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Study of the profile morphology and physico-chemical properties of Nilgiri Soils*

by

T. S. MANICKAM[1]

Synopsis: Six profiles from Naduvattam, Gudalur, Ootacamund, Nanjanad, Kotagiri and Coonoor of Nilgiris district in Madras State were studied for their profile morphology and physico-chemical properties. Detailed profile studies were conducted and the horizon-wise samples of each profile were examined for their mechanical composition, physical properties consisting of apparent density, real specific gravity, pore space, water holding capacity and volume expansion, total nitrogen, organic carbon, soil reaction, electrical conductivity and soil colour. From the available field and laboratory data a possible explanation has been offered for the genesis of the Nilgiri soils and the soils found in the district characterised as forming a separate group by themselves.

Introduction: Laterite and related soils form one of the four major soil groups of India and constitute one of the major cultivated soils of India. The laterites and lateritic soils have been studied with reference to different aspects but no definite conclusion about their genesis and physico-chemical properties could be drawn because of the divergences in the definition of the laterite. The data available was found to be inadequate to draw any definite lines of characterisation and because of the non-availability of first hand knowledge of representative data on typical laterites and lateritic soil profiles, the study of laterite becomes increasingly vital. Too many schools of thought were there to define and to characterise the laterite and related soils. Laterite and lateritic soils were defined on their chemical nature, morphological characters or by combination of both. But of late the soil workers have almost agreed and prefer to define the laterite on morphological aspects.

Considering the profile as the basic unit in the study of soils to have a complete understanding of the genesis and physico-chemical properties that had taken place in the past, such study has not been undertaken to understand the genesis of Nilgiri soils. In the Nilgiri of Madras State, soils were found to occur at different altitudes (elevation), climatic pattern (rainfall and temperature) and slope and these were previously classified roughly under lateritic soils. But a detailed study regarding the profile characters and physico-chemical properties for these soils was not

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[1] Assistant Lecturer in Chemistry, Agricultural College, Madurai.

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done and only scanty data are available which are found to be insufficient to have better understanding. Hence an attempt was made to study the soils of the Nilgiris on profile basis and the physico-chemical properties so as to gain information on their genesis and development and also on their classification.

Review of Literature: *Laterites and laterisation:* Buchanan (1807) first suggested the name 'Laterite' for the deposits of sesquioxidic nature formed by *in situ* weathering of the rocks and leaching away the bases. Lang (1915), studying the soils of Java, concluded that in the humid tropics, only humus-rich brown soils could be formed, and kaolinisation rather than laterisation would be the predominant soil forming process. Fox (1923) studied Indian laterites and concluded that no laterite soils were formed above an altitude of 5600 feet. Erhart (1929) concluded that low temperature in high elevations and low rainfall retarded the laterisation and he found that laterisation stopped at an altitude of 2000 metres. Mohr (1930) was of the opinion that laterites were formed only in the tropical low lands where the rainfall was abundant, and in the conditions of alternate wet and dry periods.

Harrison quoted by Hardy and Follett-Smith (1931) studied the weathering of igneous rocks both under tropical and temperate climates and concluded that the laterisation was the same on high or low level. On well-drained mountain plateaus, where the rainfall was 150 inches, the laterite appeared to be permanent as such and accumulated in considerable thickness when not exposed to leaching. On badly drained low-lying areas, the primary laterite was not permanent, but transformed into crystalline kaolin through resilicification. Humbert (1948) studied the tropical soils and concluded that in the tropical forests, no laterites could be formed because of the continuous moist condition and a well developed laterite would be formed between altitudes of 500 feet and 2000 feet. Dames (1955) reported the occurrence of red, laterite and brown soils formed from similar parent rock under different rainfall. From the foregoing review it can be seen that no definite single process can be said to bring about laterisation.

