.

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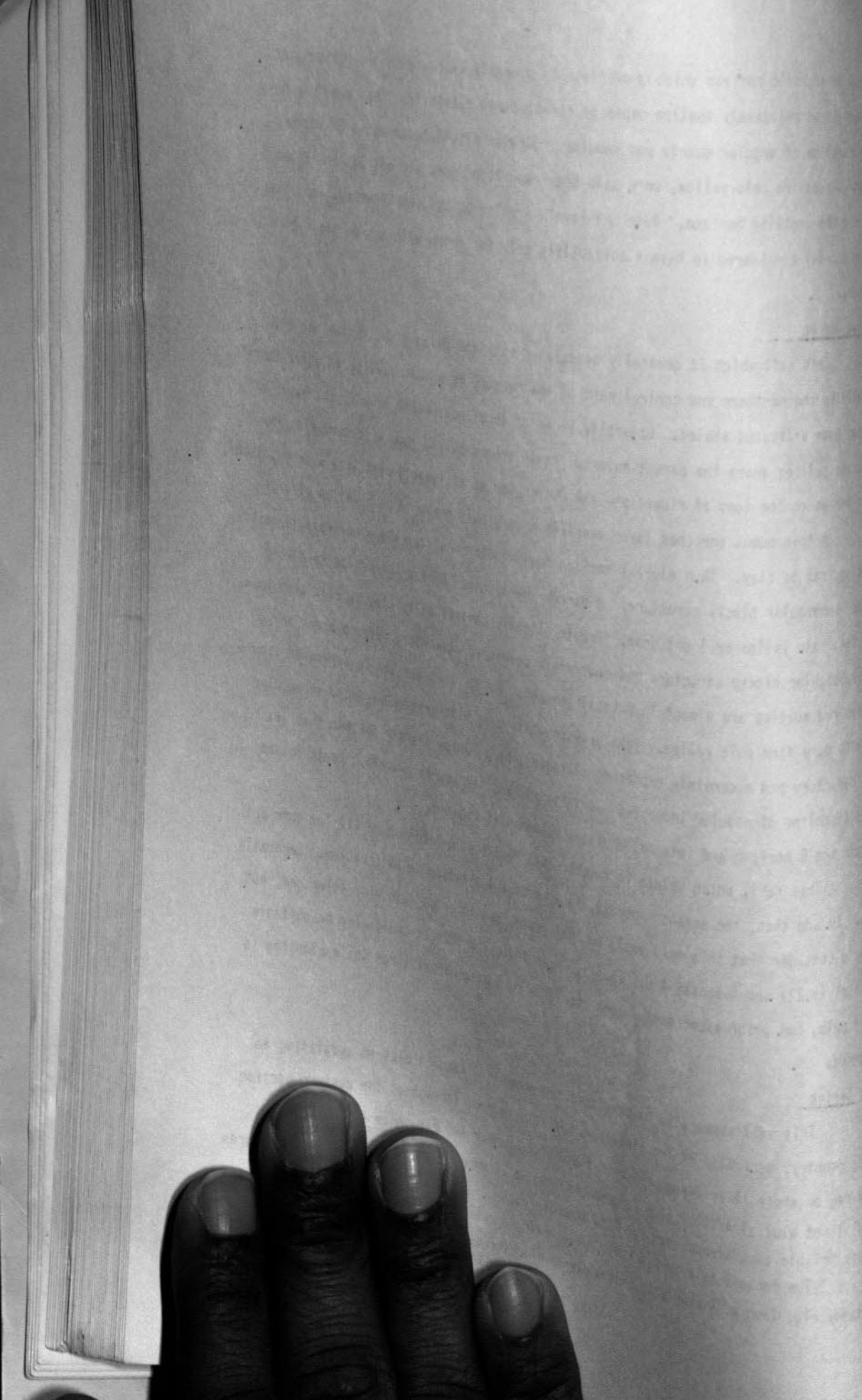

This horizon is underlain by a pale brown, to very pale brown or pale yellow, fine sandy clay loam to very fine sandy clay with friable to firm consistence, weak to moderate sub-angular blocky structure and weakly developed clayskins. Light gray, yellowish brown and yellowish red mottles are invariably present and increase in number and contrast with depth. This horizon usually has an abrupt boundary with a firm light gray to pale yellow very fine sandy clay which in turn is underlain, below about four feet by broken parent rock.

Despite low nutrient levels by Malayan standards, the more friable nature and the generally easier terrain make this soil slightly more suitable for cultivation than the Batu Anam series. Dumanski & Ooi (p. 41) noted that rubber has been cultivated on these soils and suggests that oil palm could possibly be grown, but recommended prior experimentation before the formulation of any hard and fast planting policy. Although the soils of this series as they occur in Pahang, have a higher clay content than those described by Panton (1958 pp. 32 - 33) it is notable that he considered many areas of this series in Trengganu as having little or no agricultural potential. Nul et al (p. 29) also concluded similarly.

18. LIGHT GREY ULTISOLS (TROPAQUULT)

These are poorly drained soils which have a gleyed or reduced horizon at relatively shallow depth, predominantly light grey colours and mottles in the B horizon. They may or may not have an argillic horizon, but in general, they are considered to display more profile development than that shown by the Entisols. Leamy (1966/2) has noted that strong subsoil structures develop when these soils are artifically drained. They are formed on alluvium which is not actively accumulating. One Faimly has been recognised within this group.

Rusila Family

The soils of this Family form the poorly drained member of the 'Bris' complex (Ives 1966/2). They are predominantly sandy in texture, being either sandy loams or clayey sands and having a relatively thick (about 6 inches) humic accumulation at the surface. With the implementation of drainage they should prove suitable for annual crops rather than tree crops.

Rusila Series

The Rusila series develops over recent marine sands, in low lying, poorly drained (often semi-permanently waterlogged) locations in the 'coastal sand ridge' region. The swales between strand lines, which are the sites of this soil, vary considerably in width from a few yards to quarter of a mile, but are invariably of some logitudinal extent. They generally support a low ground cover of sedges and ferns which appear after clearing the natural vegetation of fresh water swamp forest.

A surface humic accumulation, containing enough mineral matter to be called a

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muck, usually of between 4 and 10 inches thickness overlies a grey or light grey, often humic, loamy sand or clayey sand. This eluvial horizon is usally waterlogged for the greater part of the year, has some very weak subangular blocky aggregation and passes into a grey or light grey, mottled, structureless sandy clay loam. Mottles vary from light yellowish brown to olive brown and olive in colour and are seen to increase in numbers with depth. Rarely a sulphurous odour may be detected below two feet, especially in those locations immediately adjacent to the coast or estuaries.

While their potential for tree crops is limited by the high watertable and the low nutrient levels in the subsoil, they could quite profitably be utilised as small, local padi areas or for the cultivation of fodder crops in a pastoral regime. Where these soils have supported 'gelam' forests (Melaleuca leucodendron), toxic elements may seriously inhibit crop growth (Coulter 1952).

19. PODZOLS (TROPHUMOD)

In Malaya, soils of this Group are called either Humus (Sand) Podzols or Grey Brown Podzols. They are characterised by an albic horizon in the position of an Ae horizon which is underalin by an slightly to strongly cemented spodic horizon. The spodic horizon occurring at any level between one and four or more feet. Sand textures prevail throughout the profile, and the horizons other than the spodic horizon, are generally loose and structureless. Colours in the albic horizon vary from very pale brown to white and in the spodic horizon from black to very dusky red.

Rudua Family

Developed over old beach strand lines, the soils of this Family are almost entirely quartz sand in which there are few or no weatherable mineral. They have an albic horizon over a spodic horizon, often with a duripan separating the two. In contrast to those observed by the writers of the 7th Approximation (Soil Survey Staff 1960 p. 56), the duripan in these soils is the cemented upper surface of the spodic horizon rather than the lower parts of the albic horizon. The chief cementing materials appear to be colloidal organic matter and iron.

It is felt that the Jambu Family (Light Grey Entisols of Leamy 1966/2) should be included with the Rudua Family, as members of the Podzols. Recent work has shown that these tow soils are relatively similar, the principal difference being the depth of the spodic horizon, In the Jambu Family it is usually found below 4 feet depth. (Ives 1966/2). Certainly it is below mormal rooting depth and thus not available as a source of nutrients to normal tree crops.

Small areas of Jambu soils do occur in South East Pahang but because of their limited extent they have neither been mapped nor discussed in more detail.

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Rudua Series

This series is found in a narrow strip paralleling the coast between Pekan and Rompin. It occurs over recent sand ridges of marine origin (often called strand lines). Generally, it supports coconut palms of poor productivity (Plate VII) or a low grass and shrub vegetation. Rarely it is planted to vegetable crops such as tapicca and water melon. The major part of the rural population of South East Pahang live on, and eke out a supplimentary living from these soils.

A relatively thick(3-5 inches) horizon of humic accumulation is generally present. This is a black or dark brown loose sand which exhibits some crumb-like aggregation, especially where grasses form the dominant cover. This horizon passes gradually into a strongly leached Ae horizon. The latter horizon is invariably light grey or white in colour, is predominantly sand and is loose and structureless. A thin transitional horizon occurs between this horizon and the underlying spodic horizon. The latter variably indurated horizon is predominantly sand, cemented with colloidal humic material and a little iron oxide (Fe_2O_3), which are responsible for giving it a characteristic, black, dark or dusky red colour. Occurring at a depth varying between one and three feet, this horizon is rarely more than twelve inches thick. Underneath, the brown to light yellowish brown, loose, structureless sand may have some mottles near the upper boundary but is generally fairly uniform in appearance. The soil is extremely porous throughout and rooting is particularly extensive, but this demonstrates a search for water and nutrients rather than high fertility. The water-table is generally at the level of the humic pan, which may occur anywhere between 14 inches and four feet.

Quite a wide range of soils have been grouped into this series and a distinct 'weakly developed phase' of the Rudua series has been recognized (Ives 1966/2). Plates XIII and XIV show the differences between these two soils. Generally, the Ae horizon is much thinner, rarely exceeding eight inches and the underlying humus enriched horizon, while showing a distinct colour difference with the Ae horizon, is neither compacted nor cemented. Usually, this latter horizon is of between 4 and 6 inches in thickness and passes into the parent material of a brown to light yellowish brown sand. Mica flakes (muscovite) are often present in the parent material in both the Rudua series and the weakly developed phase.

Nutrient levels are very low, although they are generally much higher in the weakly developed variant than in the Rudua series proper. Coconuts and rough grazing are the current uses but is felt that, with care and attention, and the application of fertilisers, these soils will have a potential for a mixed tree crop/grazing economy based on citrus, cashew nuts, coconuts, vegetables, and the introduction of exotic, quality, pasture grasses (Ives 1966/2).

20. BROWN ENTISOLS (HAPLUDENT)

These are recent soils, developed over alluvia, which are characterised by an

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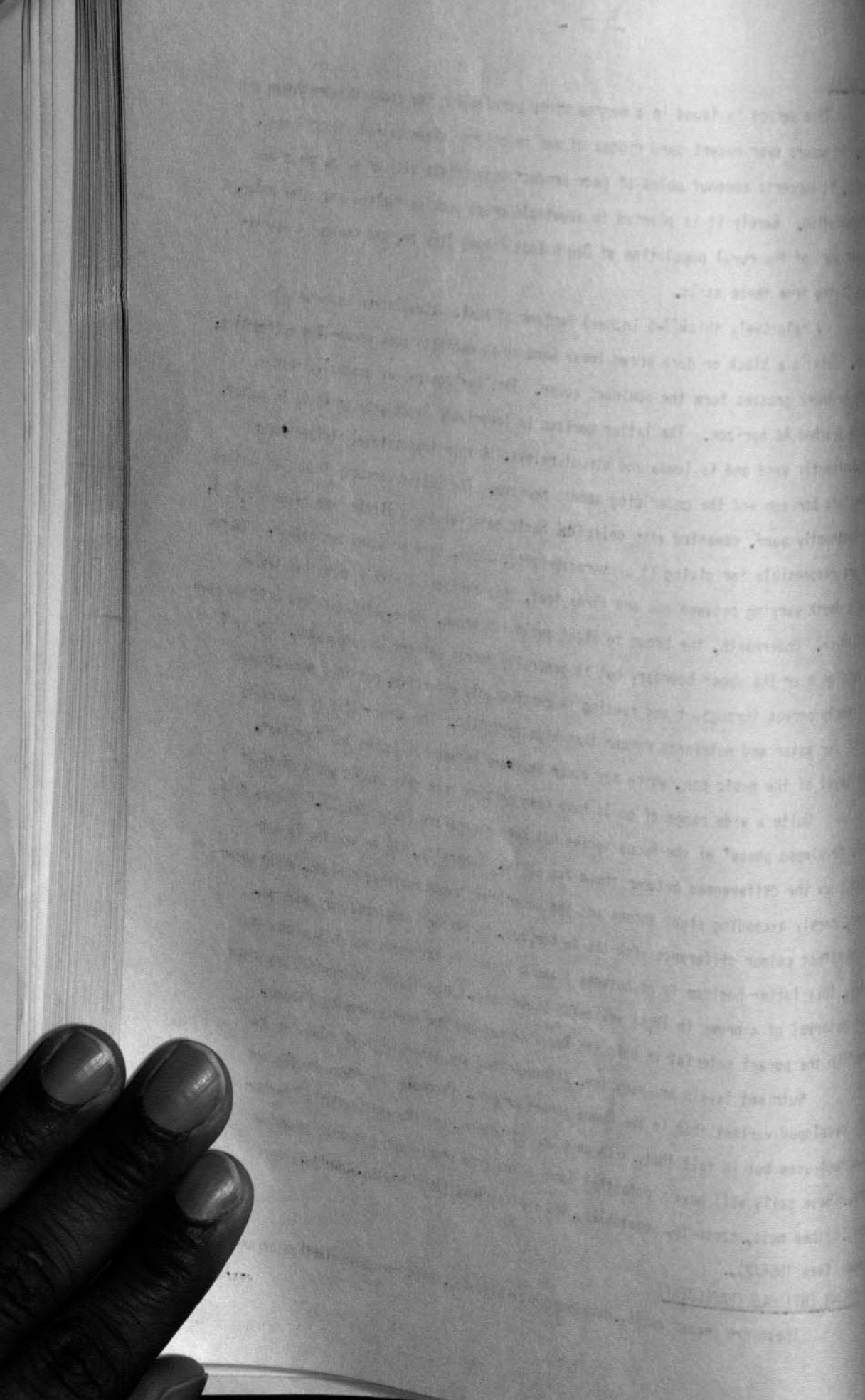

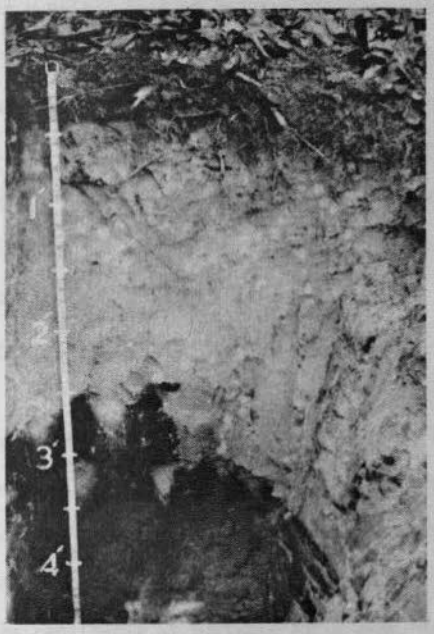

Plate XIII. Rudua Series a Humus-Sand Podzol on old strand lines adjacent to the coast. A distinct albic horizon and under-lying spodic horizon are in evidence.

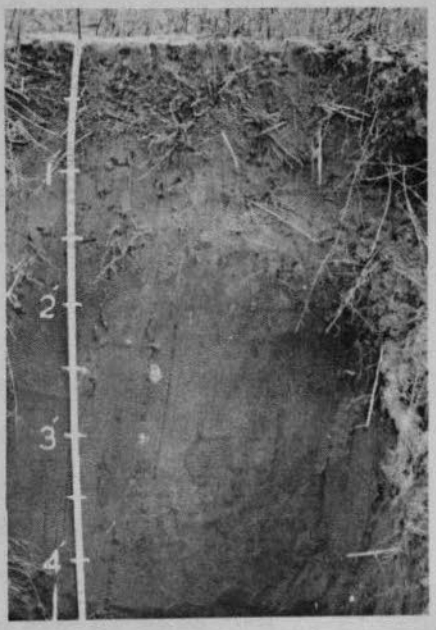

Plate XIV. Rudua Series (weakly developed phase) - note the incipient albic horizon forming, and lack of a distinct spodic horizon.

Plate XV. Rompin Series - a Brown Entisol forms over recent sandy marine alluvium in the Rompin - Endau area.

almost complete lack of genet c horizons apart from a thin humic horizon at the surface. They are generally sandy or silty in texture, h ve very friable and fr able consistences and weakly developed structures below the topsoil. They are usually quite porous and clay-skins are absent. Iron staining, as mottling may be present along root channels in the topsoil. Depositional bands of differing textures are common within the profile. One new Family, the Bag ng Family, and Telemong Family have been located and mapped during the present survey.

Telemong Family

These are immature so ls varying in texture from sandy loams to silty clay loams. Rarely mottles except in the topsoil adjacent to roots, they are found on the levees and floodplains of the major rivers where they are subject to additions of material by periodic flooding. Their nutrient levels vary considerably, depending on the nature of the flood sediments and their periodicity of accumulation, but generally these soils may be considered as suitable for a wide range of tree crops wh ch are not adversely affected by flooding, or for annual crops which may be grown during the drier months.

Telemong Series

The soils of the Telemong series are characterised by little or no profile development, variable sand and clay content, both within the profile and between profiles, and the presence of weatherable minerals, commonly muscovite, within four feet of the surface. They form on recent riverine alluvia which form the lower terraces and levees of the major streams and rivers in the area. The most extensive developments are adjacent to the Sungei Rompin and the Sungei Pahang.

The surface soil is usually darker than the rest of the profile due to enrichment with incorporated humus. Below this horizon textures and colours are usually remarkably uniform. Colours vary between yellowish brown and strong brown, textures may be either sandy loam, sandy clay loam, clay loam and rarely silty clay loam, consistence is either friable or firm and structures are generally weakly or moderately developed, with subangular blocky and granular shapes predominating. Pale brown and pale yellow mottles may be present in varying number and weakly formed clayskins in the form of flushings are usually present as linings on channels. Rootsnare commonly present to below three feet and the soil has fairly rapid internal drainage. Below three tofour feet the parent material in the form of alternating layers of very fine to coarse sand, appear, Some of these layers may even show weak soil formation in which case they constitute buried horizons.

Unfortunately, while these soils are of considerably longitudinal extent, they are rarely of any significant width. Laterally, they generally pass into the poorly drained soils of the Briah Family. Nutrient levels, despite the presence of weatherable

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minerals, are below average for Malayan soils, although high levels of exchangeable calcium and magnesium may be encountered in the topsoil. As the weatherable minerals are subjected to chemical weathering a release of nutrients will almost certainly take place. Their medium texture, moderate consistence, and their occurrence over level terrain make them ideal for a wide range of annual and tree crops, especially oil palm, which are not adversely affected by periodic inundations.. However, it would be advisable to retain at least two chains adjacent to the rivers in protective forest to reduce the threat of river ban erosion.

Baging Family

Two soils are recognized within this Family. The Baging and Rompin series, both being described for the first time. They are predominantly sandy in texture, have very friable or loose consistence and only very weakly developed structures. Colours vary from olive brown to brownish yellow and there appears to be some very weak development of a B horizon within this Family. Located during the present survey, they form part of a catenary sequence of soils developed on recent, sandy coastal alluvium, on the east coast of West Malaysia (Ives, 1966/2). Due to their sandy nature they may best be fitted into a new sub-group- Psammic Hapludent.

Because of their relatively recent origin, the soils of this Family are more suited to development than their slight older counterparts on sandy marine alluvium. Their greatest potential probably lies in a mixed tree crop/grazing economy.

Baging Series

A new soil series, located during a detailed soil survey of the Sungei Baging Crop Testing Station, it is reported in full for the first time. It is found on the most recent beach ridges in the northern and southern parts of the region adjacent to the coast. Horizonation is very weakly expressed and small flakes of muscovite are found throughout the profile. Kemunting, lalang, 'love grass' and casuarinas are the commonest vegetation association found on these soils, which occur on level topography over recent marine sands.

A thin loose , structureless, brown or greyish brown, humusenriched, loamy sand or sand, usually overlies a deep eluvial horizon of yellowish brown to olive yellow, sand or loamy sand with loose consistence and very weak subangular blocky aggregation. Below, a transitional BC horizon of a loose to very friable sand with very weak subangular blocky aggregation and olive brown to very pale brown colours overlies the parent material proper of olive brown to brown sand. White, pale yellow and rarely strong brown mottles, are often found throughout the subsoil. Roots are particularly numerous, especially in the surface horizons and the soil is highly porous.

While this soil has been tentatively grouped in Class 4 of the soil suitability classification, it is felt that this soil has a greater potential than the soils of the Rudua

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Family. Nutrient levels are generally higher (although still low by Malayan standards) than those of the Rudua Family. With careful management they could be induced to produce reasonable crops of specialised, environmentally adapted, tree fruits, vegetables and pasture grasses.

Rompin Series

This soil, which occurs over almost level terrain on recent sandy marine alluvium, may be differentiated from the Baging series, by its darker colours, obvious red and yellow mottles, and absence of mica flakes. This is another new series, which is confined to the area between Kuala Rompin and Endau in this region, although the author has located small areas of the same soil in other parts of coastal Pahang and Smallwood (pers. comm.) has found it in the Mersing District of Johore.

A brown, humic, loamy fine sand with loose or very friable consistence and very weak fine granular and crumb structure overlies an eluvial horizon which also displays humic enrichment. This horizon is a yellowish brown to brown, loose or very friable, fine sand with some very weak crumb and granular structure. A transitional layer separates the top soil from a weakly formed B horizon which is generally a loose or very friable, yellowish brown or brownish yellow, fine sand, displaying some very weak subangular blocky aggregation and red and grey coloured mottles. This merges gradually into the parent material below three feet. A very pale brown or pale yellow structureless, fine sand of very friable consistence, and with yellow and yellowish brown mottles usually occupies this position.

A variety of fruit trees and vegetables are being grown on these soils. Rubber, under a reasonable standard of management, seems to do quite well. While nutrient levels are considered low by Malayan standards, they are the highest of any soil forming the 'Bris' Complex (Ives, 1966/2). It is felt, that complementary to fruits, vegetables and minor tree crops, the establishment of quality pastures could be attempted.

