

# THE SOILS OF CEYLON

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The history of human civilization indicates the importance of soil as a determining factor in agrarian settlements, as in the Nile delta and Indus valley, which sprang as a result of the natural fertility of alluvial soils. Though soils are thus traditionally one of the most important of a country's natural resources, the systematic identification, classification and mapping of soils, or the Soil Survey is of recent origin. In this country, the pioneer in this field was A. W. R. Joachim, while in more recent years, the Hunting Survey Corporation of Canada, rapidly assessed the natural resources of the Island by the modern technique of the Aerial Survey. All this earlier work helped Morrmen and Panabokke in their first generalized soil map of Ceylon.

The present article is based on the above work, and the original Soil Surveys carried out by the writer in the low country, mid country, and hill country areas of the Island.

As the soils of a region are intimately connected with its climate and vegetation, its landforms and geology, a brief introduction will be made to these aspects, before the soils of Ceylon are discussed.

## **Climatic Zones of Ceylon**

On the basis of effective rainfall and temperature, where effective rainfall is that which is in excess of evaporation, Ceylon could be divided into four major zones of climate, the Low Country Wet Zone (Hot), Hill-Country Wet Zone (Cool), Low Country Dry Zone (Hot), and Low Country Arid Zone (Hot).

The rainfall in the Wet Zone is high (75"-100" annually), with a good distribution, and though the temperatures are high, there is an excess of rainfall over evaporation. The identical conditions hold in the highland areas but there the temperatures are low.

In the Dry Zone area, the rainfall is between 60"-70" and since temperatures are high the rate of evaporation is very great, so that in the major part of the year, severe drought conditions prevail. In the hill country areas, which are in a rain shadow (as the Uva basin) sub dry-zone conditions prevail, and these regions may be called the hill-country Dry Zone. In the Arid Zone the rainfall is only between 25"-50", and this hardly balances the rate of evaporation, so that the area is permanently under severe drought conditions.

## Vegetation

The natural vegetation of the Low Country Wet Zone is the tall, stout trees of the Tropical Rain Forest, and its sub canopy of dense undergrowth. In the Hill-country Wet Zone, the vegetation is closely related to altitude, the Highland Core area above 6000 ft. being occupied by stunted gnarled trees and abundant epiphytes. Characteristic of the hill slopes and plateau of the Highland Core area are the Wet Patanas, while in drier areas of the hill-country as on the rounded hills of the Uva basin, are the Dry Patanas, typical of Diyatalawa and Bandarawela.

The natural vegetation of the Dry Zone area is of the Monsoon Forest type, with its partial adaptation to drought conditions. Trees and the ground flora of grasses are fairly dense. In the Arid Zone areas as at Puttalam and Hambantota, the vegetation, is of the Thorn-Scrub type, with a dense thorny undergrowth.

A characteristic feature of this tree flora as may be observed along the Puttalam-Anuradhapura road, or at Wellawaya, is the staining of the trunks, by red soil dust, which may be mistaken for red bark.

## Physiography

Ceylon could be divided into the physiographic regions of the central highlands, the midcountry platform and the coastal peneplain (peneplain = almost a plain) the Deniyaya massif and the Matale highlands. The central highlands could be subdivided into the Highland Core, consisting of the Pidurutalagala-Hantana ridge, the Elk plains, Moon plains and Horton plains, regions above 6000 ft. in elevation. In the Highland Core subregions (3000'-5000') is the Hatton plateau and the Bandarawela-Diyatalawa depression called the Uva basin. In the mid country elevations (1000'-3000') are the Kandy plateau, Balangoda plateau, Deniyaya massif and the Matale highlands. The coastal peneplain (0'-500') is built up of the flat coastal plain, and an inner rolling coastal plain having ridges up to 500 ft. in height. The typical landforms encountered with these three physiographic regions just described, are the ridge-valley systems. Very high ridges like the Pidurutalagala-Hantana ridge may be called mountainous, while ridges of moderate elevation are called hills. Landforms are related to a history of erosion. Very high narrow ridges, and V shaped valleys typical of the central highlands are "youthful". The moderately high and somewhat rounded ridges and moderately broad valleys of the mid country are "mature", while the low rounded ridges left as islands in very broad valleys are "senile" landforms typical of the coastal peneplain.

