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EDITORIAL

Soil Surveys

THE identification, mapping and classification of the island's soils is one of the basic pre-requisites to formulating a national land use programme. The classical studies of the early Russian pedologists from which derive the contemporary systems of soil identification and classification, with certain refinements and modifications, have become a powerful tool in the hands of the modern soil scientist. Such fundamental studies are therefore indispensable to our understanding and efficient management of the country's soil resources.

The first systematic studies of the soils of Ceylon were those of Dr. A. W. R. Joachim and his colleagues during the decade 1935–1945. Considering the state of development of soil science in the tropics at that period, Joachim's work was indeed a significant contribution to the knowledge of Ceylon soils. However, the vast strides that have been made during the intervening years in tropical regions have forced a re-appraisal and revision of the earlier concepts and knowledge of Ceylon soils.

Recent years have witnessed a successful application of modern concepts in the study of Ceylon soils, most noteworthy being the fundamental morphological studies of some Dry Zone soils at Maha Illuppallama. This investigation has had a far reaching significance in formulating scientifically sound as well as agriculturally valid principles of land use over a greater part of the Dry Zone's soil landscapes.

A soil survey of fifteen river basins covering an extent of 7,500 square miles in north-western Ceylon, which was carried out by the Canada–Colombo Plan Resources Survey in collaboration with the Land Use Division of the Department of Agriculture during 1959–61, marks the beginning of modern organised and systematic surveys of the island's soils, and this has served as a model on which the future programme could be developed and built on.

With mounting land pressures and increasing invasion of subsistence agriculture into marginal lands, empirical methods of land selection by trial and error can no longer be afforded. High investment costs on irrigation projects in this country compel a careful and systematic investigation into the land use potentials of the regions which are to be influenced by the Mahaweli diversion and the Walawe basin development programmes. Basic findings at Maha

Illuppallama, in respect of arable farming in the dry zone together with the modern land use concepts, should provide the basis for evolving a sound system of integrated agricultural development for these regions.

Unlike in the temperate regions of the world, where over half a century of pedological research and soil surveys have resulted in the acceptance of well defined great soil groups, not much progress has been made in this branch of the science in the tropical regions. It has, therefore, been singularly fortunate that the Food and Agriculture Organisation of the United Nations had made available the valued services of Dr. F. R. Moormann (Soil Classification Consultant) during this important phase of development in the national soil survey programme. This has contributed towards establishing convincingly the identity of the great soil groups of this country in accordance with the modern concepts of soil classification, developed in the U. S. A. and adopted by several countries and by the F. A. O.

SOILS OF CEYLON

A NEW APPROACH TO THE IDENTIFICATION AND CLASSIFICATION OF THE MOST IMPORTANT SOIL GROUPS OF CEYLON

By

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3——R 20026 (10/61)

FOREWORD

In accordance with the agreement between the Government of Ceylon and the Food and Agricultural Organisation of the United Nations, the services of a F. A. O. Soil Classification Consultant were provided for a period of two months in 1961.

Dr. F. R. Moormann undertook the assignment of assisting the Government of Ceylon, through the Land Use Division of the Department of Agriculture, in the identification and classification of the broad soil groups of the country in terms of contemporary international systems. He assumed duties in March, 1961, and visited most of the important soil and climatic zones of the island.

The authors are aware that this study could not possibly have been carried out without the integration of numerous observations made by other research workers in the field of soil classification. In particular, they wish to acknowledge the work of Dr. A. W. R. Joachim which provided much valuable information and also the more recent soil survey and classification studies covering fifteen river basins in Western Ceylon carried out by W. Holland and L. de Vries, soil scientists of Hunting Survey Corporation Limited.

The senior author wishes to express his gratitude to the Director of Agriculture and to the Head of the Land Use Division and its staff for their assistance in carrying out the study of the major soils of Ceylon. He also wishes to thank the Director of the Rubber Research Institute and its Soil Chemist who enabled him to study the soils in the rubber growing regions.

SOILS OF CEYLON

CHAPTER I

INTRODUCTION

OUR approach in this study is based on the **morphological system of soil classification** in which the inherent morphological characteristics of the soils units are identified and studied in the field, while their chemical and physico-chemical properties are determined in the laboratory. Environmental factors which have caused a soil to acquire its properties do not enter into consideration in the classification proper*. Thus for instance, the concept of 'wet patana soils' is not acceptable since several morphologically different soils are found under wet montane grassland ; namely, red-yellow podzolic soils, meadow podzolic soils and bog or peaty soils. Similarly, terms such as paddy soils, coconut soils, rubber soils, etc., are not appropriate because these crops are grown on soils of different morphology, or else quite often some of these crops occur together on soils with similar features.

The principal morphological features used in defining the soil units are the nature and arrangement of the genetic soil horizons, their color, texture, structure and consistence. Other diagnostic characteristics are the content and nature of organic matter, and the presence of lime, soluble salts and concretions of different nature. The water regime of the soil is also considered an important diagnostic feature both in relation to soil climate and to the presence of a permanent or periodic water table.

Chemical and physico-chemical properties which are used as diagnostic characteristics include the pH in water and 1N KCl ; cation exchange capacity ; base saturation expressed as the sum of cations ; conductivity which is indicative of the amount of soluble salts ; and free calcium carbonate content. The diagnostic mineralogical features are the nature of the clay minerals and both the nature and approximate content of minerals other than quartz in the coarser fractions. Clay mineralogical data are yet incomplete in this study, although in a few cases the (SiO_2/R_2O_3 and SiO_2/Al_2O_3) ratio of the clay fractions are quoted.

* This statement does not hold entirely true for the distinction between alluvial soils and regosols, which groups are separated not so much based on differences in soil morphology but on differences in geology and topography.

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In this classification of Ceylon soils, the diagnostic features are described in accordance with the methods developed in the United States of America (12,13) which have been adopted by several countries and also by the F. A. O.

In the morphological system of classification, the soil profiles are classified in increasingly broader categories ; namely soil types, soil series, families, great soil groups, suborders and orders. Sometimes intermediate categories have to be adopted. In this study, the category of generalization used is that of the **great soil group** as proposed by Thorp and Smith (15). An intermediate category of the **subgroup** is introduced in order to classify soils which differ from the modal soils of the great soil group in one important feature. Categories higher than that of the great soil group level have not been introduced in this paper. Although the principles of zonality which are adopted to classify soils in the category of the orders and suborders may prove valuable in understanding the relation between soils and their environment on a continental scale, the implementation of these principles become increasingly difficult on the scale of a country the size of Ceylon.

In recognizing and naming the great soil groups of Ceylon, we have based ourselves mainly on the classification developed by Thorp and Smith (15) in the U. S. A. which in turn derives both from earlier American work and also from the classical studies of the Russian pedologists. However, since all the great soil groups of Ceylon could not find a place in the above classification system, other sources have been resorted to, notably the classification developed by Stephens (14) for Australian soils and also the miscellaneous classifications used by F. A. O. experts in tropical countries.

Of great interest for modern soil classification is the taxonomic system developed in recent years by American soil scientists assisted by pedologists of several other countries. The results of this new approach were recently published (12) in a 7th approximation*. In this system the taxonomic units are determined according to observable, and if possible, measurable properties in as much as these properties affect soil genesis or result from soil genesis. In determining the great soil groups of Ceylon, the methods of diagnosis of the 7th approximation have been followed as closely as possible. Furthermore, in Chapter III, an attempt has been made to group the soils of Ceylon according to this new classification system. It will be observed that most Ceylon soils can be satisfactorily arranged within the categories of the new system. Although in a few cases it has proved to be incomplete, it should be borne in mind that this new system is yet an approximation and that new units could be introduced as they become known.

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* In this paper this system is referred to as " 7th approximation ".

To illustrate the soil units which will be discussed in this paper, detailed descriptions and analytical data are given for most of the great soil groups and some of the subgroups. For readers who are not familiar with the physical geography of the island, we refer to the maps at the end of the text.

The authors wish to present this study as a manual of the soils of Ceylon, which might serve as a guide for recognizing the main soils of the country. Since several of the great soil groups are inadequately studied and their subdivision at the subgroup and lower levels of classification has yet to be undertaken, the nature of this paper is essentially provisional. With further observational and analytical data the definition of the units could be made more exact. Information from further soil surveys could result in the introduction of other groups and also in the modification of the definition and nomenclature of the present groups.

CHAPTER II

GREAT SOIL GROUPS OF CEYLON

Following great soil groups are described in this chapter :—

1. Reddish brown earths
2. Noncalcic brown soils
3. Reddish brown lateritic soils
4. Red-yellow podzolic soils
5. Red-yellow latosols
6. Immature brown loams
7. Rendzina soils
8. Grumusols
9. Solodized solonetz
10. Low-humic gley soils
11. Meadow podzolic soils
12. Bog and half-bog soils
13. Alluvial soils
14. Regosols

Furthermore, some remarks are made on the laterite and lateritic formations observed in Ceylon.

1. REDDISH BROWN EARTHS

Profile description No. 1

Nomenclature

These soils are believed to be the equivalent of part of the red-brown earths of Australia as described by Stephens (14). Similar soils have been called red mediterranean soils in Indonesia by Dudal and Soepraptohardjo (3) and in Viet-Nam and Cambodia by Dudal (2) and the senior author (unpublished work). Reddish brown earths on limestone are often referred to as terra rossa. The group is thought to cover most of the non lateritic red and reddish brown loams, distinguished by Joachim (7) and also his chocolate brown loams on (Archaean) limestone. However, it does not include his brick red loams of the limestone area in the Jaffna district.

Morphology

Besides the modal soils, a *subgroup with a predominant brown color and with definite signs of wetness (gley) at some depth*, is recognized.

In the modal soils, the A horizon is never differentiated into A1 and A2 horizons. A transitional A3 horizon is often found. Generally, the transition from A to Bt is gradual. The A horizon is usually less than 10 inches, often only around 5 inches thick. The color is dark brown to dark reddish brown* and more reddish in cultivated soils than in soils under a natural vegetation. The texture is mostly sandy clay loam ; less frequently sandy loam or clay loam. Structure may be weak crumb or weak subangular blocky when the texture is heavy. More often, and especially in cultivated soils, the A1 is structureless or nearly so. Consistence is friable when moist or soft to slightly hard when dry.

The Bt horizon can be subdivided into B1t, B2t and B3t, with a fairly clear distinction between the three sub horizons. Very often, the B1t is developed in a semi-recent colluvial material, whereas the B2t and B3t have been formed in a much older, frequently somewhat transported, residual material. The two layers are often separated by a stone line (erosion pavement). Such profiles can be termed polygenetic, the Bt development in the residuum having started long before that in the colluvial cover. These profiles do not, however differ in their inherent diagnostic properties from soils developed on a uniform residual parent material and thus cannot be considered as a separate soil group. The color in the Bt horizon is distinctly redder than in the A horizon. In the B2t, the dominant colors are dark reddish brown to dark red. Soils on Archaean limestone are usually somewhat redder

* Color names according to the Munsell soil color charts.

than soils on residuum from other rocks. The color of the B2t horizon in profile No. 1 is slightly lighter and somewhat less red than average. Texture of the Bt horizon, and especially of the B2t is distinctly heavier than that of the A horizon; and is mostly clay loam or clay. Thus the B horizon definitely is an illuvial or argillic horizon, which is confirmed by the presence of distinct clay skins or coatings on the structural units. The structure in the B2t is moderate to strong, fine subangular blocky; sometimes the peds are arranged in weak prisms, which however are only visible in dry profile exposures. The consistence varies quite strongly with texture and moisture status; usually it is firm when moist and hard to very hard when dry. The B3t has characteristics which are transitional to those of the C horizon; a somewhat lighter color and especially a higher content of unweathered minerals and decomposing rock fragments. In some cases, the B3t is calcareous or may even contain secondary lime concretions. The C horizon consists of more or less decomposed parent material, usually residuum of rather diverse character. In soils developed on Archaean limestone, the B3t and C horizons may be absent or at least be so thin that they hardly can be observed in the field.

In the wetter part of the zone of reddish brown earths (e.g., Puttalam district), profiles are found in which the B3t and the C horizons show signs of recurrent seasonal wetness, even to a stage where a weak groundwater laterite may be observed in which the red mottles become irreversibly hard upon drying.

The one subgroup which has been recognized has a distinctly browner color in both A and Bt horizons. The color often observed for the B2t horizon is dark brown (7½ YR 4/4). Signs of recurrent wetness are a light mottling or rather an unevenness of color in the B2t horizon at medium depth (e.g., 15-30 inches) and a more distinct gley in the lower horizons. Also manganese concretions and spots, which do occur in most of the modal soils are much more numerous in these profiles. These soils do not necessarily have laterite in the subsoil, but soils of this subgroup with a weak groundwater laterite can be observed in the wetter part of the zone of the reddish brown earths.

Chemical and Physico-chemical Characteristics

The pH values in reddish brown earths are usually between 6 and 7 with a general tendency to increase with depth. The soil may become slightly alkaline in the lower Bt and in the C horizon, often dependent on the nature of the parent rock. In areas with a higher rainfall the surface pH tends to be lower but seldom falls below 5·5. The cation exchange capacity of the Bt horizon, expressed in m.e. for 100 grams clay is usually between 45 and 55.

Base saturation values are above 40%, usually higher than 70% and increasing with profile depth.

The few data available indicate that the O.M. content of these soils is rather low ; somewhat around 1·2% C and the C N ratios are usually below 12. Panabokke (10) found that the dominant clay mineral is kaolinite, with traces of illite and with montmorillonite in the lower horizons (B3t and C). Fusion analyses of the clay fraction indicate the "non lateritic" character of these soils. Joachim (7, 6) found SiO_2/Al_2O_3 ratios of more than 2·2 for reddish brown earths both on intermediate rocks and crystalline limestones.

Occurrence

In extent, the reddish brown earths are the most important soils of Ceylon. They occupy by far the largest part of the lowland dry zone in the Northern, North Central, Eastern and Southern provinces. A small area occurs in the uplands around Teldeniya (Kandy district).

Environmental Factors

The reddish brown earths are the modal soils of the dryer part of Ceylon ; they do extend however to zones of intermediate rainfall. They are found in areas with less than 85 inches rainfall. However, in the zone between the 65 and 85 inch isohyets they may occur side by side with red-yellow podzolic soils or even be absent in some areas. Also, in the dry upland zone, roughly above 2,000 ft. no reddish brown earths were found. Average annual temperatures are between 79 and 82° F.

These soils are mainly developed on parent material derived from Archaean rocks, mostly of a sedentary but sometimes of transported nature. The rocks vary from fairly acid to highly basic (crystalline limestone). No reddish brown earths seem to have formed on rocks without an appreciable amount of ferro-magnesian minerals.

Relief is not an important factor. Although most of these soils are found on undulating to gently rolling mantled plains, they do occur in hilly terrains as well. Free drainage however is necessary and in the depressions this great soil group is replaced by hydromorphic soils (alluvial soils, low-humic gley soils).

The natural vegetation, most commonly found is dry mixed evergreen forest, characterized by the predominance of evergreen species with an admixture of deciduous species. Most of this forest is secondary, the original forest having been destroyed by shifting cultivation at one time or another. In the dryest part of the zone of reddish brown earths a vegetational type of low open thorny shrub with isolated trees is found. Anthropomorphic forest-savannah with Imperata cylindrica and Cymbopogon confertiflorous is observed in the Bibile area (Badulla district).

Present Land Use and Agricultural Potential

A greater part of the reddish brown earths are uncultivated or else have been regularly used for ' chena ' or shifting cultivation since medieval times. The period of forest fallow varies with the population density of the region, often approaching a three year period in some areas. Where sufficient underground water is available, settled arable crops are grown with supplemental water. Successful dry farming is restricted to the government farms and a few large private holdings. In the transition zones of higher rainfall towards the wet zone more settled forms of agriculture including some plantation crop such as coconut and rubber are found. Fair extents of poor grade soils associated with quartzitic rocks and rough topography remain unused even for ' chena ' cultivation.

Research investigations at Maha Illuppallama have demonstrated that with efficient weed control and correct tillage practices, the reddish brown earths could be brought under very productive and sustained systems of rainfed cropping. The sluggish drainage of the textural B horizon often has an adverse effect on crops during seasons of heavy rainfall. The soils are poorly supplied with phosphorus which therefore has to be supplemented by phosphatic fertilizers. Prospects for large scale irrigation development are very good in areas with suitable topography. Flood irrigation should essentially be restricted to the brown colored subgroups and the alluvial associates. The shallow soils which occupy the crests of the undulating landscape are best utilized for forestry.

2. NONCALCIC BROWN SOILS

Profile description No. 2

Nomenclature

These soils are similar to the noncalcic brown or shantung brown soils of the United States (California). They have been described under the same name by Moormann (9) in Viet-Nam. Joachim's non lateritic gray brown sandy loams include these as well as some other soils.

Morphology

Since only a few of these soils have been studied and described, the general morphological features are not as yet known in full detail.

In profiles developed on acid residuum under natural vegetation a distinct differentiation into an A1 and A2 horizon can be observed. The A1 has a grey brown color while the A2 is brown to yellowish brown. Texture is predominantly sandy loam. In cultivated soils the A1 horizon is mixed with the A2 horizon resulting in a grey brown color which assumes a lighter and greyish color when the surface dries out. This 'leached' character of the A horizon distinctly differentiates these soils from the reddish brown earths which may occur in the same area.

The Bt horizon is yellowish brown to brown or very rarely yellowish red, and has a distinctly higher clay content than the A horizon. Structure is subangular blocky and clay coatings or clay bridges between the coarser grains are present. The consistence is firm, and slightly hard to hard when dry. Base saturation in this horizon is above 40%. The C horizon consists of decomposed acid gneisses with a low content of ferro-magnesian minerals.

Weakly developed noncalcic brown soils were observed on sandy old alluvium (terrace deposits) in the Polonnaruwa district. These soils show the same characteristics as above, except that the Bt horizon is only slightly heavier than the A1 and there is no distinct color differentiation between the A2 and Bt.

Some soils of the transition zone between the reddish brown earths and the red-yellow podzolic soils in the Puttalam and Kurunegala districts may have to be classified with the noncalcic brown soils. These soils have the morphological characteristics of red-yellow podzolic soils but their base saturation is higher (more than 40% in the Bt) than permitted for this group.

Occurrence

The noncalcic brown soils are a group of lesser importance in Ceylon. They occur mainly in the Batticaloa and its adjacent districts and are found scattered in the zone of the reddish brown earths, especially in the transition areas towards the lowland wet zone.

Environmental Factors

The noncalcic brown soils are found in the intermediate and dry zones of Ceylon with an average temperature between 79 and 82° F.