21. BROWN GREY ENTISOLS (HAPLAQUENT)

In the South East Pahang region these are soils developed over recent or semi-recent (younger than the sub-recent alluvium of Leamy & Panton p. 9) alluvia of riverine origin. They are dominated by brown and yellowish brown topsoils over light-brownish grey, light grey and grey subsoils. Textures are generally silty clay loams to clays; consistences are firm, or plastic and sticky, and structures, usually weakly developed on initial exposure may develop into moderately strong, coarse prisms on drying out (Plate XIX). They are poorly drained and the incipient B horizon usually displays gley characteristics. Two Families have been recognised and mapped. One, the Serok Family, being newly described, is an attempt to isolate and map as separate units, those soils previously grouped as 'river (or riverine) alluvium' (Leamy & Panton p. 12; Dumanski & Ooi p. 47).

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Briah Family

Soils of this Family occur on recent river alluvia, in poorly drained locations, adjacent to the coastal plain or on the floodplains of larger rivers. Water-tables fluctuate between the surface and about three feet, and as a consequence reducing conditions are generally present below three feet and buried horizons are generally encountered at about this depth. Where drainage can be implemented they should prove suitable for a wide range of tree crops wh ch are tolerant to periodic flooding. Otherwise, they are eminently suited to wet padi cultivation. With irrigation, double cropping should be encouraged, and if not , vegetable crops for the local market should do well.

Briah Series

The poorly drained soils of this series occur on level to depressional sites and are developed over alluvium, usually of fresh-water origin which, either contain a high proportion of organic matter, or are deposited over older organiform soils. They are light grey in colour, have silty clay loam to clay textures and are almost invariably strongly mottles. They generally occur as a narrow strip between the peat and muck soils of the 'inland swamp basin', and the better drained alluvial soils bordering the rivers which pass across this sub-region.

A thin accumulation of decomposed and semi-decomposed plant remains overlies a grey or light grey, clay loam or silty clay loam, with friable or firm consistence, moderately developed subangular blocky structure, and faint, pale yellow mottling. A narrow transitional layer separates this horizon from the underlying B horizon wh ch normally occurs at about 12 inches depth. This latter horizon is usually, a plastic and sticky, massive, weakly structured, light yellowish brown, olive yellow or pale olive, clay or silty clay, which shows weak clayskin development and is strongly mottled in red, reddish yellow and light grey. Below about two feet, this horizon may give way to a sandy or clayey parent material which may be olive or olive yellow in colour exhibiting weak subangular blocky structure and common grey and dark brown mottles. Below 30 inches, a humus enriched, buried gley horizon may be encountered. This can vary from dark brown or dark grey to olive in colour and sandy clay loam to clay in texture. Roots normally penetrate to below three feet and small flakes of muscovite are found throughout the profile. The level of the water-table varies from the surface to about three feet depending upon the season.

Nutrient levels are average by Malayan standards, and the principal limitation is the relatively high level of the water-table, which may be a serious impediment to deep rooting crops. With the implementation of a system of drains, this soil should be ideal for shallow rooting crops, such as oil palm, which are not adversely affected by periodic inundations. Alternately, wet padi can be cultivated with controlled drainage.

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Akob Series

The Akob series occurs on level to depressional sites over recent riverine alluvium. It generally occurs immediately adjacent to the rivers in areas of low elevation, or is located immediately inland of the sandy levees of the larger rivers. These poorly drained soils are found adjacent to most of the rivers and larger streams in the region and while many areas are still in primary forest, a large acreage has been devoted to padi, rubber and shifting cultivation (See Plate XVIII).

The topsoil is generally a light yellowish brown or yellowish brown, fine sandy clay loam to clay with friable to firm consistence and moderate to weakly developed, granular and subangular blocky structures. Some clayskins are usually present as thin ped coatings. Below 10 or 12 inches, a transitional horizon of a yellowish brown to pale brown, firm, very fine sandy clay loam to clay, with weakly developed granular and subangular blocky structures, many conspicious clayskins and mottled in yellowish red and light grey, separates the eluvial A horizon, from an underlying gleyed B horizon. This latter horizon is a light grey or grey very fine sandy clay or clay with friable or firm consistence and weakly developed subangular blocky structure. Clayskins are only weakly developed but it is strongly mottled in reddish yellow, yellowish red and brownish yellow. This rests on a light grey, gleyed clay horizon, mottled in a similar fashion to the overlying B horizon, and it may be either fossil gley from an older soil or a deeply leached parent material. At considerable depth (12-15 feet) under these soils small scale drilling operations have revealed non-hardened plinth te similar to that forming the parent material of the Malacca and Tavy series. Fine flakes of muscovite are found throughout the normally exposed profile, and rooting rarely exceeds 24 inches, which is usually the level of the water-table.

Nutrient levels are average by Malayan standards, and the only impediments to cultivation are the poor drainage experienced by these soils and their susceptibility to flooding. The implementation of an adequate drainage system would do much to remove the former limitation, consequently rendering these soils su table for specialised crops, such as oil palm, that are tolerant of minor flooding and a standing water-table at about four foot depth. These soils, once drained, could also be used extensively for vegetable cultivation. In addition, their level topography and naturally poor drainage make them ideal soils for mechanically cultivated padi.

Serok Family

Occupying terraces at slightly higher levels than the present floodplains of the major rivers of the area, these soils display only weakly gleyed features. Locally, depressions may occur where these soils do display a distinct gley horizon, but normally gleization is confined to the occurrence of white, light grey and pale yellow mottles in the subsoil. They

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Plate XVI. Serok Series - a Brown Entisol developed on low terraces of the larger rivers over finely textured alluvia.

Plate XVII. Linau Series - a Brown Grey Entisol which is characterised by a sulphurous horizon below 24 inches.

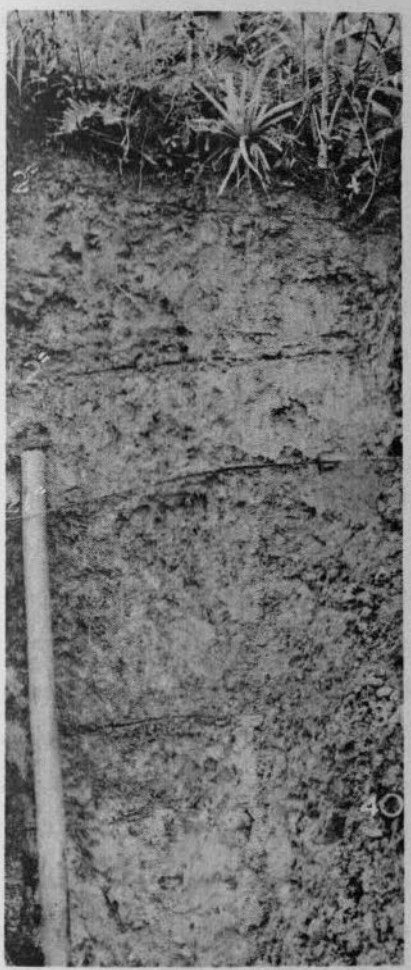

Plate XVIII. Akob Series (Briah Family) - gleyed alluvial soil which forms over recent riverine alluvium adjacent to the major streams and rivers of the region.

Plate XIX. Akob Series - an eroded surface on this soil showing the coarse columnar structure of the BG horizon.

show yellowish brown to reddish yellow colours, have silty clay or clay textures, firm consistence, moderately to weakly developed subsoil structures and commonly show weak to moderate clayskin development. The water-table, for most of the year is below five feet. Unfortunately, leaching has proceeded sufficiently to remove all of the easily soluble nutrients but they do have a potential for a wide range of tree crops under good management practices. At present, only one series, has been separated.

Serok Series

A new series, this soil derives its name from Kampong Bukit Serok in the Keratong basin. The soils of the Serok series are developed over semi-recent alluvium which forms a moderately dissected set of low terraces in the west and south west of the Keratong basin. This soil is a firm, brownish yellow to strong brown, mottled clay, which exhibits rather strong cutan development, in the B horizon.

A thin humus enriched layer overlies the A horizon proper, which is a firm yellowish brown, clay, with moderate to strong subangular blocky structure. A narrow transitional horizon of about 6 inches separates the A horizon from a weakly formed B horizon. This latter horizon is generally a firm, strong brown or reddish yellow clay with moderately developed subangular blocky structure, and strong clayskin development. Distinct red mottles are prevalent. Below three feet, a very firm, highly mottled, brownish yellow to pale brown clay appears, and this horizon although displaying very extensive clayskin development, exhibits only weak structural aggregation. Roots rarely penetrate below 12 inches depth.

The firm and very firm consistence of the subsoil and the low nutrient levels, suggest that this soil be restricted to shallow rooting crops or tree crops with a wide range of tolerance. At present, the greater part of this soil is either under primary or secondary forests, but recent planting of fruit trees and vegetable crops at Kampong Bukit Serok could serve to indicate its suitability for more specialised crops such as oil palm and sugar cane.

22. DARK GREY ENTISOLS (HYDRAQUENT)

'This Great Soil Group includes soils which have been called Acid Sulphate Soils and Saline Gley Soils. They are formed on recent marine alluvium in coastal swamps, under mangrove vegetation in the natural state. They are characterised by a high content of organic matter in the surface horizons overlying bluish or greenish sulphurous clay at depth. They have very low pH figures and, when drained, deposits of iron-sulphur compounds with a characteristic yellow colour appear throughout the profile'. (Leamy 1966/2). One family has been recognised in the area surveyed.

Kranji Family

The Kranji Family includes both Acid Sulphate Soils and Saline Gley Soils. The latter division is located in present estuaries where these soils are still accumulating.

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The Acid Sulphate Soils are found in areas adjacent to these estuaries where the Soils are not at present accumulating and are not subject to tidal inundation. The soils of this Family are characterised by dark grey or dark greyish brown colours, clay textures and a strong smell of hydrogen sulphide at some level. Generally, due to the waterlogged conditions of the environment, organic matter is subject to only partial decomposition and while this serves as a rich source of nutrient, it is partly responsible for inducing strongly acidic conditions when these soils are dried out after drainage. Under such conditions greenish - yellow layers of sulphur are seen to coat ped faces, pores and channel linings.

Two series have been recognised in this region. The Kranji series would be best retained as forest reserves, but the soils of the Limau series, although not as strongly influenced by saline conditions as the Kranji series, develops high acidity upon drainage, thus limiting its agricultural potential. Perhaps, they are more productively in fish ponds for fresh water fish culture (Kanapathy 1966).

Kranji Series

This soil occurs under mangrove and nipah (Nipa fruiticans) forests adjacent to the estuaries of the larger streams and rivers, on the eastern margin of the region. Their parent material is estuarine alluvial silts and clays with rare sandy lenses and they are tidally inundated by saline waters.

A thin dark brown, plastic and sticky, humic, very fine sandy clay loam, with moderately developed fine blocky structure, normally occurs at the surface. Dark red and reddish brown mottles in this layer indicate a reduction of iron rich compounds. Below one to two inches, a dark grey, friable to firm, very fine sandy clay loam to fine sandy clay occurs. Structures are weakly developed and living and decaying roots abound. Iron oxide stained clayskins line pores and channels, and in addition dark red mottles are common. At between 15 and 20 inches, this horizon gives way to dark greyish brown to dark olive gray, plastic and sticky, fine sandy clay loam, with very weak blocky structure. Dark yellowish brown, dark red and olive coloured mottles are prevalent, as are dead and decaying roots. Small flakes of muscovite are found in all horizons and a noticeable smell of hydrogen sulphide can be detected at all levels; crab mounds, of varying sizes, dot the surface of this soil and consequent oxidation of the exposed subsoil on these mounds gives rise to thin, pale yellow crusts of sulphur, compounds.

Neutral to alkaline reactions throughout this soil would seem to be almost ideal for plant growth, but due to the high levels of sodium, sulphur (Coulter p. 22 - 35) and iron,

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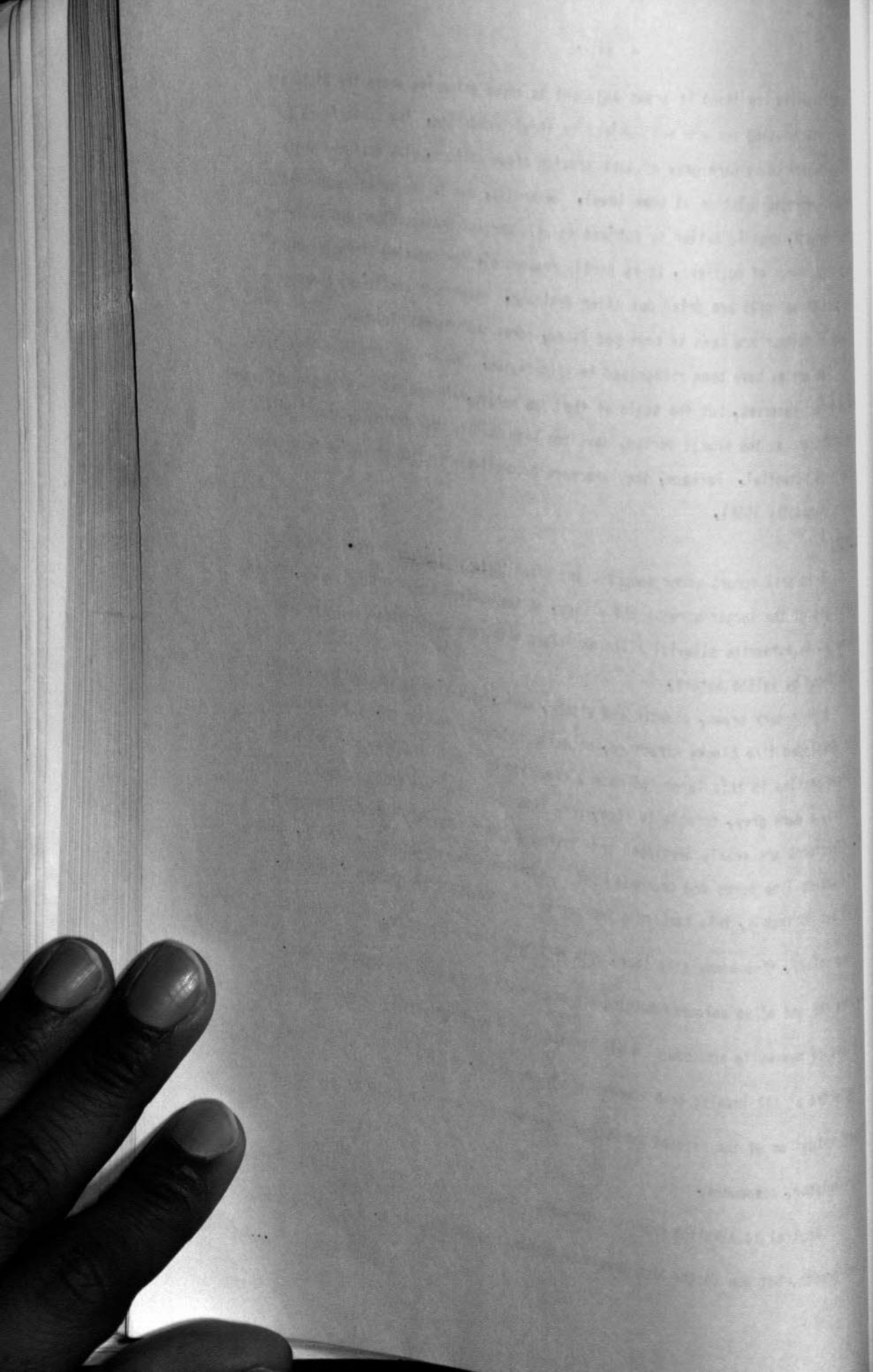

these soils are found to be toxic to almost all cultivated crops. Drainage of these soils would not provide an initial solution to the problem, since once the waterlogged conditions have been removed there would be a considerable increase in acidity (Kanapathy 1966). However, if these soils are allowed to stand for a number of years after draining, rain waters would probably remove in solution, many of the toxic elements, making these soils suitable for shallow rooting crops, although coconuts could probably be introduced at this stage as they appear to be more tolerant of such saline and sulphurous subsoils than other tree crops. Two alternatives remain, either to leave them as forest reserves used solely for the production of wood and charcoal for cooking fires, or convert these areas into ponds for fish culture.

Linau Series

Soils of the Linau series develop from soils of the Kranji series in areas where estuarine alluviums are no longer subject to tidal inundation and where the vegetation is mixed mangrove and fresh water swamp forest. These soils are still poorly drained and distinctly sulphurous in the subsoil below about two feet.

Under primary forest, three of four inches of muck generally form the surface layer. This horizon has a black to reddish grey colour, loose consistence and weakly developed granular and crumb structure. This is underlain by a very dark greyish brown to olive, sandy clay loam to silty clay loam which has friable consistence and weakly to moderately developed subangular blocky and crumb structures. Dead and decaying roots and large quantities of incorporated humus are a distinct feature. Below about two feet, a firm, almost structureless, dark greyish brown to bluish grey, sandy clay loam to silty clay appears. This horizons exudes a strong sulphurous odour and large amounts of incorporated humus are invariably present. The water-table varies seasonally between the surface and about two feet. Mica flakes are normally found at all levels below the surface horizon.

Because this soil is not subject to inundation by saline waters it may be considered as being one step ahead of the Kranji series in productivity rating but as intense acidity develops on drainages this may not be the case in practice. If drainage can be implemented slowly and gradually this soil could probably be developed for shallow rooting crops such as padi and vegetables. Smallwood (p. 17) notes that rubber does not do particularly well on the drained phase of this soil due to root penetration to, and within, the sulphurous horizon. However, as with the Kranji series, these soils could possibly be utilised as ponds for fish culture.

23. GREY YELLOW ENTISOLS (NORWACRENT)

These soils are slightly better developed than most other Entisols, and generally displays a weakly expressed, juvenile, illuvial B horizon. Horizon boundaries, however, are commonly very diffuse. Textures vary from loamy sands to clay loams, while colours are

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generally uniformly yellowish brown to pale yellow or light grey throughout the profile. The major unifying factors appear to be their occurrence over alluvia of subrecent age and their strongly leached nature and consequent low nutrient status. Three Families have been mapped within this Group.

Holyrood Family

These are yellowish brown to yellow, rarely very pale brown, sandy loams to sandy clay loams which generally occur on well drained sites on terraces and fans adjacent to the larger rivers of the area, and are indicative of former meanders and/or courses of these rivers. Often they are formed on a shelving deposit between the foothills and the inland swamp basin. In such a location they may represent an old coastal beach deposit or old terrestrial fans at the mouths of river valleys. Nutrient levels are low and it is best to think in terms of crops with a wide range of soil tolerance when planning the utilisation of these soils. One series has been recognised in this Family.

Holyrood Series

This soil occurs over level to gently undulating terrain in the form of a weakly to moderately dissected old terrace. It is found to overlie subrecent sandy alluvia of predominantly riverine origin. The most extensive area of this soil is in the northern part of the region where its distribution marks the site of the old flood plain of the Sungei Pahang. It is also found scattered throughout the region, forming a moderately high terrace adjacent to some of the larger rivers and streams.

The surface horizon is usually a very friable or loose, greyish brown or brown, loamy sand to sandy loam, with weakly developed granular and subangular blocky structures. This is normally underlain by 6 to 12 inches of eluvial A horizon which is a yellowish brown to yellow, very friable, sandy loam with weakly developed subangular blocky structure. Below about fifteen inches, a weakly expressed B horizon has sandy loam to sandy clay loam textures, and may vary from brownish yellow to pale yellow or very pale brown in colour. Consistence is normally very friable and the subangular blocky structure is only weakly developed. Reddish yellow and light grey mottles may be visible. This gradually passes into a brownish yellow to yellow, friable sandy clay loam, with weak subangular blocky structure, common reddish yellow and red mottles, and a few weakly expressed clayskins.

Nutrient levels are very low by Malayan standards and in North Johore these soils produce only very poor stands of rubber. Potentially, they may prove suitable for intensive cultivation of short term crops such as maize, groundnuts, tapioca, sorghum etc. However, at present, it may be more sensible to retain the areas of these soils as reserved forest than plant then to rubber.

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Rasau Family

Generally occurring on terraces above the flood plains of the smaller rivers and larger streams of the region, these soils have stronger profile development and heavier textures than the soils of the Holyrood Family. Soil colours are usually yellowish brown or brownish yellow, textures are silty clay loams or clay loams and nutrient levels are generally higher than those observed in the soils of the Holyrood Family. However, at this stage it is probably best to consider them as more suited to crops other than those demanding optimum soil conditions. Only one series has been located.

Rasau Series

This series appears to be restricted to the eastern Pahang area where it occurs in association with the Holyrood and Lunas series. In South East Pahang it is located over level to gently undulating surfaces of subrecent alluvium and varying in height between twenty and fifty feet above present river level. It is confined mainly to the areas adjacent to the Sungei Mentiga and the Sungei Tepesok.

The topsoil is generally a friable, yellowish brown, silty clay loam to clay, with moderately developed subangular blocky and granular structures. Below six to eight inches, this passes into a brownish yellow to yellowish brown, silty clay loam to clay with friable to firm consistence, moderately developed subangular blocky structure, and weakly expressed clayskins. Light grey and reddish yellow mottles are usually present. Below two to three feet consistence becomes firmer and there is a gradual increase in sand content. Clayskins coating some ped and lining channels are usually darker in colour than the soil matrix. Roots usually penetrate to below three feet.

Nutrient levels are generally slightly higher in these soils than in other soils developed over subrecent alluvia. This is almost certainly due to the higher silt and clay contents of these soils, which are a direct result of a much finer grade of material in the original alluvium. However, until field trials have been conducted on these soils it is better to regard them as being suitable only for those crops with a wide range of soil tolerance, and consequently of only marginal suitability for oil palm.

Bukit Tuku Family

The soils of this Family are dominated by pale colours, sandy loam or sandy clay loam textures, weak structural development, and very low nutrient levels, usually being deficient in trace elements. They are considered to occur in low lying locations in subrecent alluvial terraces, and consequently it is thought that the resultant imperfect drainage is responsible for their light grey or pale yellow colours (Leamy 1966/2 p. 31). In some places they occur on the watershed between two streams and in such locations are probably indicative of river capture at sometime in the recent past.