## Geology of Ceylon

Ceylon is built up of ancient rocks of Archean age, the granites and granitic banded rocks or gneisses bearing the mica biotite, and the rocks altered by heat and pressure, the metasediments consisting of the greenish charnokites, quartzites, crystalline limestones, and the calc rocks.

Apart from the igneous and metamorphic rocks mentioned above, are the rocks formed by hardening or consolidation of sediments, the limestones, sandstones and clayrocks or shales. Northwest and Northern Ceylon in the Puttalam and Jaffna areas are underlaid by limestone, while shales and sandstones occur in a limited area at Andigama and Tabbowa respectively.

Transported sediments occur in the flood plains and coastal plains, and consist of clayey or sandy sediments. Where the sediments are transported by wind, characteristic sand dunes are formed, which are typical of the arid zones of the North West and South Ceylon.

### **Rock Forming Minerals**

The common rock forming minerals are the heavy iron magnesium minerals and the lighter alkaline aluminium minerals, the feldspars. All these minerals are combined with the constituents of sand (silicon and oxygen) and thus named silicates, the first group being the ferro-magnesium silicates, and the latter the aluminosilicates.

### **Rock Weathering**

With climate playing a dominant role, with its control over other natural processes such as chemical and biochemical activities (bios. life), rocks decay or weather forming soil.

In the process of weathering, the ferromagnesium silicates break down to simpler compounds containing iron, giving the red and yellow colours to the soils, while the feldspars containing aluminium break down to form the clays, like the common kaolin or china-clay.

### **The Soil Profile**

If the face of a soil pit or a roadside exposure of earth is examined (a soil profile), it is generally differentiated into layers or horizons, a dark coloured surface layer, or "A" horizon, a lighter middle layer or "B" horizon, and a region containing decomposing rock, the "C" horizon. The A horizon is rich in organic matter or humus, while the B horizon is enriched with mineral matter. The horizons are sometimes further differentiated into  $A_1$ ,  $A_2$ ,  $B_1$ ,  $B_2$ , and  $B_3$  horizons.

### **Texture, Structure and Drainage**

Soil particles are in different grades or sizes, the coarse gravels, sands and the finest particles, the clays. A loam refers to a mean texture containing the *ideal* proportions of sand and clay and soil particles are further aggregated into peds, which have definite shape and firmness. The percolation of water into the soil or internal drainage is closely related to soil texture and soil structure, so that sandy soils are well drained, and clayey soils poorly drained. Well drained soils are also generally reddish in colour, and poorly drained soils, like paddy soils have grey tones.

### **The Soils of Ceylon**

The soils of Ceylon can be now discussed within the above framework of climate and vegetation, landforms and geology, and the brief introduction to weathering and the soil profile.

### **Soils of the Wet Zone**

The predominant soils of the wet zone are the lateritic soils. In the process of laterization, the ferromagnesium silicates break down to form compounds with water, (the hydroxides of iron and aluminium) and if this process is completed, only a residue of the above compounds is left behind.

This is the common laterite or building stone. Laterization however in a soil profile may not always reach completion, the degree of the process varying with altitude, the strongest lateritic profiles being found in the hot low country wet zone, and weak lateritic profiles being found in the cool hill-country areas.

#### **Soils of the Low Country Wet Zone: Strongly Lateritic Soils**

These soils are typical of the low rounded ridge and broad valley landforms of the coastal plains of the western and south western regions, and since the soils are lateritic they form the "island laterite" landforms. The A horizon has rounded gravel, the B is differentiated into a loamy horizon which passes into a mottled zone containing red mottles (lateritic) and a clay zone. The soils are generally well drained.

#### **Land Use**

The natural vegetation is that of the Tropical Rain Forest. The plantation crops consist of coconut in the Colombo District, rubber in the Kalutara District, rubber and coconut in the Galle and Matara Districts.

#### **Soils of the Mid Country Wet Zone: Moderately Lateritic Soils**

These soils are associated with the moderately high, rounded ridges and moderately wide valley landforms of the midcountry, and also on the plateaus of Mawanella and Kandy. The soils are deep, well drained and reddish brown in colour, and the strongly lateritic B<sub>2</sub> horizon is absent, but is replaced by a mildly lateritic horizon. As typical of the hills of Matale and Kegalle, the soils contain an abundance of quartz grains, while the deep soil on the slopes sometimes shows an accumulation of white mica.

#### **Natural Vegetation and Land Use**

The natural vegetation of the Tropical Rain Forest may still be found on the hills, but most of the land is under Rubber and Tea cultivation. In the Matale area Cocoa is also an important crop.