These soils seem to develop mainly on acid parent materials such as the Bintenne gneisses which have a low content of ferro-magnesian minerals and also on quartzitic transported materials which are derived from acid rocks.

The transitional soils of the intermediate zone are found on somewhat less acid parent material.

Relief is not an important factor, but the drainage definitely is ; noncalcic brown soils are not found in poorly drained depressional sites. The natural vegetation is dry mixed evergreen forest which gives place to damana or shrub-savannah on sandy soils in the Polonnaruwa district.

Present Land Use and Agricultural Potential

A greater part of the noncalcic brown soils remain uncultivated except for occasional 'chena' cultivation which requires long fallow periods of 15–25 years. Settled forms of agriculture are rarely practiced on these soils except on the transitional soils of the intermediate zone where permanent plantation and orchard crops are grown. Irrigation development has brought some extents of these soils under rice cultivation in the Eastern province.

The agricultural potential of this soil group is fairly restricted under dry zone conditions. The rough, irregular topography of the landscapes on which these soils occur limits large scale irrigation development. Dry cropping under dry zone rainfall conditions is hazardous because of the poor structural stability of these soils. Provided efficient soil conservation measures are adopted, they could however be satisfactorily used for extensive pasture development.

3. REDDISH BROWN LATERITIC SOILS

Profile description No. 3

Nomenclature

These soils have been variably described as reddish brown lateritic soils and yellowish brown lateritic soils in tropical soil literature. However, it is believed that there is no exact equivalence with either of the two groups.

The term 'lateritic' does not imply the presence of a lateritic horizon, but rather that the material of the solum shows low silica-sesquioxide and silica-alumina ratios ; usually below 1·5 and 2·0 respectively. The use of the term lateritic is not very satisfactory.

Some of the reddish to yellowish red lateritic loams of the wet zone which are described by Joachim (7) can be considered equivalent to the reddish brown lateritic soils.

Morphology

The A horizon is never differentiated into A1 and A2 horizons, but in most profiles a transitional A3 horizon is observed. Under uncultivated natural forest the thickness of the A horizon is 12 inches or more. In cultivated soils on slopes, the Ap horizon is very much thinner or almost absent due to soil erosion. On the other hand, on the lower aspects of the slope the eroded A horizon materials have accumulated into a fairly thick, rather light colored A. In the modal soils, the color of the A horizon varies from reddish brown to brown and is always distinctly darker than in the underlying horizons. The texture is mostly sandy clay loam ; less frequently clay loam, loam or sandy loam. Primary minerals most frequently micas, are always found in this horizon. Structure is rather strong crumb to granular under natural vegetation, with a definite loss of structure in most cultivated soils. Consistence is friable.

Transition to the illuvial Bt horizon or argillic horizon is gradual. Clay content increases regularly with depth, the textures being generally clay loam or clay. Clay coatings, often strongly developed can be observed on the peds. The thickness of the Bt varies considerably, from less than 30 inches in eroded profiles to more than 12 feet in normal profiles. Color in this horizon is variable, ranging from red, reddish brown, yellowish red to strong brown colors. In profiles developed on charnockite the color is somewhat redder and darker than those developed on the less basic parent materials. Structure of the Bt horizon is well developed subangular blocky, with a tendency towards the peds being arranged into weak prisms. The consistence is friable to firm when moist, and slightly hard when dry. The B3t is transitional to the C and has a higher content of weatherable minerals than the B2t. Transition to the C horizon is gradual. The C horizon consists of residuum of decomposed rocks ; this horizon is usually thick except in the profiles developed on charnockite where it is thin (generally less than 15 inches).

Some reddish brown lateritic soils have developed on transported residuum (old slope colluvium). These soils may contain transported lateritic concretions, gravels or boulders from disintegrated older landscapes. Laterite formation in situ is rarely observed.

Chemical and Physico-chemical Characteristics

The pH values of these soils are usually between 5·5 and 6 with slightly higher values for the surface horizon. There is no tendency for the pH to increase in the deeper horizons or even in the C. The pH in water is distinctly higher than pH in lN KCl in all horizons.

Cation exchange capacity of the B2t horizon is quite variable, ranging from 25 to 40 m.e. per 100 grams clay. Base saturation of the Bt horizon is generally lower than 40%, but values lower than 15% are less common. Joachim (7) reports a silica-alumina ratio of 1·59 and a silica-sesquioxide ratio of 1·26 for the A horizon of a reddish brown lateritic soil near Kandy.

Occurrence

The reddish brown lateritic soils are the dominant soils of a greater part of the Kandy and Kegalle districts. Narrow zones of this great soil group are also encountered on the Eastern and South Eastern lower slopes of the central highlands, but their extents have yet not been adequately assessed.

Environmental Factors

Occurence of the reddish brown lateritic soils is distinctly related to both climate and topography. They are best expressed within the 75 to 110 inch rainfall isohyets. Below the 75 inch rainfall region they are largely replaced by the reddish brown earths and where the rainfall is over 110 inches the red-yellow podzolic soils are dominant. The topography is mainly hilly and at least sharply rolling. Most, if not all of these soils occur on terrains which have been strongly incised by geological erosion. Since they have developed on a rejunevated relief the reddish brown lateritic soils are comparatively young soils. These soils are replaced by wet alluvial soils (paddy lands) in the narrow intervening valleys.

The parent material on which the reddish brown lateritic soils are found is mainly residuum or transported residuum (slope colluvium) which is derived from the Khondalite series of Archaean rocks. Residuum derived from the more basic charnockites is also fairly common.

Hardly any natural vegetation is left on these soils ; the original dominant vegetation is believed to have been a tropical wet evergreen forest.

Present Land Use and Agricultural Potential

Typical of the mid-country settlements are the mixed home garden crops such as bananas and fruit trees which are grown on these soils. Apart from a few tea, rubber and coconut plantations, the best quality cocoa estates are found within this soil group. Vegetables and tobacco are grown in the rain shadow region immediately east of Kandy.

Almost the total extent of these soils are already under settled agriculture, so that further utilization has to be based on increased production on the presently cultivated land. The excellent drainage of these soils, coupled with their relatively high structural stability, readily lend them to intensive agricultural use with the aid of fertilizer. Simple terracing has been applied on these soils to a satisfactory degree, but further anti-erosion measures appear to be necessary on the steeper slopes.

4. RED–YELLOW PODZOLIC SOILS

Profile descriptions : No. 4 *Modal subgroup*

No. 5 *Subgroup with prominent A1 horizon*

No. 6 *Subgroup with dark horizon*

Nomenclature

This great soil group is the equivalent of the red-yellow podzolic soils of the South Eastern United States. Recent work has shown that the red-yellow podzolic soils are a dominant group of soils in the wet tropics of South East Asia (3, 2, 9). They are developed on a wide range of parent materials other than ultra-basic rocks. Stephens (14) recognizes separate groups of red podzolic and yellow podzolic soils in Australia. A part of the Australian lateritic red earths would also probably go with the red-yellow podzolic soils as defined in this publication.

Soils belonging to this great soil group have been described as lateritic red loams and earths, and in some instances as ground water laterites when such a formation is present in the sub soil. Joachim (7) refers to them by such names as 'the laterites and lateritic reddish yellow loams of the ultra wet zone' and also as 'the reddish to yellow red lateritic loams of the wet zone'. His dry patana (grassland) soils, kekilla (fernland) soils, and a part of the wet patana (grassland) soils are all found to belong to this great soil group.

Morphology

Besides a *modal subgroup*, the following subgroups are recognized :—

subgroup with soft laterite (cabook)

subgroup with prominent A1 horizon

subgroup with dark horizon

More subgroups may have to be introduced with further observational and soil survey data.

In the modal soils under natural vegetation, the A horizon is distinctly differentiated into A1 and A2 horizons. The A1 varies in thickness and is not strongly pronounced or very humiferous. Under cultivation the A2 horizon tends to become less distinct as a result of erosion and mixing with the A1 horizon. This phenomenon is very common in the hilly terrains, especially in the tea growing regions, where the A horizon may be practically absent or else a new Ap horizon is formed on the former Bt horizon. In contrast to erosion, there is also the phenomenon of accumulation in the lower aspects of the slope where a thick A horizon develops, which is neither very prominent nor very dark coloured. Profiles which have more than 20-30 inches of this young colluvium without a clear horizon differentiation will have to be excluded from this great soil group and classified with the regosols.

The color of the A1 horizon is dark grey brown to dark brown ; the predominent color of the A2 is a strong brown to yellowish brown. These brownish colors persist under cultivation unless the A horizon is entirely eroded. The predominant texture of the non eroded A horizon is either a sandy loam, sandy clay loam or loam. Structure of the A1 is usually weak to moderate crumb or granular. Weak, subangular, blocky structures are predominant in the A2, but it could often be nearly structureless. The distinctness of the structure diminishes with cultivation. Consistence is friable.

Transition to the illuvial Bt or the argillic horizon is usually rather distinct, but rarely abrupt ; generally a B1 transitional subhorizon can be distinguished. The thickness of the Bt horizon is highly variable, but is usually more than 40 inches in profiles which have not been subject to strong erosion. A Bt horizon of 80 inches or even 120 inches is no exception among soils of this group. The color of the Bt is much redder than that of the A and always distinctly brighter (higher chroma). In a majority of the profiles the B2t is yellowish red, seldom red, but could be quite frequently of a brown to yellowish brown color. There seems to be no definite pattern in the occurrence of these colors and quite often reddish and yellowish brown colors can be observed side by side in a single profile exposure. Thus, no subgroup divisions could possibly be made on the basis of the color of the Bt horizon. The clay content of the Bt horizon is usually higher than that of the A horizon with the dominant textures being either sandy clay loam, clay loam or clay. Prominent clay coatings can be observed in all profiles of this group. Consistence is mainly friable when moist or slightly sticky and slightly plastic when wet. Since these profiles hardly dry out at any particular time of the year, the consistence when dry is not very well known ; but it is believed that it could be slightly hard, or very rarely it could be hard.

Although there may be a few of these soils which may have certain aberrant characteristics they need not be excluded from the modal group. As for example, those soils on the lower slopes which are formed on slope colluvium of different ages tend to be 'underdeveloped' in that there is only a relatively small difference in clay content between A and Bt and in having weak clay coatings around the peds of the B horizon. Likewise, soils on basic charnockite have a Bt which shows the characteristics of a latosolic or oxic B horizon, similar to the reddish brown latosols on basalt described by Dudal (2) and by Moormann (9). In the ultra-wet zone (roughly more than 150 inches rainfall), soils developed even on other parent materials show this transitional character to latosols in certain characteristics such as a much weaker structure in the Bt, a high degree of friability, a lower bulk density and the apparent absence of any appreciable quantity of weatherable minerals.

Subgroup with soft laterite (cabook)

Many of the red-yellow podzolic soils which contain laterite concretions, boulders or slabs are not necessarily classified under this subgroup. Soils of this subgroup should have hard laterite or lateritic concretions which are formed in situ at depths of less than 50 inches and passing to soft laterite at less than 100 inches. When the soft laterite is present at depths greater than this or is altogether absent, then the soil belongs to the modal subgroup or one other of the subgroups. Usually, the hard, in-situ laterite starts at a shallow depth ; sometimes in the A1 horizon, but more often in the B. These concretions may be partly decomposed. The soft laterite usually starts at a depth of 70 to 100 inches ; very rarely at less than 50 inches. This laterite may be 'complete' (cabook) in the sense that the whole mass becomes irreversibly hard upon drying ; or else, it may be 'incomplete' with only the red mottles becoming hard upon drying.

Subgroup with prominent A1 horizon

Noncultivated soils of this subgroup have a deep (10 inches or more) and very dark (10 YR 3/2 or 2/2) A1 horizon which is sharply contrasted to the A1 horizon of the modal soils. This A1 horizon could become less dark and shallower with cultivation and erosion, so that the soil may gradually trend towards the modal subgroup. It is possible that there could be soils which, apart from the prominent A1, may possess the requisites of the previous subgroup, i.e., have soft laterite at less than 100 inches. In such a case, the presence of the dark A1 horizon is considered preferential.

Subgroup with dark horizon

Soils of this subgroup show a dark colored horizon which coincides mainly with the upper part of the Bt. This dark color is apparently caused by humus infiltrating from above. The horizon is from 2 to 6 inches thick and is very distinct. This dark color does not necessarily indicate a humus content higher than in the overlying A2 as revealed in the analytical data for profile 6.

In some cases the humus content is higher than in the A2, but even in such a case the dark color may be due to a particular combination of clay and humus. The dark horizons appear in profiles with both a 'normal' and a prominent A1, but the presence of the dark horizon has preference in classifying the soil.

Chemical and Physico-chemical Characteristics

The pH values in these soils are generally below 6 and often below 5·5, with no tendency to increase with depth except in the weakly weathered C horizon. In the very wet zone, values of less than 5 are often found in the argillic horizon. The pH values determined in the 1N KCl are always lower than those in the water.

Both cation exchange capacity (in m.e. for 100 grams clay) as well as base saturation tend to be lowest in the wettest zone of the country. Here, the cation exchange capacity may be less than 10 m.e. for 100 grams clay, while the base saturation may be very low. Base saturation in the Bt horizon increases with diminishing rainfall, but should be less than 35% if the soil is to be included within this great soil group. The base saturation of the soils with a prominent A1 is low to very low throughout as may be seen in the analytical data of profile 5. Fusion analysis of the clay fractions (7) show silica-alumina ratios of less than 1·7, while the soils from the ultra wet zone and soils with prominent A1 (soils under wet grassland and fernland) show values of even less than 1·4.

Occurrence

The red-yellow podzolic soils are the dominant soils of the wet zone of Ceylon and also of the intermediate zones at elevations over 2,000 ft. which include the semi-dry enclave of the Badulla-Bandarawela uplands. The subgroup with laterite is mainly concentrated in the wet lowlands of the Sabaragamuwa and Western provinces. The subgroup with prominent A1 is dominant on the undulating plateau areas of the second and third peneplains, while the subgroup with dark horizon appears to be confined to the Nuwara Eliya district at elevations of 5,500 ft. and over. The modal soils are found throughout the wet zone, but their largest extents are in the hilly areas of central Ceylon.

Environmental Factors

The red-yellow podzolic soils are the modal soils of Ceylon's wet zone, both in the lowlands as well as in the central highlands. In the lowlands, the lower annual rainfall limit above which they occur is around 80 inches, while in the highlands over 2,000 ft. elevation they occur in regions where the rainfall is over 65 inches annually (Diyatalawa). Temperatures vary from an average of 81°F in the lowlands to less than 55°F with occasional frosts in the highlands.

They are developed on a wide variety of parent materials. These are mainly residuum from Archaean rocks (with the probable exception of the crystalline limestones), colluvium derived from such residuums, and old alluvial sediments of river terraces such as those found in the valley of the Kalu ganga around Ratnapura.

Relief, on the whole is not a very important factor, and topographical conditions may vary from nearly flat to mountainous. In the depressions these soils are replaced by hydromorphic alluvial soils, low-humic gley soils, meadow podzolic soils and bog and half-bog soils. On the other hand, the subgroups other than the modal soils appear to be related to relief. Thus, the subgroup with laterite is mainly found in the undulating to gently rolling parts of the lower peneplain ; when the relief is more accentuated this subgroup is only found on the footslopes of the hills. The subgroup with prominent A1 seems to be confined mainly to the gently rolling, more or less stable plateaus of the second and third peneplains. The subgroup with dark horizon is found on the plateau of the third peneplain at an altitude of 5,500 ft. or more.

Proceeding from the lowlands to the uplands, the most important natural vegetation types under which these soils are formed are the lowland tropical wet evergreen forest, the sub-montane tropical wet evergreen forest, the montane temperate forest and the (degraded) dry montane grassland or patana. The soils with prominent A1 are found mainly under fern vegetation (kekilla) and also under wet montane grassland or patana. The dark horizon red-yellow podzolic soils seem to be confined exclusively to the wet montane grassland. It should be remembered that a large part of the natural vegetation has been cleared so that it is possible that the red-yellow podzolic soils may have been developed under other vegetational types as well.

Present Land Use and Agricultural Potential

The red-yellow podzolic soils are extensively used under a wide range of crops. Limited extents under wet patana and in some inaccessible regions are yet unused. Where these soils occur in the wet zone lowlands coconut is the chief plantation crop ; rubber is grown both in the lowlands and in intermediate elevations of the wet zone. Large extents of this soil group which occur in the hilly regions of central Ceylon are mainly under tea. Where they occur in the semi-dry uplands of Uva, the best flavoured tea is grown.

In this same region increasing extents are being terraced and brought under highly productive market crops. Vegetables and tobacco are grown in the rain shadow areas immediately east of Nuwara Eliya.

Great potentialities for increased production exist on these soils. Almost all crops have shown striking fertilizer responses to the major elements (N, P & K) on these soils, the best example being that of tea which has shown an average 35% increase in yield over a ten-year period which has resulted mainly from correct fertilizer usage. Management on these soils is fairly straightforward. Anti-erosion measures are necessary especially on the steep slopes which are increasingly coming under cultivation.

5. RED-YELLOW LATOSOLS

Profile descriptions: No. 7 *Red latosol subgroup*

No. 8 *Calcic red latosol subgroup*

Nomenclature

The term latosol was first introduced by Kellogg (8) for the highly weathered, deep, strongly colored soils of equatorial Africa. The term has since been used in South East Asia (2, 9) and also in Hawaii (1) essentially for soils derived from basic and ultra basic rocks, mainly basalt. Thus, the red-yellow latosols of Ceylon may differ considerably from the latosols which have been described in other Asian countries and also from the krasnozems as described by Stephens (14) in Australia.

Joachim has made no specific description of these soils except that of the calcic red latosol subgroup which he has classified as the brick red loams derived from Miocene limestone (7, 6).

Morphology

Three subgroups are recognized :—

Red latosols

Yellow latosols

Calcic red latosols

The red latosols are considered modal and will be described first.

One of the most striking characteristics of these soils is their extreme uniformity to a great depth with a distinct lack of horizon differentiation.

The A horizon is fairly thin and its color is hardly different from the underlying B or oxic horizon. The A horizon is loamy sand or sandy loam, without structure and of a loose consistence. The B horizon though slightly heavier has no indication of being an illuvial or argillic horizon. Typical for the texture of the B horizon is the very low fine silt (2–20μ) content. The B horizon may continue unchanged to as much as 40 feet. It is structureless or at most, very weak coarse subangular blocky ; and is loose or slightly cemented when dry. The color of the B horizon is red to dark red ; seldom yellowish red (transition to the yellow subgroup).

