SSP—89/A2

SCHOOLS SCIENCE PROGRAMME

APRIL — JUNE, 1989

COURSE NOTES

EARTH AROUND US: AN INTRODUCTION TO GEO-SCIENCES

Prof. P. G. Cooray
Senior Research Scientist
Institute of Fundamental Studies
Kandy

Saturday, 29th April, 1989

THE INSTITUTE OF FUNDAMENTAL STUDIES
HANTANA ROAD, KANDY
Tel: 08-32002

School Science Programme

29-04-1989

SSP-89/A2

COURSE NOTES

"THE EARTH AROUND US"

(AN INTRODUCTION TO 'GEOSCIENCE' OR 'GEOLOGY')

by

Prof. P.G. Cooray

Senior Research Scientist

I.F.S., Kandy

CONTENTS

THE INSTITUTE OF FUNDAMENTAL STUDIES

Hantana Road, Kandy.

1. THE "WHAT" AND "WHY" OF GEOSCIENCE

1.1. PLANET EARTH is made up of three spheres (Fig.1-1), namely, ATMOSPHERE, HYDROSPHERE AND LITHOSPHERE. These spheres make up the environment in which we live, ecah of which plays an important part in our lives. "Earth Science" is a general name for explaining and understanding what happens in these different spheres, and "Geoscience" (or "Geology") is just one part of earth science.

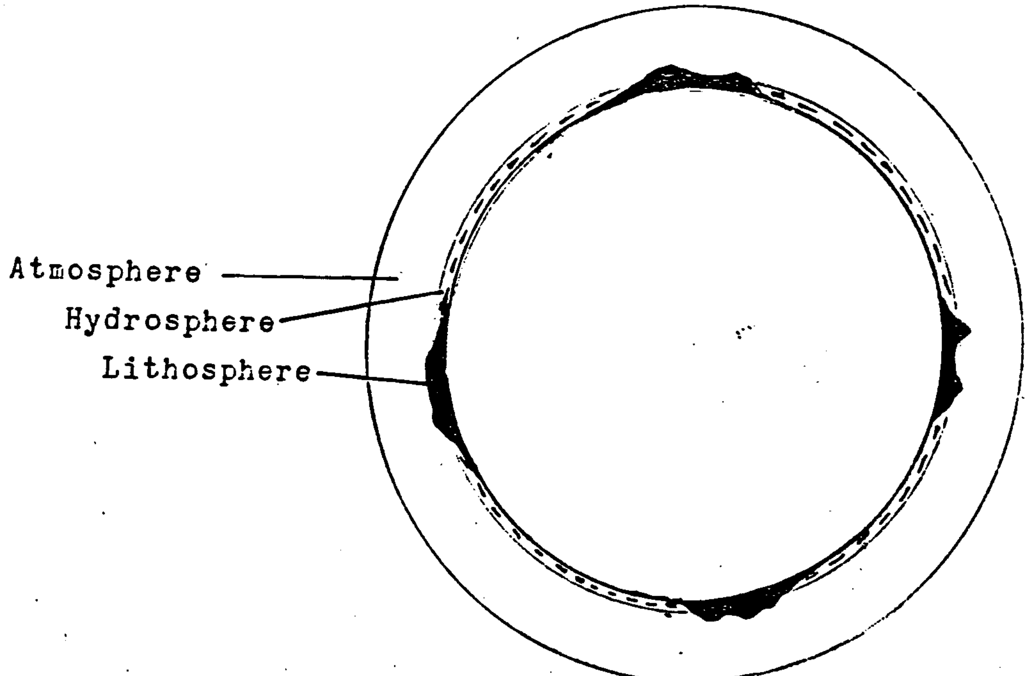


Fig. 1-1

Concentric structure of planet Earth.

1.2. The ATMOSPHERE - the envelope of air that surrounds the planet - the science of this atmosphere is METEOROLOGY. Involves measurement of various atmospheric conditions, e.g. air pressure, air temperature, wind direction and strength, precipitation, relative humidity, cloud formation and weather "fronts". The evolution of oxygen in the atmosphere led to the formation of an ozone layer (Fig.1-2) in the stratosphere as oxygen atoms and molecules combined to form the three-atom molecule O_3. This layer absorbs much of the shortwave ultraviolet rays from the sun and protects surface life from this cell-damaging radiation. Now a "hole" has appeared in this layer, due to man's malpractices, which is affecting our climate and our lives.