#### **Soils of the Hill-Country Wet Zone: Weakly Lateritic Soils of the Highland Core.**

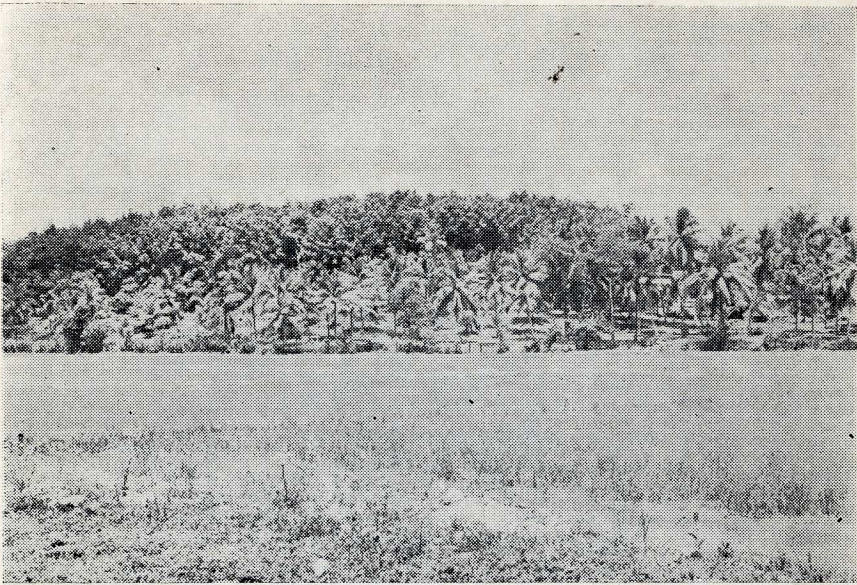
Humus or organic matter is rich in the soils of cooler climates, as temperature is important for the decomposition of humus. The soils of the Highland Core area, at Nuwara Eliya, Pattipola, Horton plains and Kandapola contain a profile with a thick A horizon of humus, and a deep yellow coloured B horizon. Lateritic streaks and nodules are present at depth.

#### **Land Use**

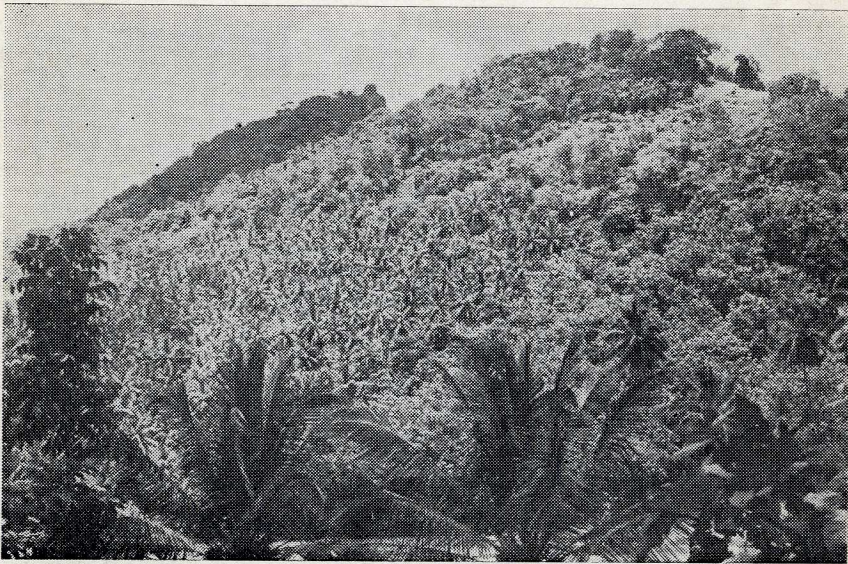
Tea plantations, and pastures for breeding cattle, and vegetable gardening is the land use practised in these soils.