The yellow latosol subgroup differs from the red latosol only in as far as the color of its B horizon is more yellowish, varying from yellowish red to yellowish brown.

The calcic red latosols are shallow red latosols developed on transported material which overlies Miocene limestone. The gradual decomposition of the underlying limestone has released bases which have influenced the overlying soil through the cyclic action of the vegetation. These soils have an extremely thin A horizon which quite often is almost absent. In the B horizon, especially adjacent to the limestone, a weak subangular blocky structure and some interrupted weak clay coatings can be observed. Such characteristics are transitional towards the reddish brown earths, and are mainly due to the mixing of minimal amounts of clay liberated from limestone weathering with the soil material of the latosol. Most of the calcic red latosols show ruptic profiles ; i.e. the soil mass is interrupted by the limestone rock which at one place may be at the surface, and then only a few feet away it may be at 4 to 6 feet under the surface. These limestone outcrops are usually only a few yards apart. Special mention should be made of the man made soils in the Jaffna penisula, where the limestone outcrops are dug out and the soil material in between the rocks is uniformly spread on the levelled land so as to produce a suitable medium for irrigated cropping.

Whereas the soils of the first two subgroups are unsaturated (base saturation less than 45%), the soils of the calcic subgroup are more highly saturated with pH values between 7 and 8 and sometimes with secondary lime being present. Soils in the Jaffna area show a silica-alumina ratio of approximately 1·6 in the clay fractions as reported by Joachim (7).

Occurrence

The red latosols and yellow latosols occur in close association in the western parts of the North Central province between Mannar and Puttalam. An isolated small patch of this soil was found in the Southern province near Hambantota. The calcic red latosols appear mainly in the Jaffna peninsula.

Environmental Factors

Although these soils appear exclusively in the dry zone, they are definitely not related to the present climate. They are old soils (probably lower Pleistocene) formed under quite different climatic conditions. The reason for their being confined to the dry zone seems to be the fact that they have been spared from erosion in this region.

Topography of these soils is quite flat with an occasional erosion valley. Near Hambantota, these soils have assumed a dune topography, probably due to the soil material having been reworked by wind at some period.

The parent material is believed to be old coastal alluvium and the geomorphological position of these soils would thus be an old coastal shelf or terrace. The parent material may have been more sandy at one time, but all weatherable minerals have decomposed to sesquioxides and clay.

The natural vegetation is mainly low dry mixed evergreen forest with some shrub land around Hambantota and Jaffna.

Present Land Use and Agricultural Potential

Very limited extents of settled agriculture are found on the red subgroup and the yellow subgroup ; and such extents are restricted to areas with a reliable source of underground water. Hardly any ‘ chena ’ or shifting agriculture is practised on these soils due to their very low inherent chemical fertility. Coconut is grown in the intermediate rainfall region.

The extremely poor water retention properties of these soils rules out any chances of dry land cultivation. Conventional flood irrigation is unpracticable on these soils due to their very rapid infiltration characteristics. However, the excellent physical status of thes› soils make them an ideal medium for raising orchard crops with the liberal aid of fertilizers and sprinkler irrigation.

The calcic subgroup in the Jaffna peninsula is one of the most intensively cultivated soils of the Island. Sustained production on this soil is achieved by liberal use of bulky organic manure and lift irrigation. Extreme land pressure is now compelling farmers to reclaim small plots of land from the bouldery patches, by blasting out the Miocene limestone boulders and then spreading out the retrieved soil on the levelled land. This operation could be mechanized to reclaim larger extents than being produced at present.

6. IMMATURE BROWN LOAMS

Profile descriptions: No. 9 *subgroup of the wet zone*

No. 10 *subgroup of the dry zone*

Nomenclature

The term immature brown loam has been introduced by Joachim (5) mainly for young soils developed on mica schists at elevations of around 1,000 ft. in the wet zone. In this paper, the concept is enlarged to include all soils with similar characteristics both in the wet and dry zones and on a wider range of parent materials.

These soils have also been described as (tropical) brown forest soils where the base saturation is high, and as ' sols bruns acides ' or ' acid brown soils ' where the base saturation is low.

Morphology

Two subgroups are distinguished according to the soil climate :—

subgroup of the wet zone. Soils moist throughout the year, or else, dry for a period of less than two months (wet zone)

subgroup of the dry zone. Soils dry for a period of two months or more during the year (dry zone).

The morphological features of the two subgroups show sufficient similarities so as to be described together.

The A horizon varies in thickness between 5 and 15 inches. Color is dark brown to dark grey brown. The dry zone soils are usually somewhat redder than those of the wet zone. Texture may vary from sandy loam to sandy clay loam and is generally rather light. The A horizon contains many undecomposed primary minerals, especially fine micas if the parent material is micaceous. Structure is moderate to strong crumb, but granular and weak subangular blocky structures may be found in the heavier textured soils. Consistence is friable to loose, and the non cultivated soils usually show a high pore volume with many larger channels and holes.

Transition to the B horizou is gradual. The B horizon is not an illuvial or an argillic horizon ; textures of the A and B horizons are nearly the same, although in some instances the A horizon may have a higher clay content than the B as in the case of the profile described under No. 9. Clay coatings should not be present in this horizon. The B horizon has been called ' color B ' in the sense that it is lighter and brighter colored than the A and at the same time it is darker than the C. In the 7th approximation this type of horizon is called a cambic horizon. Texture is predominantly sandy loam or loam. Like in the A horizon, numerous unweathered mineral particles may be observed ; especially micas if the parent material is more or less micaceous. Color of this horizon varies from reddish brown to yellowish brown. The dry zone subgroup, as a rule, has distinctly redder colors in the B horizon than the wet zone subgroup. Structure in this horizon is indistinct, often weak crumb and sometimes weak subangular blocky. Consistence is loose to friable and soft when dry. Transition to the C which is usually observed at a depth of less 40 inches, is gradual to clear ; quite often it is wavy or even irregular with tongues and sacs penetrating the C. At times, the B horizon rests directly on hard rock. The C horizon is either decomposed rock or colluvium.

Occurrence

The wet zone immature brown loams can be observed in the Kandy and Kegalle districts, where they occur in close association with the reddish brown lateritic soils. In their local distribution, they are found scattered in small patches while in the larger patches they occur in a complex pattern together with shallow reddish brown lateritic soils.

The dry zone immature brown loams appear in scattered locations throughout the dry zone. They rarely occupy a large surface area and are most frequent in areas having a marked relief as well as on the rock knob plains. In their local distribution they are closely associated with the great soil group of the reddish brown earths.

Environmental Factors

The immature brown loams are apparently young soils formed on surfaces which have been continuously exposed to erosion or alternatively, in places where transported colluvium has had a chance to accumulate. The latter case is sometimes observed in the dry zone, but hardly ever in the wet zone.

Topography is an important factor in the wet zone ; for here, the immature brown loams are always found on rather steep slopes. In the dry zone these soils are observed on the slopes of hills and rock knob plains, but the relief need not be excessive. North of Bibile for instance, these soils are found on moderate slopes in places where the original reddish brown earths have been entirely eroded after periods of intensive cultivation several centuries ago, and where the anthropomorphic savannah with a incomplete grass cover exposes a considerable surface of the soil to further erosion.

The immature brown loams of the wet zone are generally formed on material derived from mica schists or other micaceous rocks ; shallow, or lithosolic phases of these soils can be found over charnockite. The parent material may therefore be an important factor in the formation of these soils, since they seem to be absent on materials derived from more acid rocks. In the dry zone, the range of parent rocks seems to include most Archaean rocks and also the colluvium derived from such rocks.

This soil group appears to be found mainly below the 110 inch rainfall isohyet, while the limit between the dry zone and wet zone subgroup is somewhere between 80 and 90 inches.

The natural vegetation of the wet zone immature brown loam soils is believed to have been a lowland or sub-montane tropical wet semi-evergreen forest. In the dry zone the natural vegetation is usually dry mixed evergreen forest, while anthropomorphic forest-savannah with Imperata cylindrica and Cymbopogon confertiflorus is observed in the Bibile area.

Present Land Use and Agricultural Potential

Present land use on the wet zone subgroup is essentially very similar to that of the reddish brown lateritic soils. Although its water retention is poorer than that of the reddish brown lateritic soils, it is better supplied with some of the chemical nutrients. Further increased production on these soils should be based on improving their moisture retention.

The dry zone subgroup which is found on steep slopes and rock knob plains is unused and has no potential for any economic development. The deeper and less sloping phases could be used in the same manner as the reddish brown earths, with main emphasis on pasture development.

7. RENDZINA SOILS

Profile description No. 11

Nomenclature

These soils have been commonly called rendzinas or rendzina soils.

Morphology

These soils have an AC profile sometimes with a thin weak, color B or cambic horizon. Profile No. 11 which has been described does not have a color B. The A horizon is usually more than 10 inches thick and is dark or very dark grey brown in color ; texture is variable with clay contents higher than 15%.

The structure is dominantly crumb, consistence is friable and the soil mass has a very low cohesion with many holes and channels. Base saturation is high, and free calcium carbonate in a finely divided form is found at some depth. Soft limestone fragments are found mixed with the A1 horizon. Transition to the C horizon is gradual and is marked by a gradual increase of the soft limestone fragments. The C horizon is soft, chalk like limestone which is derived from the weathering of the hard crystalline limestone. This weathering of the hard limestone to the soft material permits the formation of a rendzina soil.

Occurrence

Rendzina soils are of minor importance and only a few such soils have been observed in the Matale and Polonnaruwa districts. They may be found in other localities where the Archaean crystalline limestone is present. They occur in close association with the reddish-brown earths.

Environmental Factors

The most important factor in the formation of rendzina soils is the parent material. They are formed only on soft limestone or on weathered hard limestone.

The rendzina soils are confined to the intermediate and dry zones with a rainfall approximately less than 80 inches.

Topography is not a very important factor, but no rendzinas seem to be present in the low wet depressions.

Vegetation is dry mixed evergreen forest.

Present Land Use and Agricultural Potential

Because of their shallow and rocky character, rendzinas are hardly cultivated. Where they are sufficiently deep, dry land tree crops could be grown.

8. GRUMUSOLS

Profile description No. 12

Nomenclature

The term grumusol is taken from the recent American literature. These soils are known under several names throughout the tropic and subtropics, chief of which are black tropical and subtropical clays, black cotton soils (India, Sudan), regur (India ; also used in Viet Nam (9)), margallite soils (Java) and gray soils of heavy texture (Australia).

Morphology

These soils show an AC or ACg profile without a trace of a B. In Ceylon, the color of the A is black or very dark grey brown ; it should be noted that this dark color is not an absolute requisite for these soils, and that even brown colours such as found in the brown soils of heavy texture in Australia (14) are possible. The A horizon is usually a heavy clay with a clay content of more than 35%. Sometimes, a thin, bleached surface sandy layer penetrates in tongues to the lower horizon. The clay of the A horizon is of the montmorillonitic type as indicated by its high cation exchange capacity and also its swelling and shrinkage characteristics. Cracks up to 5 inches wide are formed when the soil dries out, and the alternate swelling and shrinking results in a mulchy surface layer (self mulching soils). This also causes the formation of slickensides or inclined flat to curved planes with a polished appearance due to the oriented clay. With increasing clay content these cracks, slickensides and the mulching become more pronounced. The consistence is plastic and sticky when wet, and very hard when dry. These soils show the characteristic 'gilgai' relief of low mounds with depressions a few inches deep, and a few square yards in surface area.

Secondary lime concretions are found in the lower part of the A horizon and a definite horizon of these concretions can be observed in the transition zone between the A and the C or Cg.

The C material is not necessarily related to the material of the A. In most instances the II C horizon is decomposed acid Khondalite rock.

Occurrence

These soils are best expressed over a limited extent near Tunnukkai (Jaffna and Mannar districts), and a smaller extent is found near Kottukachiya (Puttalam district). They may occur occasionally throughout the dry zone.

Environmental Factors

These soils are formed on montmorrillonitic parent material which in Ceylon seems to be recent or semi-recent ponded alluvial clay. In one case at least, it appears as if the clays which have been deposited in now abandoned tanks are an ideal parent material for the formation of these soils The grumusols found in Ceylon are therefore essentially soils of depressed areas ; however, this low situation is not a necessary condition for their formation. These soils are confined to the dry zone where the annual rainfall is less than 70 inches.

Vegetation around Tunnukkai is a grassland with scattered thorny shrubs and a few trees, while at Kottukachiya the dry mixed evergreen forest is hardly different from that which is found on the adjacent reddish brown earths.

Present Land Use and Agricultural Potential

Despite the good chemical characteristics of these soils they present difficult management problems which arise out of their physical properties. The extreme stickiness when wet, and the hardness when dry make the cultivation of these soils very difficult. Where water is not available for irrigated rice, a system of dry land cultivation on ridged land may be resorted to.

9. SOLODIZED SOLONETZ

Profile description No. 13

Nomenclature

This group includes both solonetz and solodized solonetz of the Russian literature. It however excludes the solonchaks, i.e., saline and alkali soils without distinct profile development, which are grouped with the alluvial soils.

Morphology

No attempt is made to separate the solonetz, and the solodized solonetz. It is believed that most Ceylon soils of this group have the leached or albic horizon as well as a low content of free salts in the A horizon which are characteristic of the solodized solonetz.

The differentiation into an eluvial A horizon and an illuvial (natric) Bt horizon is very marked. The A horizon which may be from a few inches to nearly 20 inches thick, is clearly subdivided into an A1 and A2 horizon. The texture of the A horizon is sandy, i.e., loamy sand to sandy loam. This horizon is structureless and has a loose consistence. The A1 is distinctly darker than the A2 and is dark brown in color. The A2 is brown to yellowish or grey brown in its upper part and has a distinct mottling (gley). The lower part which penetrates in tongues into the Bt horizon is lighter in color, i.e., light grey (albic horizon). These horizons generally do not contain free salt and their pH is neutral or even slightly acid. The transition from the A to the Bt is characteristically abrupt.

The Bt horizon which is texturally strongly contrasted to the A has a sandy clay loam texture. Color of the Bt varies, but it is usually dark or very dark grey and is strongly mottled with yellowish brown and blackish spots. Structure is angular blocky, but the peds are arranged into coarse columns with typically rounded caps. These columns are often separated from each other by tongues or thin layers of sandy material of the A2 horizon. Consistence of the Bt is very firm to very hard when dry, and slightly plastic and sticky when wet. This horizon has a high exchangeable sodium content and may contain free salts.

The C material has nearly the same texture as the Bt and it gradually goes over to sandy material at some depth. It always contains free salt at some depth.

Occurrence

Solodized solonetz occur along the seacoast in all provinces of the dry zone and may therefore cover a significant extent.

Environmental Factors

The occurrence of solodized solonetz appears to be related to the presence of salts in the parent material. Thus they are found on the more clayey parts of the tidal flats and the estuary deposits. Some of these deposits are semi-recent, while others which are situated as high as around 100 ft. like in the Mahaweli ganga estuary, may be much older ; probably dating from the upper Pleistocene era.

The solodized solonetz are distinctly soils of the dry zone and the maximum rainfall limit within which they occur is about 75 inches per annum.

Vegetation is predominantly grassland with thorny shrub and a few scattered trees. Halomorphic plants are found on the younger and therefore probably more saline soils, and at times even the grass cover is interrupted by numerous bare spots. The older solodized solonetz have a more continuous grass cover with more bushes and trees ; halomorphic plants are absent. A typical example of such vegetation is the damana grassland on the lower right bank terrace of the Mahaweli ganga.

Present Land Use and Agricultural Potential

These soils are hardly used at present other than for some extensive grazing.

Some of these soils could be reclaimed by modern techniques. Intensive drainage and use of the correct quality irrigation water should be the foremost requisites. In the reclamation of those lands which are only a few feet above the average sea level, more expensive techniques may have to be resorted to.

10. LOW-HUMIC GLEY SOILS

Nomenclature

These soils have been described as low-humic gley soils with a textural B horizon in the American literature. This term apparently covers a part of the inadequately defined hydromorphic soils which are so often mentioned in soil literature. They are comparable to the low-humic gley soils described in Viet Nam (9).

Morphology

Only those hydromorphic soils which have an illuvial Bt or argillic horizon are grouped with the low-humic gley soils. No detailed description is given for this soil group since these soils have not been studied in sufficient detail.

The A horizon generally shows a differentiation into A1 and A2, but these two horizons are very often mixed due to cultivation (e.g., rice cultivation). The A1 or the Ap is dark grey to dark grey brown in color, while the A2 is lighter, usually pale brown and possibly strongly leached and thus very pale. There is a distinct textural difference between the A and the Bt horizons with the latter being clayey.

Due to the recurrent wetness, the Bt horizon is strongly mottled. This mottling may be lateritic in nature if the red parts become hard upon drying. In the wet zone, ground water laterite (cabook) is common in these soils ; the presence of this material may necessitate the distinction of a separate subgroup.

A further subgroup division could be made on the basis of the base saturation of the Bt horizon ; the low-humic gleys of the dry zone having a high base saturation, while those of the wet zone are highly unsaturated.

Occurrence

The low-humic gley soils are found throughout the lowlands of Ceylon usually in the lower topographic sites. They may occur in the uplands, especially on the plateau areas, but are not found in the hilly terrains or in regions of mountainous relief. These soils are associated with the main great soil groups, especially the red-yellow podzolic soils and the reddish brown earths. In such associations, they are usually the lower members of the drainage catena, unless they are replaced by hydromorphic alluvial soils.

Environmental Factors

The dominant factor which governs the expression of these soils is the periodically high groundwater level ; this may be the true groundwater or a water table which develops on an impermeable stratum during the rainy season. These soils are therefore generally found in flat or depressional areas ; quite often in the border zone of the depression.

This soil group is found on alluvial material ; occasionally on transported residuum (colluvium) of varying lithology.

In the dry zone, the vegetation is a mixed evergreen forest which is hardly distinguishable from the forest on the dryer, well drained members of the drainage catena. The vegetation in the wet zone is not sufficiently known.

Present Land Use and Agricultural Potential

In the wet zone regions, rice and coconut are the chief crops grown on this soil group, while in the dry zone this same pattern is observed where irrigation from traditional village tanks is available.

There is yet a fair extent of these soils in the dry zone which awaits development. Where irrigation water will be made available, rice could be grown very successfully. Intensive pasture production is possible on these soils with an occasional supplemental irrigation during the dry periods.

11. MEADOW PODZOLIC SOILS

Profile description No. 14

Nomenclature

These soils are named after similar soils which have been described as meadow podzolic soils in Australia by Stephens (14). They are closely related to some of the humic gley soils, or wiesenboden which have been described in the American and European literature. However, it should be pointed out that the meadow podzolic soils as described for Ceylon are acid, whereas the wiesenboden usually have a high base status.