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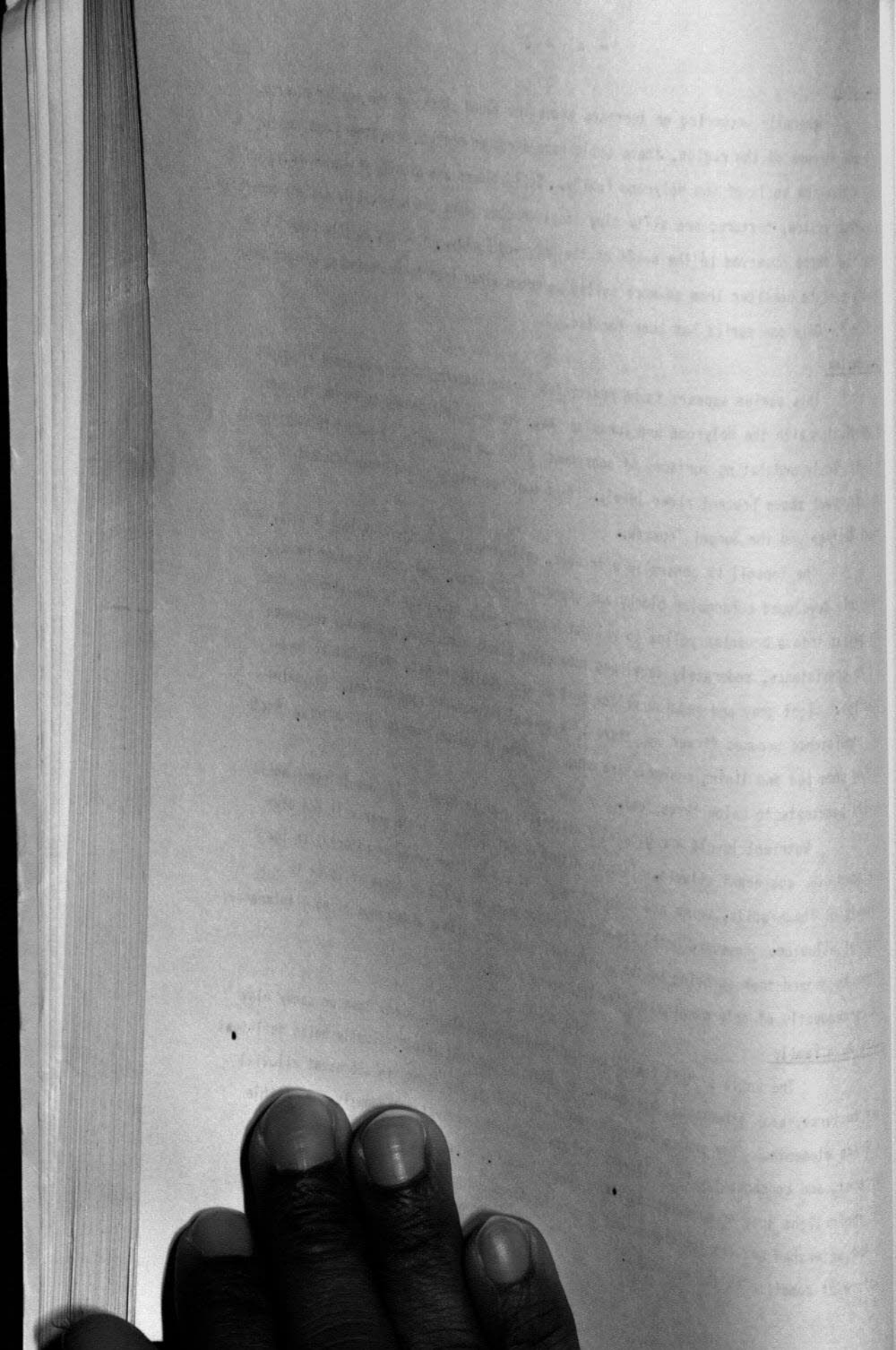

Only one series within this Family has been located during the present survey. This is the Lunas series.

Lunas Series (Holyrood Series - Grey Variant)

Following recent investigations on a Malayan - wide basis it has been proposed to rename the Holyrood series (Grey Variant), the Lunas series (Law Wei Min pers. comm.). This soil is developed over sandy subrecent alluvium and is found on level to gently undulating terrain. It is confined to lower lying areas in the northern parts of the region and in the Ulu* Sungei Aur where it represents an old terrace of the Sungei Pahang, or river capture involving some of the major streams of the South East Pahang region.

A thin, dark greyish brown, humic loamy sand or sandy loam with loose or very friable consistence, and weakly developed subangular blocky and granular structures usually caps a humus enriched deep Ae horizon. This latter horizon is usually a weakly structured, very friable, pale brown to yellow sandy loam. Below about fifteen inches this passes into a weakly expressed B horizon which is almost invariably a light grey, sandy loam to sandy clay loam, with very friable consistence and very weakly developed subangular blocky structure. With increasing depth this horizon passes gradually into a similarly coloured parent material, which varies in texture between a sandy loam and a sandy clay, and has very friable consistence and very weakly developed structure. Some very thin clayskins may be observed in the B and underlying horizons and these are generally in the form of clay coatings on individual quartz grains. Roots seldom penetrate below the A horizon.

As would be expected, nutrient levels are generally very low and the sandy textures allow rapid subsurface drainage. Removal of the forest only tends to accelerate the rapid leaching rate experienced by these soils and consequently they would be best utilised as reserved forest areas.

While the author is in general concurrence with the surmise that these soils are developed over intermediate-level terraces, the consideration that they are in fact developed over old marine sands deposited adjacent to an emerging coastline should not be overlooked by future workers investigating the formation and genesis of this and related soils.

24. ORGANIC SOILS

Leamy (1966/2) has suggested, that due to a lack of detailed morphological data concerning the Histosols of West Malaysia, all such soils, containing a high percentage of organic matter, should be referred to as Organic Soils at the Great Soil Group Level. Three broad subdivisions of this Group have been recognised.

a) Peat - having a 'loss on ignition' greater than 65%

b) Muck - having a 'loss on ignition' between 35% and 65%

* Ulu (Malay) = Headwaters.

c) Organic Clay - having a 'loss of ignition' of less than 35%

Due to the higher contents of mineral matter, and their slightly higher potential for development, the Organic Clays and Mucks have been grouped into one complex for mapping purposes, while all Peats have been grouped into a separate mapping unit.

Organic Clays and Mucks

The soils of this complex (Leamy & Panton, 1966) have a 'loss on ignition' between 20% and 65%. The organic horizons are seldom thicker than 24 inches and almost invariably they are accumulated over strongly reduced, massive, bluish grey to dark grey, sandy clays, silty clays or almost pure clay mineral soils of alluvial origin. The organic matter which is considerably more decomposed in the organic clays than in the mucks is predominently of a woody nature being derived from fresh-water alluvial fringe, and riverine alluvial, swamp forests.

They are semi-permanently or permanently waterlogeed and this lack of effective drainage is a serious limitations to their development. In addition, due to the highly acidic nature of the organic horizons and the reducing conditions currently operating in the subsoil, even if drainage can be effected it will be necessary to allow some time for the oxidation and amelioration of these layers by air and rain waters before cultivation can be initiated.

Peat

While in some areas it has been possible to subdivide Peat into depth phases (Acton, 1966), this has not been possible due to a lack of time and funds during the present survey. It has been noted however, that there is a very rapid transition from Organic Clays and Mucks into Peat of greater than 3 foot depth. Locally, areas of considerable thickness of peat may be encountered, but in general, it is felt that the majority of the peats vary in thickness between 4 and 10 feet. Certainly areas characterised by a luxuriant growth of mengkuang will most probably be shallower than 4 feet.

These are all woody or fibrous peats often containing large, relatively undecayed logs at shallow depth. These logs will provide a considerable hazard to mechanical cultivation when the peats are drained. They have a highly acidic reaction and are almost permanently waterlogged. Although the 'inland swamp basin' is rarely distinctly depressional in nature, most areas have very low elevations and it is unusual to find heights greater than 25 feet above sea level. Consequently, it should be a long time before these areas come under consideration for development. Smaller areas in the south of the region, between the Sungei Rompin and Sungei Endau, however, could possibly be drained and developed in pineapple, fruits and vegtables, in order to provide additional land for the many smallholders already settled in that area, but considerable attention must be paid to prior soil amelioration practices before such settlement and development takes place.

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25. MISCELLANEOUS LAND UNITS

As stated earlier, these are convenient groupings of soils which characteristically occur over distinct landscape units and have very low agricultural potential. While the use of such units is unscientific, this loss in detail is outweighed by the ease with which they can be identified, separated and mapped at the reconnaissance survey level.

Steepland

For convenience, all land occurring above the "steepland boundary" was designated as steepland. For the most part this included almost all land above the 250 foot contour (Fig. 2), although in some areas, especially the Keratong Basin, where original slopes have been modified by the deposition of high level alluvia during the Pleistocene;strongly incised valleys have sides with steep slopes, while the overall terrain is relatively level. In some regions, notably the Lesong Forest Highland, plateau like features at some considerable elevation, have average slopes of less than 20^{0}. These areas are of only limited extent and because of their general inaccessibility have been inculuded as steepland.

Many different soils are included within this grouping, the chief among them being, Kedah, Malacca, Bukit Lunchu, Bukit Temiang, and Kulai series, all characterised by shallow profiles and extremely high susceptibility to erosion.

Such areas should be retained in either productive or protective forests, depending on the nature and value of the natural forest. Often, despite the presence of favourable species, it may be more advisable from the point of view of watershed and catchment preservation to retain these areas solely as protective forests.

Disturbed Land

Areas which have been utilised for mining, as tailings areas, as urban or rural township sites, or for quarry and mine stockpiles are considered to have very little or no agricultural potential and have been designated as 'disturbed land'.

Minor Valley Soils on Alluvium

It is the general practice, in the Malayan Soil Survey, to employ the term Local Alluvium (Association), for all alluvium derived soils found in the valleys of the smaller rivers and streams, and of varied morphology. The writer, however, feels that while this term is adequate, a far better idea of the nature of the soils involved, can be gained from the use of the name 'Minor Valley Soils on Alluvium', as used initially by Panton(1958). Consequently, for the purpose of this report (at least) these two terms may be regarded as synonomous, with the addition to the definition proposed by Leamy and Panton (1956) of one sentence from the original definition of Panton:-

"The soils are a complex mixture of locally derived, waterlogged, clays, sandy clays, and clayey sands together with occasional patches of muck soil and peat."

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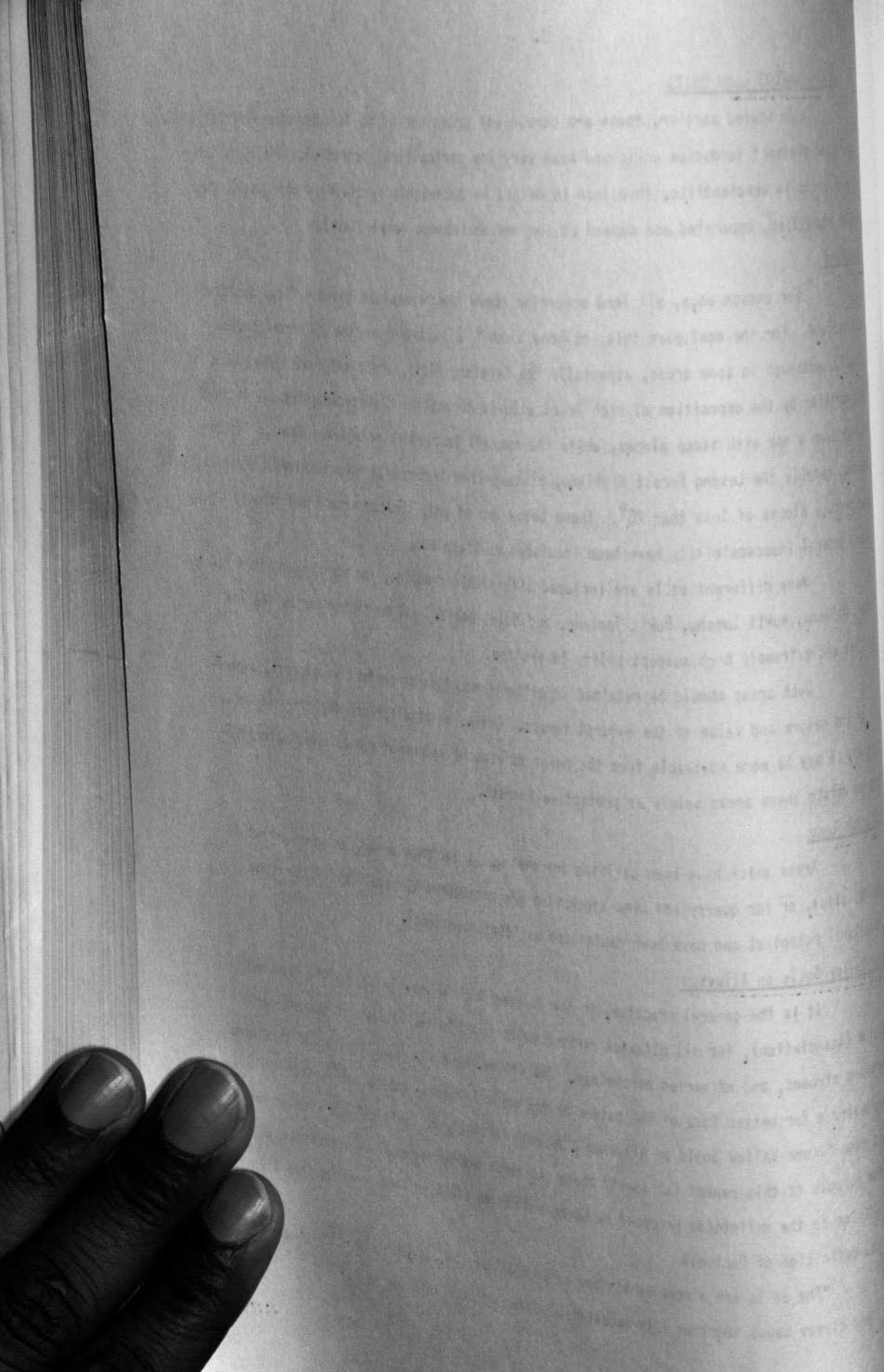

In the South East Pahang region, the soils of this unit are of limited local extent, but taken collectively, including areas which cannot be shown at the scale of mapping they are of considerable total acreage (See Table 4). They are found in the valleys of the smaller rivers and streams of the area and are formed over a wide variety of parent materials. Generally, they are poorly drained or waterlogged, often with a peat or muck accumulation overlying mineral soil, but it is not uncommon to find freely drained varieties. They generally support 'riverine swamp forests'.

Textures vary considerably from fine and coarse sands through sandy clays, clays, silty clay loams to silty clays. Lighter textured soils are usually freely drained with very weak structures and loose or very friable consistence. Often, these sandy soils have a thick overlying humic accumulation. Those with sandy clay and clay textures exhibit brownish yellow to light grey colours with many grey, yellow and red mottles, very friable or friable consistence and very weak structures. Soils characterised by silty textures are usually light grey or white in colour, have only few or common, yellow and red mottles, firm and very firm consistence and commonly have a massive and stuctureless subsoil.

Despite prevalent poor drainage, these soils do have a potential for development, the actual extent, however, to which they may be utilised, is dependent upon the drainage potential and the nature of the soils from which they have been derived. In areas of better sedentary soils, these soils on alluvium will obviously have a greater potential than those derived from regions of low quality sedentary (or alluvial) soils. Subsequent investigations, however, will be necessary to elucidate their true nature in any particular place. At present they are all shown as being of Soil Suitability Class 3.

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PART 5

SOIL EROSION

26. One of the ever prevalent limitations to the successful cultivation of many crops is the effect of running water on the soil. The removal of varying quantities of the soil by these running waters constitutes the destructive process called 'erosion'.

In the humid tropics, erosion occurs during heavy rain when the soils become completely saturated and excess rain-water escapes down-slope as surface runoff. Under a cover of natural forest, erosion due to runoff is relatively slight, but with the removal of this protective forest prior to cultivation, a large portion of the upper surface of the soil, including the overlying leaf litter may be removed by the processes of erosion.

Initially the humus enriched more fertile soil is removed by sheet erosion. In areas of stronger relief, this is followed by the development of small runnels or rills which penetrate the subsoil to shallow depths. On steep slopes, these rills may develop into shallow, gradually deepening gullies, which eventually expose the parent rock. Where soils on steep slopes have silty parent materials or are developed over shaly parent rocks, slumping may occur in the heads of the developing gullies.

While the extent to which erosion will take place is dependent on five main factors:-

a) the nature of the soil
b) the depth to the water-table,
c) the nature of the existing vegetation,
d) the nature of the terrain, and
e) the amount, annual distribution and variability of the rainfall.

a generalised table (Table 5) based principally on slope/terrain is presented to indicate the probable nature and form of erosion which will take place over areas in South East Pahang which have been cleared for cultivation:-

TABLE 5

SLOPE RANGE	TERRAIN (COMPLEX SLOPES)	EROSION SUSCEPTIBILITY	TYPE OF EROSION
0^0 - 2^0	Level	Nil	None
2^0 - 6^0	Undulating	Slight	Minor sheet
6^0 - 12^0	Rolling	Moderate	Sheet & some rill wash
12^0 - 20^0	Hilly	High	Rill wash & some gullying
20^0+	Steep& very steep	Very high	Gully & slumping

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Although present knowledge regarding the degree of erodability of various soils is extremely limited and is based purely on field observation, the following tentative conclusions may be of some use to the soil user:-

1. a) Oxisols - generally highly or moderately porous, erosion only becomes a problem where these soils occur on slopes steeper than 12 or 14°. However where shallow, compact or semi-compact horizons (Concretionary Oxisols) restrict internal precolation, sheet erosion and rill wash will be significant on slopes steeper than about 10°.

b) Ultisols - the marked textural change between the A and B horizons in these soils serves as a distinct impediment to internal drainage, consequently runoff is usually much higher than in the oxisols. On clearing, areas with slopes steeper than 12° will almost certainly suffer a loss of all of the Ah horizon and probably most of Ae horizon. On lesser slopes the Ah horizon will most probably be removed along with part of the Ae horizon.

c) Spodosols - these soils have rapid internal drainage and generally erosion is not a problem. However, many of them having a high water-table, may at times of heavy and continuous rain suffer washings of surface materials into adjacent lower lying area.

d) Entisols - due to their occurrence over level or depressional terrain, these soils are often subjected to an accumulation rather than a removal of soil. Those soils having a high water-table may be eroded by runoff into a series of minor micro-channels. (See Plate XIX).

e) Histosols - erosion is no problem on these soils, but rather, they may be subjected to the addition of mineral materials from adjacent eroding soils.

In order to reduce erosion to a minimum, three cardinal rules should be adhered to:-

2. a) Avoid steep slopes.

b) Remove existing cover during the dry months, and establish an effective, protective cover crop before the onset of the wet period.

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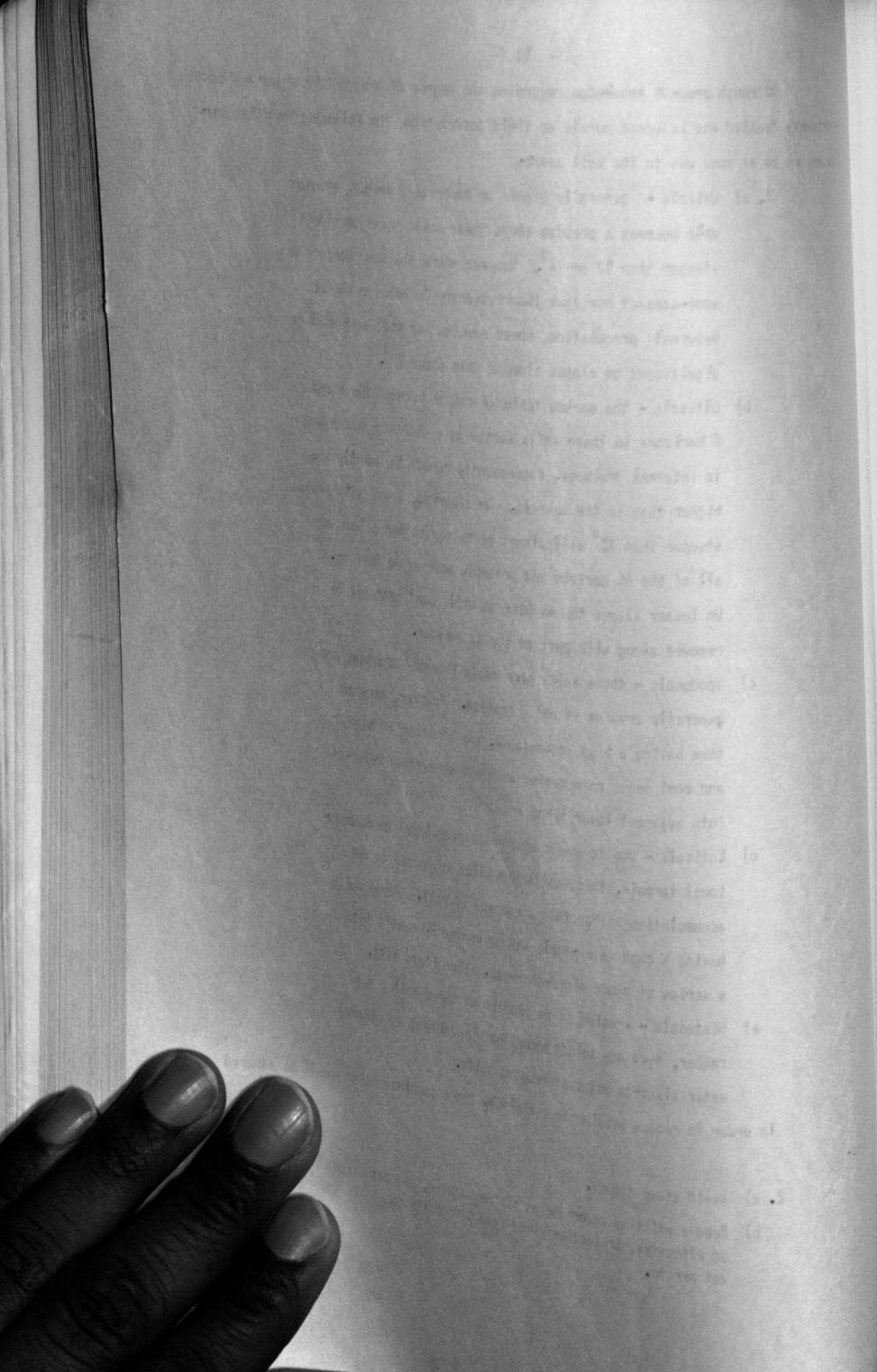

c) On rolling or stronger terrain adopt effective conservation practices (See Agricultural Leaflet No. 39, Ministry of Agriculture, Federation of Malaya. - 'Soil Conservation and Erosion Control'. 1960).

PART 6

SOIL SUITABILITY AND LAND USE

27. SOIL SUITABILITY CLASSIFICATION

Soil suitability assessment is the fundamental tool not only of the 'Land Use' planner but also of the potential cultivator. In this respect Soil Suitability Maps are complementary to Soil Maps and form an integral part of all soil reports.

The current soil suitability classification in use in Western Malaysia, proposed by Leamy and Panton (p. 190 - 194), expanded and ammended by Wong (p. 153 - 156), is based on a determination of the characteristics which would limit the agricultural potential of an area. The assessment of the extent and degree of these limiting factors is based primarily on field observations, but these observations are complemented by laboratory analyses which reveal serious major and minor nutrient deficiencies and toxicities. Two broad generalisations must however, be borne in mind when employing this classification:-

a) it is assumed that basic nutreient deficiencies which are common to practically all Malayan soils will be corrected with fertiliser application, and

b) the classification was evolved principally to determine and indicate those soils suitable for oil palm and rubber, and as such does not contain sufficient detail to predict for those crops with special requirements. The facts however, are presented and the soil user will no doubt interpret them for his own special use.