#### **Weakly Lateritic Soils of the Highland Core Sub-Region**

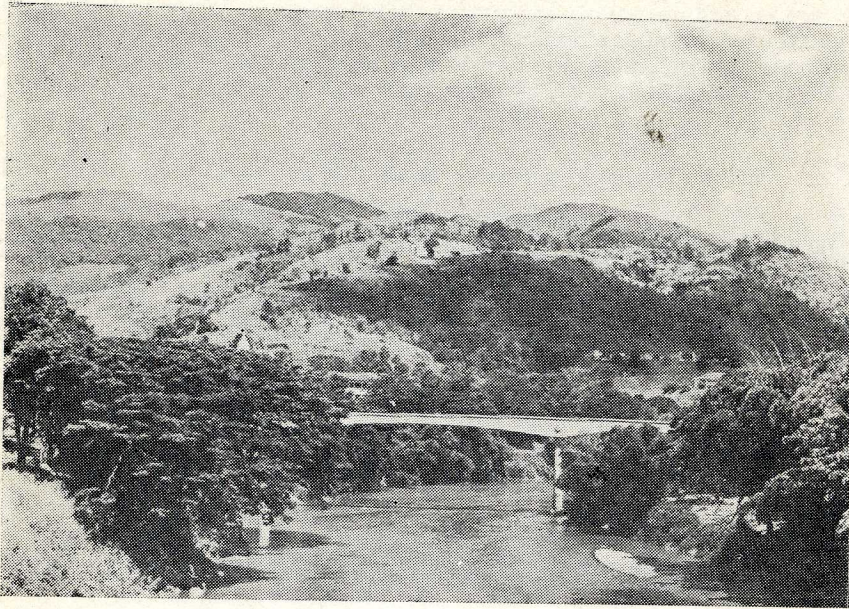
Here also a distinct humic A horizon is present, but it is brownish black, and the B horizon is differentiated and contains lateritic mottling. Soils are typical of Haputale and of the Uva basin. Soils are well drained, and have a favourable texture.



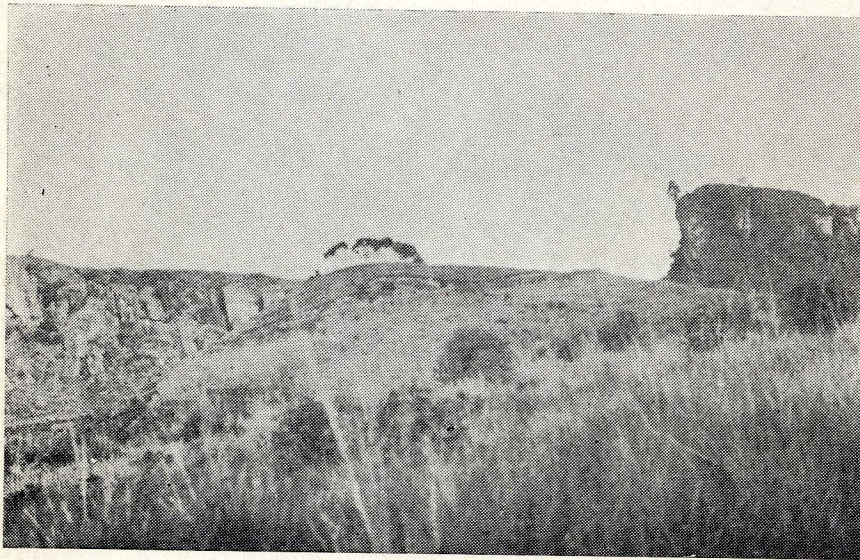
I. Island laterite landform of the coastal peneplain.



II. A close-up of I above.



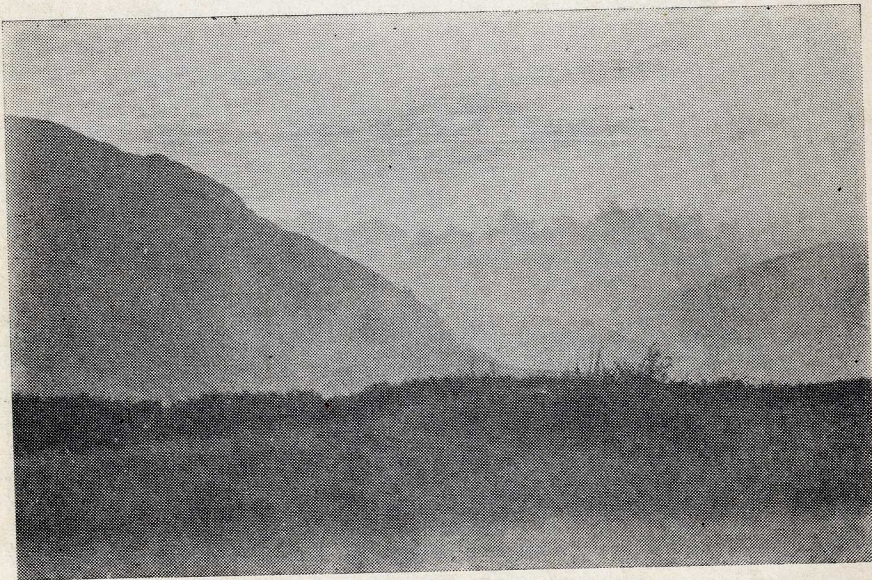
III. Mid-Country landforms seen from the Peradeniya bridge.