Characteristics of Laterites: Martin and Doyne (1927) analysed the laterite soils of Sierra-Leone and reported a very low silica-alumina ratio. They also concluded that differentiation of laterite, lateritic and other related soils could be done based on chemical criteria and tentatively differentiated laterites and lateritic soils using the silica-alumina ratio. Harrassovitz (1930) studied typical laterites of the tropics and reported high amounts of combined water, and oxides of iron and alumina, very low amounts of combined silica and meagre amounts of bases. Hardy (1933) studied the laterite soils and concluded [that laterites consisted mainly of sesquioxides with some quartz.] He reported the occurrence of [shot-like concretions consisting chiefly of iron oxides throughout the profile and particularly in the upper layers.] Joachim and Kandiah (1941) analysed the Ceylon laterites and reported a wide variation in properties among the soils studied, which they concluded as due to the variation in the parent rock composition. They concluded that because of this wide variation it would be incorrect to classify the soils as laterite and lateritic based on chemical composition. Pendleton and Sharasuvana (1946) analysed the Siamese laterites and they also concluded that the laterite soils could not be characterised by the chemical composition, but based only on morphological characters. They concluded that a soil could be called as 'laterite' only when there was an illuvial soil horizon of iron oxides, with a slag-like cellular or pisolitic structure.

Characteristics of Indian Laterites: GEOLOGY: Wadia (1939) described the rock formation of Nilgiris as charnockite, also called as Nilgiri gneiss which consists of a series of granitoid rocks occurring as intrusions in granites, gneisses and schists of the peninsula. Krishnan (1949) described the charnockite as a series of rocks varying from acid to ultra-basic one, the intermediate syeno-diorite type being the most common. The acid type of rock was also found to occur.

PROPERTIES: Sen *et al* (1941) studied these soils in India and attempted to classify them as laterites or lateritic soils. From the study they concluded that any attempt to classify laterites and related soils on chemical criteria would not be correct. Raychaudhuri (1941) studied red and related soils all over India and classified them, according to morphological characters, as red loams characterised by argillaceous nature, red earths with a loose and friable top soil, rich in concretions of sesquioxidic nature, and laterite soils with a surface related to red earths but with the presence of a definite layer of vesicular rock below. Lall (1955) studied red and laterite soils and concluded that both groups could be better defined by a judicious combination of both morphological features and chemical composition of the profiles.

Srinivasan and Venkataraman (1960) studied laterite soils of Coorg (West Coast) and examined the profile samples for their mechanical and chemical composition; from the data of silica-alumina ratio they classified the soils as laterite and lateritic soils. Mahalingam (1962) studied the morphological features, physical properties and chemical composition of Nilgiris soils and concluded that they could be classified as laterite and lateritic ones. Durairaj (1962) studied the morphological features of more than 21 soil profiles in the Nilgiris and reported the complete absence of vesicular or pisolitic laterite horizon in any of the profiles studied. He reported wide variations in the properties even within a small area and concluded that the differences observed might be due to variations in the composition of parent rock, and that it would be very difficult to classify the soils of Nilgiris into any definite categories. He pointed out the urgent need for agreement among the soil workers in defining the laterites and lateritic soils based on morphological, physical and chemical data for the profile samples.

Materials and Methods: The Nilgiris district lies between 11·8' and 11·55' of the northern latitude and 76·13' and 77·2' of the eastern longitude. Very great variations in rainfall ranging between 50 and 150 inches, elevation ranging between 1500 and 8600 feet and slope are the characteristic features of this district.

Profile study: The profiles examined in the present investigation from Naduvattam, Gudalur, Ootacamund, Nanjanad, Kotagiri and Coonoor were either road or clearance cuttings. The profile characters, colour, texture, structure, arrangement of horizons and other special features were studied in detail. General information regarding locality, elevation, rainfall, vegetation, parent material and other features was noted for each profile. Soil samples were collected horizon-wise for laboratory studies.

Laboratory analysis: The soil was examined for mechanical composition, physical constants, organic carbon content, total nitrogen, pH, electrical conductivity and colour. The mechanical components were estimated by the International Pipetee Method (Piper 1950). The physical constants, apparent specific gravity, true specific gravity, pore space, volume expansion and maximum water holding capacity were determined by employing the Keen-Raczkowski brass cup method (Piper 1950). Total nitrogen was estimated by the Kjeldahl method (Piper 1950) and organic carbon by Walkley's and Black's chromic acid digestion method (Piper, 1950) The pH was estimated using a Beckman pH meter (Jackson, 1958) and electrical conductivity (e. c.) was estimated using a solubridge. The color determinations were done with a Munsell Colour Chart.