Those limitations which may impede or impair agricultural development in South East Pahang are found to be:-

Very Serious Limitations

These are limitations to development which are extremely difficult to correct; they severely reduce the productivity of the soil or result in severe damage to the soil under cultivation.

1. Slopes steeper than 20^{0}.
2. Massive or densely packed nodular indurated plinthite at or very close to the surface.
3. Land disturbed by mining.

Serious Limitations

These limitations are an initial impediment to agricultural development, but may be either corrected, ameliorated, or tolerated by the use of special techniques or under a high standard of management:-

1. Acute nutrient deficiencies

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2. Very poor and poor drainage
3. Moderately steep slopes (14^{0} - 20^{0})
4. Massive or compact nodular indurated plinthite within 2 feet of the surface.
5. Two feet or more of acid peat
6. Compacted subsoils
7. Sandy or stony textures throughout
8. Acid sulphate or highly reducing conditions
9. Strong susceptibility to erosion

Minor Limitations

These limitations, only slightly reduce the productivity of the soil; generally they may be either easily corrected, or where they cannot, they restrict only slightly the range of crops which may be grown.

1. Susceptibility to flooding
2. Imperfect drainage
3. Moderately steep slopes (6^{0} - 14^{0})
4. Moderate compaction or the presence of an impenetrable layer of indurated plinthite between 2 and 4 feet depth
5. Acid peat less than 2 feet thick
6. Potential minor nutrient deficiencies
7. Only slight to moderate susceptibility to erosion
8. Moderate stoniness which may impede mechanical cultivation.

On the basis of these limitations, five major soil suitability classes emerge:-

Class 1.

The soils in Class 1 do not have any limitation to agricultural development. They are suitable for a wide range of crops.

Class 2.

Class 2 soils have one or more minor limitations to agricultural development and because of this they are not suitable for as wide a range of crops as Class 1 soils.

Class 3.

In Class 3 are soils with at least one serious limitation to agricultural development. These soils can only be economically exploited if they are cultivated with more tolerant crop such as rubber.

Class 4.

The soils in Class 4 have more than one serious limitation to agricultural development. They can be cultivated profitably when a very high standard of management is available.

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Class 5.

Class 5 so ls have at least one very serious limitation to agricultural development, and , because of this, they are best utilised as reserved forest or wild life reserves or for other non-agricultural pursuits.

In addition Table 6 is included to show the basic morphological characteristics of each soil encountered and the suitability of each, w th particular reference to oil palm cultivation.

26. Suitability of the Soils for Agriculture

Of a total of approximately 1.73 million acres in the South East Pahang region, one million acres (or 60% of the region) appear suitable for agricultural development under existing management practices. A further 417,300 acres have a lower potential for such development but over the long term, when pressure for land increases these areas may be developed for agricultural purposes.

Table 7 shows the areas of soils of the various Classes within each sub-region.

FAMILY/UNIT	SERIES	PARENT ROCK	TERRAIN	SUBSOIL COLOUR	SUBSOIL TEXTURE	AGRICULTURAL SUITABILITY CLASS	FOR OIL PALM	LIMITATIONS TO USE
KAMPONG KOLAM	Jerangau	Granodiorite	Rolling - hilly	Strong brown-yellow red	Clay.	1	Suitable	Moderately steep slopes in some areas
	Katong	Quartz andesite	Undulating- rolling	Strong brown	Clay loam	1	Suitable	Shallow soils in some places
JEMPOL	Jempol	Tuffaceous conglomerate	Hilly	Yellowish red	Fine sandy clay loam-clay	3	Marginal	1. Steepslopes 2. Shallow soils
	Jeram	Ferruginous shales	Rolling-steep	Reddish brown-red	Clay	3	Marginal	1. Steepslopes 2. Shallow soils
MUNCHONG	Munchong	Shale	Rolling	Strong brown	Fine sandy clay-clay	1	Suitable	No limitations
SEGAMAT	Segamat	Andesite	Undulating-hilly	Yellowish red-red	Clay	1	Suitable	Steepslopes in some places
MALACCA	Malacca	Shales & sandstones	Rolling-hilly	Yellowish brown-yellowish red	Stony clay loam	3	Marginal	1. Steepslopes 2. Shallow soil & compact subsoil
TAVY	Tavy	Shales & sandstones	Undulating-rolling	Strong brown- reddish yellow	Fine sandy clay loam	3	Marginal	1. Shallow soils 2. Compact subsoil
RENGAM	Rengam	Granite	Undulating-hilly	Yellowish brown-reddish brown	Sandy clay loam-sandy clay	1	Suitable	No limitations
SERDANG	Serdang	Sandstone & Conglomerate	Rolling-hilly	Strong brown reddish yellow	Sandy clay loam-sandy clay	1	Suitable	Steep slopes in places
	Kedah	Sandstone & quartzite	Hilly-steep	Strong brown-yellowish red	Sandy clay loam	3-5	Unsuitable	1. Steepslopes, 2. Shallow soil 3. High susceptibility-erosion
HARIMAU	Harimau	Older Alluvium	Level-rolling	Brownish yellow	Sandy clay loam	3	Marginal*	Major & minor nutrient deficiencies
	Tampoi	Older Alluvium	Level-rolling	Reddish yellow	Sandy clay loam	3	"	Major & minor nutrient deficiencies
	Kawang	Sub-recent alluvium	Level-rolling	Brownish yellow	Coarse sandy clay	3	"	Major & minor nutrient deficiencies
DURIAN	Durian	Shales & sandstones	Undulating-hilly	Brownish yellow-yellow	Clay loam-clay	3	Marginal	1. Steepslopes in places 2. Compact subsoil
	Bungor	Shales & sandstones	Undulating-hilly	Brownish yellow-reddish yellow	Sandy clay -clay	2	Suitable	Steepslopes in places
	Kuala Brang	Sandstones & quartzite	Undulating-hilly	Brownish yellow	Sandy loam-sandy clay loam	3	Marginal	1. Steepslopes in places 2. Shallow & sandy soils
KULAI	Penyabong	Acidic tuffs	Hilly & steep	Brown	Stony clay loam	5	Unsuitable	1. Steepslopes 2. Shallow & stony soils
BATU ANAM	Batu Anam	Shales	Rolling-hilly	Pale yellow grey (M)	Silty clay-clay	3	Marginal	1. Steepslopes 2. Compact subsoil 3. Shallow soil
	Marang	Shales	Undulating-rolling	Pale yellow (M)	Fine sandy clay loam	3	Marginal	Low nutrient levels
RUSILA	Rusila	Sandy marine alluvium	Depressional	Light grey (M)	Sandy loam	4	Unsuitable	1. Very poor drainage 2. Major & minor nutrient deficiencies
RUDUA	Rudua	Sandy marine alluvium	Level-undulating	Light grey	Sand	4	Unsuitable	1. Very sandy textures 2. Major & minor nutrient deficiencies
TELEMONG	Telemong	Recent river alluvium	Level	Yellowish brown-brown	Sandy loam-clay loam	2	Suitable	1. Often sandy texture 2. Susceptible to flooding
BAGING	Baging	Sandy marine alluvium	Level	Pale brown	Sand	4	Unsuitable	1. Sandy textures 2. Major & minor nutrient deficiencies
	Rompin	Sandy marine alluvium	Level	Yellowish brown (M)	Sand	4	Unsuitable	1. Sandy textures 2. Major & minor nutrient deficiencies
SEROK	Serok	Sub-recent alluvium	Level-undulating	Strong brown-reddish yellow (M)	Clay	3	Marginal	1. Compact subsoil 2. Low nutrient levels
BRIAH	Briah	Recent river alluvium	Level-depressional	Yellow (M)	Clay-silty clay	2	Suitable	1. Massive subsoil 2. Poor drainage 3. Flood liable
	Akob	Recent river alluvium	Level-depressional	Light grey (M)	Sandy clay-clay	2	Suitable	1. Massive subsoil 2. Poor drainage 3. Flood liable
KRANJI	Kranji	Estuarine alluvium	Level	Dark grey	Sandy clay loam	4	Unsuitable	1. Tidally flooded 2. Toxic conditions in subsoil
	Linau	Estuarine alluvium	Level	Grey brown-blue grey	Sandy clay loam	4	Unsuitable	1. Poor drainage 2. Toxic conditions in subsoil
RASAU	Rasau	Sub-recent alluvium	Level-undulating	Brownish yellow	Clay loam	3	Margingal	Lower major and minor nutrient levels
HOLYROOD	Holyrood	Sub-recent alluvium	Level-undulating	Yellow	Sandy loam	3	Marginal	1. Sandy textures 2. Major & minor nutrient deficiencies
BUKIT TUKU	Lunas	Sub-recent alluvium	Level-undulating	Light grey	Sandy clay loam	4	Unsuitable	Major minor nutrient deficiencies
ORGANIC CLAY - MUCK		Alluvium/Organic debris	Level-depressional	Black-very dark brown	Clay-muck	3	Marginal	1. Very poor drainage 2. Highly acidic reaction
PEAT		Organic debris/ Alluvium	Level-depressional	Black	Peat	4	Unsuitable	1. Very poor drainage 2. Highly acidic reaction
STEEPLAND		Varies	Steep-very steep	Varies	Varies	5	Unsuitable	1. Very steepslopes 2. Shallow soils
DISTURBED LAND		Varies	Generally level	Varies	Varies	5	Unsuitable	Currently in non-agricultural usage
MINOR VALLEY SOILS ON ALLUVIUM		Recent riverine alluvium	Level-depressional	Brownish yellow-light grey(M)	Sand-clays	3	Marginal	1. Poor drainage 2. Sandy textures 3. Massive subsoil 4. Shallow soils

(M) - mottled

* Pilot plantings have now shown these soils to be suitable for oil palms.

TABLE 7 SOIL SUITABILITY BY PHYSIOGRAPHIC UNITS

TOTAL	SUB-REGIONS	CLASS	CLASS 2	CLASS 3	CLASS 4	CLASS 5
81,010	1. Coastal Sand Ridge Country	10	7,210	16,710	56,092	970
486,409	2. Inland Swamp Basin	997	32,608	111,851	340,077	796
30,145	3. Sungei Pahang Flood Plain	-	22,350	6,975	-	820
11,260	4. Ayer Hitam Depression	150	-	10,520	590	-
65,245	5. Peripheral Downland & Ridge Country	11,730	4,080	42,170	2,530	4,755
55,570	6. Merchong Basin	11,930	3,440	36,700	500	3,000
97,921	7. Mantiga-Aur Lowland	1,730	9,550	68,136	3,900	14,605
25,660	8. Mantiga-Gt. Sombilan Ridge Country	4,610	400	8,550	1,030	11,070
49,240	9. Jeram-Tepesok Valley System	910	2,330	29,050	160	16,790
345,257	10. Keratong Basin	148,545	19,743	156,447	1,530	18,991
226,826	11. Lesong Forest Highland	9,512	2,335	58,232	-	156,747
92,466	12. Rompin Valley	4,500	26,356	54,014	6,256	1,240

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TABLE 7 SOIL SUITABILITY BY PHYSIOGRAPHIC UNITS

TOTAL	SUB-REGIONS	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5
48,530	13. Rompin Downland	6,560	-	32,680	330	8,960
74,749	14. Berabong-Selendang Downland	2,840	24,726	38,234	2,855	6,094
13,100	15. Endau Lowland	2,980	710	7,980	1,450	-
26,880	16. Tioman	-	-	1,952	-	24,928
1,730,268	TOTALS	207,094	155,907	660,201	417,300	269,766

Note: Acreages have been calculated by 'dot counting' and by 'planimeter' and have a ± 3% error.

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29. Conclusions Relating to Soil Suitability

a) The region with the most extensive area of Class I soils is the Keratong Basin. Almost 150,000 acres of land are suitable for immediate development, probably in oil palm, and a further 20,000 acres of Class 2 soils will almost certainly be suitable for the same crops.

b) Of smaller extent, the Peripheral Downland and Ridge Country and the adjoining Merchong Basin, should provide 15,000 and 14,000 acres respectively of Class 1 and 2 soils, suitable for planting in oil palm.

c) The Rompin Valley and Berabong-Selendang Downland sub-regions have approximately 26,000 and 25,000 acres of Class 2 soils respectively. In the latter region these soils should prove eminently suited to oil palm, but since the majority of these soils in the Rompin Valley are alluvials, and susceptible to seasonal water-logging and/or flooding, they might be more profitably utilised for the development of large scale rice cultivation. A similar extent of Class 2 soils occur on the Sungei Pahang Flood Plain, but most of these are currently being utilised for agriculture by small holders.

d) Throughout the whole of the South East Pahang region some 680,000 acres (approximately 39% of the total) of Class 3 soils occur. An appreciable acreage in this Class occurs adjacent to the many small streams and rivers as Minor Valley Soils on Alluvium, having a variable potential, but probably suitable for small holders padi and dusun crops. An extensive area of swampy soils occurring in the southern part of the Inland Swamp Basin and continuing south through the Endau Lowland into North Johore could probably be developed after drainage into an extensive rice growing area, probably of the order of 40,000 acres in extent. The Ayer Hitam Depression could also prove suitable for a smaller rice scheme of the order of about 8,000 acres. Similarly the areas of poorly drained soils in the Coastal Sand Ridge Country could provide a number of small areas for localised irrigaged padi schemes. Similarly a large area of poorly drained soils in the Merchong Basin could provide the site of yet another padi scheme.

e) Of the balance of Class 3 suitability soils, predominantly of sedentary origin, all should prove well suited to the cultivation of rubber

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on either small holdings or commercial plantations. Some of the these areas, under a high degree of management could be encouraged to produce profitable returns of oil palm. But, should this crops be considered, it might be desirable to think in terms of large rather than small holdings. Notable areas which may be satisfactory for oil palm should be found in the Peripheral Downland and Ridge Country, Mentiga-Aur Lowland, Jeram-Tepesoh Valley System, Merchong Basin, Keratong Basin, along the western edge of the Lesong Forest Highlands, in the Rompin Valley, Rompin Downland and in the Berabong-Selendang Downland sub-regions. In addition, the extensive areas of Harimau Family soils, designated as Class 3 suitability, in the Keratong Basin are likely to prove suitable for commercial plantations of oil palm.

f) The majority of Class 4 soils could be retained under forest until pressure for land demands their reinvestigation and utilization. Some 56,000 acres of ridge and swale topography occur throughout the Coastal Sand Ridge Country. Although a large part of this area is being farmed, steps should be taken to develop more extensive agricultural practices. This region has already been the subject of a special investigation (Ives 1966/2), and there appears to be a definite potential for utilization of many areas on a mixed, grazing, citrus, cashew nut or coconut basis. Other areas of Class 4 soils; excepting the peats of the Inland Swamp Basin; might also eventually prove better suited to a mixed tree crop/grazing regime.

g) The areas of Class 5 suitability soils, occurring mainly in the Lesong Forest Highlands, the Mentiga-Bukit Sembilan Ridge Country, the Mentiga-Aur Lowland, the Jeram-Tepesok Valley System, the northern part of the Keratong Basin, and on Pulau Tioman should be kept in forest to serve a watershed catchment protection purpose. An acceptable arrangement would be to include these areas as Forest Reserves by readjusting existing reserve boundaries to exclude the areas more suited to future agricultural development.

PART 7

SUMMARY AND CONCLUSIONS

This report which is slightly more comprehensive than previous reconnaissance soil survey reports in this series, is intended to meet an increasingly apparent need for more detailed soils information, both for research purposes and for land use planning. Considerable time was spent in field studies directed towards deducing exactly the catenary relationship of the various soil sets and families, and it was felt that this significant information should be incorporated into the report.

Of the soils encountered, the most extensive are those members of the Rongam and Durian Families, together with the peats of the Inland Swamp Basin. Three new soil series; Baging, Rompin and Serok; are described for the first time. The soils have been mapped on a Soil Family basis as this seems to be a more satisfactory method of mapping from the utilization point of view, than the use of Soil Associations.

This under-populated region which is almost entirely forested can now be seen as forming part of the greatest area of untapped agricultural resource in West Malaysia. Despite the strongly weathered nature and the variety of soils encountered, an area in excess of one million acres appears to be suitable for future alienation and development in a variety of economic crops ranging from oil palm through rubber to irrigated rice.

The areas which appear to warrant the highest priorities for future investigations are the Keratong Basin, the Peripheral Downland and Ridge Country and Berabong-Selendang Downland, which are accessible from Segamat, Pekan, and Kuala Rompin respectively and could form the nuclei of future development plans. As longer term prospects, the Rompin Valley, Merchong Basin, Rompin Downland and Mentiga-Aur Lowland are the next obvious choices.

Communications could be designed to open up the Keratong Basin and the Peripheral Downland and Ridge Country, connecting through the Mentiga-Aur Lowland and joining the Berabong-Selendang Downland with a road through the Rompin Valley. A ring road through the Merchong Basin and Rompin Downland would serve eventually to provide access into these areas.

Careful planning will be necessary to preserve areas of forest for soil conservation protection in the watersheds. At the same time areas of agriculturally unsuitable soils could be considered for development as wild life sanctuaries or hunting and other recreational preserves. The interests of the large aborigine population must also be considered in any allocation plans for agricultural settlement.

Land is the heritage of the people of Malaysia. Use the soils wisely and they will repay many-fold; used unwisely the soils can become impoverished and barren, leaving many problems for future generations.

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APPENDIX 1

DESCRIPTIONS OF TYPICAL PROFILES OF THE MAJOR SOILS OF SOUTH-EAST PAHANG

Full profile description and laboratory analysis of major soil series have been obtained and are given in the following pages.

Mechanical analysis was done by the Bouyoucos Hydrometer method with "Tetron" as a dispersant.

pH was determined with a glass electrode.

The Walkley - Black method was applied to carbon determination while the micro-Kjeldahl method was used in the nitrogen determination the catalyst being a mixture of selenium, copper sulphate and potassium sulphate.

Easily soluble phosphorus was obtained by leaching with a solution of 2N sodium chloride and 0.2N hydrochloric acid and extraction with 0.1N sodium hydroxide.

Easily soluble potassium was determined by extraction in N/2 acetic acid (ration 10.1) followed by estimation on the large flame photometer.

Organic phosphorus was determined by finding the difference between the phosphorus content of an ignited 0.3N NaOH extract and an un-ignited extract.

Cation exchange capacity values were obtained by leaching with 0.1N barium chloride and titrating with N/50 versenate. Percentage base saturation was calculated as a function of the total cations present in the leachate.

Soil samples were also digested in 6N hydrochloric acid for 8 hours after ignition at 450°C for 2 hours. This method was used for the determination of iron, calcium and magnesium besides the more resistant forms of phosphorus and potassium.

(Horizon nomenclature after Leamy & Panton 1966).

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JERANGAU SERIES (JRU)

LAB. NO: RR 875

SEP: 011

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air-dry)	Moisture % (air dry - ov. dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Aeh	0-2½	63	6	22	14	1.15	Nil	4.0	2	12.0	2.60	1.52	0.18	8.44	80	59	12.08	0.09	0.21	0.06	0.47	7	
AB	2½-9	72	5	16	10	2.92	Nil	4.2	3	12.3	2.07	1.22	0.11	11.09	72	46	10.89	0.07	0.21	0.06	0.21	5	
Bt	9-17	80	9	10	6	2.24	1.22	4.6	3	12.0	1.04	.64	0.06	10.66	40	46	9.70	0.09	0.26	0.08	0.16	6	
Btcn	17+	72	5	12	15	24.50	5.94	5.3	3	13.0	0.52	.30	0.02	15.00	28	32	6.81	0.05	0.16	0.12	0.16	8	

Series: JERANGAU (1)

Family: Kampong Kolam

Great Soil Group: Red Brown Oxisol

Location: About 2 miles north of Bt. Ibam on the Bt. Hitam road.

Map Sheet and Grid Reference: 99/187018

Terrain: Rolling 7°

Vegetation: Primary forest - lowland dipterocarp

Elevation: 150' a.s.l. Rainfall: 90-100"

Drainage: Well drained

Erosion: Sheet erosion on clearing

Parent rock: Diorite

Profile:-

Aeh	0 - 2½"	Brown to dark brown (7.5YR 4/4); clay; friable; moderate to strong fine subangular blocky nd medium crumb; common fine woody roots; many fine pores; diffuse boundary to:-
AB	2½- 9"	Strong brown (7.5YR 5/6); clay; friable; moderate very fine to medium subangular blocky and medium crumb; few large woody roots; many pores and patch clayskins; a few, fine , faint, dusky red mottles present; distinct boundary to:-
Bt	9-17"	Yellowish red (5YR 5/8); clay; friable to firm; moderate to strong, medium to very fine subangular blocky; few woody roots; many pores; abundant clay-skins coating most peds and pores; distinct boundary to:-
Btcn	17-36"+	Yellowish red (5YR 4/6); stony clay; friable; weak to moderate, very fine and fine subangular blocky; rare roots; few pores; discontinuous clayskins on some peds and coating stones; abundant fine subangular laterite stones and rare large diorite boulders.

Notes: A little too red in B horizon for modal Jerangau

Capability Classification: Class I

Limitations: 1. Stony subsoil may impede rooting.

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SEP: 080

KATONG SERIES (KTG)

LAB. NO: RR 881

Horizons	Depth (ins.)	Percentage On Original Sample						pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0 - 2	43	20	28	10	Nil	Nil	5.1	2.3	6.7	1.90	1.12	0.13	8.61	96	157	13.82	0.44	0.26	0.12	0.35	13	6.00
Ae	2-10	54	20	21	8	Nil	Nil	5.0	2.6	6.5	1.21	0.71	0.03	8.87	84	121	12.08	0.37	0.16	0.08	0.52	9	6.00
AB	10-22	62	15	15	6	1.81	Nil	4.8	3.3	7.5	0.96	0.56	0.07	8.00	76	92	15.63	0.30	0.16	0.09	0.47	6	6.21
Bt	22-34	68	17	13	4	2.45	Nil	4.8	3.9	8.8	0.96	0.56	0.06	9.33	64	66	15.66	0.22	0.16	0.08	0.31	5	6.47
BC	34-46	65	16	16	5	Nil	Nil	4.9	4.1	8.6	0.43	0.25	0.04	6.25	59	53	16.00	0.18	0.16	0.08	0.31	5	6.75

Series: KATONG (1)

Family: Kampong Kolam

Great Soil Group: Red Brown Oxisols

Location: Track to Kuala Rekoh - Pahang/Johore border.

Map Sheet and Grid Reference: 106/843379

Terrain: Undulating 4^0

Vegetation: Primary forest - Lowland Dipterocarp forest

Elevation: 160' a.s.l. Rainfall: 75-80"

Drainage: Moderately well drained.