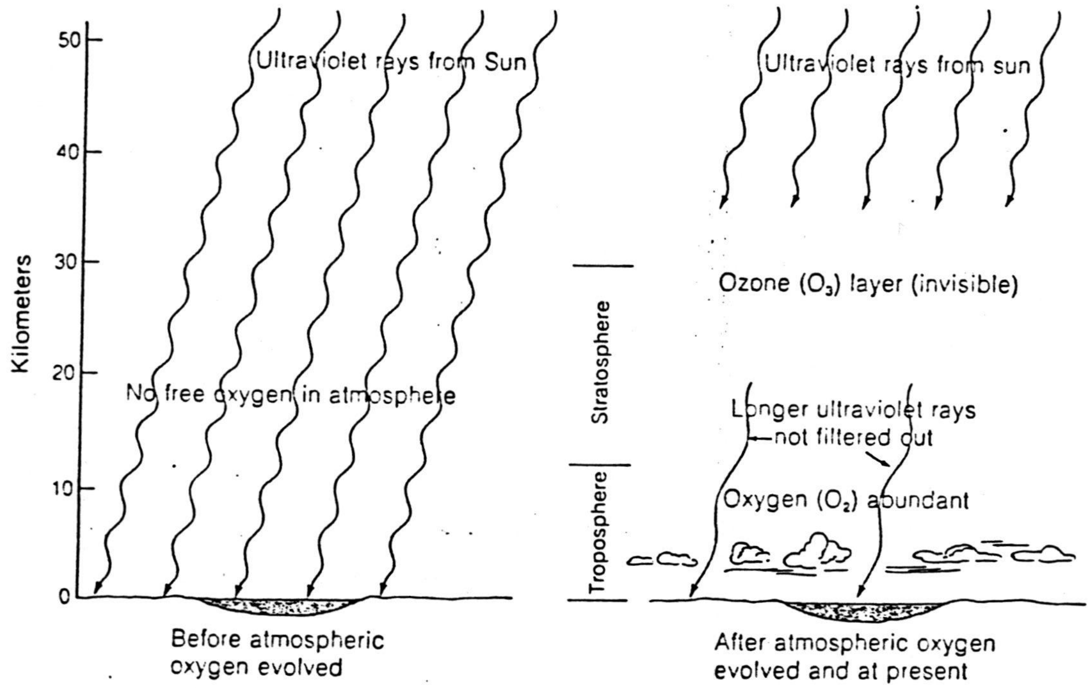


Fig. 1-2. Evolution of the ozone layer in the atmosphere.

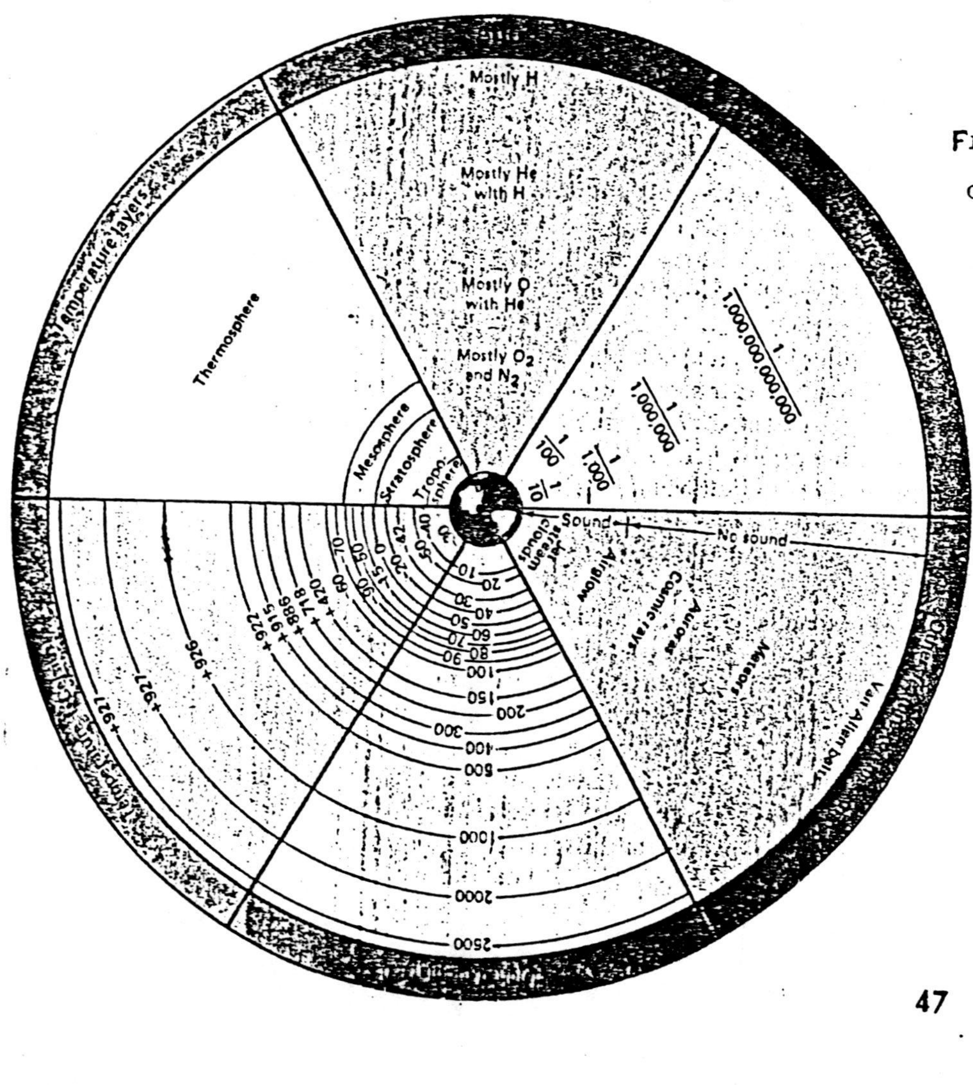


Fig.1-3. Layered structure of the atmosphere

The interaction of meteorological factors gives us climate, and the climate of any region influences our lives and our environment. (How does the climate of your region affect your life? Spend time thinking about this after you return.)

1.3. THE HYDROSPHERE - the envelope of water that surrounds the earth -- seas, oceans, lakes, rivers. Because we are and island, the seas and oceans that surround us and what happens in them have a major influence on our lives and our environment. The science of the oceans is called OCEANOGRAPHY, and it involves study of the geology, geography (Fig. 1-3), chemistry, physics (Fig.1-4) and biology of the oceans and the sea floors. (If you live on the coast, spend a little time after your return, thinking about how the sea influences your lives.)