Morphology

The meadow podzolic soils have a prominent A1 horizon and an illuvial Bt or argillic horizon. An A2 horizon which may be strongly bleached is usually observed.

The A1 horizon is thicker than 10 inches and generally around 20 inches in thickness ; it is dark grey to very dark brown in color. The organic matter content is high, and at times can be so high that it may be transitional to peat.

The A2 horizon when present, shows distinct signs of wetness (mottling), and has a low organic matter content. Color is grey brown to grey. A strongly leached, light grey subhorizon (albic horizon) may be present. Transition to the Bt is abrupt.

The Bt horizon is distinctly heavier than the A and is usually sandy clay loam in texture. This horizon is vividly mottled with a pale brown or light yellowish brown matrix and yellowish red ferruginous mottles or bands. Occasionally, a thin iron pan is found in the upper part of the horizon ; quite frequently, some of the red spots are concretionary (lateritic.)

The C horizon is light grey in color and is more or less reduced material of variable texture.

These soils have a low pH and a low base saturation throughout the profile. C/N ratios of the organic material are high.

Occurrence

These soils have been observed only in the highland plateau area around Nuwara Eliya. They are distinctly associated with the two subgroups of the red-yellow podzolic soils one of which has a prominent A horizon and the other a dark horizon.

Environmental Factors

Two main factors governing the expression of these soils are the periodically high groundwater and the cool humid climate. These soils are therefore developed only in the higher altitudes (5,000 ft. or more) with a rainfall in excess of 80 inches per annum.

These soils are found in the depressional areas of the high plateau, usually in the zone bordering the deeper parts of the depression.

Parent material is colluvial or alluvial valley fill of variable texture.

Vegetation is wet patana grassland with Chrysopogon sp., Rhododendron thicket and giant fern.

Present Land Use and Agricultural Potential

Very little use is made of these soils at present. Despite their limited occurrence, these soils have a high potential for intensive pasture management if adequate drainage is provided.

12. BOG AND HALF-BOG SOILS

Nomenclature

This name is taken from the American literature (11) and it includes those soils which have been described under such names as peat soils, muck soils and mcor soils ; or, in more general terms have been named organic soils.

Morphology

Bog and half-bog soils have an organic surface layer at least 12 inches thick and containing a minimum of 25 to 30% organic matter, or 14·5 to 17·5% organic carbon. The bog and half-bog soils of Ceylon are mainly composed of acid peat which rests on marine alluvial material or alluvial valley fill.

Occurrence

The majority of the peat soils occur in the wet lowlands of the Colombo district ; very limited extents are found in the Nuwara Eliya district.

Environmental Factors

Peat formation takes place in wet, depressional sites and is therefore restricted to the wet zone of Ceylon. The bog soils of the Colombo district have been formed in backswamp areas which are barely above sea level, thus having an absolute deficient drainage. In the uplands, peat formation is confined to the lowest part of some of the flat valleys in the plateau areas of the third peneplain. The valley bottoms have a deficient drainage and they also receive an excess of water from the surrounding high land. The reduced evaporation at this cooler altitude has also helped in the formation of peat in these valleys.

Vegetation of the lowland is a marshy swamp, while that of the highland is wet patana grassland.

Present Land Use and Agricultural Potential

Most of these soils both in the lowlands and in the uplands are waste land.

The lowland bog soils can be reclaimed by regulating the hydrography and maintaining a permanent groundwater table at a shallow depth. Deep drainage should not be practiced since these soils tend to subside and dry up irreversibly when deeply drained.

Horticultural gardens around the Kelani bridge in Colombo demonstrate how these bog soils could be transformed into excellent land for truck cropping. Minor element investigations may be necessary on these soils.

13. ALLUVIAL SOILS

Morphology

Alluvial soils are restricted to soils formed on recent water laid deposits in which no profile development other than an accumulation of some organic matter in the surface A1 horizon has taken place. The distinction between alluvial soils and regosols is quite often arbitrary, especially in the case of regosols on water-deposited slope colluvium. In this publication, alluvial soils are mainly restricted to those soils which have formed on alluvium deposited on more or less flat flood plains and in valley depressions, which thus excludes most of those soils found on slope colluvium.

The pedological horizons are restricted to A1 or Ap and C or Cg ; however, these soils show a considerable variation in morphology. Texture varies from heavy clay to coarse sand with considerable texture variation within the profile itself. Medium to medium heavy textured soils seem to be the most common in Ceylon. Natural drainage of the alluvial soils show a very wide range of characteristics. Those formed on the semi-recent terraces in the Bibile area are fairly dry and hardly any gleying is observed to a depth of 60 inches or more. At the other extreme, the very wet members which have a slight organic surface layer and are saturated with water throughout the year show blueish or neutral grey reduction colors. The alluvial soils of Ceylon are usually medium hydromorphic soils with gley throughout the profile, the reduced horizon occuring at a depth beyond 40 inches or so. The hydrology of these soils is complicated by the fact that most of these soils are periodically innundated for rice cultivation. This often leads to the formation of an 'inverted gley' with stronger mottling and more neutral gley colors. (eventually blueish during innundation) in the surface horizons, in contrast to the underlying zone.

Occurrence

Alluvial soils occur all over Ceylon, usually in narrow strips in the valleys and in the flood plains of rivers. Their total surface is believed to be around $1\frac{1}{2}$ million acres.

Environmental Factors

Time is an important factor in respect of these soils. Since these soils are of recent age, no genetic soil horizons have had a chance for sufficient expression.

Parent material is water transported and sedimentary. Topography is that of the flat to slightly concave flood plains and valleys.

Natural vegetation is usually absent due to cultivation, but is extremely variable and related to the hydrography, texture, and salt content of the soils. Dry mixed evergreen forest is found on most of the well drained soils in the dry zone, swamp forest in the backswamps of the rivers, and salt tolerant plant covers including mangrove swamps on the tidal flats.

Present Land Use and Agricultural Potential

A large proportion of the alluvial soils of Ceylon are used for rice cultivation and indeed these are the main rice producing soils of the country. The somewhat better drained members are used for growing coconut where the moisture conditions permit. A small proportion is uncultivated due to several limiting factors. For example, most of the tidal flats are affected by a high salt concentration and have drainage problems, while some river valleys are recurrently affected by flash floods.

Further exploitation of these soils should be based on an increased output on the already cultivated land. To this end, improved irrigation practices, more efficient use of fertilizer, use of improved seed material and organised plant protection are the main techniques that have to be resorted to.

14. REGOSOLS

Morphology

Regosols are those soils without profile development other than the formation of an A1 horizon which are not included with the group of the alluvial soils. In this publication, they are meant to also include shallow, skeletal soils over hard bed rock ; bare rock outcrops are excluded. These shallow soils have been described as lithosols or lithosolic soils in the literature.

Like the alluvial soils, regosols show considerable variation in morphology. However, no clayey or very wet regosols have been observed.

Two main kinds of regosols can be distinguished on the basis of their geologic origin :

(i) The sandy regosols of the dunes and elevated beaches of the coastal area.

(ii) The medium textured, often stony or gravelly regosols on recently deposited erosion products, i.e., slope colluvium.

The sandy regosols, though usually dry, may show a fluctuating water table at medium or shallow depths. A distinction can be made according to the state of weathering of the sand. Regosols from young beaches and dunes are yellowish, and contain a fair amount of weatherable mineral fragments. Others are composed almost entirely of quartz sand, which may be bleached and whitish ; or which may be red to yellow due to a thin ferruginous coating around the individual grains, i.e., latosolic regosols.

The colluvial regosols vary strongly in clay content, amount of stones and gravels, and also in color. The color often reflects the color of the soils from which they are derived.

Occurrence

Sandy regosols occur in more or less narrow strips in all coastal areas of Ceylon. Colluvial regosols are mainly found on the lower aspects of the slopes in hilly areas

Environmental Factors

Time is an important factor for these soils as in the case of the alluvial soils, regosols being usually so young that no genetic horizons cound possibly have formed.

Man's activity is an important factor in the formation of the colluvial regosols since these are mainly erosion products resulting from the cultivation of slopes.

Present Land Use and Agricultural Potential

Sandy regosols are hardly cultivated except those on which Gyben-Herzberg lenses of fresh water occur, where coconuts have been successfully grown. These are usually the regosols which occur in flat to very gently undulating topography. Those with a dune topography have a very low potential value. Increased production on regosols will depend mainly on an efficient use of fertilizer.

The land use pattern on the colluvial regosols of the wet zone follows the same as that of the soil higher on the slope from which it is derived. Improved production on these could be obtained by the same methods which would be applied to the associated soil higher on the slope.

5——R 20026 (10/61)

LATERITE AND LATERITIC FORMATIONS

In the original concept which was proposed by Buchanan, laterite is the soil material with reticulate, strong mottling that is usually soft, but becomes irreverisbly hard upon drying and can be then used as building material. According to this definition, the only laterite present in Ceylon would be the true cabook. Subsequent authors have extended the definition of both laterite and lateritic formations to include not only the soft material which becomes hard on drying, but also the hard forms of the material which are present in the soil as boulders or sheets. Materials in which only the red mottles become irreversibly hard upon drying have been called lateritic, while the hard forms of these lateritic mottles have been called lateritic concretions and lateritic gravels. Several authors, including Joachim have extended the concept yet further, when they applied the terms lateritic and laterite to soils rather than to the soil material. They have classified soils which have a silica-alumina ratio less than 1·8 in the clay fraction, as lateritic soils.

In this publication, the definition of laterite or *plinthite* as developed in the 7th approximation has been adhered to. According to this definition plinthite is the sesquioxide rich, humus poor, mixture of clay with quartz and other diluents which commonly occur as red mottles in platy, polygonal or reticulate patterns and which may be soft or irreversibly changed to hard pans or irregular aggregates. In the 7th approximation, plinthite or laterite is further characterized as a highly weathered material, but this appears to be untrue as a general statement. Indeed, quite frequently primary minerals and at times even free lime may be observed within the hard laterite concretions.

In Ceylon and probably in the whole of South East Asia laterite formation s observed in those horizons which are being presently, or have been influenced, by periodically high water tables. Thus, laterite and lateritic formations are strictly hydromorphic formations which fall within the same category of soil features as, e.g., gley-phenomena. Laterite formation is not related to any particular kind or direction of soil formation ; and lateritic concretions can be found in practically all soils in the country if the hydrological conditions for their formation exist. A typical example can be observed in the Hambantota coastal area where lateritic concretions formed in situ, are present in soils on semi-recent alluvium which is calcareous in spots. In these profiles, the concretions are present in the lower part of the alluvial cover which rests on less permeable residuum on which a ground water table builds up with the rains. Nevertheless, it can be observed that laterite formation is strongest in the wet zone under acid soil conditions such as those which occur in the red-yellow podzolic soils.

Laterite in Ceylon is best expressed in the flat and undulating wet lowlands where relief and high rainfall satisfy the conditions for the presence of fluctuating water tables. In the hilly uplands the laterite is scarce because of the rejuvenation of the relief and the soils. The hydrologic conditions in this part of the country are not favourable for a renewed laterite formation.

CHAPTER III

CLASSIFICATION OF THE PRINCIPAL SOILS OF CEYLON ACCORDING TO "SOIL CLASSIFICATION, A Comprehensive System", 7th APPROXIMATION

In classifying the Ceylon soils according to the 7th approximation, the lowest category to which subdivision is carried out is that of the **great group,** which is roughly equivalent to the former **great soil group** level. No sufficient data were available to make a satisfactory subdivision of the Ceylon soils at the **subgroup** level of the new system. It appears that several new units may have to be introduced at this level in order to satisfy the classification requirements of the soils of Ceylon. Further detailed studies will be necessary before these units can be correctly identified.

For each unit in each category a summary of the diagnostic characteristics, *as they apply to the soils of Ceylon*, is given. The numbers used are those of the 7th approximation. For each great group the equivalent great soil group, as described in Chapter II is mentioned.

1. ENTISOL ORDER

Soils exclusive of vertisols and mollisols with no diagnostic horizon other than an A1 or Ap (ochric or histic epipedon).

1·1 AQUENT SUBORDER

Entisols that are saturated with water at some season, having in addition a peaty surface horizon (histic epipedon) or colors of the soil matrix which approach the grey or blue or both these characteristics.

1·12 Psammaquent great group

Aquents that have a sandy texture to a depth of 20 inches or more. Wet sandy *alluvial soils* and wet sandy *regosols* of Ceylon would go with this great group.

1·13 Hydraquent great group

Aquents with very high water content and low bearing capacities. In Ceylon some *alluvial soils* of the tidal marshes (mangrove swamps) are believed to be hydraquents.

1·14 Haplaquent great group

Aquents with a texture finer than loamy sand in all or part of the upper 20 inches and that do not have the characteristics of the 1·13 great group. This great group covers the majority of the *alluvial soils* of Ceylon ; notably, all the wet, medium or fine textured members of this great soil group.

1·2 PSAMMENT SUBORDER

Entisols, sandy to a depth of 20 inches or more and that are not saturated completely with water at any season.

1·21 Quartzopsamment great group

Psamments that have more than 95% quartz and other minerals resistant to weathering.
In Ceylon, this group would cover the strongly bleached *regosols* of the area between Puttalam and Chilaw, i.e., so called cinnamon soils ; and possibly some red sands, i.e., latosolic *regosols* in Wilpattu.

1·22 Orthopsamment great group

Psamments that have more than 5% soluble or weatherable minerals such as feldspars, micas, calcite, ferro-magnesian minerals etc :
The majority of the *sandy regosols* of Ceylon belong to this great group.

2. VERTISOL ORDER

Soils with a high percentage of expanding clay (35% or more at some depth in the A1 horizon) ; with cracks in the dry season going down to at least the middle of the A1 horizon, with tilted, wedge or parallelopiped structural aggregates, with gilgai or slickensides, or both.

2·1 AQUERT SUBORDER

Vertisols with gray or black colors which are saturated with water at some season.

2·11 Grumaquert great group

Aquerts which, when dry have a loose, porous surface mulch. Most of the *grumusols* of Ceylon go with this group.

2·12 Mazaquert great group

Aquerts lacking a porous surface mulch when dry, having a thin cover of lighter textured material with bleached sand grains which tongues into the underlying blackish or dark gray horizon. A few of the *grumusols*, especially those with a thin sandy cover are mazaquerts.

3. INCEPTISOL ORDER

Soils that have an A1 horizon which is not prominent (ochric epipedon) and that have a color B horizon (cambic horizon) which shows no appreciable signs of clay illuviation. In Ceylon, these soils contain considerable amounts of weatherable minerals in the sand and silt fractions of all horizons.

3·4 OCHREPT SUBORDER

In Ceylon, this order is defined by the characteristics of the inceptisol order.

3·44 Dystochrept great group

Ochrepts that are usually moist and do not dry out entirely for periods of more than 60 days, and with a base saturation in the B or cambic horizon of less than 80%.
The wet zone subgroup of the *immature brown loams* can be classified with this great group.

3·45 Ustochrept great group

Ochrepts that are entirely dry for periods of more than 60 days. The dry zone subgroup of the *immature brown loams* can be classified with this great group.

5. MOLLISOL ORDER

Soils that have a prominent, thick and highly saturated A1 horizon (mollic epipedon), and that do not have the characteristics of the vertisols. These soils may have a color B or cambic horizon.

5·1 RENDOLL SUBORDER

In Ceylon this suborder is defined by the characteristics of the mollisol order. Rendolls have developed on parent material which contains more than 40% calcium carbonate. No great groups have been distinguished.

The *rendzina soils* are rendolls.

7, ALFISOL ORDER

Soils without a prominent, highly base saturated A1 horizon (mollic epipedom with distinct evidence of clay illuviation in the Bt horizon (argillic or natric horizon) and with a base saturation of more than 35% in the Bt horizon.

7·1 AQUALF SUBORDER

Alfisols that are saturated with water at some season, thereby showing distinct mottling, or grey colors, or both at shallow depth.

7·13 Ochraqualf great group

Aqualfs without a high sodium content in the Bt or argillic horizon and without soft laterite (plinthite) at less than 50 inches depth.

These soils are the high base status *low-humic gley soils* without soft laterite at shallow depth.

7·16 Natraqualf great group

Aqualfs with a textural B horizon (natric horizon) with columnar structure and with more than 15% saturation with exchangeable sodium at some depth.

The *solodized solonetz* of Ceylon belong to this great group.

7·17 Plintaqualf great group*

Aqualfs with soft laterite in the form of red mottles at less than 50 inches depth.

These soils which are sporadically encountered in the dry zone of Ceylon, are the high base status *low-humic gley* soils with soft laterite at shallow depth.

7·4 USTALF SUBORDER

Alfisols in which some part or all of the solum is dry for three months or more, unless irrigated, and which do not show mottling, or grey colors, or both at shallow depth.

7·43 Rhodustalf great group

Ustalfs with a dark reddish brown to dark red color in the illuvial Bt or argillic horizon, i.e., hue of 5 YR or redder, value of 4 or darker ; having a cation exchange capacity of more than 40 m.e. per 100 grams clay.

These are the *reddish brown earths*, with the exception of the subgroup with a predominant brown color.

7·44 Ultustalf great group

Ustalfs with an argillic horizon in which the cation exchange capacity is less than 40 m.e. per 100 grams clay.

The *noncalcic brown soils* go with this great group.

7·45 Typustalf great group

Ustalfs with an argillic horizon, browner or lighter colored than the rhodustalfs, and having a cation exchange capacity more than 40 m.e. per 100 grams. clay.

The subgroup of the *reddish brown earths* with a predominant brown color can be classified as typustalfs.

8. ULTISOL ORDER

Soils without a prominent, highly base saturated A1 horizon (mollic epipedon) with distinct evidence of clay illuviation in the Bt horizon (argillic horizon), and with a base saturation of less than 35% in the Bt horizon ; some weatherable minerals are present in the sand and silt fractions.

* This is a proposed great group which is not mentioned in the 7th approximation.

8·1 AQUULT SUBORDER

Ultisols that are saturated with water at some season, showing distinct mottling, or grey colors, or both at shallow depth.

8·11 Plintaquult great group

Aquults that have at depths of less than 50 inches, plinthite or laterite that has not hardened. In Ceylon, those low base status *low-humic gley soils* and *meadow podzolic soils* which have soft laterite at less than 50 inches go with this great group.

8·12 Ochraquult great group

Aquults without soft laterite at less than 50 inches and with a thin or weak A1 horizon (ochric epipedon).
The *low-humic gley soils* of low base status and without soft laterite at less than 50 inches are ochraquults.