Experimental Results: Six profiles, one each from Naduvattam, Gudalur, Ootacamund, Nanjanad, Kothagiri and Coonoor of Nilgiris district representing various elevation and rainfall regions were studied in detail for their morphological characters, physical constants, and some of their chemical constituents.

Profile study: The detailed profile descriptions for the six profiles are presented below:

Profile I (P. I) — Naduvattam

Location — Between 21/4th and 21/5th mile on the road leading to Gudalur near culvert No. 304

Elevation — 6100 feet

Rainfall — 100 inches

Vegetation — Shrubs and Roadside weeds

Surface feature — Sloping

Parent material — Not visible

0—8″ Dark brown (10 YR 3/4), clayey, weakly developed prismatic structure. Absence of grit particles. pH : 5·6

8—25″ Brown (10 YR 4/4), clayey, well developed prismatic structure, some ferruginous grits seen. pH : 5·2

25—35″ Light yellowish red (7·5 YR 5/4), clayey, weakly developed prismatic structure, ferruginous gravel present. pH : 5·2

35—45″ Reddish brown (7·5 YR 5/6), clayey, absence of grit, prismatic structure. Ferruginous concretions seen pH : 5·1

Remarks : No laterite horizon was seen

Profile II (P. II) — Gudalur

Location — Between 31/0 and 31/1 mile on the road leading to Mysore

Elevation — 3600 feet

Rainfall — 90 inches

Vegetation — Grasses and shrubs

Surface feature — Gentle slope

Parent material — Not seen

0—8″ Light orange brown (7·5 YR 6/6), clayey loam, weakly developed prismatic structure, ferruginous gravel sparsely distributed. pH : 5·6

8″—28″ Brown (7·5 YR 4/4), weakly developed prismatic structure, clayey loam sparse distribution of bigger ferruginous gravel. pH : 5·1

28″—35″ Reddish brown (7·5 YR 5·6), more gravel, blocky structure, more ferruginous gravel pH 5·2

35″–130″ Reddish brown (7·5 YR 7/8), clayey, blocky structure, sparse distribution of ferruginous grits. pH : 5·3

Profile III (P. III) — Ootacamund

Location — On the western side of the Panchayat Union Office

Elevation — 7200 feet

Rainfall — 55 inches

Vegetation — Grasses

Surface feature — Gentle slope

Parent material — Weathered charnockite

0—30″ Light brown (7·5 YR 4/4), loamy, fairly well developed prismatic structure, presence of small grits. pH : 5·0

30″—44″ Light dark brown (7·5 YR 5/6), loamy, well developed prismatic structure, large number of grits. pH : 4·9

44″—54″ Light yellow brown (7·5 YR 7/6), gravel horizon, angular ferruginous gravels. Soil portion is compact and clayey. pH : 4·9

54″–152″ Weathered parent material, mottling of pink, cream and orange colours (7·5 YR 8/6 dominant), clayey compact. pH : 5·0

Profile IV (P. IV) — Nanjanad

Location — Near the second culvert on the road leading to Agricultural Research Station from the main road.

Elevation — 7400 feet

Rainfall — 55 inches

Vegetation — Grasses and Eucalyptus trees

Surface feature — Sloping

Parent material — Not seen

0—11″ Brown (10YR 4/3), loamy, blocky structure but with a poorly developed prismatic structure, presence of grits. pH : 4·8

11″—35″ Blackish brown (10YR 3/2), well developed prismatic structure, clayey, more of grits. pH. 4·9

35″—46″ Yellow (limonite) (10 YR 8/6), clayey, blocky no coarse particles. pH : 5·0

46″—86″ Kaolin layer, free quartz present soft and light white in colour (10 YR 8/2), pH : 5·6