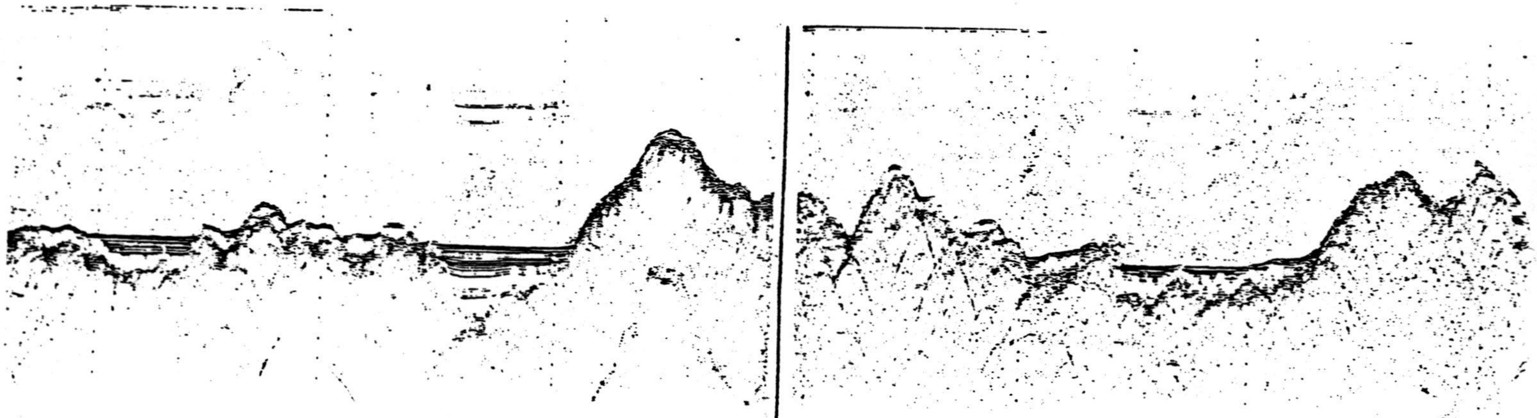


Fig. 1-4. Profile of Atlantic Ocean floor, from seismic soundings.

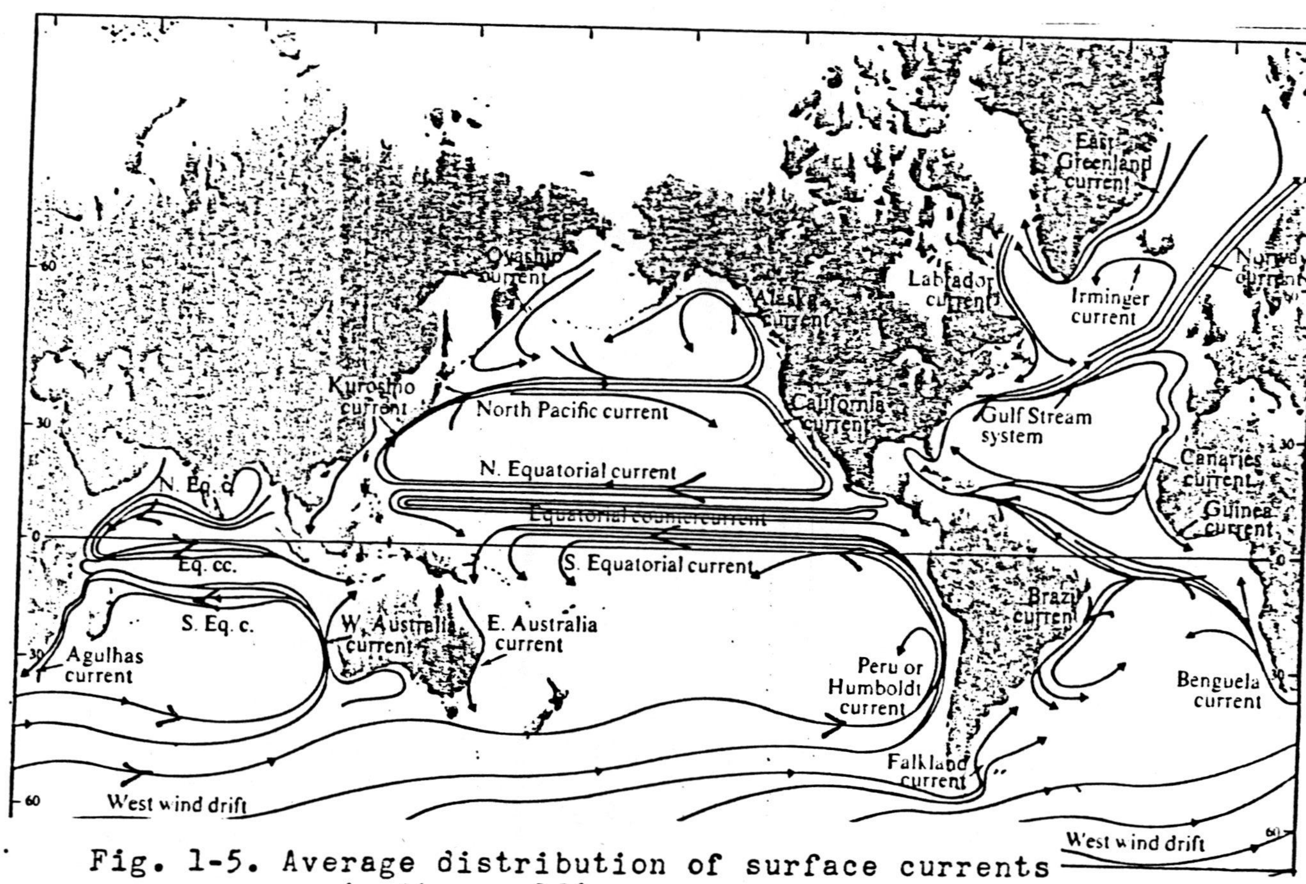


Fig. 1-5. Average distribution of surface currents in the world's oceans.