8·13 Umbraquult great group

Aquults that have a prominent A1 horizon of low base status (umbric epipedon), and without soft laterite at 50 inches.
The *meadow podzlic soils* without soft laterite at less than 50 inches can be classified as umbraquults.

8·2 OCHRULT SUBORDER

Ultisols which do not have the characteristics of wetness, diagnostic for the aquults and which do not have a prominent A1 of low base status (umbric epipedon).

8·22 Rhodochrult great group

Ochrults with dark brown to dark red colors (value of 4 or darker) throughout the profile, including the transition between the Bt and C horizons. No such soils have been definitely recognized in Ceylon, but it is believed that at least part of the dark *reddish brown lateritic soils* which are developed on charnockite may go with this great group.

8·23 Typochrult great group

Ochrults with lighter colors than the rhodochrults and without a dark horizon as in humochrults.

This great group includes the majority of the *red-yellow podzolic soils* and the *reddish brown lateritic soils* of Ceylon, with the exception of those soils that go either with the rhodochrults or the humochrults or which have a prominent A1 of low base status (umbric epipedon). The typochrult great group thus seems to be too all-inclusive and it is therefore suggested that the *reddish brown lateritic soils* be recognized as a separate great group based on the presence of an appreciable amount of weatherable minerals in the A horizon, i.,e., under the name **eutochrult.** Sufficient data are not yet available to make this separation on a quantitative basis.

8·25 Humochrult great group *

Ochrults in which the upper part (at least 4 inches) of the Bt or argillic horizon shows a distinctly darker color than the horizon above or below (hue of 7·5 or 10 YR, value of 3 or darker, and chroma of 3 or less). The humus content of this horizon is always distinctly higher than that of the horizon below, but not necessarily higher than that of the horizon above.
The *red-yellow podzolic soils* with dark horizon, but without a prominent A1 of low base status (umbric epipedon) would go with this new great group.

8.3 UMBRULT SUBORDER

Ultisols with a prominent A1 of low base status (umbric epipedon) and without the characteristics of wetness, diagnostic for aquults.
In the provisional definition of the 7th approximation, the umbrults should not have an A2 horizon. The umbrults, recognized in Ceylon, however do have an A2 horizon.
No great groups are described in the 7th approximation. For Ceylon, at least two great groups would be necessary to accommodate the *red-yellow podzolic soils* with a prominent A1 and those dark horizon *red-yellow podzolic soils* which have a prominent A1 as well.
It is suggested that the presence of a prominent A1 (umbric or mollic horizon) is recognized at too high a level in the classification and that it might be better to enlarge and rename the ochrult suborder so as to include the present umbrults. The presence of a prominent A1 (umbric or mollic horizon) should then be recognized at the great group, or even the subgroup level.

* This is a proposed great group which is not mentioned in the 7th approximation.

9. OXISOL ORDER

Soils without or with only a weak illuvial Bt or argillic horizon, and having a sub surface horizon that has been called a latosolic B or oxic horizon which is characterised by a weak blocky structure or no structure at all, many pores, fifteen percent or more clay sized minerals, and no more than one percent micas, feldspars or ferro-magnesian minerals in the sand and silt fraction.

The tentative subdivision of this order in the 7th approximation does not provide for a satisfactory way to accommodate the *red-yellow latosols* of Ceylon on the suborder or great group level.

10. HISTOSOL ORDER

Soils with an organic surface horizon of at least 12 inches, and containing a minimum of 25 to 30 percent organic matter (or 14·5 to 17·5 percent organic C).

No subdivision of this order has been made in the 7th approximation. The *bog* and some of the *half-bog soils* of Ceylon belong to this order.

CHAPTER IV

DESCRIPTIONS AND ANALYTICAL DATA OF REPRESENTATIVE PROFILES

All profiles described in this chapter were studied by the authors and the staff of the Land Use Division, except profile No. 7 which is adopted from the profile description by Holland et alia (4); profiles similar to this were observed, though not described in detail, by the authors. Profile locations are indicated on the location map.

The descriptive terminology is in accordance with the Soil Survey Manual (13) and the 7th approximation (12). Climatological data were obtained from the Report of the Director, Department of Meteorology, for 1956. Physiographic terms such as 'mantled plain', 'rock knob plain', are adopted from the land-form studies which have been carried out by the Hunting Survey Corporation Limited.

The following analytical methods were used :—*

Mechanical analysis : the 'International' pipette method with sodium hydroxide as dispersing agent. The 'stone and gravel' fraction comprises all mineral particles failing to pass a 2 mm sieve.

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* Soil analysis were carried out under the direction of T. Sivakumaran, assisted by T. B. Gamagedera and H. Dissanayake. Results are reported on the oven-dry basis, except for organic matter which is on the air-dry basis.

pH : glass electrode on a 1 : 1 soil-water mixture and a 1 : 1 soil-IN KCl mixture.

Conductivity : Type RC Conductivity bridge, 1 : 5 soil suspension at 25°C.

Organic carbon : Walkley and Black method.

Total exchangeable bases : Bray and Willhite method.

Cation exchange capacity : Sodium saturation at pH 8·2 followed by displacement with 1 N ammonium acetate of pH 7 and determination of the displaced sodium.

Exchangeable cations : Sodium and potassium were determined using a 'Lange' model flame photometer, while calcium and magnesium were determined by the 'versenate' titration method.

Total nitrogen : Kjeldahl method.

(Profile No. 1) REDDISH BROWN EARTH

Area : Ratnapura district, Timbolketiya.

Vegetation : Tropical mixed evergreen forest and shrubs.

Parent material : Semi-recent colluvium over residuum from mica schist (Khondalite series).

Topography : 2 – 3% slope on the side of a low ridge ; undulating, 'mantled plain' ; 250 – 300 ft. elevation.

Climatic data : Temperature : Hambantota, Rainfall : Embilipitiya.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature (1928–1956) °F	79	79	81	82	82	82	82	81·5	81	81	80	80	81
Mean rainfall—(1915–1956) inches	4·6	3·0	6·75	7·0	4·6	1·6	2·1	1·4	3·0	8·8	9·95	8·2	61

Profile Description

A1 0 – 4 inches ; dark brown (7·5 YR 3/3) sandy loam, somewhat fine gravelly, mica fragments ; structureless massive ; friable ; many fine to coarse tubular and interstitial pores ; many roots ; smooth, gradual transition to :

Blt 4 – 15 inches ; reddish to dark brown (5–7.5 YR 4/3) sandy clay loam, somewhat fine gravelly, mica fragments ; weak fine subangular blocky ; weak clay coatings ; firm ; many fine and very fine tubular inped pores ; many roots ; wavy, abrupt transition to :

II B2t 15 - 41 inches ; yellowish red (5 YR 4/6) gravelly and fine gravelly sandy clay with angular quartz gravels and decomposing feldspar fragments, mica fragments; very stony (erosion pavement) in upper 5 inches which layer contains some potsherds of primitive pottery ; moderate fine subangular blocky ; strong, continuous clay coatings ; firm, hard when dry ; many fine to very fine tubular inped pores ; less and thinner roots than in foregoing ; wavy, gradual transition to :

II B3t 41 – 51 inches ; yellowish red (5 YR 5/6) fine gravelly sandy clay loam, many decomposing feldspar fragments, angular quartz gravels ; numerous mica fragments ; yellowish lighter spots ; weak medium subangular blocky ; fewer clay coatings ; friable ; some pores ; fewer roots ; wavy, gradual transition to :

II C 51 inches + ; multicoloured loamy sand with yellowish (10 YR 7/6) decomposed mica schist, stratified, very micaceous in layers ; some layers somewhat stronger weathered ; massive, structureless ; very friable ; few pores and roots.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution: Sand > 50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ	pH H₂O 1 : 1	pH 1NKCl 1 : 1	Cond. m—mhos/cm	Exchangeable cations, m.e / 100g: Na	K	Ca	Mg	TEB me/100g	CEC me/100g	Base Sat %	Organic matter: C %	C/N ratio
0– 4	A1	11·4	58·0	25·2	7·1	18·0	7·1	6·1	0·06	0·07	0·82	6·2	2·3	9·8	12·7	77	1·2	9
4–15	B1t	8·9	52·6	23·0	6·2	23·1	6·8	5·5	0·04	0·06	0·41	4·4	2·3	7·4	14·4	51	0·5	5
15–41	II B_2t	28·8	53·0	12·6	4·7	35·6	6·5	5·2	0·04	0·09	0·35	5·2	3·1	9·1	17·4	52	—	—
41–51	II B_3t	8·4	51·1	21·0	7·4	28·2	6·2	5·0	0·03	0·13	0·45	7·7	1·1	9·8	18·4	53	—	—
51+	IIC	14·5	76·7	18·9	3·3	4·7	6·6	4·9	0·07	0·13	0·22	3·7	1·5	6·0	8·1	74	—	—

(Profile No. 2) NONCALCIC BROWN SOIL

Area : Batticaloa district, Padagoda.

Vegetation : Low tropical mixed evergreen forest and shrubs ; some planted trees.

Parent material : Residuum from acid gneiss (Bintenna series) with a low content of ferro-magnesian minerals.

Topography : 2 - 4% slope ; low ridge in a 'mantled plain' ; undulating with alternating low hills and alluvial plains ; 200 - 300 ft. elevation.

Climatic data : Temperature : Batticaloa, Rainfall : Amparai.

	J	F	M	A	M	J	J	A	S	O	N	D	Y
Mean temperature—(1928–1956)°F	78	78	80	82	84	85	84	83	83	81	79	78	81·4
Mean rainfall—(1875–1956) inches	14·15	4·9	3·8	3·55	3·5	1·7	1·7	2·8	3·6	7·1	10·9	14·45	72·4

Profile Description

A1 0 - 8 inches ; dark gray brown (10 YR 4/2) fine gravelly sandy loam ; weak granular and weak fine subangular blocky ; slightly hard ; common fine interstitial pores and many fine tubular inped pores ; many roots ; wavy, abrupt transition to :

A2 8 - 10 inches ; ruptic horizon with A1 horizon penetrating ; brown (10 YR 5/3) fine gravelly sandy loam ; weak fine subangular blocky ; friable ; many fine tubular inped pores ; many roots ; smooth, clear transition to :

B1t 10 – 14 inches ; yellowish brown (10 YR 5/4) fine gravelly sandy clay loam ; weak fine subangular blocky ; weak clay coatings and clay bridges between coarser grains ; friable ; common fine tubular inped pores ; less roots ; smooth, clear transition to :

B2t 14 – 26 inches ; brown (7·5–10 YR 5/4) fine gravelly sandy clay loam ; moderate fine and medium subangular blocky ; distinct clay coatings and clay bridges between coarser grains ; firm ; common fine tubular inped pores ; some roots ; smooth, gradual transition to :

B3t 26 – 38 inches ; reddish yellow (7·5 YR 6/6) fine gravelly sandy clay loam ; weak medium subangular blocky ; weak clay coatings ; firm ; common fine tubular inped pores ; few roots ; wavy, clear transition to :

C 38 inches + ; decomposing feldspar-quartz gneiss with few micas, some stratification still visible.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution: Sand > 50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ	pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m—mhos/cm	Exchangeable cations, m.e/100g: Na	K	Ca	Mg	TEB me/100g	CEC me/100g	Base Sat %	Organic matter: C %	C/N ratio
0– 8	A1	21·7	64·3	23·4	13·2	14·0	6·4	5·5	0·04	0·04	0·37	4·4	1·5	6·9	9.4	73	1·3	10
10–14	B_1t	12·5	48·2	26·7	14·8	27·4	6·4	5·0	0·03	0·04	0·33	2·5	1·7	4·5	8·2	55	0·5	7
14–26	B_2t	10·4	48·9	22·4	11·9	29·0	6·2	4·8	0·03	0·04	0·32	2·4	2·2	4·9	8·8	56	—	—
26–38	Bt	17·5	51·9	23·9	14·4	23·7	6·4	4·8	0·02	0·04	0·30	2·4	1·2	4·3	7·3	59	—	—

(Profile No. 3) REDDISH BROWN LATERITIC SOIL

Area : Kandy district, Kandy.

Vegetation : Tropical wet forest and some bamboo. The forest has been thinned out considerably and part of the undergrowth has been cleared.

Parent material : Slope colluvium over residuum from micaceous schist (Khondalite series).

Topography : 40% slope on the side of a hill in a deeply incised ridge and valley, landscape ; 1450–1550 ft. elevation.

Climatic data : Temperature and Rainfall : Kandy-King's Pavilion.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature (1928–1956) °F	74	75	77·5	79	78	76	75	76	75	77	75	74	76
Mean rainfall— (1926–1956) inches	6·2	2·3	5·55	6·0	7·05	8·1	6·9	5·0	6·1	10·1	10·6	8·1	82

Profile Description

0 — 0.5 – 0 inches ; partly decomposed litter of forest leaves.

A1 — 0 – 6 inches ; reddish brown (5YR 4/3) fine gravelly clay loam, some fine mica fragments ; moderately strong fine crumb and granular ; friable ; many find and very fine interstitial and tubular inped pores ; many roots ; smooth gradual transition to :

A3 — 6 – 10 inches ; reddish brown (2.5 YR 5/4) fine and coarse gravelly clay loam, some quartzites, some fine mica fragments ; moderately strong fine crumb and granular, subangular blocky in spots ; friable ; many fine and very fine interstitial and tubular inped pores ; many roots ; smooth, gradual transition to :

B2t — 10 – 15 inches ; reddish brown (2.5 YR 5/5) fine and coarse gravelly clay, some quartzites, some fine mica fragments ; moderate fine subangular blocky ; weak, continuous clay coatings ; friable to firm ; many fine interstitial and tubular inped porse ; somewhat less roots ; smooth, gradual transition to :

II B2t — 15 - 37 inches ; red (2.5 YR 5/6) fine and coarse gravelly clay, moderate content of fine angular quartz gravel, frequent fine mica fragments ; moderately strong fine subangular blocky structure composed to weak coarse prismatic units in the dry profile exposure ; distinct to strong continuous clay coatings ; firm and hard when dry ; many fine tubular inped pores ; few roots ; smooth, clear transition to :

II B3t 37 – 51/61 inches ; red (2.5 YR 5/6) somewhat fine gravelly clay loam, increasing content of fine mica fragments and some nearly decomposed rock fragments ; moderately weak fine subangular blocky ; distinct clay coatings ; slightly hard ; common fine random tubular pores ; few roots ; irregular, clear transition to :

II C 51/61 inches + ; mixed horizon with somewhat weathered material and decomposing rock in which original rock structure is still visible. The weathered part is light red to reddish yellow (2.5 YR 6/6) micaceous loam ; structureless ; very friable.

Analytical Data

Depth inches	Horizon	Stone & gravel %	Particle size distribution: Sand > 50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ	pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m–mhos/cm	Exchangeable cations, m.e/ 100g: Na	K	Ca	Mg	TEB me/100g	CEC me/100g	Base Sat %	Organic matter: C%	C/N ratio
0– 6	A_1	20·9	37·7	29·8	24·5	31·7	6·4	5·5	0·16	0·19	0·38	10·4	6·5	19·8	31·8	61	4·1	10
6–10	A_3	69·5	34·6	24·0	19·8	40·3	6·6	5·7	0·08	0·03	0·37	4·6	4·3	10·3	20·0	51	1·5	8
10–15	B_2t	55·8	30·5	14·5	11·0	56·3	6·0	5·2	0·05	0·03	0·21	2·2	2·4	5·4	16·4	31	0·9	8
15–37	II B_2t	23·8	26·1	19·4	15·5	54·1	5·8	5·3	0·03	0·02	0·11	1·3	2·7	4·1	15·8	26	—	—
37–51/61	II B_3t	7·2	31·2	32·5	20·5	34·9	5·5	4·3	0·02	0·04	0·10	0·8	1·6	2·7	13·5	20	—	—
51/61 +	II C	0·6	36·9	51·1	25·9	13·8	5·7	4·2	0·02	0·07	0·09	0·5	1·9	3·3	13·3	24	—	—

(Profile No. 4) **RED-YELLOW PODZOLIC SOIL**

Area : Ratnapura district, Pelmadulla.

Vegetation : Rubber garden, local thorny brush and grass.

Parent material : Slope colluvium with lateritic gravels over residuum from garnet-sillimanite schists (Khondalite series).

Topography : 10% slope ; lower slope of a low ridge in a sharply rolling to hilly ' ridge and valley ' landscape ; approx. 500 ft. elevation.

Climatic data : Temperature : Ratnapura, rainfall : Pelmadulla.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature—(1928–1956)°F	80	81	82	82	82	81	80·5	80·5	80·5	80	80	80	81
Mean rainfall—(1870–1956) inches	6·4	4·8	9·1	10·4	15·6	15·1	10·5	9·5	11·1	14·1	13·5	9·6	129·6

Profile Description

Ap 0 – 3 inches ; dark brown (10 YR 4/3) fine gravelly sandy clay loam, lateritic pebbles, bleached white sand grains ; moderate crumb ; friable ; common interstitial exped pores ; many roots ; smooth, clear transition to :

A2 3 – 15 inches ; yellowish brown (10 YR 5/5) fine gravelly sandy clay, lateritic pebbles ; very weak fine subangular blocky ; friable ; common fine and medium interstitial exped pores ; many roots ; smooth, clear transition to :

B1t 15 – 23 inches ; strong brown (7.5 YR 5/6) fine gravelly sandy clay, lateritic pebbles and quartz gravel ; moderate fine subangular blocky ; clay coatings ; friable to firm ; pores as above ; less roots ; smooth, clear transition to :

II B21t 23 – 39 inches ; yellowish red to strong brown (5 – 7.5 YR 5/6) clay with some decomposing rock fragments ; moderately strong fine subangular blocky ; distinct, continuous clay coatings ; firm ; common fine interstitial and tubular pores ; few roots ; smooth, clear transition to :

II B22t 39 – 62 inches ; yellowish red (5 YR 5/7) clay with decomposing rock fragments which give more yellowish and more red spots ; moderately strong fine subangular blocky ; distinct, continuous clay coatings ; firm ; common fine tubular pores ; diffuse, wavy transition to :

I B3t 62 inches + ; strong brown (7·5 YR 5/7) clay with numerous decompsing rock fragments, mottled with red and yellow ; weak subangular blocky ; clay movement and coatings in the matrix but not in freshly weathered parts ; friable ; few very fine tubular exped pores (description discontinued at 80 inches).