Remarks: Clear lines of demarcation were observed

Profile V (P. V) — Kothagiri

Location — Near the approach road leading to Bower lands, 100 yards from Main road between 10th mile and 10 mile 1 furlong

Elevation — 6500 feet

Rainfall — 60 inches

Vegetation — Grasses and Eucalyptus

Surface feature — Sloping

Parent material — Disintegrated charnockite

0—20″ Light brown (7·5 YR 4/4), clayey loam, well developed prismatic structure pH : 4·7

20″—30″ Dark brown (5 YR 4/8), ferruginous gravels and grits present, weak crumb structure. pH : 4·9

30″—40″ Brownish yellow (5YR 4/8), weak crumb structure, loam, size of grits increase with depth. pH : 5·0

40″ & below Bright brownish red (5 YR 5/8), disintegrating parent material compact. pH : 5·1

Remarks: Clear line of demarcation

Profile VI (P. VI) — Coonoor

Location — Inside pomological station, Model Orchard *cum* nursery

Elevation— 5800 feet

Rainfall — 50 inches

Vegetation — Grasses and shrubs, apple trees

Surface feature — Sloping

Parent material — Charnockite

0—16″ Brown (5 YR 4/4), Clayey loam, compact structure. pH : 4·8

16″—37″ Light brown 7·5 YR 5/6), blocky structure, sandy loam, increase in coarser fractions. pH : 5·2

37"—51" Light brownish orange (7·5 YR 6/8), compact but powdery, presence of grit particles. pH : 5·5

below 51" Compact disintegrated parent material. Colour (7·5 YR 6/6). Parent rock (charnockite) is seen at the bottom. pH : 4·7

Laboratory analysis: MECHANICAL COMPOSITION: The results of mechanical analysis expressed on oven dry basis are given in Table I. The data revealed the variable nature of the different profiles studied. In the Naduvattam profile (P. I) the clay content was maximum in the second horizon and the last horizon. Silt content was found to decrease gradually with depth and appreciable differences could not be observed in the coarse and fine sand fractions. In the Gudalur profile (P. II) the coarse sand and

TABLE I

Mechanical Composition (on moisture-free basis)

Location	Depth in inches	Moisture percentage	Coarse sand	Fine sand	Silt	Clay	Acid solubles
Profile I Naduvattam	0—8	9·8	10·5	5·9	15·8	61·9	5·9
	8—25	7·4	9·8	5·2	12·4	70·9	1·7
	25—35	5·6	12·5	7·3	10·5	68·4	1·3
	35—45	6·7	11·5	5·3	8·4	73·7	1·1
Profile II Gudalur	0—7	2·4	16·6	8·2	24·3	46·8	4·1
	7—28	3·5	17·4	8·4	14·1	55·6	4·5
	28—35	3·5	19·2	6·1	11·1	60·3	3·3
	35 and below	2·7	12·1	9·1	25·7	51·1	2·0
Profile III Ootacamund	0—30	7·1	13·7	6·5	17·3	58·2	4·3
	30—44	5·1	14·0	11·6	12·0	62·2	0·2
	44—54	4·4	22·2	10·6	18·5	48·7	...
	54-152	1·6	12·5	15·4	37·1	31·6	3·4
Profile IV Nanjanad	0—11	5·8	19·5	8·3	12·9	55·9	3·4
	11—35	6·1	13·9	7·5	14·1	60·6	3·9
	35—46	2·7	35·8	10·3	27·3	24·1	2·5
	46—86	3·8	41·2	14·4	26·2	15·6	2·6
Profile V Kothagiri	0—20	6·2	17·8	11·0	18·5	49·5	3·2
	20—30	4·1	40·0	11·5	11·4	35·2	1·9
	30—40	2·5	55·8	11·6	8·5	23·8	0·3
	40 and below	2·6	41·6	20·9	11·0	24·8	1·3
Profile VI Coonoor	0—16	3·4	35·0	14·2	16·3	31·5	3·0
	16—37	2·7	47·7	13·7	12·6	24·0	2·0
	37—51	1·5	48·7	27·3	13·4	9·1	1·5
	51—62	2·4	48·4	25·5	13·4	12·2	0·5

clay increased with depth upto the third horizon and fine sand and silt decreased with depth. In the Ootacamund (P. III) and Nanjanad (P. IV) profiles clay content decreased with depth except in the second horizon. The fine sand and silt were found to increase with depth. In the case of Kothagiri (P. V) and Coonoor (P. VI) profiles, the clay content decreased with depth and sand fractions increased with depth.