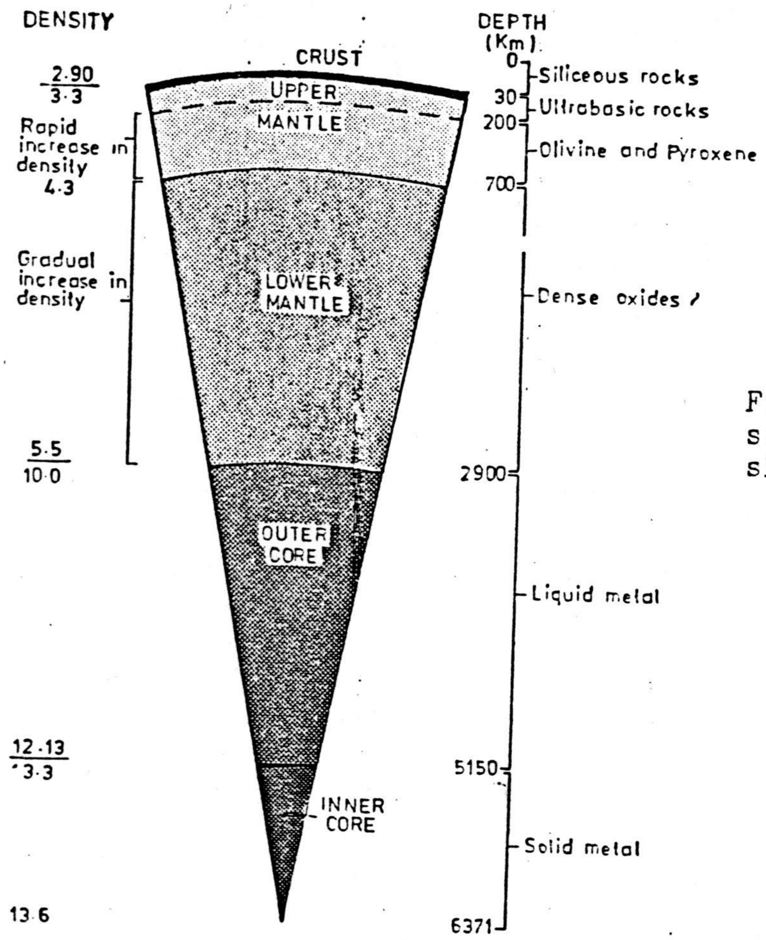


Fig. 1-6. Schematic section through earth showing layered structure.

1.4. THE LITHOSPHERE. This is the solid earth itself, made up of layers - - crust, mantle and core, each with different properties (Fig.1-5). We are mostly concerned with the crust, the uppermost few kilometers of the earth. GEOSCIENCE or GEOLOGY is the science of the rocks and minerals that make up the earth -- their composition, their origins, their occurrences, their uses, their weathering and their landforms.

1.5. PLATE TECTONICS. This is a new concept that gives us a unified explanation of many of the earth's features. In its simplest form, it says that the lithosphere is made up of 6 or 7 semi-rigid plates, 100-150 km thick, that are in constant motion relative to each other. Their boundaries are of three kinds - constructive, destructive and conservative - and it is along these boundaries that volcanoes, earthquakes and mountain building take place.

Constructive. Oceanic ridges, where new oceanic crust is being format. Floods of basalt are outpoured and move away from each other in "sea-floor spreading". This explains continental drift. At these margin we have volcanoes, shallow earthquakes and normal faulting.

Distructive. Continental margins and oceanic trenches where one plate descends below another in a Subduction Zone. Here we have island arcs, mountain belts (e.g. Andes), volcanoes, deep-focus earthquakes.

Plate may also collide giving rise to Mountain belts (e.g. Himalayas).

<u>Conservative</u>. Plates slip past each pther. Earthquakes common.

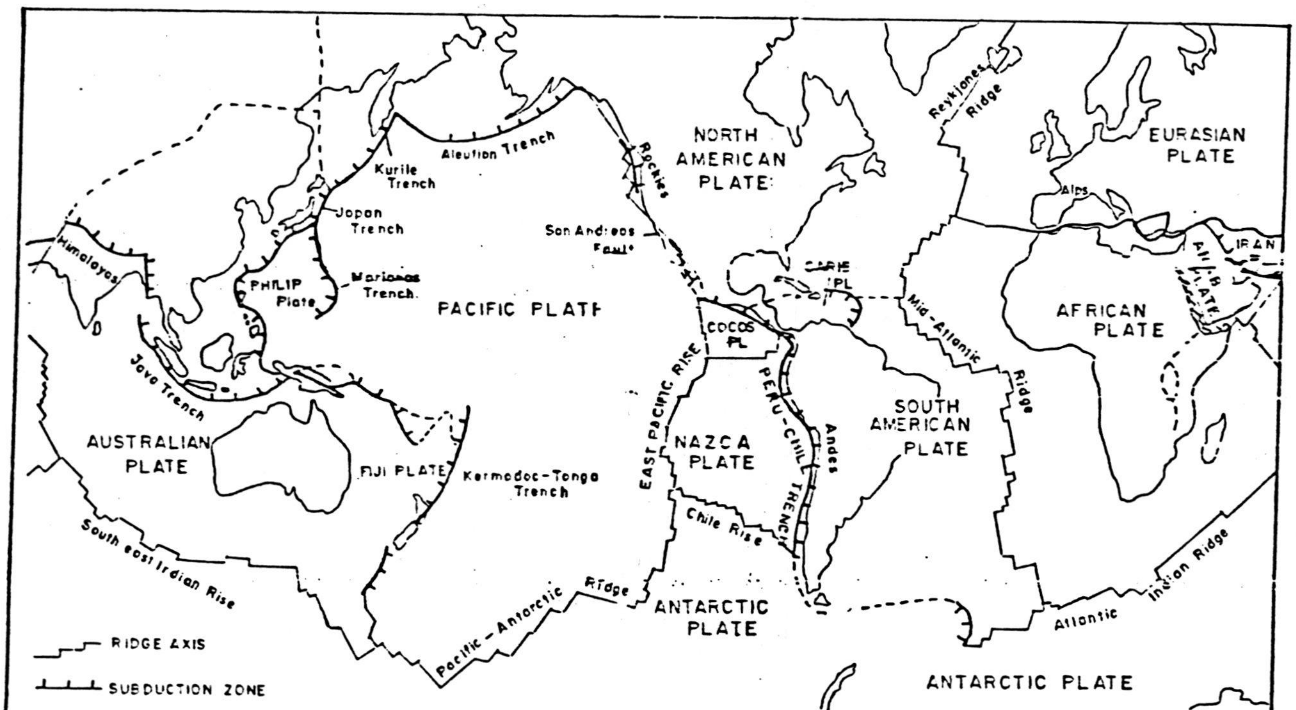


Fig.1-7. Map of the world showing boundaries of major lithospheric plates.