Erosion: Nil

Parent rock: Intermediate (andesitic) tuff.

Profile:-

Ah	0-2"	Dark yellowish brown (10YR 4/4); clay loam; very friable to friable; weak, medium and fine subangular blocky, fine crumb and fine granular; abundant fine roots; common fine pores; fine incorporated humus present; distinct boundary to:-
Ae	2-10"	Yellowish brown - strong brown (10YR 5/8-7.5YR 5/6); clay loam friable; moderate, medium and fine subangular blocky and fine granular; common fine roots; common channels and very few casts; common pores; very fine angular quartz fragments present; diffuse boundary to:-
AB	10-22"	Brown (7.5YR 4/4-5/4); clay; friable; moderate to strong, fine and medium subangular blocky and fine granular; common roots and channels; common pores; clayskins on some peds and lining channels and pores; fine angular quartz fragments; diffuse boundary to:-
Bt	22-34"	Reddish brown (5YR 5/4); clay; friable; moderate fine and medium subangular blocky and medium granular; few roots, common fine channels; common pores; clayskins on some peds and lining channels and pores; fine angular quartz fragments; few, fine, faint, yellowish red mottles, distinct boundary to:-
BG	34-46"+	Yellowish red to reddish brown (5YR 4/6-5/4); clay; firm moderate to weak, medium and fine subangular blocky; common channels; few pores; rare clayskins in channels.

Notes: In the weathered state parent rock has a black, red and white variegated appearance.

Capability Classification: Class 1.

Limitations: 1. Shallow soils

2. Sheet erosion on stronger slopes.

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SEP: 078

JEMPOL SERIES (JMP)

LAB. NO: RR 879

Horizons	Depth (ins)	Percentage				On Original Sample		pH (ov. dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++		
Ah	0- 2	39	23	37	6	Nil	Nil	4.0	2.5	7.9	4.60	2.68	0.21	12.8	80	144	18.38	0.38	0.47	0.11	0.47	8	1.92
Ae	2- 9	45	20	34	5	Nil	Nil	4.3	2	4.4	1.82	1.06	1.10	10.6	74	82	12.42	0.24	0.26	0.12	0.31	8	2.29
Btj	9-21	52	18	30	4	Nil	Nil	4.6	3	3.9	0.86	0.50	0.05	10.0	65	53	12.59	0.18	0.16	0.10	Nil	3	2.81
Btv	21-43	60	19	23	3	Nil	Nil	4.8	4	3.9	0.53	0.31	0.05	6.2	61	24	15.66	0.11	0.16	0.11	Nil	2	3.80

Series: JEMPOL (2a)

Family: Jempol

Great Soil Group: Red Brown Oxisols

Location: Timber track north of Pekan Jabi just inside Pahang.

Map Sheet and Grid Reference: 106/853386

Terrain: Rolling to hilly

Vegetation: Primary forest - Lowland Dipterocarp forest

Elevation 200' a.s.l. Rainfall: 75-80"

Drainage: Moderately well drained.

Erosion: Some sheet erosion.

Parent rock: Weathered shales and tuffaceous sandstones.

Profile:-

Ah 0-2" Brown (7.5YR 5/4); clay loam, loose; moderate to strong, fine granular, fine subangular blocky and finecrumb; abundant fine roots, common fine channels; few pores; incorporated humus indistinct boundary to:-

Ae 2-9" Yellowish red (5YR 5/6); clay loam to clay; friable, peds friable to firm, moderate fine and medium subangular blocky and fine granular; many fine and small roots; few channels; few ant casts; rare pores, rare clay-skins; few, fine, faint reddish mottles; indistinct boundary to:-

Btj 9-21" Reddish brown (5YR 4/4); clay; firm, peds firiable to firm; moderate to strong, coarse to fine subangular blocky and fine granular; few roots, few channels; and few ant casts; few pores, patchy clayskins on some peds and channels; diffuse boundary to:-

Btv 21-43" Yellowish red (5YR 4/6); clay; firm, peds firm; moderate coarse to fine sub-angular blocky; few roots, rare channels; few pores, many clayskins coating most ped faces; many, fine, distinct red and pinkish white (7.5YR 8/2) mottles; distinct boundary to:-

BCcn 43-54" Yellowish red (5YR 4/6) stony clay; weak cementation, moderately compact; weak, coarse to fine subangular blocky; rare roots; patchy clayskins on some peds; many, fine, distinct red and pinkish white mottles; stony with nodular laterite gravels and angular quartz; distinct boundary to:-

Cu 54"+ Weathering shales and tuffaceous sandstones.

Notes:

Capability Classification: Class 3

Limitations: 1. Hilly terrain
2. Compact subsoil
3. Stony soils.

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SEP: 033

JERAM SERIES (JEM)

LAB. NO: RR 30

Horizons	Depth (ins)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov. dry)	Percentage				Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen	C/N Ratio	P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++	
Ae	0- 4	33	26	40	2	-	-	4.3	1.9	3.9	-	1.12	.08	14	15	39	10.02	.14	.10	.02	.37	6	1.99
AB	4-12	37	28	37	1	-	-	4.4	1.8	2.8	-	.36	.04	9	11	18	8.64	.09	.16	.04	.21	6	2.69
Bt	12-19	43	24	32	1	1.12	-	4.6	2.2	3.0	-	.30	.04	7.5	13	18	9.16	.09	.16	.04	.31	6	3.54
Cucn	19-36	71	14	14	4	56.3	9.03	4.6	4.4	5.4	-	.30	.04	7.5	8	7	15.38	.14	.21	.04	.16	4	8.57

Series: JERAM (2b)

Family: Jempol

Great Soil Group: Red Brown Oxisols

Location: Just east of Kg. Buloh Nipis

Map Sheet and Grid Reference: 98/192905

Terrain: Hilly 16°

Vegetation: Primary forest - Lowland Dipterocarp forest

Elevation 100: a.s.l.

Drainage: Well drained

Erosion: Subject to sheet and rill erosion on clearing.

Parent rock: Red shales (slightly laterised)

Profile:-

Ae 0-4" Yellowish red - reddish yellow (5YR 5/6-6/6); clay loam; friable to firm; weak to moderate, fine and medium subangular blocky; abundant fine roots, few fine channels; common pores, few weak eluvial clayskins; diffuse boundary to:-

AB 4-12" Yellowish red (5YR 5/6); clay loam; friable; weak fine and medium subangular blocky breaking to weak fine platy; may roots, few fine channels; common pores, patchy clay-skins on some peds and channels; diffuse boundary to:-

Bt 12-19" Yellowish red (5YR 5/6-5/8); clay loam to clay; friable to firm; weak fine and medium subangular blocky breaking to weak very fine angular blocky; few fine roots, few fine channels; common pores, discontinuous clayskins on ped faces and in pores, and channels; common, very fine, subrounded, slightly laterised shale fragments; distinct boundary to:-

Cucn 19-36"+ Red to yellowish red (2.5YR 4/6-5YR 5/6); stony clay; firm; weak, coarse subangular blocky breaking to fine angular blocky; few pores, almost continuous clayskins coating peds; many gravel sized fragments of laterite and slightly laterised red shale.

Notes:

Capability Classification: Class 3

Limitations: 1. Hilly terrain
2.. Shallow soils.

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MUNCHONG SERIES (MUN)

LAB. NO: RS 176

Horizons	Depth (ins.)	Percentage On Original Sample						pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++		
Ah	0-½	85	8	5	5	Nil	Nil	5.1	3	21	6.75	3.92	0.30	13.06	108	85	29.44	.20	6.39	.19	2.86	33	-
Ae	½-5½	93	3	Nil	Nil	Nil	Nil	4.3	2	15	1.68	0.98	0.08	12.25	64	18	10.89	.05	.31	.08	0.31	7	-
Btj	5½-14	84	14	Nil	Nil	Nil	Nil	4.3	2	15	1.47	0.86	0.06	14.32	61	18	9.70	.03	.21	.10	0.21	6	-
Bt	14-56	96	4	Nil	Nil	Nil	Nil	4.5	2	14	0.74	0.43	0.04	10.75	56	18	6.98	.05	.16	.10	0.21	6	-

Series: MUNCHONG (3) Profile No: SEP 040

Family: Munchong

Great Soil Group: Red Brown Oxisols

Location: One mile west of Sg. Tepesok and 6 miles south of Bt. Ibam.

Map Sheet and Grid Reference: 98/168897

Terrain: Rolling - 6° at the foot of a low ridge.

Vegetation: Primary forest

Elevation: 50' a.s.l. Rainfall: 90-100".

Drainage: Well drained

Erosion: Nil

Parent rock: Shales

Profile:-

Aeh	0-3"	Yellowish brown (10YR 5/6); loam to silty clay loam; very friable to friable; moderate medium and fine subangular blocky and weak fine crumb; many roots, few medium channels, diffuse boundary to:-
AB	3-10"	Strong brown (7.5YR 5/6); silty clay loam; friable; weak to moderate, medium and fine subangular blocky; common roots, common, medium and fine channels; few pores, patchy clayskins lining pores and channels; few, fine, distinct pale brown mottles at the top at this horizon; diffuse boundary to:-
Btj	10-23"	Strong brown (7.5YR 5/6); clay loam; friable; moderate fine and very fine subangular blocky and fine crumb; rare roots, few channels; common pores, discontinuous clayskins on peds and lining channels and pores; diffuse boundary to:-
Btv	23-36"+	Strong brown to yellowish red (7.5YR 5/6-5YR 5/6); clay loam; friable to firm; moderate fine subangular blocky and fine crumb; rare roots, common pores, almost continous clayskins on peds and lining pores.

Notes:

Capability Classification: Class 1

Limitations:

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SEP: 079

SEGAWAT SERIES (SGT)

LAB. NO: RR 880

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K $N/2\ CH_3COOH$		K	Ca+	Na^+	Mg++		
Ah	0- 1	37	22	27	14	Nil	Nil	4.7	2.3	10.4	5.50	3.21	0.22	14.59	112	37	18.72	0.40	1.66	0.19	1.46	20	7.43
Ae	1-11	43	24	26	9	Nil	Nil	4.8	1.9	5.2	1.05	0.62	0.07	8.86	106	77	9.53	0.22	0.16	0.10	0.26	8	6.28
Btj	11-25	71	19	11	4	2.81	Nil	4.7	3.6	8.1	0.86	0.50	0.05	10.00	96	59	14.47	0.20	0.26	0.17	0.42	7	8.00
Bt	25-36	75	15	12	4	2.17	Nil	4.7	4.3	9.2	0.53	0.31	0.05	6.20	85	58	15.83	0.18	0.26	0.17	0.42	7	8.86
BG	36-42	72	14	16	3	0.72	Nil	4.7	4.5	9.4	0.34	0.19	0.03	6.33	76	48	17.02	..	0.16	0.15	0.42	5	7.14

Series: SEGAMAT (4)

Profile No: SEP 079

Family: Segamat

Great Soil Group: Yellow Red Oxisols

Location: Origin Rentis 62(90)°, 10 chains north of Pahang/Johore border on Kuala Rekoh Track.

Map Sheet and Grid Reference: 106/844380

Terrain: Undulating 4°

Vegetation: Primary forest = Lowland Dipterocarp forest

Elevation: 150' a.s.l. Rainfall: 75-80"

Drainage: Very well drained.

Erosion: Nil

Parent rock: Andesite

Profile:-

Ah 0-1" Reddish brown (2.5YR 4/4); humic clay loam; very friable; moderate, fine granular and fine crumb and some fine subangular blocky; abundant fine roots, few obvious channels; common pores; distinct boundary to:-

1-11" Yellowish red (5YR 4/8); clay loam to clay; friable to firm; moderate fine and medium subangular blocky and fine granular; many roots, common channels; common pores, patchy clayskins on some peds; rare gritty laterite fragments; indistinct boundary to:-

11-25" Red (2.5YR 4/8); clay; very firm, peds firm; strong medium and coarse subangular blocky; many fine roots, common channels; few casts; few pores; many clayskins on peds and in channels; reddish brown in colour; rare, fine, faint, pale yellow mottles; few nodular laterite gravels; indistinct boundary to:-

25-36" Red (2.5YR 4/6); clay; firm, peds friable; moderate medium to fine subangular blocky; few small roots, few channels; few pores, patchy clayskins on peds; few nodular laterite gravels; indistinct boundary to:-

36-42"+ Red (2.5YR 4/6); firm, peds friable; moderate fine and medium subangular blocky; few channels; few pores, patchy clayskins on ped faces; common, medium, distinct pale yellow mottles; slightly stony, subangular decayed andesite stones.

Notes: The 6N HCl soluble Fe_2O_3 figures are rather low for this soil.

Capability Classification: Class 1

Limitations: None

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TAVY SERIES (TVY)

LAB. NO. RR

Horizons	Depth (ins)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov. dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeabl Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble	P ppm. 6N HCl
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++			
Ah	0- 4	42	35	17	6	Nil	Nil	3.8	-	5.3	-	1.33	0.11	13.82	-	-	9.68	0.09	0.16	0.02	0.26	5	3.39	150
Ae	4-14	44	33	16	6	1	Nil	4.0	-	4.0	-	0.66	0.08	8.25	-	-	8.47	0.04	0.13	0.01	0.18	4	3.47	152
BCnt	14-21	59	29	11	5	20	4.5	4.5	-	5.2	-	0.53	0.08	6.75	-	-	9.50	0.05	0.29	0.02	0.18	6	5.54	152
BCcn	21-33	71	21	8	4	41	4.7	4.7	-	8.0	-	0.41	0.07	5.86	-	-	12.44	0.04	0.16	0.01	0.16	3	11.07	152
C	33-52	77	17	8	2	30	5.0	5.0	-	8.1	-	0.28	0.07	4.00	-	-	12.61	0.02	0.31	0.02	0.16	4	12.79	115

Series: TAVY (6)

Profile No:

Family: Tavy

Great Soil Group: Concretionary Oxisol

Location: Just beside timber track about 2 miles from Jalan Cheroh in the Tersang Forest Reserve, Pahang.

Terrain: 5^{0} slope in near level terrain.

Vegetation: Primary forest

Elevation:

Drainage:

Erosion:

Parent rock: Shale .

Profile:-

Ah	0-4"	Yellowish brown (10YR 5/6); friable silty clay loam with a moderate fine and medium subangular blocky, granular and crumb structure; abundant roots; many casts and channels; many pores; weakly developed clayskins; few quartz grits, boundary diffuse.
Ae	4-14"	Yellowish brown to brown yellow (10YR 5/6-6/6); friable silty clay loam; moderate medium, coarse and fine subangular blocky structure; many roots, casts and channels; many pores; moderately developed clayskins; few fine angular quartz fragments; few faint fine reddish yellow (7.5YR 6/6) mottles; very few nodular laterite gravels; boundary indistinct.
Bcnt	14-21"	Strong brown (7.5YR 5/8); friable very gravelly silty clay; weak coarse and medium subangular blocky and fine crumb structure; few roots, casts and channels; few pores; moderately developed clayskins; few fine angular quartz fragments; few medium reddish yellow (7.5YR 6/6) mottles; abundant stones and gravels of nodular laterite; boundary indistinct.
BCcn	21-33"	Yellow red (5YR 5/8); friable to firm very stony clay; weak coarse and medium subangular blocky structure; very few roots and channels; few pores; moderately developed clayskins; many faint strong brown (7.5YR 5/8) mottles; abundant stones and gravels of nodular and fragmental laterite; boundary distinct.
C	33-52"	Variegated strong brown (7.5YR 5/8); weak red (10YR 4/4) and red (10YR 4/6) friable stony clay; weak medium and fine subangular blocky structures; very few roots; few pores; strongly developed reddish yellow (7.5YR 6/8) mottles; many angular laterite stones and gravels becoming few with increasing depth.

Notes:

Capability Classification: Class 2

Limitations: Somewhat compact nature and shallow depth of horizon of indurated plinthite fragments.

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SEP: 058

RENGAM SERIES (RGM)

LAB. NO: RR 526

Horizons	Depth (ins)	Percentage				On Original Sample		pH(air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0-2½	22	4	21	58	36.36	Nil	5.2	1	5	3.99	2.32	0.20	11.6	31	46	5.45	0.02	0.52	0.08	0.88	28	0.80
Ae	2½-13	42	5	11	46	68.61	Nil	4.8	1	6	1.38	0.80	0.08	10.0	15	24	4.77	0.07	0.16	0.08	0.62	19	1.69
Btm	13-48	59	2	8	36	38.64	Nil	5.0	1	8	1.10	0.64	0.06	10.66	14	32	4.77	0.05	0.16	0.10	0.47	17	2.54
BCtm	48-84	57	4	10	31	54.43	Nil	5.0	2	9	0.59	0.34	0.03	11.33	10	32	5.11	0.05	0.16	0.10	0.52	16	3.00

Series: RENGAM (7)

Profile No: SeP 058

Family: Rengam

Great Soil Group: Red Yellow Ultisols

Location: Ulu Sg. Atoh, about 4 miles north of Kg. Gambir.

Map Sheet and Grid Reference: 106/958491

Terrain: Undulating 4° - dissected erosion surface

Vegetation: Primary forest - Lowland Dipterocarp forest

Elevation: 200' a.s.l. Rainfall: 80-90"

Drainage: Well drained

Erosion: Gullying on clearing

Parent rock: Granite

Profile:-

Ah 0-2½" Brown to dark brown (10YR 4/3) coarse sandy clay loam; very friable; moderate very fine and fine subangular blocky and fine medium granular; many fine roots, common channels; many pores; common angular quartz grains; diffuse boundary to:-

Ae 2½-13" Yellow (10YR 7/6), coarse sandy clay; very friable; peds friable; moderate very fine medium subangular blocky and medium and fine granular; few roots; common fine channels; many pores; weak patchy clayskins in some channels; common angular quartz grains; diffuse boundary to:-

Bt 13-48" Reddish yellow (7.5YR 6/7); coarse sandy clay; very friable, peds friable; weak to moderate, fine and medium subangular blocky and moderate fine and medium granular; few roots, common channels; many pores; discontinuous clayskins in channels and on some peds; common angular quartz grains; diffuse boundary to:-

BCm 48-84"+ Reddish yellow (7.5YR 6/7); gritty clay; very friable; weak to moderate medium and fine subangular blocky and medium and fine granular; rare roots, few channels; common pores, almost continuous clayskins (7.5YR 6/6) on peds and in pores and channels; many angular quartz grains; many, medium to large, distinct red blotches appearing at 7' depth.

Notes:

Capability Classification: Class I

Limitations: 1. Susceptibility to erosion n steeper areas.

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SEP: 075

SERDANG SERIES (SDG)

LAB. NO: RR 876

Horizons	Depth (ins)	Percentage				On Original Sample		pH(air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K	Ca+	Na+	Mg++		
Ah	0- 2	22	4	47	33	Nil	Nil	4.1	1	5.0	2.77	1.62	0.11	14.73	56	46	9.53	0.05	0.21	0.06	0.36	7	0.91
Aa	2- 9	28	4	45	27	Nil	Nil	4.6	1	3.4	0.71	0.43	0.03	14.33	48	7	6.47	Nil	0.16	0.03	0.10	5	1.41
AB	9-20	32	6	39	29	Nil	Nil	4.4	1	3.8	0.52	0.30	0.03	10.00	46	7	6.64	Nil	0.16	0.04	0.10	5	1.71
Btj	20-38	35	4	39	27	Nil	Nil	4.4	2	4.0	0.36	0.21	0.02	10.50	44	tr.	6.81	Nil	0.16	0.06	0.10	4	1.77
Bt	38-56	41	4	37	23	Nil	Nil	4.5	2	4.7	0.32	0.19	0.01	19.00	41	tr.	8.81	Nil	0.16	0.06	0.10	4	2.17
BC	56-72	43	4	34	25	Nil	Nil	4.8	2	4.8	0.21	0.12	0.01	12.00	37	tr.	6.81	Nil	0.16	0.08	0.10	4	2.22

Series: SERDANG (8a) Profile No: SEP 075

Family: Serdang

Great Soil Group: Red Yellow Ultisols

Location: About half a mile east of the Kuala Rekoh track at the Pahang/Johore border.

Map Sheet and Grid Reference: 106/857926

Terrain: Rolling 7^{0} on top of a low hill

Vegetation: Primary forest - Lowland Dipterocarp forest.

Elevation: 250' a.s.l. Rainfall: 75-80"

Drainage: Well drained.

Erosion: Sheet erosion on clearing

Parent rock: Sandstones and quartz veins.

Profile:-

Ah 0-2" Dark brown (10YR 4/3-3/3); sandy loam; very friable, moderate fine and very fine subangular blocky and fine granular, abundant fine roots, common channels; incorporated humus, common fine angular quartz grains; distinct boundary to:-

Ae 2-9" Yellowish brown (10YR 5/6); sandy clay loam; friable, peds very friable; moderate to weak fine and medium, subangular bocky breaking to medium granular; common large and fine roots, many fine channels; few pores, patchy eluvial clayskins lining channels; incorporated humus; indistinct boundary to:-

AB 9-20" Yellowish brown (10YR 5/8); sandy clay loam; friable peds very friable; weak to moderate, fine and medium subangular blocky, breaking to fine and medium granular; few roots, many fine and small channels; few fine ant casts; few pore, patchy clayskins lining channels; and pores; incorporated humus and some fine angular quartz grains indistinct and irregular boundary to:-

Btj 20-38" Strong brown (7.5YR 5/6); sandy clay loam to sandy clay friable to firm; weak fine and medium subangular blocky; few roots, common fine channels; few pores, patchy clayskins on ped faces and in pores and channels; incorporated humus; some fine subangular quartz grains; indistinct boundary to:-

Bt 38-56" Strong brown (7.5YR 5/8); sandy clay; friable, peds friable to firm; weak fine subangular blocky; rare roots, few channels; common pores, discontinuous clayskins on peds and in pores and channels; incorporated humus from dead roots; some fine subangular quartz grains; indistinct boundary to:-

BC 56-72"+ Reddish yellow(7.5YR 6/8); sandy clay; friable; peds friable to fir; weak fine and medium subangular blocky; rare roots, few channels; common pores, rare thin clayskins.

Notes: Rare indistinct pale yellow mottles in B horizon.

Capability Classification: Class 1

Limitations: 1. Susceptibility to erosion.