Physical constants: The apparent specific gravity, real specific gravity, percentage of pore space, water holding capacity and volume expansion are reported in Table II.

TABLE II

Physical Properties

Location	Depth in inches	Apparent specific gravity	Real specific gravity	Pore space %	Water holding capacity %	Volume expansion on wetting %
Profile I	0— 8	1·04	1·91	55	55·5	21·0
Naduvattam	8—25	1·10	1·92	53	55·3	20·1
	25—35	1·05	1·97	55	58·1	13·1
	35—45	1·05	2·06	55	58·8	13·2
Profile II	0— 7	1·16	2·01	55	59·5	4·7
Gudalur	7—28	1·19	2·10	55	62·3	10·8
	28—35	1·21	2·19	57	57·8	7·7
	35 and below	1·26	2·26	54	55·8	4·0
Profile III	0—30	1·11	2·00	56	54·0	4·7
Ootacamund	30—44	1·11	2·13	51	43·4	12·3
	44—54	1·12	2·24	49	45·1	13·8
	54–152	1·14	2·30	58	57·9	0·7
Profile IV	0—11	1·15	2·09	56	56·1	16·8
Nanjanad	11—35	1·18	2·13	55	51·7	25·0
	35—46	1·17	2·17	53	49·9	11·0
	46—86	1·21	2·13	47	38·5	2·6
Profile V	0—20	1·12	2·09	57	53·5	16·5
Kothagiri	20—30	1·31	2·18	49	38·3	13·6
	30—40	1·44	2·24	47	36·4	17·9
	40 and below	1·30	2·43	53	43·4	9·7
Profile VI	0—16	1·12	2·15	70	57·5	14·3
Coonoor	16—37	1·29	2·16	56	43·3	15·7
	37—51	1·35	2·36	49	38·7	10·3
	51—62	1·40	2·31	47	36·6	11·7

Apparent and real specific gravity: In all the profiles both the apparent and real specific gravity were found to increase with depth. The apparent density varied from 1·04 to 1·40 and real specific gravity varied from 1·91 to 2·43.

Pore space: The percentage of pore space was found to be almost same throughout the profiles of Naduvattam (P. I) and Gudalur (P. II). The pore space was found to decrease up to the third horizon and increase in the fourth horizon in the profiles of Ootacamund (P. III) and Kothagiri (P. V) and gradually decrease throughout the profiles of Nanjanad (P. IV) and Coonoor (P. VI).

Water holding capacity: In the Naduvattam profile (P. I) this capacity was found to be almost uniform throughout the profile, but in the case of Nanjanad (P. IV) and Coonoor (P. VI) profiles there was gradual decrease with depth. In the Gudalur (P. II) profile the water-holding capacity decreased with depth, except the second horizon which recorded the maximum value. In other profiles the water-holding capacity decreased with depth except the lower horizons.

Volume Expansion: This was found to decrease with depth in all the profiles studied. Maximum expansion (20.1 per cent) was obtained for the second horizon of Naduvattam profile (P. I) and minimum expansion (0.71 per cent) was given by the last horizon of Ootacamund profile (P. III).

Organic Carbon: The organic carbon estimated by Walkley and Black's chromic acid digestion method and expressed as percentage is presented in Table III. The organic carbon content was found to decrease with depth except in the Gudalur profile (P. II) where the second horizon contained more organic carbon. The Nanjanad surface sample analysed 6.8 per cent organic carbon.

Total Nitrogen: The total nitrogen of each horizon estimated by Kjeldahl method is reported in Table III. Same trend like that of organic carbon, i. e. decrease with depth except in the Gudalur profile (P. II) where the second horizon contained maximum nitrogen, was observed for the nitrogen also. The nitrogen content was found to vary between 0.001 and 0·319 per cent for the different profiles studied.