1.6 In a one-day course limited to a few hours, I can only give you a very broad and superficial introduction to a few aspects of Geoscience. In doing so, I have two objectives in mind:

A .- to help you to understand something of the environment in which you live, what it does for you, and how important it is that you look after that environment for your own sakes.
B - to arouse your interest in geology so that some of you will want to study the subject further, and perhaps take it up as a profession. Being a geologist is a great experience. It may not bring you wealth, but being essentially a field science, it will take you to many parts of the island that other people will never visit, and perhaps even to other parts of the world. And you will become a member of a global community that is unique and not found in any other science.

2. LANDFORMS

2.1. All of you come from different parts of the island, such as the lowlands, the hill country, the coastal regions the Dry Zone, the Wet Zone (Fig.2-1). Each of these areas is characterised by different landforms, or physical features. We look at some of these now.

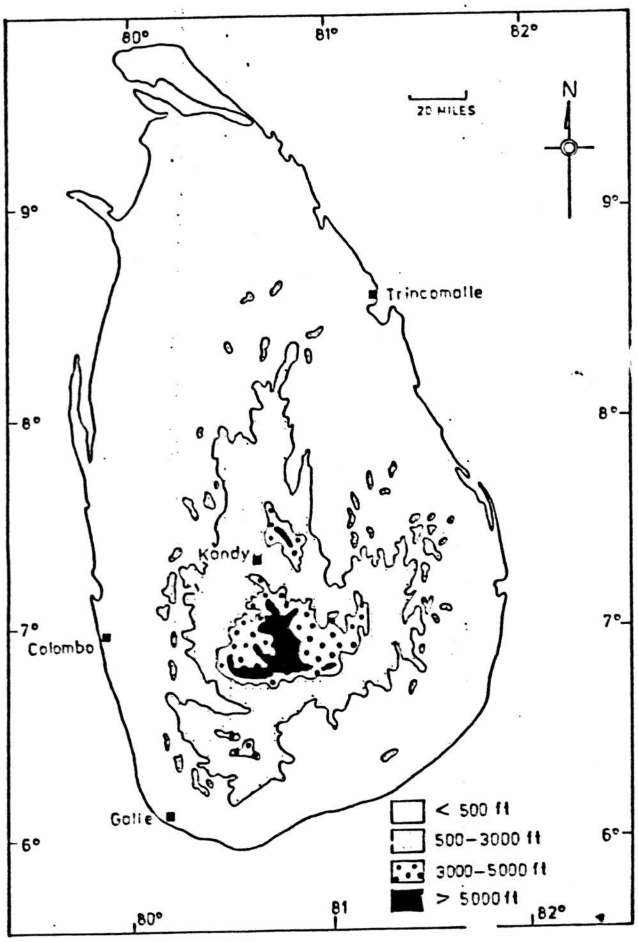


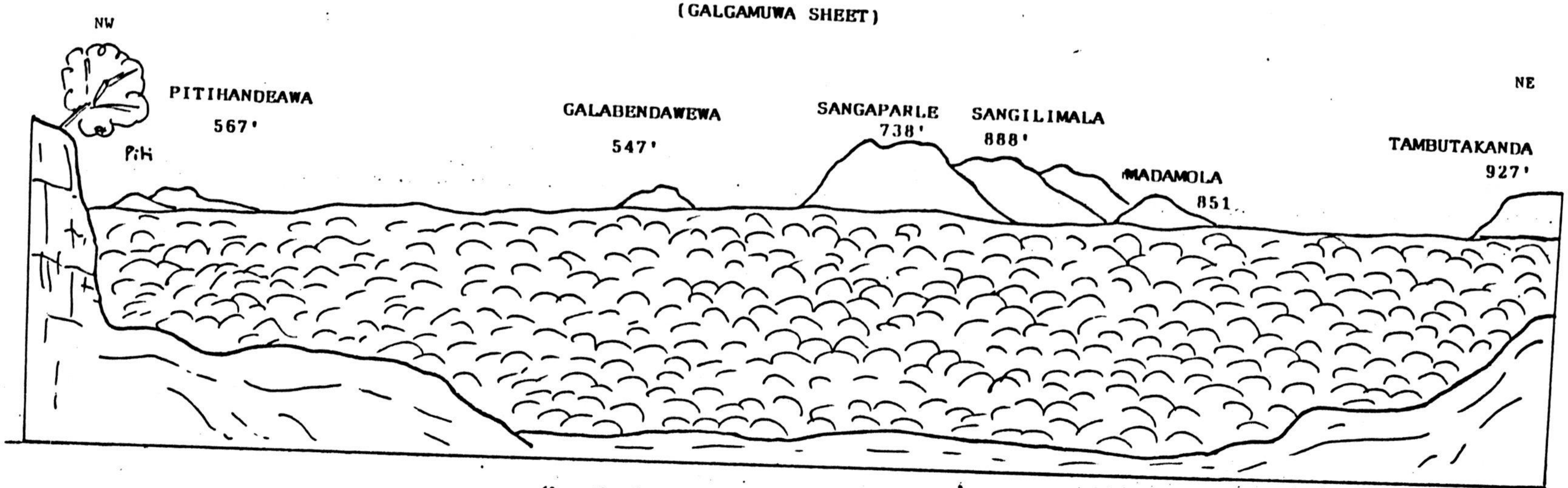
Fig. 2-1. Sketch map of relief of Sri Lanka.