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SEP: 101

KEDAH SERIES (KDH)

LAB. NO: RS 320

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0-1½	22	6	28	49	0.4	Nil	5.1	1	-	2.76	1.60	0.11	14.55	84	165	9.08	0.45	0.70	0.79	1.62	39	1.03
Ae	1½- 5	30	4	26	44	0.2	Nil	4.4	1	-	0.77	0.45	0.05	9.00	64	68	5.83	0.22	0.16	0.48	0.70	27	1.39
AB	5-12	32	4	27	42	0.4	Nil	4.6	1	-	0.59	0.34	0.04	8.50	62	45	6.34	0.14	0.16	0.18	0.27	12	2.00
Btj	12-26	34	6	25	40	0.6	Nil	4.5	1	-	0.59	0.34	0.04	8.50	60	28	6.00	0.09	0.16	0.14	0.27	11	2.33
Cu	26+	36	6	20	43	0.9	0.6	4.6	1	-	0.28	0.16	0.02	8.00	65	20	6.00	0.06	0.16	0.19	0.32	23	2.33

Series: KEDAH (8b) Profile No: SEP 101

Family: Serdang

Great Soil Group: Red Yellow Ultisols

Location: Side of ridge on eastern edge of Ulu Sg. Serai valley

Map Sheet and Grid Reference: 99/362080

Terrain: Steep - 22°

Vegetation: Primary forest - Lowland Dipterocarp forest

Elevation: 250' a.s.l. Rainfall: 110-120"

Drainage: Well drained

Erosion: Sheet and rills - gullying on clearing

Parent rock: Sandstone

Profile:-

Ah 0-1½" Brown to dark brown (7.5YR 4/4); loamy sand; loose to very friable, peds very friable; moderate fine crumb, fine granular and weak to moderate, very fine subangular blocky; many small roots, many channels, few casts; many pores; distinct boundary to:-

Ae 1½-5" Brown (7.5YR 5/4); sandy loam; very friable, peds friable; weak to moderate, fine and medium subangular blocky and fine crumb; many small roots, many channels, few casts; common pores; diffuse boundary to:-

AB 5-12" Brown (7.5YR 5/4); sandy clay loam; friable, peds friable; weak to moderate fine and medium subangular blocky and fine crumb; common fine roots, common channels, few casts; common pores, patchy clayskins on some peds and in pores and channels; diffuse boundary to:-

Btj 12-26" Brown (7.5YR 5/4); sandy clay loam to sandy clay; friable to firm, peds friable; moderate fine cast granular, moderate to weak, fine and medium subangular blocky and fine crumb; few roots, common channels; many ant casts; common pores, discontinuous clayskins reddish brown in colour, coating pores and channels and on cast granular peds; distinct and irregular boundary to:-

Cc 26"+ Brown (7.5YR 5/4); sandy clay; friable to firm, weak fine and medium subangular blocky; rare roots, few channels; common pores, patchy clayskins on peds; common, fine, distinct, yellowish brown mottles; slightly stony, small and large angular sandstones and nodular laterite stones - stones increasing with depth.

Notes:

Capability Classification: Class 5

Limitation: 1. Steep slopes
2. Shallow stony soils
3. Very high susceptibility to erosion.

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SEP: 077

HARIMAU SERIES (HRU)

LAB. NO: RR 878

Horizons	Depth (ins.)	Percentage On Original Sample						pH (air dry)	Moisture % (air dry - ov.dry)	Percentage					Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen	C/N Ratio	P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0- 2	20	6	38	42	0.92	Nil	4.4	1	4.4	2.41	1.40	0.10	14.0	57	46	7.66	0.07	0.16	0.15	0.31	9	0.63
Ae(h)	2-11	22	6	33	43	2.84	Nil	4.5	1	3.1	0.43	0.25	0.03	8.33	50	7	4.77	0.02	0.05	0.08	0.05	4	0.99
BA	11-22	32	8	26	39	6.57	Nil	4.5	1	4.6	0.43	0.25	0.03	8.33	48	7	5.62	Nil	0.05	0.10	0.05	4	1.41
Bt	22-46	35	6	26	37	7.11	Nil	4.7	2	4.6	0.43	0.25	0.03	8.33	44	tr.	5.79	Nil	0.05	0.06	Nil	2	1.77
BC	46-60	30	6	27	42	9.47	Nil	4.8	1	3.4	0.10	0.06	0.02	3.0	42	tr.	4.45	Nil	0.05	0.12	Nil	4	1.26
C	60-70	22	4	35	44	6.41	Nil	4.7	1	2.0	0.03	0.02	0.02	1.0	39	tr.	2.21	Nil	0.10	0.08	Nil	8	0.70

Series: HARIMAU (9)

Profile No: SEP 077

Family: Harimau

Great Soil Group:

Location: Ulu Sg. Rekoh, Chain 200 Rentis Ch 1 (60°)

Map Sheet and Grid Reference: 106/885394

Terrain: Rolling - site on edge of terrace - slope 14°

Vegetation: Primary forest - Lowland Dipterocarp forest

Elevation: 150' a.s.l.

Rainfall: 75-80"

Drainage: Moderately well drained.

Erosion: Sheet erosion on clearing

Parent material: Older Alluvium (fluviatile)

Profile:-

Ah	0-2"	Dark yellowish brown (10YR 4/4); sandy loam; very friable; moderate fine and medium subangular blocky and fine granular; abundant fine roots, few fine channels; rare fine pores; incorporated humus, common angular quartz grains; distinct boundary to:
Ae(h)	2-11"	Brownish yellow (10YR 6/6); loam sandy clay loam; very friable to friable; weak to moderate medium and fine subangular blocky and fine granular, common fine and medium roots, few channels; few pores; incorporated humus, common angular quartz grains, diffuse boundary to:-
BA	11-22"	Brownish yellow (10YR 6/6); sandy clay loam; friable; weak to moderate fine and medium subangular blocky and medium and fine granular; few roots, common channels; common pores; many angular quartz grains; few, fine, faint pinkish gray mottles; diffuse boundary to:-
Bt	22-46"	Brownish yellow (10YR 6/8); sandy clay loam; friable; weak to moderate medium and fine subangular blocky and fine granular; rare roots, few channels; many pores, discontinuous clayskins in pores and on peds; many angular quartz grains; few, fine, faint, red and yellowish red mottles; diffuse boundary to:-
BC	46-60"	Brownish yellow (10YR 6/6-6/8); sandy clay loam; very weakly cemented, peds friable; weak fine and medium subangular blocky and fine granular; few channels; common pores, rare clayskins along channels; many angular quartz grains; many fine, distinct, yellowish red mottles; distinct boundary to:-
C	60-70"	Reddish yellow (7.5YR 6/6-7/6) sandy clay loam; friable to very friable; weak fine and medium subangular blocky and fine granular; few channels; common pores; many angular quartz grains; many, fine and medium, prominent yellowish red and pale yellow mottles.

Notes:

Capability Classification: Class 3

Limitation: 1. Very low nutrient status

2. Susceptibility to erosion

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SEP: 076

TAMPOI SERIES (TMP)

LAB. NO: RR 877

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0- 4	26	6	34	39	1.65	Nil	4.4	1	5.5	2.45	1.43	0.10	14.3	51	46	7.49	0.07	0.16	0.10	0.72	14	-
Ae	4-10	24	8	37	36	5.58	Nil	5.1	1	3.3	0.74	0.43	0.04	10.75	43	18	3.91	0.04	0.16	0.04	0.31	14	-
AB	10-22	43	8	25	29	16.21	Nil	5.0	2	5.7	0.53	0.31	0.03	10.33	36	18	3.06	0.04	0.16	0.15	0.31	21	-
Bt	22-42	63	6	16	20	5.48	Nil	5.2	2	8.7	0.53	0.31	0.02	15.5	31	7	6.81	0.04	0.10	0.11	0.16	6	-
Ccn	42-70	55	6	20	23	20.16	0.65	5.2	2	7.4	0.34	0.20	0.02	10.0	30	7	5.45	0.02	0.10	0.11	0.05	5	-

Series: TAMPOI (9) Profile No: SEP 076

Family: Harimau

Great Soil Group: Red Yellow Ultisols

Location: Mile 2 on rentis running north-east from origin on Kuala Rekoh at Pahang/ Johore border.

Map Sheet and Grid Reference: 106/878389

Terrain: Gently undulating - 4° - eroded high level terrace

Vegetation: Primary forest - Lowland Dipterocarp forest

Elevation: 150' a.s.l. Rainfall: 70-80"

Drainage: Moderately well drained

Erosion: Nil

Parent material: Older alluvium (fluviatile)

Profile:-

Ah 0-4" Yellowish brown, (10YR 5/4); sandy loam to sandy clay loam; friable; moderate fine subangular blocky with fine granular and fine crumb; abundant fine roots, few channels; common pores; some incorporated humus; distinct boundary to:-

Ae 4-10" Yellowish brown (10YR 5/6-5/8); sandy loam to sandy clay loam; friable ; moderate to weak, medium and fine subangular blocky and fine granular; many fine roots, and few small channels; few pores; thin patchy clayskins lining root channels, some incorporated humus; indistinct boundary to:-

AB 10-22" Strong brown to reddish yellow (7.5YR 5/[illegible]-6/6); sandy clay; friable; weak to moderate, medium and fine subangular blocky and medium and fine granular; few roots, few channels; common pores; discontinuous clayskins lining roots and channels; indistinct boundary to:-

Bt 22-42" Reddish yellow (7.5YR 6/8); sandy clay; friable to firm, peds friable; weak to moderate, medium and fine subangular blocky, breaking to fine granular; few roots, few channels; few pores, discontinuous clayskin lining roots and channels; and on grain surfaces; many, fine and medium, distinct, red mootles; distinct boundary to:-

BC 42-70"+ Reddish yellow (7.5YR 6/6-7/6); sandy clay; slightly compact, peds firm; very weak, fine and medium subangular blocky; rare channels; few pores; variegated with approximately 50% red mottles of varying sizes; abundant fine quartz grits and few nodular gravels of indurated plinthite.

Notes: Quartz grits recognisable throughout.

Capability Classification: Class 3

Limitations: 1. Generally major and minor nutrient deficiencies.
2. Susceptible to gully erosion.

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KAWANG SERIES

AVERAGE CHEMICAL ANALYSIS FROM FOUR REPRESENTATIVE PROFILES

Horizon	% clay /_.002mm.	% silt .002-.02 mm.	% fine sand .02-.2mm.	% coarse sand .2-2mm.	% gravel 2-10mm.	pH	C.E.C. me/100 gm.	% Satn.	% Fe_2O_3 (6N HCl)	% C	% N	Easily Soluble P p.p.m.	Easily Soluble K p.p.m.
Ah	34	10	32	26	1.0	4.7	13.0	9	1.00	1.72	0.15	150	68
Ae	38	9	28	27	4.6	4.7	8.8	6	1.54	0.56	0.07	65	26
Btg	50	8	19	26	13.6	4.7	8.8	10	1.96	0.41	0.04	51	16
C	46	8	20	31	24.8	4.7	6.0	5	3.77	0.21	0.03	56	11

Series: KAJANG (9) Profile No: SEP 054

Family: Harimau

Great Soil Group: Red Yellow Ultisols

Location: Kampong Kuala Rekoh - Sg. Keratong

Map Sheet and Grid Reference: 106/891447

Terrain: Moderately steeply sloping 15° - terrace edge

Vegetation: Abandoned aborigine ladang

Elevation: 120' a.s.l. Rainfall: 90-100"

Drainage: Moderately well drained.
Erosion: Sheet
Parent material: Older Alluvium

Profile:-

Surface litter of fragments of organic material and wash of subangular quartz grains.

Ap 0-7½" Dark grayish brown (10YR 4/2); sandy loam; very friable to friable; weak to moderate fine and very fine subangular blocky; common fine roots, few channels, few pores; common small pieces of carbon; diffuse boundary to:-

Ae 7½-17" Pale yellow (2.5Y 7/4); coarse sandy loam to coarse sandy clay loam; friable; weak to moderate fine and medium subangular blocky; common very fine roots, few channels; few pores; small pieces of carbon; indistinct boundary to:-

AB 17-27" Pale yellow (2.5Y 7/4); coarse sandy clay loam; friable; weak fine and medium subangular blocky and moderate to weak fine crumb; few fine channels; few pores, patchy clay skins lining pores; distinct boundary to:-

Btj 27-37" Brownish yellow (10YR 6/8); coarse sandy clay; firm, weak fine and medium subangular blocky; rare channels; few pores, patchy clayskins in pores and channels and on some ped faces; common, fine, faint, 10YR 6/8 mottles; diffuse boundary to:-

BC 37-60" Brownish yellow (10YR 6/6) coarse sandy clay; very firm; very weak fine and medium subangular blocky; rare channels; few pores; patch clayskins in channels and pores; many, fine and medium, distinct white and red mottles; gradually merging to:-

Cu 60"+ Reddish yellow, strongly mottled, stony clay, with abundant quartz grains and grits, rounded quartz gravel and rare nodular lateritic concretions.

Notes: Common angular and subangular quartz grains throughout.

Capability Classification: Class 3

Limitations: 1. Usually very low nutrient levels - often with trace element defieciencies.
2. Subject to erosion on terrace edges.

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SEP: 035

DURIAN SERIES (DRN)

LAB. NO: RR 31

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K	Ca++	Na+	Mg++		
Aeh	0- 4	27	26	46	1	-	-	4.2	1.8	5.5	-	1.57	.09	17.5	13	32	12.79	.07	.26	.02	.58	9	1.12
Ae	4- 8	28	25	46	1	-	-	4.4	1.6	3.7	-	.73	.05	14.6	10	18	8.81	.05	.21	.02	.26	6	1.34
BA	8-24	33	24	46	1	-	-	4.6	1.7	3.3	-	.27	.03	9.0	6	7	7.26	.04	.16	.02	.10	4	1.82
Bt	24-36	37	22	42	1	-	-	4.5	1.9	3.7	-	.21	.02	10.5	9	7	7.60	.04	.16	.02	.10	4	2.00

Series: DURIAN (10) Profile No: SEP 035

Family: Durian

Great Soil Group: Yellow Grey Ultisols

Location: Just west of the S. Tepesok, 6miles south of Bt. Ibam

Map Sheet and Grid Reference:

Terrain: Gently undulating 2^{0}

Vegetation: Secondary forest 20 years regrowth after clearing

Elevation: 70' a.s.l. Rainfall: 95-100"

Drainage: Moderately well drained.

Erosion: Nil

Paranent material/rock: Mottled clay over quartz porphyry

Profile:-

Aeh	0-4"	Yellowish brown (10YR 5/4); very fine sandy clay loam; friable; moderate fine subangular blocky; many fine roots, few channels; few pores; diffuse boundary to:-
Ae	4-8"	Yellow (10YR 7/6); very fine sandy clay loam; friable; moderate to a strong, fine subangular blocky; common roots, few channels, few casts; few pores, patchy clayskins in channels; a fine white coating on some ped faces; diffuse boundary to:-
BA	8-24"	Brownish yellow (10YR 6/8); clay loam; friable to form; moderate to weak, fine and medium subangular blocky and weak fine platy; few roots, few casts, few channels; few pores, discontinuous clayskins on ped faces and in pores and channels distinct boundary to:-
Bt	24-36"	Brownish yellow (10YR 6/6); clay loam; slightly compact, peds friable; weak, fine and medium subangular blocky; few roots, few fine channels; few pores, discontinuous clayskins on ped faces and in pores and channels; rare, fine, subangular and nodular laterite gravels.

Notes:

Capability Classification: Class 3

Limitations: 1. Compact subsoil
2. Often stony below 3'
3. Susceptible to erosion on steeper slopes.

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SEP: 049

BUNGUR SERIES (BGR)

LAB. NO: RR 524

Horizons	Depth (ins.)	Percentage				On Original Sample		pH(air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++		
Ap	0- 9	26	16	47	16	Nil	Nil	4.3	1	5	2.20	1.28	0 .09	14.22	17	32	6.64	0.07	0.31	0.06	0.36	12	1.05
Ae	9-17	28	14	41	21	Nil	Nil	4.6	1	3	0.45	0.26	0.05	5.20	9	18	3.91	0.02	0.10	0.04	0.10	8	1.37
Btj	17-30	45	12	34	14	Nil	Nil	4.6	1	5	0.36	0.21	0.02	10.50	5	7	5.11	0.02	0.10	0.06	0.05	5	2.39
Bt	30-3	53	10	30	12	Nil	Nil	4.5	2	6	0.31	0.18	0.02	9.00	5	7	5.62	0.02	0.16	0.04	0.10	6	2.94
Bti	39-60	51	14	27	10	Nil	Nil	4.6	2	6	0.26	0.15	0.02	7.50	4	Tr	5.11	0.02	0.16	0.10	0.10	7	3.53

Series: BUNGOR (10b) Profile No: SEP 049

Family: Durian

Great Soil Group: Yellow Gray Ultisols

Location: Mile 22 Pekan - Batu Balek road

Map Sheet and Grid Reference: 3 D/9/379384

Terrain: Undulating 2^0 - broad ridge of old erosion surface

Vegetation: Two year old rubber and lalang

Elevation: 50' a.s.l. Rainfall: 120-130"

Drainage: Moderately well drained.

Erosion: Nil

Parent rock: Quartzite

Profile:-

Ap 0-9" Dark grayish brown (10YR 4/2); sandy clay loam; very friable to friable; moderate to strong, very fine and fine subangular blocky and fine east granular; many fine and medium roots, rare casts, rare channels; few pores; some angular quartz grains; distinct boundary to:-

Ae 9-17" Yellowish brown to brownish yellow (10YR 5/6-6/8); sandy clay loam; friable; weak to moderate, fine and medium subangular blocky; few roots, common casts, channels; and pores; some angular quartz grains; common, fine, distinct, reddish yellow and brown mottles; diffuse boundary to:-

Btj 17-30" Brownish yellow (10YR 6/6); sandy clay; firm; moderate fine and medium subangular blocky and fine granular; rare roots, rare casts and channels; few pores, discontinuous; very thin, clayskins on peds and in channels; some subangular quartz grains, diffuse boundary to:-

Bt 30-39" Reddish yellow (7.5YR 6/8); sandy clay to clay; firm, moderate fine and medium subangular blocky and fine granular; rare fine channels; few pores, patchy very thin clayskins on peds and in channels; and pores; some angular and subangular quartz grains; diffuse boundary to:-

Bti 39-60"+ Brownish yellow (10YR 6/6); clay; very firm; weak to moderate fine and medium subangular blocky and fine granular; rare fine channels; few pores, patchy clayskins on peds and in pores and channels; some angular and subangular quartz grains; many fine prominent red mottles.

Notes:

Capability Classification: Class 2

Limitations: 1. Compact subsoil
2. Susceptible to erosionon steep slopes.

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SEP: 100

KUALA BRANG SERIES (KLG)

LAB. NO: RS 319

Horizons	Depth	Percentage				On Original Sample		PH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3% 6N HCl Soluble
		Clay %	Silt %	Fine Sand %	Coarse Sand %	Gravel	Stones			Loss on ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/3 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0-1½	18	4	30	52	Nil	Nil	4.5	1	-	2.06	1.17	0.09	13.0	88	63	6.00	0.18	0.49	0.52	0.76	32	0.54
Ae	1½-6	22	6	30	47	Nil	Nil	4.7	1	-	0.71	0.41	0.03	13.66	80	28	5.48	0.09	0.05	0.16	0.38	12	0.93
AB	6-10	26	8	30	40	Nil	Nil	4.7	1	-	0.31	0.18	0.02	9.00	72	20	3.60	0.06	0.16	0.14	0.32	19	1.12
Btj	10-28	28	4	28	45	0.4	Nil	4.6	1	-	0.31	0.18	0.02	9.00	64	20	4.29	0.06	0.16	0.16	0.32	17	1.24
BC	28-36+"	30	4	25	44	Nil	Nil	4.5	1	-	0.71	0.41	0.02	20.50	62	20	4.11	0.03	0.16	0.18	0.32	7	1.49

Series: KUALA BRANG (10) Profile No: SEP 100

Family: Durian

Great Soil Group: Yellow Gray Ultisols

Location: Side of ridge on eastern edge of valley of Ulu Serai.

Map Sheet and Grid Reference: 99/382077

Vegetation: Primary forest - lowland Dipterocarp forest.

Elevation: 250' a.s.l.

Drainage: Well drained Rainfall: 110-120"

Erosion: Sheet - rills and gullying on clearing

Parent rock: Banded sandstones

Profile:-

Ah 0-1½" Brown to dark brown (7.5YR 4/4); sandy loam; loose to very friable; peds friable weak to moderate, very fine subangular blocky, fine crumb and fine granular; few fine roots, few channels; few casts; common to many pores; incorporated humus and fine angular quartz grains; distinct boundary to:-

Ae 1½-6" Yellowish brown (10YR 5/6); sandy loam; friable; peds very friable; weak fine and medium subangular blocky, and fine crumb; few roots, common channels, few casts; common pores; fine angular quartz grains and incorporated humus; diffuse boundary to:-

AB 6-10" Yellowish brown to brownish yellow (10YR 5/6-6/8); sandy loam; friable, peds friable, peds friable; weak to moderate, fine and medium subangular blocky and fine crumb; few roots, common channels; few casts; common pores, few very thin clayskins lining channels; fine angular quartz grains; and incorporated humus; diffuse boundary to:-

Bt 10-28" Brownish yellow (10YR 6/6); sandy loam to sandy clay loam; friable to firm; friable to firm, peds friable; weak to moderate, fine and medium subangular blocky and fine crumb; few roots, common channels; common pores, few very thin clayskins lining channels; fine angular quartz grains; few, fine, distinct, yellowish red and strong brown mottles; diffuse boundary to:-

BC 28-36" Reddish yellow (7.5YR 6/8) sandy clay loam; firm, peds friable; weak to moderate, fine and medium subangular blocky and fine crumb, few roots, common channels; common pores, patchy clayskins in pores and channels; fine angular quartz grains; few, fine distinct, yellowish red, mottles; below 36" becoming extremely stony with sandstone boulders.

Notes: 1. May be slightly truncated
2. Common ants nests in voids throughout.

Capability Classification: Class 3

Limitations: 1. Hilly terrain
2. Sandy soils
3. High susceptibility to erosion.

.../85

SEP: 095

PENYABONG SERIES (PBG)

LAB. NO: R8.367

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++		
Ah	0- 1	35	34	26	7	Nil	Nil	5.4	2	-	4.20	2.44	0.20	12.20	112	NOT DETERMINED	18.17	0.46	2.48	0.14	3.29	35	1.12
AB	1- 4	37	34	24	5	0.1	2.9	4.8	2	-	3.54	2.06	0.17	12.12	104		15.94	0.29	0.76	0.18	1.73	19	1.54
BC	4-14	39	29	23	15	0.4	5.3	4.9	2	-	1.43	0.83	0.07	11.86	88		11.65	0.22	0.43	0.13	0.65	12	3.98

Series: PENYABONG (11)

Profile No: SEP 095

Family: Kulai

Great Soil Group: Yellow Grey Ultisols

Location: Tanjong Batu, JKR Quarry

Map Sheet and Grid Reference: 100/758042

Terrain: Strongly sloping 18^{0} on side of low hill

Vegetation: Lalang and low bushes and young rubber

Elevation: 125' a.s.l.