Carbon/Nitrogen ratio: The ratios calculated from the data of organic carbon and total nitrogen content are reported in Table III. From the data it could be seen that in each profile there was variation in the C/N ratio. In the Naduvattam (P. I) profile, the C/N ratio decreased

TABLE III

Organic carbon, nitrogen and C/N ratio

Locality	Depth in inches	Percentage of organic carbon	Percentage of total nitrogen	Carbon/nitrogen ratio
Profile I	0— 8	2·28	0·237	9·6
Naduvattam	8—25	1·80	0·158	11·5
	25—35	0·96	0·119	8·1
	35—45	0·65	0·091	7·1
Profile II	0— 7	1·45	0·158	9·2
Gudalur	7—28	2·23	0·287	7·8
	28—35	1·40	0·102	13·9
	35 and below	0·25	0·023	11·6
Profile III	0—30	1·97	0·166	11·9
Ootacamund	30—44	0·69	0·074	9·3
	44—54	0·56	0·059	9·4
	54–152	0·19	0·020	9·3
Profile IV	0—11	6·82	0·211	32·3
Nanjanad	11—35	3·19	0·182	17·5
	35—46	0·37	0·023	16·3
	46—86	0·12	0·006	19·8
Profile V	0—20	3·62	0·319	11·3
Kothagiri	20—30	1·48	0·128	11·5
	30—40	0·71	0·043	16·4
	40 and below	0·57	0·029	19·3
Profile VI	0—16	3·89	0·208	18·7
Coonoor	16—37	1·64	0·095	17·1
	37—51	0·42	0·028	14·6
	51—62	0·29	0·006	49·8

with depth except in the second horizon where it was maximum. In the Ootacamund profile (P. III) the ratio decreased with depth. In other profiles the C/N ratio was found to vary in an irregular manner within the horizons.

Colour: The colour of each horizon sample determined with reference to a Munsell Color Chart, is reported in the profile descriptions. In the Naduvattam (P. I) profile the colour was found to vary from dark brown (10 YR 3/4) to strong brown (7.5 YR 5/6). In Gudalur (P. II) profile the variation was between dark brown (7.5 YR 4/4) and reddish yellow (7.5 YR 7/8), in Ootacamund (P. III) profile dark brown (7.5 YR 4/4) and reddish yellow (7.5 YR 8/6), in Nanjanad (P. IV) profile dark brown (10YR 4/3) and white (10 YR 8/2), in Kothagiri (P. V) profile dark brown (7.5YR 4/4) and yellowish red (5YR 5/8) and in Coonoor (P. VI) profile reddish brown (5 YR 4/4) and reddish yellow (7.5 YR 6/6).

Reaction (pH) and electrical conductivity: The data on pH (reaction) for the profile samples are given in the profile description. The electrical conductivity was found to be less than 0.2 millimhos in all the profiles and the pH was found to vary between 4.5 and 5.5.

Discussion: Six profiles from Naduvattam, Gudalur, Ootacamund, Nanjanad, Kothagiri and Coonoor were studied for their morphological characters, physical properties and some of the chemical components.

Profile characters: In all the profiles the superficial or the first horizon started with brownish or dark brown colour which could be attributed to the presence of high organic matter content and this was found to be supported with experimental evidences. But in the profiles of Kothagiri (P. V) and Nanjanad (P. IV) the sequences of horizons were found to be altered which may be due to colluvial action and variation in the topography and this was found to be supported by clear lines of demarcation in the profiles. In the profile formed by *in situ* weathering (Coonoor profile) the properties were found to be changing gradually and the original parent rock (charnockite) was seen at the bottom.

In Naduvattam (P. I) profile, the superficial horizon was dark brown and no gravel or laterite horizon was seen and only in the last horizon some ferruginous concretions were seen which indicated the presence of free sesquioxides. A well developed prismatic structure and high content of clay indicated the illuvial action that had taken place previously. Low electrical conductivity (less than 0.2 millimhos/sec.) and decrease in pH with depth indicated the highly leached nature and absence of bases in the profile and the presence of free sesquioxides in the profile. The low bulk density, high pore space and water holding capacity of the superficial horizon indicated the presence of high content of organic matter and clay.