2.2. Lowlands.

- wide, alluvial flood plains, e.g. Bentota Ganga.
- erosional, undulating plains of north and east (Fig.2-2).
- flat country of Jaffna region.
- inselbergs or erosion remnants (Fig.2-2), e.g. Sigiriya.

Fig. 2-2. EROSION LEVEL IN THE LOWEST PENEPLAIN, LOOKING NW FROM PANSALKANDE, IHALAGAMA

(GALGAMUWA SHEET)



(Length of section about 14 miles)

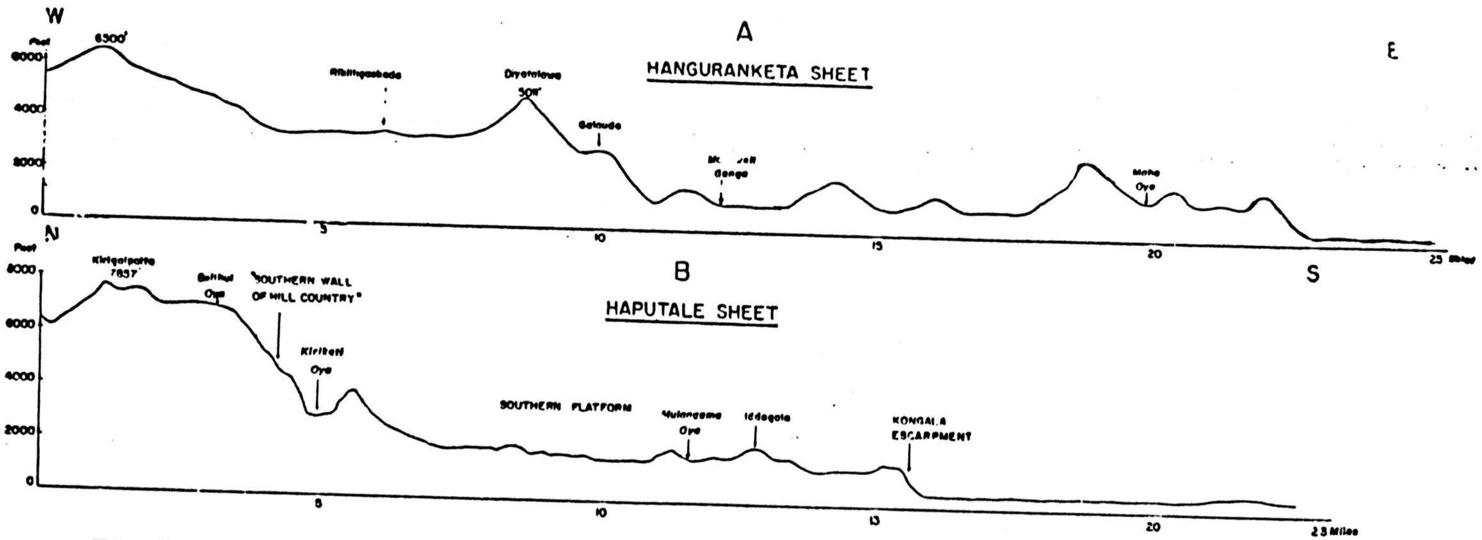


Fig.2 - 5

Cross-sections showing erosion levels.
A. Hanguranketa sheet. B. Haputale sheet.
(Vertical scale is 2½ times horizontal scale)

2.3. Hill Country - strike ridges and valleys (Fig.2-3)
- plateaus, e.g. Horton Plains, Hatton Plateau (Fig.2-4)
- escarpments e.g. Southern Wall of Hill Country (Fig.2-4,2-5)
- waterfalls, e.g. Devon, St. Clair, Ramboda
- mountains and scree slopes - Mt. Peacock

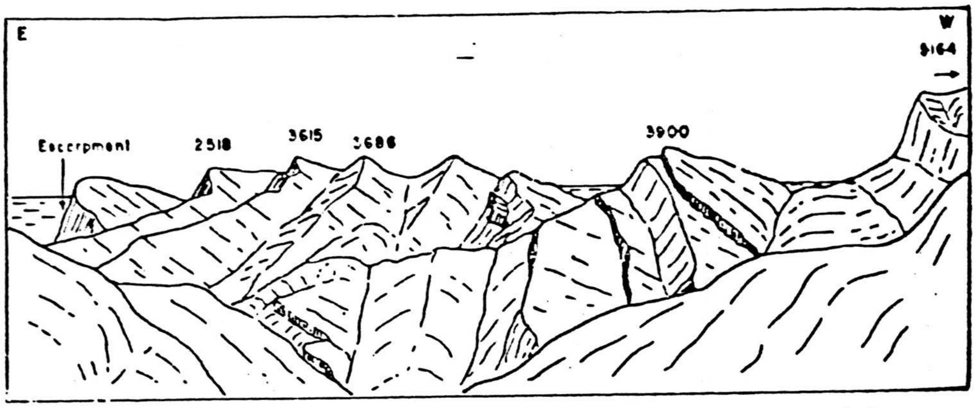


Fig. 2-3. Sketch of the erosion level above Weragantota, looking south-eastwards from near Hunnasgiriya; heights in feet.