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m–mhos/cm	Exchangeable cations, m.e/100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand > 50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ				Na	K	Ca	Mg				C %	C/N ratio
0– 3	Ap	33·2	55·1	10·6	4·4	33·5	5·3	4·0	0·04	0·03	0·12	0·56	1·2	2·0	10·1	20	1·6	10
3–15	A_2	68·4	47·7	11·6	4·0	40·9	5·5	4·1	0·02	0·04	0·09	0·39	0·3	0·8	9·0	9	0·8	10
15–23	B_1t	63·2	45·4	12·2	5·9	43·3	5·7	4·1	0·02	0·04	0·08	0·17	0·4	0·6	9·0	7	0·6	9
23–39	$IIB_{21}t$	31·5	37·4	14·4	7·8	47·9	5·7	4·2	0·02	0·03	0·07	0·09	0·4	0·6	10·2	6	—	—
39–62	$IIB_{22}t$	17·0	40·2	15·3	8·2	46·1	6·0	4·3	0·02	0·02	0·09	0·17	0·4	0·6	9·1	6	—	—
62+	II B_3t	9·3	41·9	16·6	9·4	41·2	6·0	4·4	0·02	0·04	0·08	0·09	0·4	0·6	8·9	6	—	—

(Profile No. 5) RED–YELLOW PODZOLIC SOIL

Subgroup with prominent A1 *horizon*

Area : Ratnapura district, Kalawana.

Vegetation : Young rubber garden on previous fernland (kekilla).

Parent material : Residuum from biotite schists, garnet sillimanite schists and feldspar rocks ; somewhat transported in the upper part.

Topography : 6% slope ; low ridge in a rolling upland plateau ; approx. 800 ft. elevation.

Climatic data : Temperature and rainfall : Ratnapura at 130 ft.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature (1928–1956)°F	80	81	82	82	82	81	80·5	80·5	80·5	80	80	80	81
Mean rainfall—(1868–1956) inches	6·2	5·3	10·3	11·2	20·9	18·5	12·7	11·4	14·5	18·0	14·8	9·1	152·9

Profile Description

A1 0 – 10 inches ; very dark gray brown (10 YR 3/?) fine gravelly sandy clay loam, lateritic concretions, fine angular quartz gravel, some rock fragments ; moderate fine granular ; very friable ; many fine random interstitial pores ; many roots ; smooth, clear transition to :

A2 10 – 21 inches ; brown (10 YR 4/3) fine gravelly clay loam, less laterite concretions ; structureless ; friable ; common fine pores ; some signs of clay or clay-humus movement ; few roots ; smooth, clear transition to :

B1t 21 – 32 inches ; brown (7.5 YR 5/5) fine gravellyclay loam ; moderately weak fine subangular blocky ; distinct clay coatings ; friable ; few roots ; smooth, clear transition to :

B2t 32 – 50/70 inches ; yellowish red (5 YR 5/6) clay ; some gravel and laterite concretions, thin oriented angular quartz gravel layers ; moderately strong fine subangular blocky ; strong, continuous clay coatings and distinct clay movement in pores ; slightly sticky, slightly plastic ; very few roots ; variable, clear transition to :

— 50/70 inches + ; horizon which varies strongly within the profile exposure ; B3t, C or Ccn. The Ccn is a mottled clay with soft lateritic red mottles. The C is decomposed rock.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m-mhos/cm	Exchangeable cations, m.e/ 100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand > 50μ	Silt 50–2μ	Fine 20–2μ silt	Clay < 2μ				Na	K	Ca	Mg				C %	C/N ratio
0–10	A_1	50·2	59·9	15·2	5·7	26·2	5·6	4·8	0·02	0·04	0·21	0·2	0·1	0·6	15·5	4	1·8	18
10–21	A_2	54·6	44·8	16·7	6·8	38·8	5·5	5·2	0·01	0·04	0·12	0·1	0·2	0·5	11·0	5	0·7	18
21–32	B_1t	28·6	36·7	24·4	13·8	37·2	5·7	5·5	0·01	0·04	0·11	0·1	0·1	0·4	11·9	4	0·6	15
32–50/70	B_2t	16·1	27·8	29·0	19·4	46·0	6·1	5·8	0·03	0·09	0·12	0·1	0·1	0·4	11·7	4	—	—

(Profile No. 6) RED-YELLOW PODZOLIC SOIL

Subgroup with dark horizon

Area : Nuwara Eliya district, Pattipola.

Vegetation : Eucalyptus, introduced on wet patana grassland ; Chrysopogon sp., rhodondendron, giant fern (Pteridium aquila).

Parent material : Slope colluvium over residuum from garnet-sillimanite schist (Khondalite series), separated by distinct stone line.

Topography : 5-7% slope, on the side of a low ridge in an undulating upland plateau ; approx. 6,350 ft. elevation.

Climatic data : Temperature and rainfall : Nuwara Eliya.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature–(1928–1956)°F	57 ..	57 ..	59 ..	61 ..	62 ..	60 ..	60 ..	60 ..	60 ..	60 ..	59 ..	58 ..	59·6
Mean rainfall— (1868–1956) inches	6·9..	2·0..	4·1..	5·0..	8·5..	10·4..	11·0..	7·5..	8·2..	9·7..	9·2..	7·85..	90·4

Profile Description

A1   0–1 inches ; dark brown (10 YR 3/3) loam ; weak fine crumb ; loose ; some bleached sand grains at the surface ; few interstitial pores ; clear, smooth transition to :

A2   1–22 inches ; yellowish brown (10 YR 5/6) sandy-clay loam ; very weak fine subangular blocky ; very friable ; few fine tubular pores ; clear, smooth transition to :

Bth 22–29 inches; (dark horizon) dark brown (10 YR 3/3) clay; moderately weak fine subangular blocky; clay and humus-clay coatings; friable; common fine tubular inped pores; clear, smooth transition to:

B2t 29–37 inches; yellowish brown (10 YR 5/6) clay; moderate fine subangular blocky; distinct clay coatings; friable to firm; common fine random tubular inped pores; smooth, abrupt transition to:

II Blt 37 inches +; separated from previous horizon by a stone line; multicolored gravelly clay (description discontinued at 50 inches).

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H20 1 : 1	pH 1NKCl 1 : 1	Cond. m mhos/cm	Exchangeable cations, m.e/100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand > 50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ				Na	K	Ca	Mg				C %	C/N ratio
0–1	A_1	6·2	51·4	31·6	17·0	16·5	4·6	4·0	0·09	0·09	0·20	2·9	1·3	4·5	34·3	13	9·4	41
1–22	A_2	0·5	47·7	16·8	7·8	32·1	4·3	4·1	0·07	0·05	0·10	0·6	0·2	0·9	17·9	5	3·0	11
22–29	Bth	12·3	41·0	15·1	6·9	42·4	5·0	4·1	0·02	0·03	0·05	0·5	0·1	0·7	15·5	5	0·9	9
29–37	$B_{2}t$	22·6	41·4	14·9	7·0	42·9	5·3	4·2	0·02	0·02	0·04	0·3	0·2	0·6	11·5	5	—	—

(Profile No. 7) RED-YELLOW LATOSOL

(Description adopted from Holland, de Vries and Panabokke (4).)

Area : North-Central Province, Mannar District.

Vegetation : Low tropical evergreen forest and shrubs.

Parent material :. Old (early Pleistocene) coastal alluvium

Topography : Flat to slightly undulating terrace or old coastal shelf; elevation somewhat over 100 feet.

Climatic data : Temperature : Mannar, Rainfall : Madhu road.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature —(1924–1956)°F	79	80	82	84	85	84	83	83	83	82	80	79	82
Mean rainfall—(1922–1956) inches	4·8	2·15	3·15	4·9	2·5	0·6	0·5	1·2	1·8	7·9	12·8	8·8	51·1

Profile Description

A1 0–15 inches ; dark red (10 R 3/5) sandy loam ; structureless massive to very weak subangular blocky ; very friable, non sticky, non plastic when wet ; numerous roots ; smooth, gradual transition to :

B 15 inches + (observed to 150 inches) uniform dark red (2. 5 YR 3/6) sandy clay loam with very little variation in clay content with depth ; massive ; no clay coatings ; friable when moist but slight cementation when wet ; porous ; diminishing roots.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m-mhos/cm	Exchangeable cations, m.e/ 100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand > 50µ	Silt 50–2µ	Fine silt 20–2µ	Clay < 2µ				Na	K	Ca	Mg				C %	C/N ratio
0–15	A1	Nil	65·1	21·3	1·2	14·1	6·8	5·7	0·04	tr	0·19	0·8	0·4	1·5	4·3	35	0·4	7
15–32	B	,,	46·2	24·8	0·8	29·9	5·5	5·0	0·03	tr	0·26	0·6	0·3	1·0	3·5	30	0·1	2
32–72	B	,,	49·4	19·1	1·6	31·0	5·6	5·2	0·03	tr	0·31	0·6	0·8	1·5	7·6	20	—	—
72–95	B	,,	45·4	25·3	1·0	29·0	5·7	5·1	0·03	tr	0·32	0·6	0·8	1·7	4·7	36	—	—
95–140	B	,,	46·2	24·6	2·8	28·3	5·9	5·4	0·03	0·01	0·27	1·1	0·6	1·7	4·4	39	—	—
40–150	B	,,	44·6	21·7	1·8	33·3	6·0	5·4	0·03	0·01	0·24	1·3	0·6	1·9	4·3	44	—	—

tr = trace.

(Profile No. 8) RED-YELLOW LATOSOL

Subgroup : Calcic red latosol

Area : Jaffna District, Achchuveli.

Vegetation : Low open shrubs and grass.

Parent material : Remnant of old alluvium, mixed with limestone fragments (Miocene vacuolary limestone).

Topography : On a micro-mound ; 2-4 feet above a flat limestone plain with numerous limestone outcrops (barrocal relief) ; elevation 20-30 ft.

Climatic data : Temperature and rainfall : Jaffna.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature *(1926–1956)°F*	78 ..	79 ..	82 ..	85 ..	85 ..	84 ..	83 ..	82 ..	83 ..	82 ..	79 ..	78 ..	81·6
Mean rainfall— (1870–1956) inches	4·4..	1·5..	1·6..	2·2..	2·0..	0·4..	0·5..	1·1..	[illegible] ..	·2 .	17·3..	10·4..	53·1

Profile Description

B1 0–0.5 inches ; red to yellowish red (2.5 YR 4/5) clay loam with limestone fragments ; some bleached sand grains at the surface ; massive structureless ; soft ; few pores ; many roots ; clear, smooth transition to :

B2 0.5–6/8 inches ; ruptic horizon with limestone rocks at intervals from 3 to 7 feet ; red (2.5 YR 4/5) clay loam with limestone fragments ; very weak subangular blocky ; some clay films in pores, especially when close to the limestone rocks ; soft ; many fine and medium tubular pores ; many roots ; wavy, clear transition to :

B3 6/8–18 inches ; ruptic horizon ; limestone gravel bedded in soil mass ; red (2.5 YR 4/5) loam ; very weak subangular blocky ; pseudomicelium of secondary CaCO3 in the soil film around the limestone fragments ; soft ; many pores and channels ; wavy, abrupt transition to :

R 18 inches + ; vacuolary limestone.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H₂O 1 : 1	pH 1NKCl 1 : 1	Cond. m–mhos/cm	Exchangeable cations, m.e/100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand > 50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ				Na	K	Ca	Mg				C %	C/N ratio
0–0.5	B_1	Nil	32·8	28·6	0·9	35·3	8·1	7·0	0·09	0·12	0·30	4·5	0·2	5·1	17·0	30	1·1	8
0.5-6/8	B_2	,,	34·0	23·4	1·4	41·3	8·2	7·1	0·12	0·10	0·23	6·9	0·3	8·0	17·0	47	1·1	9
6/8–18	B_3	,,	32·4	27·4	2·3	40·0	8·3	7·2	0·11	0·10	0·14	8·2	0·2	9·0	19·0	48	—	—

(Profile No. 9) IMMATURE BROWN LOAM

Subgroup of the wet zone.

Area : Kegalle District, Mawanella.

Vegetation : Coconut and banana grove, abandoned ; grasscover with patches of Imperata cylindrica.

Parent material : Residuum from mica schist (Khondalite series).

Topography : 10% slope on an isolated knoll in a strongly incised 'ridge and valley' landscape ; elevation approx. 800 ft.

Climatic data : Temperature : Kandy, 1,600 ft. rainfall. Kegalle, 550 ft.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature (1928–1956) °F	74	75	77·5	79	78	76	75	76	75	77	75	74	76
Mean rainfall— (1912–1956) inches	4·65	2·8	7·9	9·6	10·3	11·3	7·5	5·9	8·0	16·7	12·9	7·4	104·9

Profile Description

Ap 0–5 inches ; dark brown (10 YR 4/3) micaceous loam ; moderate crumb and weak subangular blocky ; friable ; frequent holes and channels ; few random tubular pores ; mycelium around some peds ; many roots ; smooth, gradual transition to :

B 5–15/26 inches ; yellowish brown (10 YR 5/4) very micaceous sandy loam with lighter spots of decomposed rocks which are not entirely integrated in the horizon ; structureless ; loose ; many interstitial pores ; holes and channels ; many roots ; clear, irregular transition to :

C 15/26 inches + ; decomposed micaceous schist ; rock structure still visible ; loamy sand, finely mottled with light gray (10 YR 7/2) matrix and many blackish points from dark minerals ; structureless ; many fine holes and channels ; less roots.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond, m-mhos/cm	Exchangeable cations, m.e/ 100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand >50μ	Silt 50–2μ	Fine silt 0–2μ	Clay < 2μ				Na	K	Ca	Mg				C %	C/N ratio
0–5	Ap	Nil	54·0	27·7	13·3	20·1	6·6	4·5	0·04	0·08	0·18	4·6	3·6	9·0	18·9	49	1·0	10
5–15/26	B	,,	74·7	17·5	4·8	6·5	6·4	4·2	0·02	0·09	0·18	1·7	2·4	4·3	7·6	57	0·3	8
15/26 +	C	,,	80·3	15·0	2·4	2·7	6·8	4·0	0·02	0·12	0·17	3·2	2·6	6·0	8·5	70	—	—

(Profile No. 10) IMMATURE BROWN LOAM

Subgroup of the dry zone

Area : Badulla District, Alutnuwara.

Vegetation : Short grass savannah with scattered brushes and trees in clumps (park savannah).

Parent material : Residuum from micaceous gneiss (Bintenna series).

Topography : 2–6% complex slope ; foot of a low hill in rolling mantled plain with rock outcrops and boulders ; elevation somewhat over 500 ft.

Climatic data : Temperature : Batticaloa, 20 ft. ; rainfall : Alutnuwara, 300 ft.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature (1928–1956)°F	78	78	80	82	84	85	84	83	83	81	79	78	81·4
Mean rainfall— (1899–1956) inches	16·55	5·7	5·65	5·8	3·4	0·55	1·1	2·05	3·2	11·1	14·2	18·15	87·5

Profile Description

A1 0–4 inches ; dark brown (10 YR 3/3) micaceous sandy loam with decomposing rock fragments ; fine crumb ; loose ; many fine and medium interstitial pores ; many roots ; smooth gradual transition to :

B 4–48 inches ; dark brown (7·5 YR 3/4) fine gravelly micaceous sandy loam with decomposing rock fragments ; structureless, crumb in spots ; soft ; many interstitial pores and channels ; many roots ; wavy, gradual transition to :

C 48 inches + ; decomposing rocks ; micaceous sandy loam with light yellowish brown matrix (10 YR 6/4) and many dark points ; books of mica with diameter up to 0.5 inch ; stuctureless ; loose ; less roots.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution: Sand >50µ	Silt 50–2µ	Fine silt 20–2µ	Clay < 2µ	pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m-mhos/cm	Exchangeable cations, m.e/100g: Na	K	Ca	Mg	TEB me/100	CEC me/100g	Base Sat %	Organic matter: C %	C/N ratio
0–4	A1	3·5	63·1	22·3	9·2	15·3	6·8	5·7	0·05	0·04	0·52	6·0	1·9	9.0	11·8	77	1·7	12
4–48	B	43·8	64·8	20·3	7·9	15·2	6·4	4·6	0·02	0·03	0·18	2·2	1·4	4·0	11·0	39	0·6	10
48+	C	2·1	75·0	18·4	5·0	6·1	6·5	3·9	0·01	0·04	0·14	2·6	1·7	4·5	10·7	41	—	—

(Profile No. 11) RENDZINA SOIL

Area : Polonnaruwa District, Habarana.

Vegetation : Dry mixed evergreen forest with dense scrub and thorny bushes.

Parent material : Residuum from crystalline limestone (Khondalite series) weathered to soft, chalky limestone.

Topography : 4 – 6% slope ; in low ridge in an undulating mantled plain ; elevation 500-550 ft.

Climatic data : Temperature : Maha Illuppallama, Rainfall : Hingurakgoda.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature (1948–1959) °F	76	78	81	83	84	83	83	83	83	81	79	79	81
Mean rainfall— (1940 – 1956) inches	11·2	3·0	4·6	5·8	4·0	0·3	1·2	2·2	3·2	9·6	12·5	13·6	71·3

Profile Description

A11 0–6 inches ; dark brown (7·5 YR 3/2) clay loam ; no effeversence with HCl ; strong fine crumb ; friable ; extremely porous with numerous holes and channels ; little cohesion in soil mass ; many roots ; wavy, abrupt transition to :

A12 6–33 inches ; dark brown (7·5 YR 3/3) clay loam ; effeversence with Hcl ; same characteristics as above ; abrupt transition to :

A+C 33 inches + ; chalky limestone fragments from 0·5 to 3 inches diameter with A1 material in between. The A1 material has the same characteristics as above.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution: Sand >50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ	pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m-mhos/cm	Exchangeable cations, m.e/100g: Na	K	Ca	Mg	TEB me/100g	CEC me/100g	Base Sat %	Organic matter: C %	C/N ration
0– 6	A_{11}	Nil	34·2	29·1	13·6	37·1	7·4	6·1	0·09	0·07	0·22	30·1	6·8	39·2	63·3	63	1·7	9
6–33	A_{12}	Nil	31·2	29·9	13·3	40·9	8·1	6·7	0·12	0·08	0·18	37·7	2·4	46·2	.65·5	71	1·5	10
33+	A+C	—	28·3	24·5	10·9	36·1	8·3	6·9	0·13	0·08	0·20	37·1	2·2	43·0	50·2	86	—	—

(Profile No. 12) GRUMUSOL

Area : Jaffna District, Tunnukkai.

Vegetation : Short grass savannah with thorny scrubs and scattered trees.