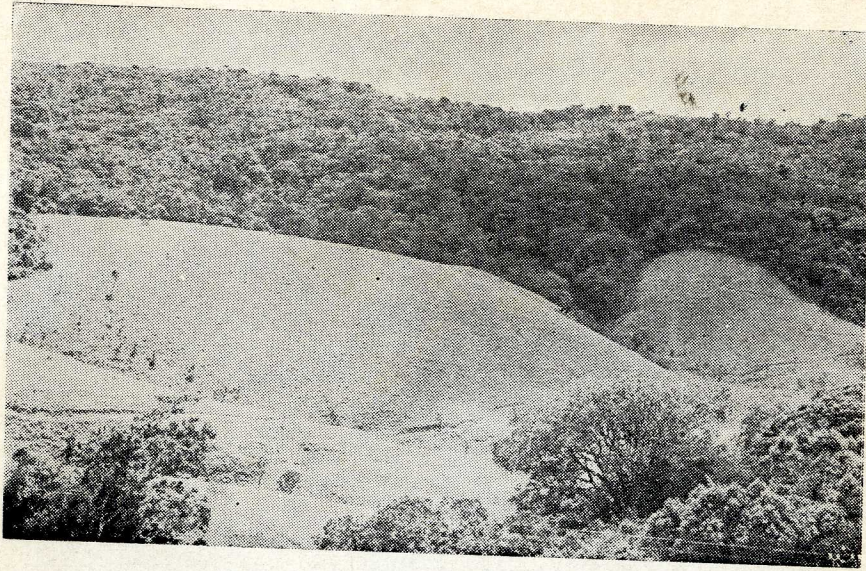
IV. Utwankande—a Mid-Country landform.



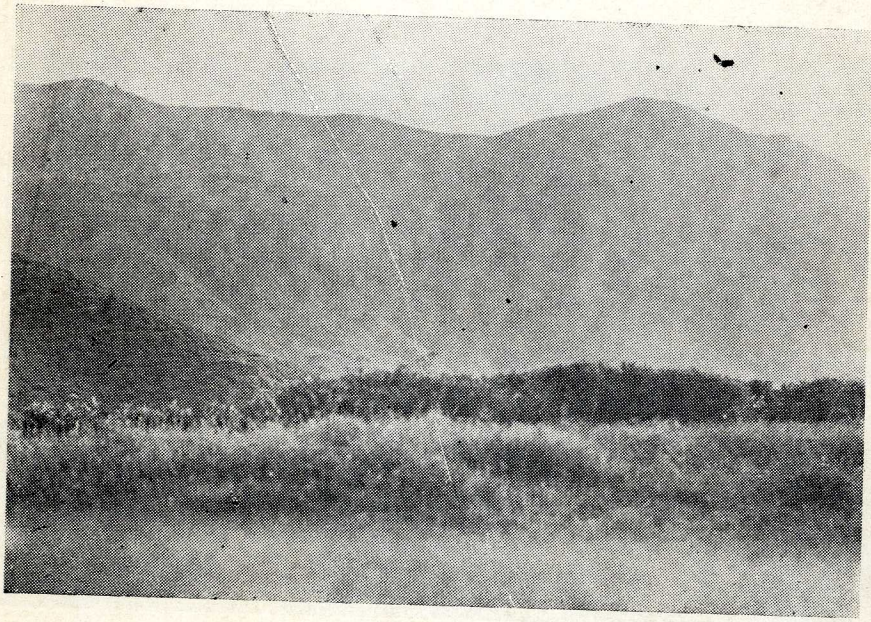
V. Landforms of the "Highland Core" seen from Ramboda.