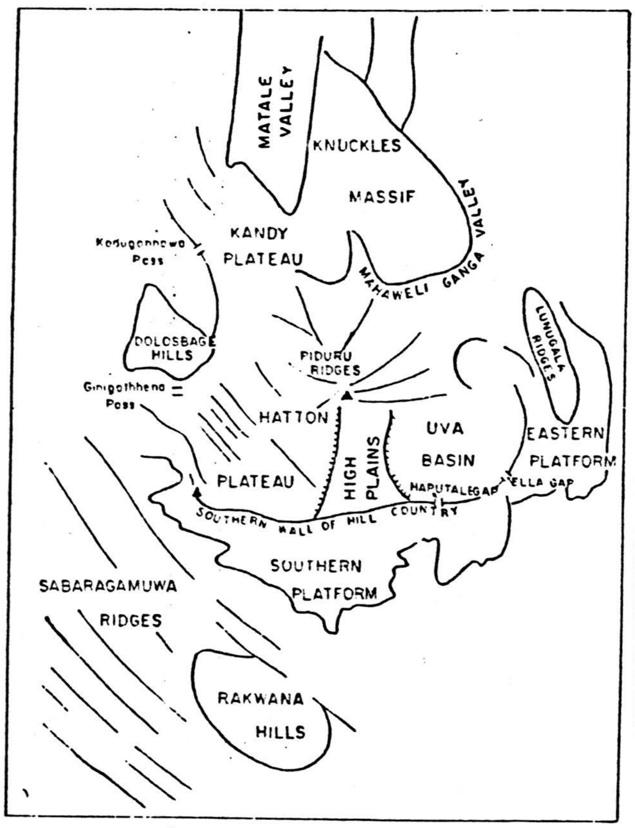


Fig. 2-4. Physiographic regions of the Hill Country,

2.4. Coastal regions - rocky headlands and intervening bays.
- cliffs.
- sand bars, sand spits and sand dunes (Fig. 2-6).
- lagoons and lagoonal flats (Fig.2-7)

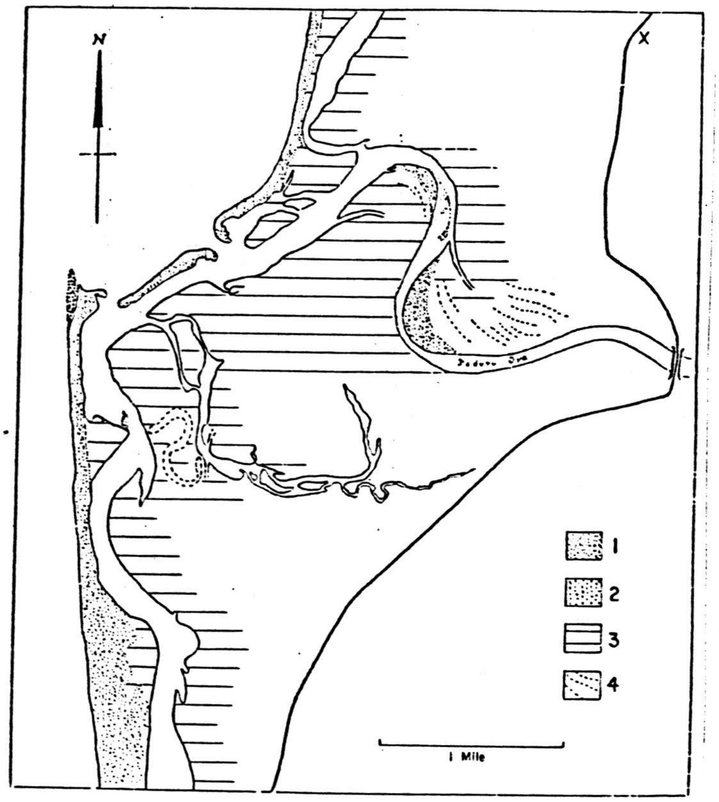


Fig.2-6 Sketch map of the mouth of the Deduru Oya showing changes in the course of the river, growth of barrier beaches and bars (see Pl. 24A), the beachrock reef, and old lagoonal beds. (*Drawn from an aerial photograph*)

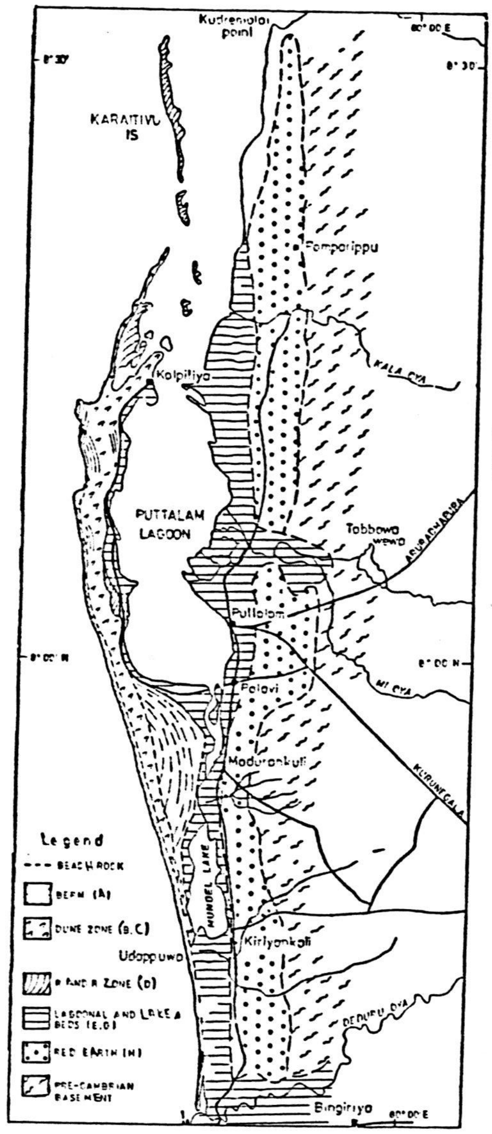


Fig. 2-7 Geomorphic zones, north-west coastal region of Sri Lanka.