Parent material : Ponded subrecent clayey alluvium over decomposed quartzitic Archaean rock (Khondalite series).

Topography : Flat, slightly depressional plain with distinct gilgai relief; elevation 250 – 300 ft.

Climatic data : Temperature : Mannar, Rainfall : Vavuniya.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature (1914–1956) °F	79	80	82	84	85	84	83	83	83	82	80	79	82
Mean rainfall— (1884–1956) inches	6·5	1·7	2·8	4·7	3·75	0·85	1·1	2·35	3·7	8·8	13·0	11·6	61

Profile Description

A11 0–3 inches ; black (10 YR 2/1) clay loam ; mulched horizon ; moderate granular ; sticky and plastic ; porous ; many roots ; smooth, clear transtion to :

A12 3–30/50 inches ; black (10 YR 2/1) clay ; moderate coarse angular blocky, disturbed by numerous parallel and crossing inclined and curved churning surfaces with extremely strongly developed slickensides ; very firm ; secondary lime concretions starting at a varying depth in the lower part of the horizon , vertical cracks ; few roots along the sides of the cracks ; clear wavy, transition to :

Cca 30/50–33/53 inches ; dark gray (10 YR 4/1) loam, mixed with sandier material from underlying horizon ; structureless ; numerous secondary lime concretions ; wavy abrupt transition to :

II Cg 33/53 inches + ; decomposed stratified quartzitic rock ; secondary lime concretions in the upper 2–5 inches.

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution: Sand > 50μ	Silt 50–2μ	Fine silt 20–2μ	Clay < 2μ	pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m-mhos/cm	Exchangeable cations, m.e/100g: Na	K	Ca	Mg	TEB me/100g	CEC me/100g	Base Sat %	Organic matter: C %	C/N ratio
0– 3	A 11	Nil	27·8	41·7	25·7	32·7	6·4	5·8	0·09	0·12	0·42	33·1	5·8	40·0	58·9	68	2·0	12
3–50	A 12	Nil	27·3	25·3	14·1	46·3	6·2	5·5	0·06	0·50	0·19	33·8	5·8	41·2	61·3	67	0·6	15
50–53	C ca	—	53·2	15·1	4·1	30·2	8·2	7·0	0·11	0·15	0·11	22·0	1·7	25·0	31·8	80	—	—

(Profile No. 13) SOLODIZED SOLONETZ

Area : Jaffna District, Paranthan.

Vegetation : Short grass with many bare spots, some halomorphic species and scattered trees (Manilkara hexandra).

Parent material : Semi-recent marine clayey alluvium.

Topography : Flat tidal plain ; no more inundated by the sea ; slight but distinct gilgai relief ; elevation approx. 20 ft.

Climatic data : Temperature : Jaffna, Rainfall : Paranthan.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Y*
Mean temperature—(1916–1956) °F	78	79	82	85	85	84	83	82	83	82	79	78	81.6
Mean rainfall—(1927–1956) inches	5.4	1.8	1.9	2.8	2.6	0.6	1.05	1.4	2.4	8.1	18.9	13.8	60.8

Profile Description

A1 0–1·5 inches ; dark brown (10 YR 4/3) loamy sand ; indistinct rusty threads alongs former root channels ; structureless to weak coarse subangular blocky ; loose ; few roots ; clear, smooth transition to :

A21g 1·5–6 inches ; brown (10 YR 5/3) loamy sand ; mottled with many fine distinct dark brown to dark reddish brown spots and threads along former root channels ; structureless ; loose ; few roots ; abrupt, wavy boundary to :

A+B 6–15 inches.

A22 (albic) horizon in tongues, maximal 3 inches wide at the top, diminishing in width with depth, average distance between tongues 5–8 inches ; light brownish gray (10 YR 6/2) loamy sand, bleached ; structureless ; loose ; few rusty spots ; very few roots.

Btg (natric horizon) in columns, separated by A22-tongues or very fine layers of bleached sand ; gray (10 YR 5/1) sandy clay loam ; very many dark brown and blackish spots ; moderate medium angular blocky, composed to strong coarse columns with rounded tops ; clay or clay-humus coatings on most of the blocky peds ; very firm and extremely hard when dry ; very few roots ; clear transition to :

Cg 15 inches+ ; light gray (2.5 Y 6/1) sandy clay loam ; strongly mottled with brownish yellow (10 YR 6/5) and some black spots ; structureless, massive ; firm (description discontinued at 30 inches).

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H_2O 1 : 1	pH 1NKC	Cond. m–mhos/cm	Exchangeable cations, m.e/100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand > 50µ	Silt 50–2µ	Fine silt 20–2µ	Clay < 2µ				Na	K	Ca	Mg				C %	C/N ratio
0–15	A1	Nil	80·7	13·6	1·1	4·9	7·2	5·9	0·09	0·15	0·34	3·4	1·8	5·7	6·8	80	1·2	15
1.5–6	A21g	,,	78·3	15·0	0·4	4·8	7·1	5·7	0·23	0·55	0·15	1·3	0·7	2·5	3·6	65	0·4	14
6–15	A22 (Alb)	,,	80·3	15·0	0·4	2·7	8·0	6·9	0·48	0·20	0·06	0·7	0·8	1·7	2·2	74	—	—
6–15	Btg (nat)	,	64·8	12·4	0·9	24·5	6·5	5·5	1·80	1·72*	0·34*	1·3*	3·5*	6·9	12·9	51	—	—
15+	Cg.	—	—	—	—	—	8·1	7·1	1·47	4·59*	0·57*	2·1*	4·2*	11·4	15·1	78	—	—

* Extractable cations

(Profile No. 14) MEDOW PODZOLIC SOIL

Area : Nuwara Eliya District, Pattipola.

Vegetation : Wet patana grassland with Chrysopogon sp., rhodondendron thicket and a few giant fern.

Parent material : Colluvial valley-fill of varying texture.

Topography : 1-2% slope, on the border of a flat valley in an undulating upland plateau ; approx. 6300 ft. elevation.

Climatic data : Temperature and rainfall : Nuwara Eliya.

	J	F	M	A	M	J	J	A	S	O	N	D	Y
Mean temperature (1928–1956) °F	59	57	59	61	62	60	60	60	60	60	59	58	59·6
Mean rainfall— (1868–1956) inches	6·9	2·0	4·1	5·0	8·5	10·4	11·0	7·5	8·2	9·7	9·2	7·85	90·4

Profile Description :

A11 0–11 inches ; dark brown (10 YR 3/4) fine sandy loam ; structureless ; non sticky, non plastic ; many roots ; smooth, clear transition to :

II A12 11–17 inches ; very dark gray brown (10 YR 3/2) fine gravelly sandy loam ; structureless ; non sticky, slightly plastic ; less roots which do not go below this horizon ; smooth, clear transition to :

II A21 17–22 inches ; dark yellowish brown (10 YR 4/4) fine gravelly loamy sand ; weakly mottled ; structureless ; non sticky, non plastic ; smooth, clear transition to :

II A22g 22–26 inches ; brown (10 YR 5/3) fine gravelly sandyloam ; distinct, fine mottles ; structureless ; non sticky, non plastic ; smooth, clear transition to :

II A23g 26–29 inches ; albic horizon ; light gray (10 YR 7/2) fine gravelly sandy loam ; no mottling ; structureless ; non sticky, non plastic ; smooth, abrupt transition to :

II Btg 29 inches + ; fine gravelly clay loam ; few mica fragments ; mottled with yellow (10 YR 8/5) matrix and very distinct, large, red (2.5 YR 5/8) mottles, part of which are concretionary (laterite) ; weak subangular blocky ; slightly sticky, slightly plastic (description discontinued at 45 inches).

Analytical Data

Depth inches	Horizon	Stone & Gravel %	Particle size distribution				pH H_2O 1 : 1	pH 1NKCl 1 : 1	Cond. m-mhos/cm	Exchangeable cations, m.e/100g				TEB me/100g	CEC me/100g	Base Sat %	Organic matter	
			Sand > 50µ	Silt 50–2µ	Fine silt 20–2µ	Clay < 2µ				Na	K	Ca	Mg				C %	C/N ratio
0–11	A11	29·3	75·3	14·4	7·1	12·4	4·5	3·9	0·16	0·08	0·28	1·9	0·4	2·7	17·1	16	4·5	18
11–17	II A_{12}	34·8	77·3	9·8	4·2	13·9	5·1	4·1	0·03	0·07	0·15	0·8	0·5	1·5	10·8	13	2·8	16
17–22	II A_{21}	52·1	81·9	7·1	4·5	10·7	5·3	4·2	0·02	0·07	0·08	0·4	0·1	0·7	4·0	17	—	—
22–26	II A_{22g}	45·6	78·2	10·4	7·6	10·9	5·4	4·3	0·02	0·05	0·06	0·3	0·2	0·6	4·0	15	—	—
26–29	II A_{23g}	41·8	67·5	26·9	12·3	6·1	5·4	4·4	0·02	0·03	0·05	0·4	0·2	0·7	2·4	27	—	—
29+	II Btg	34·6	31·2	37·1	17·3	29·7	5·4	4·3	0·05	0·15	0·06	0·5	0·1	0·8	11·2	7	—	—

BIBLIOGRAPHY

1. Cline, M.G. et al ; *Soil survey of the territory of Hawaii ;* U.S.D.A. Soil Conservation Service, Series 1939, No. 25, 1955.

2. Dudal, R ; *Les sols du bassin du Mekong inférieur et leur utilisation ;* Pedologie, X, 24–47, Gand 1960.

3. Dudal, R. and Soepraptohardjo, M ; *Soil classification in Indonesia ;* Contr. Gen Agr. Res. Station, 148, 1–16, Bogor 1957.

4. Holland, W., de Vries L. and Panabokke, C.R. (to be published).

5. Joachim, A.W.R. ; *Studies on Ceylon soils II ;* Trop. Agriculturist, LXXXIV, 254–275, 1935.

6. Joachim, A.W.H. and Kandiah, S ; *Studies on Ceylon soils V ;* Trop. Agriculturist LXXXV, 67–77, 1935.

7. Joachim, A.W.R ; *The soils of Ceylon ;* Trop. Agriculturist, CXI, 161–172, 1955.

8. Kellogg, C.E. ; *Preliminary suggestions for the classification and nomenclature of great soil groups in tropical and equatorial regions ;* Comm. Bur. Soil Sc., Tech. comm., 46, 76–84, 1949.

9. Moormann, F.R ; *General soil map of the Republic of Viet-Nam, with explanatory text ;* Saigon *1961*.

10. Panabokke, C.R ; *A study of some soils in the dry zone of Ceylon ;* Soil Science, 87 67–74, 1959.

11. *Soils and Men ;* U.S.D.A. Yearbook 1938.

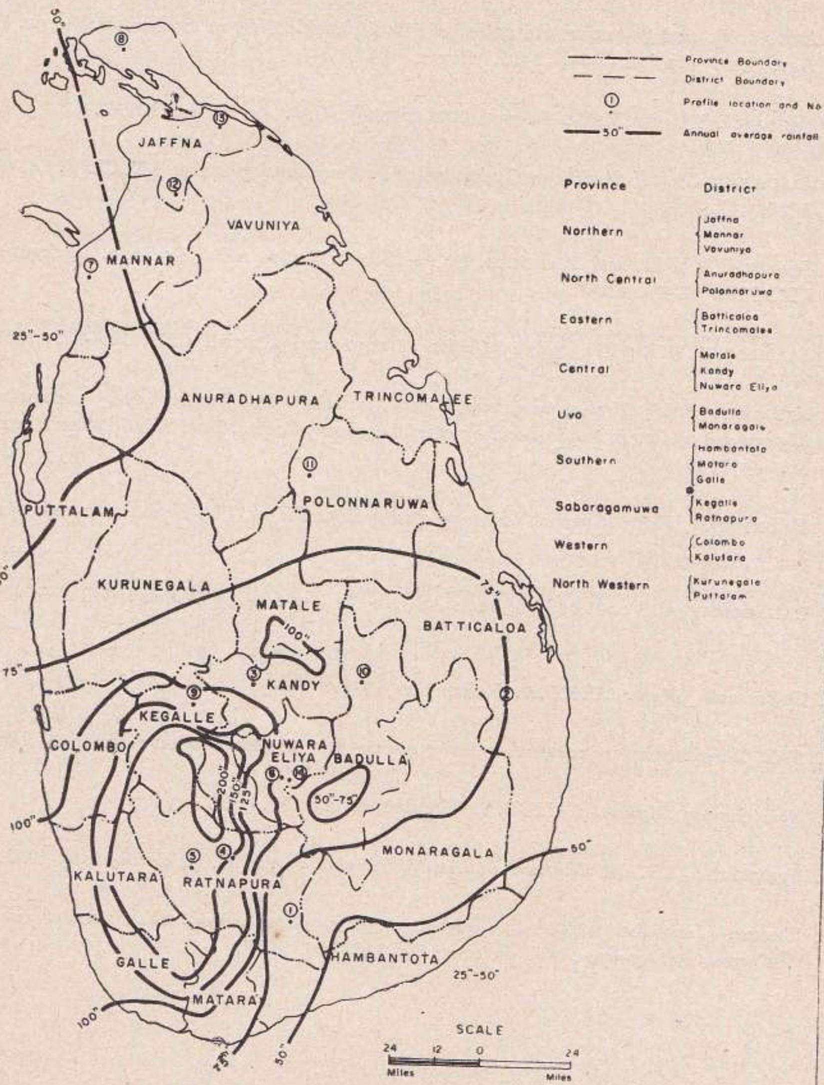
12. *Soil Classification a comprehensive system ;* 7th approximation ; U.S.D.A, 1960.

13. *Soil Survey Manual ;* U.S.D.A. Handbook No. 18, 1951.

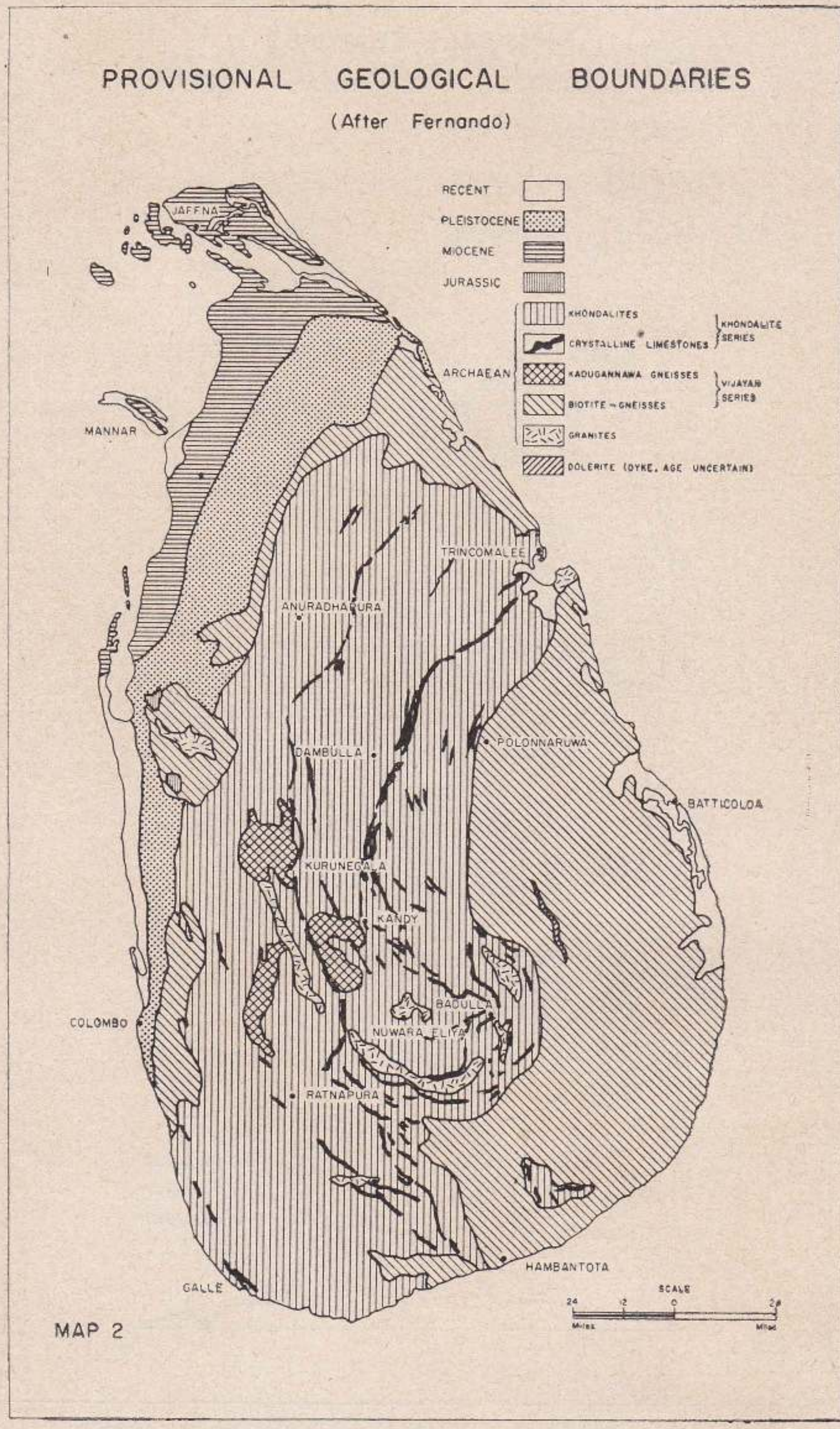
14. Stephens, C.G., *A Manual of Australian soils ;* C.S.I.R.O., Melbourne, 1953.

15. Thorp, J. and Smith, Guy D ; *Higher categories of soil classification : order, suborder and great soil groups ;* Soil Science 67, 117–126, 1949.