Rainfall: 110-120"

Drainage: Well drained

Erosion: Highly susceptible to rillwash and gullying

Parent rock: Rhyolitic tuff

Profile:-

Ah 0-1" Dark greyish brown (10YR 4/2); silty clay loam; loose to very friable, peds friable; moderate to strong, medium and fine crumb and granular; moderate, very fine subangular blocky; many fine roots; many channels; many casts; few pores; incoporated humus; diffuse and irregular boundary to:-

Ae 1-4" Brown (7.5YR 5/2) clay loam; friable, peds friable; moderate strong; fine to very fine subangular blocky, fine granular and fine crumb; many fine and small roots, common channels; common casts; common pores; thin clayskins on casts; rare, angular, stones, of rhyolitic tuff; distinct boundary to:-

AC 4-14" Brown (7.5YR 5/4); stony clay loam; friable to firm, peds friable; moderate to strong, fine subangular blocky and fine granular; common fine and medium roots, many channels, common casts; common pores, thin clayskins on casts; very stony, angular, gravel to large stones of rhyolitic tuff.

Notes:

Capability Classification: Class 5

Limitations: 1. Generally steep terrain
2. Shallow soils
3. High susceptibility to erosion.

.../86

BATU ANAM SERIES

AVERAGE CHEMICAL ANALYSIS FROM FOUR REPRESENTATIVE PROFILES

Horizon	% clay /_.002mm.	% silt .002-.02 mm.	% fine sand .02-.2mm.	% coarse sand .2-2mm.	% gravel 2-10mm.	pH	C.E.C. me/100 gm.	% Satn.	% Fe_2O_3 (6N HCl)	% C	% N	Easily Soluble P p.p.m.	Easily Soluble K p.p.m.
Ah	47	23	22	7	-	4.4	11.7	9	1.52	2.03	0.16	39	88
Ae	54	22	19	5	-	4.7	7.3	7	2.10	0.54	0.07	27	44
Bt	58	19	11	3	1.8	4.7	8.4	6	3.94	0.27	0.05	18	22
Btg	74	18	7	2	1.0	4.7	8.8	5	2.63	0.18	0.04	12	15
C	71	19	10	1	-	4.8	7.7	5	2.01	0.15	0.03	9	14

Series: BATU ANAM (12) Profile No: SEP 062

Family: Batu Anam

Great Soil Group: Yellow Grey Ultisols

Location: Just north of Bukit Chepamak on track to Batu Gong

Map Sheet and Grid Reference: 91/112989

Terrain: Rolling 8^{0} - on dissected old erosion surface

Vegetation: 140' a.s.l. Rainfall: 100-110"

Drainage: Somewhat imperfectly drained

Erosion: Minor sheet

Parant rock: Shales

Profile:-

0-1½" Dark brown (7.5YR 4/2); loam to clay loam; very friable, peds friable; moderate to weak fine subangular blocky and weak fine crumb; many roots, common fine channels; few pores; some incorporated humus; distinct boundary to:-

1½-12" Pale yellow, (2.5Y 8/4); silty clay loam; friable moderate to weak medium and fine subangular blocky, common roots, few channels; few pores; diffuse boundary to:-

12-18" Pale yellow (2.5Y 7/4); silty clay loam; firm; weak medium and fine subangular blocky; few pores; common, very fine and fine, distinct light grey mottles; distinct boundary to:-

18-27" Pale yellow (2.5Y 7/4); silty clay; firm, weak, medium and fine subangular blocky; rare pores; rare angular quartz grains; many, fine and medium, distinct, light grey and strong brown mottles; distinct boundary to:-

27-48"+ Pale yellow (2.5Y 7/4); silty clay; very firm; weak medium and fine subangular blocky; rare pores, patchy clayskins; many, fine and medium prominent white and yellowish red mottles; few quartz grits and some fine nodular gravels of indurated plinthite.

Notes:

Capability Classification: Class 3

Limitations: 1. Often over hilly terrain
2. Compact subsoil
3. Low nutrient levels.

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SEP: 063

MARANG SERIES (MRG)

LAB. NO: RR 528

Horizons	Depth (ins)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3% 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0- 1	22	11	55	10	Nil	Nil	4.1	2	9	6.58	3.82	0.21	18.19	20	59	17.70	0.11	0.47	0.12	0.31	6	0.33
Ae	1-6½	22	12	58	9	Nil	Nil	4.4	1	4	1.62	0.94	0.07	13.43	15	32	8.34	0.04	0.05	0.11	0.21	5	0.43
Btj	6½-27	33	12	51	9	Nil	Nil	4.4	1	5	0.64	0.37	0.04	9.25	10	18	6.98	0.02	0.10	0.06	0.05	3	0.74
Bt	27-48	35	12	48	9	Nil	Nil	4.7	2	4	0.46	0.27	0.03	9.00	8	7	5.96	0.02	0.10	0.08	0.05	4	0.74

Series: MARANG (12b) Profile No: SEP 063

Family: Batu Anam

Great Soil Group: Yellow Grey Ultisols

Location: Just south of Sungei Dimor on the track from Batu Gong

Map Sheet and Grid Refwrence: 91/099986

Terrain: Undulating 4^{0} - old erosion surface

Vegetation: Primary forest

Elevation: 120' a.s.l. Rainfall: 100-110"

Drainage: Moderately well drained

Erosion: Nil

Parent rock: Shales

Profile:-

Ah 0-1" Brown to dark brown (10YR 4/3); very fine sandy clay loam; very friable; moderate to weak fine granular, fine crumb and weak very fine subangular blocky; abundant fine roots; common channels; common pores; incorporated humus; distinct boundary to:-

Ae 1-6½" Pale brown to very pale brown (10YR 6/3); very fine sandy clay loam; very friable, peds friable; weak to moderate fine subangular blocky and fine granular; common fine roots, few channels; few pores; diffuse boundary to:-

Btj 6½-27" Pale brown to very pale brown (10YR 6/3 to 7/3); very fine sandy clay loam; friable, peds friable to firm; weak to moderate fine and medium subangular blocky and weak fine crumb; common roots, few channels; few pores, patchy thin clay skins on some peds and pores; some angular quartz grains; rare, fine, distinct white blotches; distinct boundary to:-

Bt 27-48" Very pale brown (10YR 7/3); very fine sandy clay loam to very fine sandy clay; friable to firm; weak to moderate very fine to medium subangular blocky; rare roots; few pores, patchy thin clay skins on some peds and pores; many, fine, distinct, light gray and yellowish brown mottles.

Notes:

Capability Classification: Class 3

Limitations: 1. Generally very low nutrient levels
2. Compact subsoil
3. Susceptibility to erosion on steeper slopes.

.../88

SEP: 091

RUSILA SERIES(RSL)

LAB. NO. RS 288

Horizons	Depth (ins)	Percentage				On Original Sample		pH(ov. dry)	Moisture % (air dry - ov. dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Od	0- 6	High organic matter - Muck				4.1	9	4.1	9	54		MUCK			-	390	68.59	.82	.94	.97	1.14	6	0.57
Ah	6-10	20	14	21	39	Nil	Nil	4.5	1	4	4.34	2.52	.09	28.0	56	50	11.23	.11	.26	.18	.05	5	0.29
Ae	10-21	14	10	30	51	Nil	Nil	4.6	1	1	0.52	0.30	.02	15.0	41	10	2.55	.03	.16	.23	.10	20	0.23
BC	21-33	28	12	65	Tr	Nil	Nil	5.3	1	4	0.48	0.25	.02	12.5	36	28	4.77	.06	.16	.40	.16	16	2.66

Series: RUSILA Profile No: SEP 091

Family: Rusila

Great Soil Group: Light Grey Ultisols

Location: Mile 5½ on the Pekan - Endau h ghway

Map Sheet and Grid Reference: 92/730324

Terrain: Level to depressional - swalw between two ridges

Vegetation: Ferns

Elevation: 13' a.s.l. Rainfall:

Drainage: Waterlogged

Erosion: Nil

Parent material: Sandy marine alluvium

Profile:-

Od	0-6"	Matted, moroid muck horizon of decaying ferns and sedges, diffuse irregular boundary to:-
Ah	6-10"	Dark greyish brown (2.5Y 4/2); humic sandy loam; wet, slightly sticky; weak aggregation; abundant fine roots; very porous; incorporated humus, and angular quartz grains; diffuse boundary to:-
Ae	10-22"	Grey to light grey (2.5Y N7 - N6); loamy sand wte slightly sticky; weak aggregation; common fine roots; very porous; angular quartz grains; diffuse boundary to:-
BC	22-36"	Light grey (2.5Y N7 -); sandy clay loam; wet, slightly sticky; structureless; few fine roots; very porous; angular quartz grains; common, fine to medium, distinct, light yellowish brown and olive brown mottles.

Notes:

Capability Classification: Class 4

Limitations: 1. Waterlogged conditions
2. Low nutrient levels
3. Saline horizon at depth.

.../89

SEP: 098

RUDUA SERIES (RDA)

LAB NO: RS 328

Horizon	Depth	Percentage				On Original Sample		pH (air dry)	Moisture % (a r dry-ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel	Stones			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Od	0- ½	0	0	3	84	Nil	Nil	4.8	2.0	7.00	9.61	5.59	0.24	23.29	112		21.94	0.34	0.02	0.16	1.56	14	0.06
Ah	½-5	0	0	6	94	Nil	Nil	4.2	0.5	1-	1.65	0.96	0.06	16.00	88		7.20	0.06	0.05	0.07	0.59	11	0.06
Aeh	5-8	0	0	5	95	Nil	Nil	4.6	0.1	-	0.16	0.09	0.01	9.00	64		2.06	Nil	0.05	0.05	0.32	20	0.06
Ae	8-30	0	0	4	96	0.2	Nil	5.2	0.1	-	0.24	0.14	0.01	14.00	66		2.62	Nil	0.05	0.09	0.32	18	0.08
Bh	30-42	0	0	8	97	2.8	Nil	4.6	1.2	-	0.96	0.56	0.03	18.66	75		14.84	0.03	0.05	0.28	0.38	5	0.37
Bi	42-52	0	0	9	91	2.8	Nil	5.0	0.5	-	0.36	0.21	0.02	10.55	70		6.11	Nil	0.05	0.23	0.32	10	0.51

NOT DONE

Series: RUDUA Profile No: SEP 098

Family: Rudua

Great Soil Group: Humus - Sand Podzol

Location: In the Menchali Forest Reserve at milestone 42¾ Pekan-Endau highway.

Map Sheet and Grid Reference: 100/731685

Terrain: Level to very gently undulating 1° - old marine beach ridge

Vegetation: Primary forest. Climax association

Elevation: 14 feet a.s.l. Rainfall: 110-120"

Drainage: Free

Erosion: Nil

Parent material: Sandy marine alluvium

Profile:-

Od	0-2"	Slightly compact litter of decaying leaves, twigs and leaf fragments.
Ah	½-5"	Black (10YR 2/1); sand; loose; weak crumb like aggregation; abundant fine to medium roots, common channels; abundant pores; abundant incorporated humus and angular quartz grains; irregular and distinct boundary to:-
Aeh	5-8"	Gray (10YR 6/1); sand; loose; structureless; common fine and small roots, common channels; abundant pores; angular quartz grains and incorporated humus; common, medium, distinct, white patches; irregular and diffuse boundary to:-
Ae	8-30"	Light brownish gray (2.5Y 6/2); sand; loose; structureless; few roots, few channels; abundant pores; angular quartz grains; common, medium, distinct, white patches very irregular and distinct boundary to:-
Bhc	30-42"	Very dusky red (2.5YR 2/2); sand; varying from weakly to strongly cemented; structureless; rare fine roots through softer patches; common to many pores; angular quartz grains; black lining on large holes containing material from the Ae horizon; distinct and irregular boundary to:-
Bic	42-52"	Dark reddish brown to yellowish red (5YR 4/6) to (5YR 3/4); sand; weakly to moderately cemented; structureless; many pores; angular quartz grains; common, medium, distinct, pale brown mottles; distinct and rregular boundary to:-
Bij	52"+	Light yellowish brown (10YR 6/4); sand; varying from loose to weakly cemented; structureless; many pores; angular quartz grains; many medium to coarse, distinct, yellowish red mottles forming a weakly cemented fragipan.

Notes: The lighter coloured holes in the Bh horizon probably represent old root channels. They are characterised by a half inch thick black periphery of humus.

Capability Classification: Class 4.

Limitations: 1. Very low nutrient levels
2. Extremely rapid drainage
3. Subject to increasing strong leaching on clearing.

.../90

SEP: 035

TELEMONG SERIES (TMG)

LAB. NO. RS 283

Horizon	Depth	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry-ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel	Stones			Loss on ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ap	0- 1	62	21	10	5	Nil	Nil	4.9	4	16	6.25	4.21	0.33	12.75	165	108	24.85	0.35	5.62	0.34	1.92	33	3.92
Ae	1-10	66	25	10	2	Nil	Nil	4.6	3	10	2.34	1.36	0.14	9.71	128	28	14.64	0.11	0.34	0.30	0.52	13	4.57
AC	10-23	49	20	32	4	Nil	Nil	4.9	2	6	0.52	0.30	0.06	5.00	96	10	9.36	0.03	0.21	0.13	0.21	6	4.33
Cu	23-32	T O S A N D Y				11.26	Nil	5.2	1	1	0.11	.06	0.01	6.00	84	Tr	1.70	Nil	0.05	0.09	0.21	2	0.97

Series: TELEMONG Profile No: SEP 085

Family: Telemong

Great Soil Group: Brown Entisols

Location: Kg. Pulau Keladi - 12 miles west of Pekan

Map Sheet and Grid Reference: 92/676418

Terrain: Level - 1^{0} - flood plain of Sg. Pahang.

Vegetation: Young rubber and lallang.

Elevation: 17' a.s.l. Rainfall: 110-120"

Drainage: Moderately well drained.

Erosion: Nil

Parent material: Recent Fluviatile Alluvium

Profile:-

Ah(p)	0-1"	Dark brown (10YR 3/3); clay; slightly hard; moderate fine subangular blocky; fine crumb and fine granular; many fine and small roots, common channels, many ant casts; common pores, incorporated humus; distinct undulating boundary to:-
Ae(p)	1-10"	Yellowish brown (10YR 5/6); clay; firm; moderate fine and medium subangular blocky and fine granular; many fine and small roots, common channels few ant casts; common pores, patchy clayskins as flushings in channels and pores. Few, fine, faint, very pale brownish yellow and reddish yellow mottles; rare fine angular quartz grains; diffuse boundary to:-
AC	10-23"	Yellowish brown to strong brown (10YR 5/8-7.5YR 5/8); clay loam to clay; firm, peds friable; moderate fine and medium subangular blocky and fine granular; rare roots, few channels, few ants casts; common pores; few mica flakes, rare fine angular quartz grains; common, fine, distinct, reddish yellow and yellowish red mottles; on -
Cu	23-46"+	Variably layered, structureless, very fine, fine and coarse brown river sand.

Notes: Much shallower and heavier textured than normal Telemong.

Capability Classification: Class 2.

Limitations: 1. Susceptibility to flooding.

2. Shallow soil and often sandy textures.

.../91

SEP: 088 BAGING SERIES (BNG) LAB. NO: RS 285

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov. dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++		
Ah	0- 2	14	6	66	19	Nil	Nil	5.1	1	3	1.72	1.00	.07	14.29	64	28	7.83	.06	.16	.07	.21	6	0.43
Aeh	2-7	16	6	66	17	Nil	Nil	5.1	1	3	1.46	0.85	.06	14.17	54	20	7.32	.03	.16	.07	.31	8	0.51
Ae	7-20	16	8	70	13	Nil	Nil	5.4	1	3	0.87	0.51	.04	12.75	48	10	6.47	Nil	.05	.09	.16	5	0.62
Bhj	20-39	12	6	76	13	Nil	Nil	5.4	1	2	0.61	0.39	.02	19.50	46	10	6.30	Nil	.10	.07	.16	5	0.66
BC	39-48	12	4	76	15	Nil	Nil	5.5	1	2	0.31	0.18	.01	18.00	40	10	3.74	Nil	.05	.11	.16	9	1.00

Series: BAGING Profile No: SEP 088

Family: Baging

Great Soil Group: Brown Entisols

Location: Just opposite, JKR Quarry at Tanjong Batu

Map Sheet and Grid Reference: 100/765044

Terrain: Level - coastal plain

Vegetation: Lalang

Elevation: 16' a.s.l. Rainfall: 110-120"

Drainage: Very well drained - water table at 6'

Erosion: Nil

Parent material: Sandy marine alluvium

Profile:-

Ah 0-2" Grayish brown (2.5Y 5/2); loamy sand; very friable to loose; weak fine subangular blocky and fine crumb; abundant fine roots, few channels; many pores; angular quartz grains; diffuse boundary to:-

Aeh 2-7" Light Olive brown (2.5Y 5/4); loamy sand; very friable to loose; peds friable; weak fine and medium subangular blocky and fine crumb; many fine and small roots, few channels; many pores; common mica flakes and abundant angular quartz grains; irregular and diffuse boundary to:-

Ae 7-20" Olive yellow (2.5Y 6/6); sand; loose to very friable, very weak coarse to fine subangular blocky; many fine and small roots, few channels; common pores; common mica flakes and abundant angular quartz grains; rare, fine distinct white patches; irregular and diffuse boundary to:-

Bhj 20-39" Olive brown (2.5Y 4/4); sand; loose to very friable; very weak coarse to fine subangular blocky; few roots and few channels; many pores; common mica flakes, and abundant angular quartz grains; common, fine, distinct, pale yellow and strong brown mottles irregular and diffuse boundary to:-

BC 39-48" Light olive brown (2.5Y 5/6); sand; loose to very friable; very weak coarse to fine subangular blocky; few roots, few channels; many pores; abundant angular quartz grains and mica flakes; rare, fine, distinct white mottles.

Notes:

Capability Classification: Class 4

Limitations: 1. Low nutrient levels
2. Very sandy textures
3. Very rapid internal drainage.

.../92

SEP: 111

ROWPIN SERIES (RPW)

LAB. NO: RS 323

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov. dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K +	Ca++	Na+	Mg++		
Ah	0- 2	0	0	94	6	Nil	Nil	5.8	1		1.05	0.61	0.50	12.20	92	28	4.80	0.11	0.48	0.11	0.54	26	1.03
Aeh	2- 7	0	0	96	4	Nil	Nil	5.7	1		0.84	0.49	0.03	16.33	66	10	4.46	0.03	0.27	0.09	0.22	14	0.84
AB_1	7-13	0	0	96	4	Nil	Nil	5.4	1		0.53	0.31	0.02	15.50	64	10	3.94	0.03	0.16	0.09	0.11	10	1.39
AB_2	13-27	12	6	84	3	Nil	Nil	5.5	1		0.21	0.12	0.01	12.00	61	10	2.23	0.03	0.05	0.09	0.22	17	1.39
BC	27-36	12	4	81	8	Nil	Nil	5.5	1		0.14	0.08	0.01	8.00	56	10	1.71	0.03	0.05	0.07	0.02	22	1.13

Series: ROMPIN Profile No: SEP 111

Family: Baging

Great Soil Group: Brown Entisols

Location: Kuala Rompin Hospital on Pekan - Endau Highway

Map Sheet and Grid Reference: 108/666387

Terrain: Level - old beach deposit forming a small sand plain.

Vegetation: Grasses

Elevation: 11' a.s.l. Rainfall: 120"

Drainage: Moderately well drained

Erosion: Nil

Parent material: Sandy marine alluvium

Profile:-

Ah 0-2" Brown to dark brown (10YR 4/3); loamy fine sand; very friable to loose; very weak f ne granular and crumb; many fine grass roots, common channels; many pores; incorporated humus; diffuse boundary to:-

Aeh 2-7" Yellowish brown (10YR 5/4); fine sand; very friable to loose; very weak fine granular and fine crumb; common fine roots and few channels; many pores; incorporated humus; few, fine and medium, distinct yellow mottles; distinct boundary to:-

ABi 7-13" Yellowish brown (10YR 5/6-5/8); fine sand; very friable to loose; some very weak aggregation observable; common fine roots, few channels; many pores; some fine incorporated humus present; common, fine and medium, distinct, red and grey mottles; diffuse boundary to:-

Bi 13-27" Yellowish brown to brownish yellow (10YR 5/6-6/6); fine sand; very friable, some very weak aggregation observable; few, fine, roots, rare channels; many pores; many, fine and medium, prominent red and grey mottles; distinct and irregular boundary to:-

BCi 27-36" Brownish yellow (10YR 6/8); fine sand; very friable; some very weak aggregation observable; rare fine roots; many pores; common, fine and medium red and light gray mottles; distinct and irregular boundary to:-

C 36-54"+ Very pale brown (10YR 7/3); fine sand; very friable; some very weak aggregat on observable; rare fine roots; many pores; many, fine and medium, distinct yellow and yellowish brown mottles.

Notes: Fine angular quartz grains are recognised at all levels.

Capability Classification: Class 3 - 4

Limitations: 1. Very sandy textures.

.../93

SEP: 090

BRIAH SERIES (BRH)

LAB. NO: RS 287

Horizons	Depth	Percentage				On Original Sample		pH (air dry)	Moisture (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 & 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Od	0-2½	Organic Matter to high - Muck						3.6	9	46	Muck		1.33	-	283	415	71.65	1.01	0.31	0.79	1.35	5	
Aeh	2½-4½	37	21	14	1	2.0	Nil	4.0	3	11	10.61	6.16	0.27	22.81	120	58	23.83	0.14	0.16	0.24	0.47	4	
AB	4½-10	41	18	44	1	Nil	Nil	4.7	2	5	1.66	0.96	0.06	16.0	80	10	9.19	0.03	0.05	0.18	0.21	5	
BCg	10-21	47	20	37	Tr	Nil	Nil	4.8	2	6	0.85	0.50	0.03	16.66	76	10	8.00	0.03	0.05	0.23	0.36	8	
bc	21-30	14	12	33	49	Nil	Nil	4.5	1	1	0.43	0.25	0.02	12.50	44	10	2.38	0.03	0.16	0.16	0.10	19	
bBG	30+	28	12	63	Tr	Nil	Nil	5.0	1	3	0.34	0.20	0.02	10.00	43	20	5.45	0.05	0.16	0.30	0.21	13	

Series: BRIAH

Profile No: SEP 090

Family: Briah

Great Soil Group: Brown Grey Entisols

Location: mile 4½ on the Pekan - Endau highway

Map Sheet and Grid Reference: 92/727336

Terrain: Level - coastal plain

Vegetation: Mixed secondary forest and fresh-water swamp forest.

Elevation: 12' a.s.l.

Rainfall: 110-120"

Drainage: Poorly drained - water table at 3'

Erosion: Nil

Parent material: Recent fluviatile alluvium over organic deposits.