In the Gudalur profile (P. II) the second horizon (8″ – 28″) was found to contain more clay, organic carbon and total nitrogen, high water holding capacity and volume expansion than the other horizons. Moreover no regular sequence in the change of properties was observed between the horizons. There were clear lines of demarcation and the parent rock was not seen. The profile was found to contain ferruginous gravel, not found anywhere else in the present study and these properties indicated the 'built up' nature of the profile with features similar to a low-level laterite but no typical laterite horizon was seen. The Nanjanad profile (P. IV) had a kaolin layer and this was found to be a peculiar occurrence and formation. The Coonoor profile (P. VI) by considering the properties exhibited by it, was considered to represent *in situ* weathering.

The general profile characteristics studied in the present investigation did not appear to be markedly dependent upon elevation and rainfall because of the occurrence of kaolin in one profile and complete absence in other profiles where the rainfall and elevation were the same. The varied nature of the profiles studied indicated that the profile characteristics were predetermined by the parent rock. The difference in the parent rock composition in conjunction with differential climate, elevation, slope and vegetation was responsible for producing different kinds of profiles in Nilgiris.

From the available data, it might be possible to define and classify the soils of Nilgiris either as laterite or lateritic. The definition and distinction of laterite, lateritic and other related soils have not been done with accuracy and even at present there is no single accepted definition for the laterite, lateritic and related soils. Martin and Doyne (1927) characterised the laterites and related soils on chemical composition. But characterisation based on chemical composition was found to be very unsatisfactory (Joachim and Kandiah (1941), Sen *et al* (1946), and Pendleton and Sharasuvana (1946)). It is now generally acceptable to define and characterise the laterites based on morphological properties of the profiles. (A soil is called a laterite, when the profile contains an illuvial horizon, largely of iron oxides, with a slag-like cellular or pisolitic structure and of such a degree of hardness that it may be quarried out and used for building construction; a lateritic soil is one where the profile contains only an immature laterite horizon of variegated mottling with red, purplish or brown iron oxide deposition.) This has been generally accepted and based on this morphological definition, the Nilgiris soils can be described only as lateritic because of the complete absence of laterite horizon and ferruginous gravel and presence of high quantities of free sesquioxides with variegated mottling. (But according to the recent Seventh Approximation for Soil Classification proposed by United States Department of Agriculture (1960) the laterite and lateritic soils were brought under 'oxisol'.) But difficulties are experienced in fitting the soils of Nilgiris into any one of the sub-order and other lower categories of the classification (Durairaj 1962) and hence more work is necessary to define and characterise the soils of Nilgiris to a complete accuracy.

Summary and Conclusion: Six profiles from Naduvattam, Gudalur, Ootacamund, Nanjanad, Kothagiri and Coonoor were studied for their profile morphology, physical properties, pH, electrical conductivity, organic carbon, total nitrogen and soil colour. The profile characteristics indicated in some cases the colluvial action and in some profiles *in situ* weathering. The parent rock was found to be charnockite. Occurrence of kaolin was noticed in Nanjanad. The profiles exhibited the complete absence of the laterite horizon and ferruginous pebbles usually considered typical of true laterite soils and only the Gudalur profile was found to contain typical ferruginous gravel. But in all the profiles free sesquioxides with mottling were present in the lower horizons. The mechanical composition, physical properties and some of the chemical components indicated the varied nature of the profiles studied. The variations observed in the present investigation may be attributed to the differential composition of the parent rock. The climate (rainfall and temperature), vegetation and slope only acted as secondary agents in modifying the properties of Nilgiris soils.

Since the soils do not contain a laterite horizon, according to morphological criteria, the Nilgiris soils are not laterites. But the presence of free sesquioxides in distinct horizons indicates incipient or immature laterisation and based on these, the soils may be called Lateritic ones. More work is required to confirm this.

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