PROFILE LOCATIONS, RAINFALL DISTRIBUTION, AND DISTRICT AND PROVINCIAL DIVISIONS



MAP 1


PROVISIONAL GEOLOGICAL BOUNDARIES
(After Fernando)
RECENT
PLEISTOCENE
MIOCENE
JURASSIC
ARCHAEAN
KHONDALITES
CRYSTALLINE LIMESTONES
KHONDALITE SERIES
KADUGANNAWA GNEISSES
BIOTITE - GNEISSES
VIJAYAN SERIES
GRANITES
DOLERITE (DYKE, AGE UNCERTAIN)
JAFFNA
MANNAR
TRINCOMALEE
ANURADHAPURA
DAMBULLA
POLONNARUWA
BATTICOLOA
KURUNEGALA
KANDY
BADULLA
NUWARA ELIYA
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24
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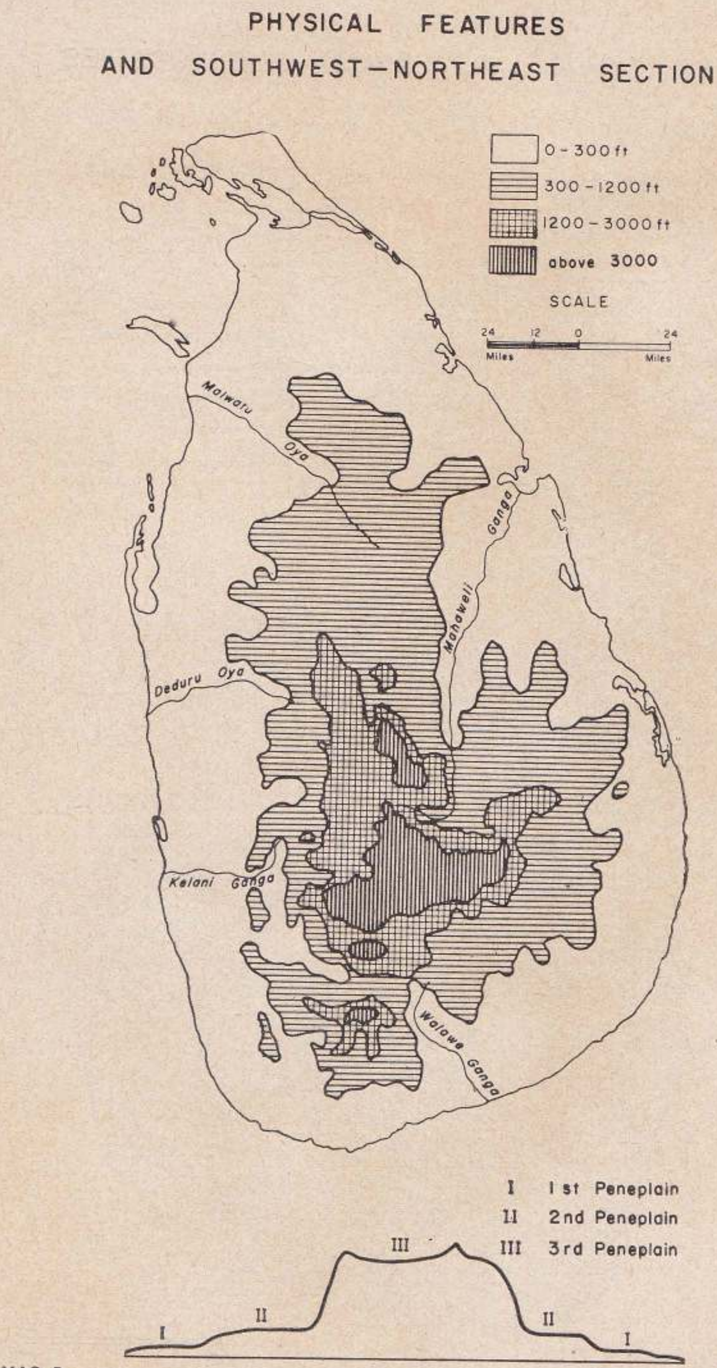
MAP 2


PHYSICAL FEATURES
AND SOUTHWEST—NORTHEAST SECTION
0 - 300 ft
300 - 1200 ft
1200 - 3000 ft
above 3000
SCALE
24
12
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Miles
Miles
Malwatu Oya
Mahaweli Ganga
Deduru Oya
Kelani Ganga
Walawe Ganga
I 1st Peneplain
II 2nd Peneplain
III 3rd Peneplain
I
II
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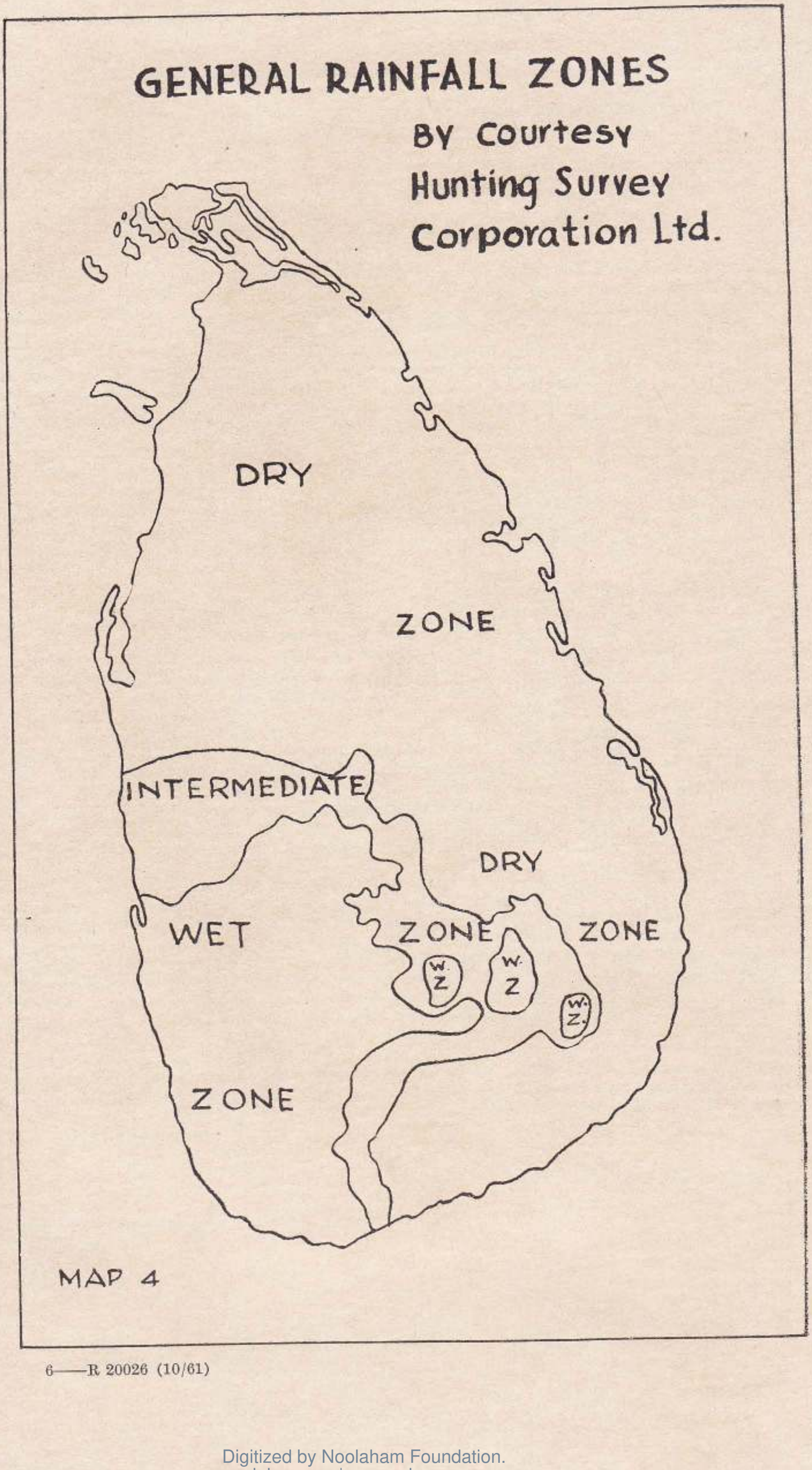
MAP 3



6——R 20026 (10/61)

METEOROLOGICAL REPORT

Summary for January to March, 1961

Two low pressure systems interrupted the otherwise mild northeast monsoon conditions that prevailed over the Island during January. The first which moved across Ceylon from East to West caused rainy weather in the north-central and north-eastern parts from 9th to 11th, a few stations recording rainfall over 5 inches on the 9th and 10th. The second which lasted from 14th to 16th caused heavier and more extensive rain, the areas worst affected being the North-Central and Eastern Provinces including the Gal Oya Valley and the North-Eastern hill-country. A large number of daily falls over 5 inches were recorded on the 14th and 15th and floods were experienced in the Gal Oya Valley and Polonnaruwa area. From the 20th onwards the weather was mainly fair, with practically no rain. The greater monthly totals of rainfall (over 20 inches) occurred along the north-eastern slopes of the central hills and in the north-central and eastern parts. Least rainfall, with totals below 2 inches, was found along the south-western slopes of the hills and in the west central region. Rainfall was above normal over a major part of the Island, deficits being generally confined to the central hills and west central areas. There were over 65 daily falls of over 5 inches, the highest one being 10·63 inches on the 14th at St. Martin's Estate (Upper Division).

Weak north-east monsoon conditions, with occasional evening thunder showers in the south-west quarter, prevailed over the Island during the first half of February. During the second half two spells of unsettled conditions resulted in the most unusual weather for February, with gloomy skies, cold days and heavy rain. The first lasted from 15th to 20th concentrating into a depression on the 16th about 300 miles to south-east of Ceylon. The rain was fairly heavy in Gal Oya area and Batticaloa District on the 16th, all stations in the area recording falls over 5 inches. This rain resulted in floods in Batticaloa District. The second spell which lasted from 21st to 23rd was caused by low pressure area to south of Ceylon and the resulting rain, though widespread, was generally light. The greater monthly totals of rainfall (totals over 15 inches) were found along the north-eastern slope of the central hills and in the Eastern Province, while the least rainfall was experienced in the Jaffna District, where the totals were below two inches. Rainfall was above normal except in parts of the south-west quarter and in the Northern Province. There were over 20 daily falls over 5 inches, the highest being 10·15 inches at Kalmunai on the 16th.

At the beginning of March the weather was dry throughout the Island and the night temperatures were unusually low. Intermonsoonal conditions, with scattered afternoon or evening thundershowers chiefly in the southwest quarter, commenced about the 6th and continued till the end of the month. Thunder has been servere occasionally and has resulted in a few deaths. On the 12th the thundershowers were widespread, several stations particularly in the southwest and among the hills receiving fairly heavy falls. The seasonal spell of warm weather set in towards the end of the month. The greater monthly totals of rainfall were found in the southwest quarter and along the eastern south-eastern slopes of the central hills and were of the order of 10 to 15 inches. The rainfall was least (totals below 2 inches), in the northern parts of the Island, and in places in Puttalam and Matale areas, a few stations receiving no rain at all. Rainfall was above normal in the eastern parts of the Island and in the Colombo District and generally below normal elsewhere. There were five daily falls over 5 inches, the highest being 5·60 inches on the 12th at Kubukkan.

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17th May, 1961.

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METEOROLOGICAL REPORT FOR THE QUARTER JANUARY–MARCH, 1961

Station	January, 1961										
	Temperature				Humidity		Amount of Cloud	Rainfall			
	Mean Max	Offset	Mean Min	Offset	Day	Night (from Min)		Amount	Offset	Rain Days	Offset
	°		°		%	%		Inches			
Anuradhapura	84·3	+0·9	71·1	+1·9	78	98	4·3	12·33	+6·53	7	—5
Badulla ..	78·0	+1·8	64·2	+0·4	82	94	5·4	8·55	—1·77	18	0
Batticaloa ..	82·5	+1·0	74·8	+1·2	79	90	5·0	15·02	+2·14	15	—1
Colombo ..	87·8	+1·4	72·6	+0·8	76	88	4·0	1·19	—2·77	7	—3
Diyatalawa ..	73·0	+1·2	58·0	+0·3	81	94	6·3	5·37	—1·27	10	—6
Galle ..	84·1	+0·3	73·8	+0·8	76	86	4·2	3·60	—0·28	13	+1
Hambantota ..	85·6	+0·7	73·7	+1·1	74	88	3·7	3·50	—0·50	9	—1
Jaffna ..	83·3	+0·3	73·7	+1·6	77	93	4·6	9·04	+4·63	12	+4
Kandy ..	84·0	+1·8	66·5	+1·6	65	84	4·3	3·67	—3·07	6	—5
Kankesanturai	83·2	+0·4	74·6	—0·3	78	86	4·4	8·44	+5·03	12	+7
Kurunegala ..	87·9	+1·5	70·0	+0·2	67	95	3·8	1·70	—3·41	7	—3
M'Illuppallama	85·3	+1·8	70·0	+0·9	72	90	4·7	8·40	+2·86	8	—1
Mannar ..	83·4	+0·1	75·2	+1·0	78	88	4·6	8·62	+4·78	10	+1
Nuwara Eliya	68·1	+0·3	48·7	+1·6	78	87	5·0	5·17	—1·79	9	—5
Puttalam ..	86·7	+1·2	71·3	+1·3	67	88	4·1	4·40	+0·97	6	—3
Ratmalana ..	88·2	+1·2	72·8	+1·4	88	88	4·1	2·46	—1·69	7	—
Ratnapura ..	91·8	+2·5	71·3	+0·2	62	85	4·9	4·13	—2·13	14	0
Talawakele ..	—	—	—	—	—	—	—	—	—	—	—
Trincomalee ..	82·7	+2·2	76·6	+1·3	77	82	5·2	10·88	+2·57	11	—2
Mullaittivu ..	82·5	—	75·0	—	80	86	4·2	11·23	—	14	—
Vavuniya ..	83·9	—	69·9	—	76	93	4·8	16·30	+9·86	14	—
Katunayake ..	88·8	—	72·0	—	68	09	3·7	4·39	—	8	—

Station	February, 1961										
	Temperature				Humidity		Amount of Cloud	Rainfall			
	Mean Max	Offset	Mean Min	Offset	Day	Night (from Min)		Amount	Offset	Rain Days	Offset
	°		°		%	%		Inches			
Anuradhapura	85·4	—1·8	70·4	+1·1	74	95	5·6	4·47	+2·75	9	+4
Badulla ..	78·2	—0·7	62·8	—0·3	78	94	6·2	7·42	+4·25	11	+3
Batticaloa ..	82·2	—0·7	73·5	—0·2	79	90	6·0	14·91	+10·70	10	+3
Colombo ..	85·6	—1·5	72·7	+0·7	76	88	5·7	1·92	—0·68	9	+3
Diyatalawa ..	74·5	—0·4	57·4	+0·5	74	91	6·3	6·62	+4·25	13	+5
Galle ..	83·4	—1·7	74·0	+0·4	73	84	6·2	2·53	—0·76	12	+5
Hambantota ..	84·1	—1·8	72·8	—0·2	76	88	6·2	5·31	+3·85	14	+9
Jaffna ..	85·4	—0·2	73·7	+1·5	70	90	4·8	0·04	—1·42	1	—2
Kandy ..	82·6	—2·8	65·2	+0·9	68	87	6·0	3·55	+1·16	8	+4
Kankesanturai	85·0	+0·3	73·7	—0·3	72	88	4·8	0·02	—1·06	1	—1
Kurunegala ..	87·3	—2·6	69·9	+0·4	66	93	5·3	5·21	+3·22	8	+4
M'Illuppallama	85·0	—2·5	69·2	+1·2	70	90	6·0	4·67	+2·76	9	+6
Mannar ..	84·8	—1·3	74·6	+0·8	72	86	5·0	0·46	—1·24	3	0
Nuwara Eliya	68·4	—1·2	49·6	+4·3	71	77	6·1	4·62	+2·63	12	+5
Puttalam ..	86·5	—1·8	71·1	+0·9	66	85	5·8	1·65	+0·28	8	+4
Ratmalana ..	85·9	—1·5	72·8	+1·5	69	88	5·9	4·99	+1·63	9	—
Ratnapura ..	89·2	—2·4	70·8	—0·5	63	80	6·4	2·98	—2·32	17	+6
Talawakele ..	71·2	—5·2	54·1	—0·3	78	87	—	—	—	—	—
Trincomalee ..	83·2	+0·7	76·0	+0·2	75	84	6·8	3·34	+0·69	8	+3
Mullaittivu ..	83·6	—	75·1	—	73	84	5·2	0·54	—0·79	3	—
Vavuniya ..	85·9	—	69·5	—	70	93	5·5	2·54	+0·81	7	—
Katunayake ..	86·0	—	71·7	—	72	90	5·4	2·72	—	9	—

STATION	March, 1961											
	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL				
	Mean Max	Offset	Mean Min	Offset	Day	Night (from Min)		Amount	Offset	Rain Days	Offset
	°		°		%	%		Inches			
Anuradhapura	90·8	—0·7	72·9	+1·3	69	93	4·0	1·56	—2·59	9	+1
Badulla ..	83·2	+0·8	63·9	—0·4	75	94	4·6	9·28	+4·23	14	+2
Batticaloa ..	—	—	—	—	—	—	—	—	—	—	—
Colombo ..	87·8	0	74·5	+0·5	79	90	4·6	10·58	+5·92	16	+5
Diyatalawa ..	78·0	+0·4	58·1	—0·1	71	88	4·9	6·20	+1·31	12	—1
Galle ..	85·6	—0·7	75·5	+0·5	75	86	4·6	4·73	—0·58	13	+1
Hambantota ..	86·4	—0·6	74·7	+0·4	76	88	4·4	3·25	—0·14	10	+1
Jaffna ..	88·8	+0·1	77·9	+2·0	73	89	3·2	0·36	—1·22	3	0
Kandy ..	86·8	—1·1	67·7	+0·6	64	87	5·0	3·35	—2·07	9	0
Kankesanturai	90·0	+1·3	76·7	+1·4	70	88	3·4	0·75	—0·72	2	0
Kurunegala ..	91·7	—1·0	72·8	+0·8	65	95	4·0	6·15	—0·13	9	—1
M'Illuppallama	90·8	—1·2	71·8	+0·3	71	88	4·2	1·80	—2·84	8	+1
Mannar ..	88·8	—0·5	76·9	+1·4	73	88	3·0	1·96	+0·12	4	0
Nuwara Eliya ..	73·2	+2.3	49·5	+2.9	71	84	4·8	3·46	—0·63	11	0
Puttalam ..	90·0	+0·1	74·1	+1·2	65	86	3·3	5·71	+2·63	7	+1
Ratmalana ..	88·4	+0·2	74·8	+0·9	70	90	4·8	7·88	+1·40	19	—
Ratnapura ..	93·3	+1·2	72·2	—0·3	62	85	5·5	6·87	—3·51	20	+1
Talawakele ..	76·1	—1·7	54·7	—0·7	73	84	4·0	4·00	—0·62	8	—
Trincomalee ..	87·8	+2·2	77·1	+0·5	74	89	3·7	1·52	—0·78	6	0
Mullaitivu ..	86·9	—	74·7	—	75	90	3·1	0·40	—1·28	5	—
Katunayake ..	88·9	—	73·9	—	73	95	4·5	8·03	—	10	—
Vavuniya ..	91·5	—	72·3	—	65	93	3·8	0·98	—1·86	7	—