Profile:-

Od	2½-0"	Matted moroid layer with very little mineral matter.
Aeh	0-2"	Light grey (10YR 6/1-2.5Y N7/-); clay loam; friable to firm; moderate, fine and medium subangular blocky; abundant fine and small roots, few channels; common pores, incorporated humus and fine mica flakes; common, fine, faint, pale yellow mottles; distinct boundary to:-
AB	2-8"	Light grey (2.5Y N7/-); clay loam; massive, peds friable to firm; moderate fine and medium subangular blocky and weak fine granular; abundant fine to medium roots; few channels; common pores, patchy clayskins on root and channel linings; mica flakes present; many, fine and medium, distinct reddish yellow mottles; diffuse boundary to:-
BCg	8-19"	Light yellowish brown to olive yellow (2.5Y 6/4-6/6); clay; massive, plastic and sticky; weak coarse, breaking to weak fine, subangular blocky; common fine and small roots, common channels, few pores, patchy clayskins along root and channel linings; common mica flakes; many, fine and medium, distinct reddish yellow and light grey mottles, especially adjacent to roots and channels; diffuse boundary to:-
bC	19-28"	Olive (5Y 5/4); sandy loam; massive, plastic and slightly sticky; weak coarse subangular blocky; common fine and small roots, few channels; common pores, very rare clayskins in some channels; common mica flakes; common fine, distinct light grey and dark grey mottles; diffuse boundary to:-
bBG	28"+	Variegated, olive and light gray (5Y 5/4 and 2.5Y N7/-); fine sandy clay loam; massive and structureless; few roots, few channels; common pores; common mica flakes; few, fine to coarse, distinct olive brown mottles.

Notes:

Capability Classification: Class 2

Limitations: 1. Poor drainage.
2. Susceptible to flooding.

.../94

SEP: 086

AKOB SERIES (AKB)

LAB. NO: 284

Horizons	Depth	Percentage				On Original Sample		pH(air dry)	Moisture % (air dry - ov. dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ap	0- 3	58	25	14	1	Nil	Nil	5.1	4	14	6.79	3.94	0.30	13.13	273	94	21.78	1.22	3.28	0.32	2.03	31	3.36
Ae	3-11	64	27	10	Tr	Nil	Nil	4.4	3	9	1.67	0.97	0.11	8.82	116	36	13.28	0.11	0.18	0.21	0.16	5	4.24
AB	11-19	68	23	13	Tr	Nil	Nil	4.4	3	7	0.67	0.39	0.08	4.87	84	20	11.06	0.06	0.04	0.21	0.36	6	4.40
BCg	19-42	43	14	49	Tr	Nil	Nil	4.7	2	5	0.26	0.15	0.02	7.50	80	10	7.15	0.03	0.04	0.30	0.51	12	5.39
C	42-55	64	27	14	Tr	Nil	Nil	4.7	3	7	0.20	0.12	0.02	6.00	54	36	9.02	0.11	0.31	0.58	0.52	17	1.60

Series: AKOB

Profile No: SEP 086

Family: Briah

Great Soil Group: Brown Grey Entisols

Location: Two-and a half miles east of Pekan on the Batu Balek road.

Map Sheet and Grid Reference: 92/666422

Terrain: Level - flood plain of Sg. Pahang.

Vegetation: Secondary forest

Elevation: Nil

Parent material: Recent Fluviatile alluvium.

Profile:-

Ap	0-3"	Yellowish brown (10YR 5/4 - 5/6); clay; slightly hard, peds friable; weak to moderate fine subangular blocky and weak fine and medium granular and crumb many small and medium roots, common channels and common casts; common pores few mica flakes; common, fine, distinct light grey mottles and iron stains; indistinct and undulating boundary to:-
Ae	3-11"	Yellowish brown (10YR 5/6 - 5/8); clay; hard; moderate to weak fine and medium granular; few casts, common small and medium roots, few channels; common pores, than clayskins along some ped faces; few mica flakes; common, fine, distinct, light grey mottles and iron stains; diffuse boundary to:-
AB	11-19"	Yellowish brown to pale brown (10YR 5/6-6/3); clay; hard; weak medium and fine subangular blocky and medium and fine granular; few medium roots, rare casts, few channels; common pores, almost continuous clayskins in channels and on some ped faces; few mica flakes; common, fine and medium, distinct, reddish yellow, yellowish red, and light grey mottles; diffuse boundary to:-
BCg	19-42"	Grey to light grey (10YR 6/1); fine sandy clay; friable; weak to moderate fine and medium subangular blocky and fine granular; rare medium roots and rare channels; few pores, patchy thin clayskins on channels; few mica flakes; many medium and coarse, distinct, reddish yellow yellowish red and brownish yellow; diffuse boundary to:-
C	42-55"	Light Grey (2.5Y 7/1); clay; friable to firm; very weak, fine and medium subangular blocky and angular blocky; rare roots and channels; few pores; few mica flakes; many, fine, distinct reddish yellow, yellowish red and brownish yellow mottles.

Notes: Many merge into Briah series away from rivers.

Capability Classification: Class 2.

Limitations: 1. Poor drainage

2. High susceptibility to flooding.

.../95

SEP: 067

SEROK SERIES (SRK)

LAB. NO: RR 805

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry -ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah/ Aeh	0-5½	72	16	15	1	Nil	Nil	4.5	3	11.6	2.24	1.30	0.12	10.08	49	39	12.94	0.07	0.36	0.11	0.47	8	2.46
AB	5½-12	72	16	10	1	Nil	Nil	4.4	3	11.4	1.25	0.73	0.07	10.43	37	18	9.53	0.04	0.26	0.10	0.10	5	3.00
Bti	12-33	74	17	11	1	Nil	Nil	4.8	3	10.7	0.62	0.36	0.03	12.00	33	Tr	9.53	0.04	0.26	0.10	0.05	5	3.33
BC	33-66	70	18	18	1	Nil	Nil	5.1	2.8	9.9	0.36	0.21	0.02	10.50	24	Tr	8.00	0.02	0.26	0.08	0.05	4	3.60

Series: SEROK (New Series) Profile No: SEP 067

Family: Serok

Great Soil Group: Brown Entisol

Location: Chain 30 on Rentis 43(270°) west of Sg. Keratong at Bt. Serok.

Map Sheet and Grid Reference: 98/994694

Terrain: Level - slightly dissected old terrace - 25' above river level.

Vegetation: Young secondary forest

Elevation: 75' a.s.l. Rainfall: 80-90"

Drainage: Moderately well drained.

Erosion: Nil

Parent material: Sub-recent fluviatile alluvium

Profile:-

Ah 0-½" Brown and dark brown (10YR 4/3); clay loam; hard; moderate fine and medium subangular blocky; many roots, few medium channels, few casts; few pores, incorporated humus; distinct boundary to:-

Aeh ½-5½" Yellowish brown (10YR 5/6); clay; hard moderate to strong medium and coarse subangular blocky, and weak, very fine cast granular; common fine and small roots, common fine and medium channels and common casts; few pores, patchy clayskins in channels; some fine incorporated humus; diffuse boundary to:-

AB 5½-12" Strong brown (7.5YR 5/8); clay; firm, moderate fine and medium subangular blocky; few roots, common fine channels, common ants casts; common pores, discontinuous clayskins in channels and on some ped faces; rare fine subangular blocky fragments of quartz; many, fine, distinct yellowish red and many fine, distinct, white mottles, diffuse boundary to:-

Bti 12-33" Strong brown (7.5YR 5/6); clay; firm; moderate coarse to fine subangular blocky; rare roots, common fine channels, few fine casts; common pores, almost continuous, reddish yellow clayskins in channels and on ped faces; rare fine and subangular quartz grains; many fine and medium distinct red mottles; diffuse boundary to:-

BC 33-66" Light yellowish brown to brownish yellow (10YR 6/4 - 6/6) clay; firm to very firm; weak coarse and medium subangular blocky and fine crumb; few channels; common pores, almost continuous yellow clayskins on ped faces and in channels; rare fine subangular quartz grains; many, medium, prominent red mottles.

Notes: White patches of kaolin from weathering pebbles in lower horizons.

Capability Classification: Class 3.

Limitations: 1. Moderate compaction at lower levels.

2. Low nutrient levels.

.../96

SEP: 089

KRANJI SERIES (KNJ)

LAB NO: RS 286

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov. dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++		
Ah	0- 1	36	17	52	Tr	Nil	Nil	6.7	5	10	2.82	1.63	.10	16.30	133	600	19.74	1.22	3.00	5.61	2.07	60	3.92
ABr	1- 5	32	10	57	Tr	Nil	Nil	6.3	5	8	2.59	1.51	.06	25.17	120	515	18.55	1.15	2.70	2.77	6.32	68	3.87
Br	5-15	30	12	65	Tr	Nil	Nil	6.0	5	6	2.18	1.27	.04	31.75	115	490	15.66	1.14	2.20	2.34	5.58	75	3.76
BCr	15-29	27	8	70	Tr	Nil	Nil	7.6	4	5	1.82	1.06	.03	35.33	79	415	25.02	.90	13.16	1.64	3.70	80	3.72

Series: KRANJI

Profile No: SEP 089

Family: Kranji

Great Soil Group: Brown Grey Entisol

Location: South bank of Sg. Bebar at Menasi

Map Sheet and Grid Reference: 100/755955

Terrain: Level - estuary of Sg. Bebar

Vegetation: Mangrove forest

Rainfall: 120-130"

Drainage: Poor - tidally flodded to water table at 19"

Profile:-

Ah	0-1"	Brown to dark brown (10YR 4/3); very fine sandy clay loam; plastic and sticky; moderate, fine subangular blocky and fine angular blocky; fine and small roots; common fine and medium channels, some fine and medium casts; common paces, incorporated humus and mica flakes; common, fine, distinct, dark red and reddish brown mottles, indistinct boundary to:-
Brh	1-5"	Very dark grey (5Y 5/1); very fine sandy clay loam; friable to firm; weak to moderate fine and medium subangular blocky; few roots, many fine and medium channels with iron stained linings; common pores; clayskins lining channels; incorporated humus and mica flakes; many, fine to coarse prominent, dark red mottles; indistinct boundary to:-
BCrh	5-15"	Grey to dark grey (5Y 5/1-4/1); very fine sandy clay loam; friable to firm; weak fine and medium subangular blocky;common small and fine roots, many fine and medium channels with iron stained linings; common pores, patchy clayskins in channels; incorporated humus and mica flakes; many, fine to coarse, prominent close red mottles; indistinct boundary to:-
Cr	15-29"	Dark olive grey (5Y 3/2); fine sandy clay loam; plastic and sticky; very weak coarse to fine angular blocky; few small roots, common fine and medium channels; common pores, rare clayskins lining root channels; incorporated humus and mica flakes; common, fine, distinct, dark yellowish brown mottles, with iron stained surrounds and along root channels; few olive mottles

Notes: Noticeable smell of H_2S throughout.

Capability Classification: Class 5

Limitations: 1. Acute mineral toxilities
2. Waterlogged conditions.

.../97

SEP: 094

LINAU SERIES (LUN)

LAB. NO: RS 312

Horizons	Depth (ins.)	Percentage On Original Sample						pH (air dry)	pH ov. dry.	Moisture % (air dry - ov.dry)	Loss on Ignition	Percentage			C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 6N HCl Soluble	Cond. mhos x 10^{-6}	Cl^- %	$SO_4^=$ %
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %					Organic matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3COOH		K+	Ca++	Na+	Mg++				
Of	0- 1		M U C K			0.4	Nil	3.4	3.6	9		M U C K						57.07	0.99	1.40	0.42	3.35	11		480	0.038	0.013
An	1-3½	22	25	37	20	1.9	Nil	3.9	3.6	2		8.44	4.91	0.18	27.28	80	355	22.97	0.16	0.92	0.16	0.54	8	0.20	64	0	0
AB(h)	3½-16	24	23	28	30	0.9	Nil	4.2	4.1	1		2.12	1.23	0.04	30.75	72	58	9.60	0.03	0.22	0.14	0.27	7	0.30	26	0	0
Bh	16-28	22	20	35	26	1.7	Nil	4.1	4.2	1		3.03	1.76	0.04	44.00	63	20	14.57	0.03	0.16	0.13	0.27	4	0.30	28	0	0
C	28+	30	21	32	22	1.0	Nil	3.5	3.8	1		2.80	1.63	0.03	54.33	74	10	12.00	0.03	0.16	0.14	0.27	5	0.33	222	0.004	0.035

Series: LINAU Profile No: SEP 094

Family: Kranji

Great Soil Group: Brown Grey Entisols

Location: East side of Pekan - Endau highway at Mile 10¼.

Map Sheet and Grid Reference: 92/727243

Terrain: Level - on the coastal plain

Vegetation: Peat swamp forest - climaz association

Elevation: 15' a.s.l. Rainfall: 120-130"

Drainage: Poorly drained - water table at 22"

Erosion: Nil

Parent material: Marine alluvium

Profile:-

Od	2-1"	Loose litter of dead twigs of whole leaves merging into a very thin Od horizon of discontinuous extent and variable thickness.
Of	1-0"	Reddish grey (5YR 5/2); muck; loose, peds very friable; moderate medium and fine crumb; abundant fine roots, many channels; few casts; few pores; distinct boundary to:-
Ah	1-2½"	Black (10YR 2/1); sandy, silty clay loam; loose; very weak fine subangular blocky, fine granular and fine crumb; many small and fine roots, few channels; few casts; few pores; angular fragments of quartz; distinct boundary to:-
	2½-15"	Light olive (5Y 6/3-6/4); sandy clay loam; firm, peds friable to firm; weak to moderate coarse to fine subangular blocky and rare fine crumb; many dead and decaying roots, common channels; few pores, patchy clayskins coating old root channels; angular quartz grains large amounts of incorporated humus from decomposing roots; distinct, irregular boundary to:-
	15-27"	Brown to dark yellow sh brown (10YR 4/3-4/4); sandy clay loam; friable to firm; very weak coarse to fine subangular blocky and angular blocky; common fine and small roots, many decaying roots; common channels; few pores; angular quartz fragments; distinct and irregular boundary to:-
	27"+	Dark grayish brown (10YR 4/2); sandy clay loam to sandy clay; firm; very weak coarse to fine subangular blocky; common fine roots; distinct smell of hydrogen sulphide.

Notes:

Capability Classification: Class 3

Limitations: 1. Sulphurous layer below 27"

2. Poor drainage.

.../98

SEP: 014

RASAU SERIES (RSU)

LAB. NO: R . 298

Horizons	Depth (ins.)	Percentage			On Original Sample			pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++		
Aeh	0- 1	43	25	24	1	-	-	4.0	2.6	10.6	5.48	3.18	0.23	13.39	58	31	23.32	.07	.34	.01	.61	4	2.04
AB	1- 6	43	28	25	Tr	-	-	4.1	2.0	6.6	2.03	1.18	0.10	11.8	46	12	14.98	.04	.10	.01	.31	3	2.24
Bj	6-29	43	26	28	Tr	-	-	4.7	1.7	4.7	0.43	0.25	0.03	8.33	15	12	10.39	.04	.16	.01	.41	6	2.46
BC	29-36	41	26	32	Tr	-	-	4.7	1.5	4.3	0.33	0.19	0.02	9.5	13	12	8.34	.03	.10	.01	.25	5	3.03

Series: RASAU Profile No: SEP 014

Family: Rasau

Great Soil Group: Grey Yellow Entisols

Location: Just east of Sg. Tepesok 5 miles south of Bt. Ibam

Map Sheet and Grid Reference: 98/184904

Terrain: Level - slightly dissected upper terrace of Sg. Tepesok

Vegetation: Primary forest - Lowland Dipterocarp Forest

Elevation: 50' a.s.l. Rainfall: 90-100"

Drainage: Moderately well drained.

Erosion: Nil

Parent material: Sub-recent to older Alluvium

Profile:-

Aeh	0-1"	Yellowish brown (10YR 5/4); clay loam to clay; slightly hard; moderate fine subangular blocky and fine granular; many fine roots, few channels, common pores; diffuse boundary to:-
AB	1-6"	Yellowish brown (10YR 5/4-5/6); clay loam to clay; hard; moderate to strong fine subangular blocky and fine granular; common roots, few channels; common pores, patchy clayskins in channels; common fine, faint, pale yellow mottles with brownish yellow surrounds; diffuse boundary to:-
Bj	6-29"	Brownish yellow (10YR 6/6); clay loam to clay; firm; moderate coarse to fine subangular blocky; few roots, few channels; and on some ped faces; common, fine, distinct, light grey mottles; diffuse boundary to;
BC	29-36"	Brownish yellow (10YR 6/6); clay loam to clay; firm moderate coarse to fine subangular blocky; few roots; few pores, discontinuous reddish yellow clayskins on ped faces.

Notes:

Capability Classification: Class 2

Limitations: 1. Low nutrient levels.

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SEP: 068

HOLYROOD SERIES (HYD)

LAB. NO: RR 530

Horizons	Depth	Percentage				On Original Sample		pH(air dry)	Moisture % (air dry - ov.dry)	Percentage				C/N Ratio	Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 % 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel	Stones			Loss on Ignition	Organic Matter	Carbon	Nitrogen		P N/10 NaOH	K N/2 CH_3 COOH		K+	Ca++	Na+	Mg++		
Ap	0- 6	16	4	53	28	Nil	Nil	4.9	1	4	1.84	1.07	0.18	5.94	21	18	16.68	0.02	0.10	0.08	0.16	2	0.69
AB	6-14	22	4	49	29	Nil	Nil	4.6	1	4	1.03	0.61	0.07	8.71	17	7	4.94	0.02	0.26	0.06	0.10	9	0.97
Btj_1	14-28	26	4	44	30	Nil	Nil	4.8	1	3	0.63	0.37	0.04	9.25	16	Tr	3.91	0.02	0.16	0.06	Nil	6	1.06
Bt_2	28-53	26	2	48	27	Nil	Nil	4.7	1	3	0.35	0.21	0.02	10.50	15	Tr	3.40	0.02	0.16	0.11	Nil	8	1.11

Series: HOLYROOD Profile No: SEP 066

Family: Holyrood

Great Soil Group: Grey Yellow Entisols

Location: Quarter mile, south-east of school at Kg. Batu Gong.

Map Sheet and Grid Reference: 91/113104

Terrain: Undulating - gently dissected terrace 3^0.

Vegetation: Bamboo and low scrub - regrowth after clearing

Elevation: 40 a.s.l. Rainfall: 100-110"

Drainage: Well drained

Erosion: Nill

Parent material: Sub-recent fluviatile alluvium

Profile:-

Ap	0-6"	Dark grayish brown (10YR 4/2); sandy loam; very friable; weak fine sub-angular blocky and fine granular; abundant fine roots, few fine channels; common pores; small pieces of carbon; irregular and diffuse boundary to:-
AB	6-14"	Light yellowish brown to brownish yellow (10YR 6/4-6/6); sandy loam to sandy clay loam; very friable; weak fine and medium subangular blocky; common fine and small roots; common fine channels; many pores, thin clayskins lining channels; small pieces of carbon; diffuse boundary to:-
Bt_1	14-28"	Brownish yellow (10YR 6/6); sandy clay loam; very friable, weak fine and medium subangular blocky; few fine roots, common fine channels; many pores, patchy clayskins in channels and on some ped faces; small pieces of carbon; diffuse boundary to:-
Bt_2	28-53"	Brownish yellow (10YR 6/6); sandy clay loam, very friable; weak fine and medium subangular blocky; rare roots, common fine channels; many pores, patchy clayskins in pores and channels and on some ped faces; angular quartz grains; few, fine, distinct reddish yellow mottles; irregular and diffuse boundary to:-
BC	53-66"+	Brownish yellow (10YR 6/8); sandy clay loam; friable; weak, medium and fine subangular blocky; few, fine, channels; common pores; patchy clayskins in pores and channels and on some ped faces; angular quartz grains; common, fine, distinct, reddish yellow and red mottles.

Notes: Washings of fine bleached quartz grains on the surface

Capability Classification: Class 3

Limitations: 1. Generally low nutrient levels
2. Sandy textures.

.../100

SEP: 065

LUNAS (HOLYROOD GREY VARIANT) LUN

LAB. NO: RR 529

Horizons	Depth (ins.)	Percentage				On Original Sample		pH (air dry)	Moisture % (air dry - ov.dry)	Percentage				Easily Soluble p.p.m.		C.E.C. m.e./100g.	Exchangeable Cations m.e./100g.				Base Saturation %	Fe_2O_3 6N HCl Soluble
		Clay	Silt	Fine Sand	Coarse Sand	Gravel %	Stone %			Loss on Ignition	Organic Matter	Carbon	Nitrogen	C/N Ratio	P	K		K+	Ca++	Na+	Mg++	
															N/10 NaOH	N/2 CH_3 COOH						
Ah/ Ae	0-19	18	9	51	21	Nil	Nil	3.5	2	9	8.12	4.71	0.18	26.16	24	7	20.76	0.02	0.26	0.10	0.36	4	0.13
Btj	19-40	22	8	51	24	Nil	Nil	4.8	1	3	0.53	0.31	0.07	4.43	12	Tr	4.08	0.02	0.05	0.05	0.10	5	0.20
BC	40-58	22	10	48	24	Nil	Nil	5.0	1	4	0.50	0.29	0.04	7.25	11	Tr	3.74	0.02	0.16	0.16	Nil	7	0.20

Series: LUNAS (HOLYROOD Grey Variant) (22) Profile No: SEP 065

Family: Bukit Tuku

Great Soil Group: Grey Yellow Entisols

Location: Three quarters of a mile east of Kg. Batu Gong

Map Sheet and Grid Reference: 91/122103

Terrain: Level to undulating - gently dissected old terrace - 1^{0}

Vegetation: Primary forest

Elevation 40' a.s.l. Rainfall: $100-110^{0}$

Drainage: Well drained

Erosion: Nil

Parent material: Sub-recent fluviatile alluvium.

Profile:-

Ah	0-1"	Dark grayish brown (10YR 4/2); humic sandy loam; loose to very friable; weak fine subangular blocky and fine granular; common fine roots, common fine channels; many pores; incorporated humus; distinct boundary to:-
Aeh	1-19"	Variegated, pale brown and dark grayish brown (10YR 6/3 & 4/2); humic sandy loam; very friable; weak fine and medium subangular blocky and fine granular; common fine and medium roots, many fine and medium channels many pores; incorporated humus; diffuse boundary to:-
Btj	19-40"	Light gray (2.5Y 7/2); sandy loam to sandy clay loam; very weak, fine subangular blocky and fine granular; rare roots, common fine channels, rare ants casts; many pores, very thin clayskins coating casts; incorporated humus; diffuse boundary to:-
BC	40-58"+	Light grey (2.5Y 7/2); sandy loam to sandy clay loam; very friable; very weak, subangular blocky; common fine channels; many pores, patchy clay skins in pores and channels; incorporated humus.

Notes: Common angular quartz grains throughout. Incorporated humus in lower horizons from decaying roots.

Capability Classification: Class 4

Limitations: 1. Very low nutrient levels