VI. "Highland Core" landforms as seen from Ramboda close to Nuwara-Eliya.



VII. Wet Patanas seen from Hakgala.



VIII. Rim of the Uva Basin seen from the Nuwara-Eliya—Welimada road.

### **Land Use and Legend**

Tea is the predominant crop in this region. The soils of the Highland Core region (the N<sup>o</sup> Eliya areas) represent the most recent places of settlement, based on the plantation industry during the British occupation. Legend however refers to a pre-Sinhalese past where the black surface soil is referred to as having been burnt by Hanuma's tail, and such place names as Sita Eliya refers to the legendary abode of Ravana.

### **Soils Developed on Crystalline Limestone Bands in the Highlands**

Soils developed on the limestone bands in the highland areas show a deep humic horizon passing into the limestone. In the Highland Core area, as at Hakgala the humus horizon is dark and deep. Vegetable gardening is practised in these soils. In the limestone bands of the Uva basin the humic horizon is shallow and brownish black.

### **Soils of the Dry Zone**

The typical soils of the dry zone are the widely distributed Reddish Brown Earths which stretch from the South to the North Central and Northern Provinces and a major portion of the Eastern Province.

As rainfall is low in these areas, laterization has been inhibited and even the feldspars are only partially weathered, giving rise to white or yellowish masses in the subsoil, which may be mistaken for limestone. Also in the more arid areas, undecomposed rounded rock masses are present in the sub-soil.

The parent rocks of the Reddish Brown Earths are generally the biotite gneisses and the metasediments, and the landform associated with these soils is the rolling mantled plain.

The soil on the top of rounded ridges are deep, well drained and red in colour, but the soil in the depressions are poorly drained and during drought conditions dry up to a hard mass.

### **Land Use**

Paddy cultivation under tank irrigation and the cultivation of subsidiary food crops is widely practised.

### **Natural Vegetation Fauna and Historical Background**

The Reddish Brown Earths are the soils of the great Monsoon Forests, and its abundant wild life. The Yala Sanctuary and most of the bird Sanctuaries are present in this region.

The history of our agrarian civilization started in these soils with the vast network of irrigation reservoirs. It should be noted that most of the jungles in the Dry zone are thus secondary jungles.

### **Alluvial and Wind Blown Soils**

In the preceding sections the soils discussed are those resting on the rocks of their origin (or developed in situ). The soils of flood plains of rivers, and the sandy soils of some coastal plains have been transported by river and marine action. The sand dunes of the Arid zone areas of Puttalam and Hambantota have been transported by wind.

The soils of Puttalam North and Jaffna rest on limestone, and research has shown that the soils especially of Puttalam North have been transported by extinct rivers to their present environments, and due to change of climate in the prehistoric era from a wet to a desert phase, the soils have assumed their present deep red colour. The red soils in these areas, which are deep, well drained loams support the densest forests and the most fertile plantations.

Underground water too has been detected in the limestone. Historically these soils were supposed to have stained the hands of the early Aryan invaders to a deep red, thus giving rise to the word "Thambapanni" and the term "Thambapanni loams."

### **Soils of the Coastal Sand Plains**

These soils are not differentiated into horizons. In the Negombo and Chilaw areas, there are white sands or Cinnamon sands, and probably they are of wind blown origin formed in a prehistoric desert climate.

In the coastal sand plains of the Puttalam South area, and the plains of the Eastern Province, the landform is clearly cut into rolling beach ridges, beaches of a receding sea of the past. This sand ridge and valley system has abundant ground water, and is very favourable for coconut cultivation.

### **Saline Soils**

These are the soils of the salt marsh, developed in the lagoon clay plains of coastal areas, and is typical of the Eastern sea border with its extensive lagoons. Mangroves and herbs like *Salicornia*, or halophytic vegetation adapted to withstand saline conditions are able to thrive.

Some areas acquire secondary salinity by entry of lagoon waters into former fertile areas, an example of such a calamity being Muthurajawela—"the field of kings".

This article gives a generalized picture of the soils of Ceylon based on the broad classification of the major soil groups. Within the framework of the above smaller soil units or soil series will be described in future articles, based mainly on the work carried out in the coconut growing areas of the country.

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### **Acknowledgements**

- (1) "A report on a survey of the Kelani Aruvi area, Ceylon"—Hunting Survey Corporation Ltd., Canada.
- (2) "Soils of Ceylon and Fertilizer Use"—C. R. Panabokke.
- (3) "Ceylon Soils"—S. N. U. Fernando.
- (4) All plates by Mr. D. B. Hettiarachchi, Technical Assistant, (Photography), Coconut Research Institute, Ceylon.