2.5. All these different landforms are the result of many factors, such as situation, rock formations, climate and weatherings, winds, waves, currents. The evolution of landforms is an important branch of geoscience. If you understand why these landforms are found where they are, and how they came to be there, then you will appreciate better the beautiful scenery of this island of ours.

3. ROCKS

3.1. As you travelled to Kandy from your different homes, you would have come past many road and railway cuttings through solid rock or weathered rock ("kabook") or combinations of both. The lithosphere is made up of many different kinds of solid rocks which are classified into three groups, depending on their origin and composition. These classes are Igneous, Sedimentary and Metamorphic. All rocks are made up of minerals known as the rock-forming minerals, the main ones being quartz, feldspars, micas, amphiboles, pyroxenes and carbonates, and minor amounts of minerals like garnet and iron ores.

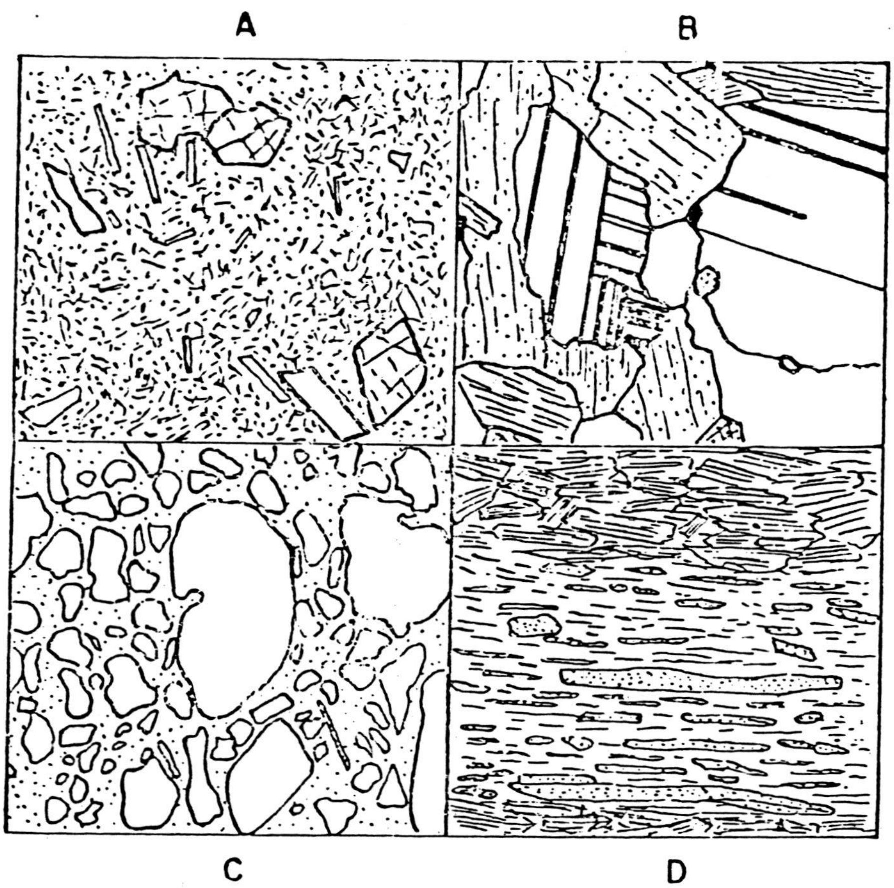


Fig. 3-1. Drawings of thin-sections of rocks seen under the microscope.
A — porphyritic texture in acid igneous rock, B — granite, C — sandstone, D — schist.

3.2. IGNEOUS ROCKS - crystalline rocks with interlooking minerals formed from magmas, which originate in the mantle (Fig.3-1). They are fine-grained to coarse-grained in texture and acid (>70% SiO_2) to basic (<55% SiO_2) in chemical composition.

Eruptive - those poured on earth's surface - volcanic lavas, basalt floods (Fig.3-2).
Intrusive - those that form sheets and large bodies within the earth's crust.

SRI LANKA - a few granites (Tonigala, Ambagaspitiya, Arangala)
- small bodies of serpentinite
- dolerite dykes ("kalubamma" at Gallodai)
- pegmatites, large and small

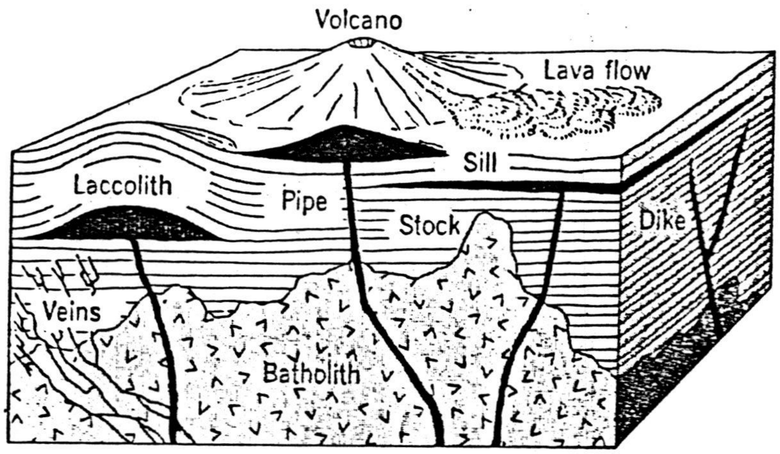


Fig. 3-2. Igneous rock bodies.

3.7. SEDIMENTARY ROCKS - both crystalline and non-crystalline. When rocks are exposed at the surface, they are acted on by heat and cold, wind and rain, snow and ice, and are subjected to weathering (Fig. 3-3). This means they are broken down into fragments and finally into the minerals of which they are formed or they are altered chemically (Fig.3-4).

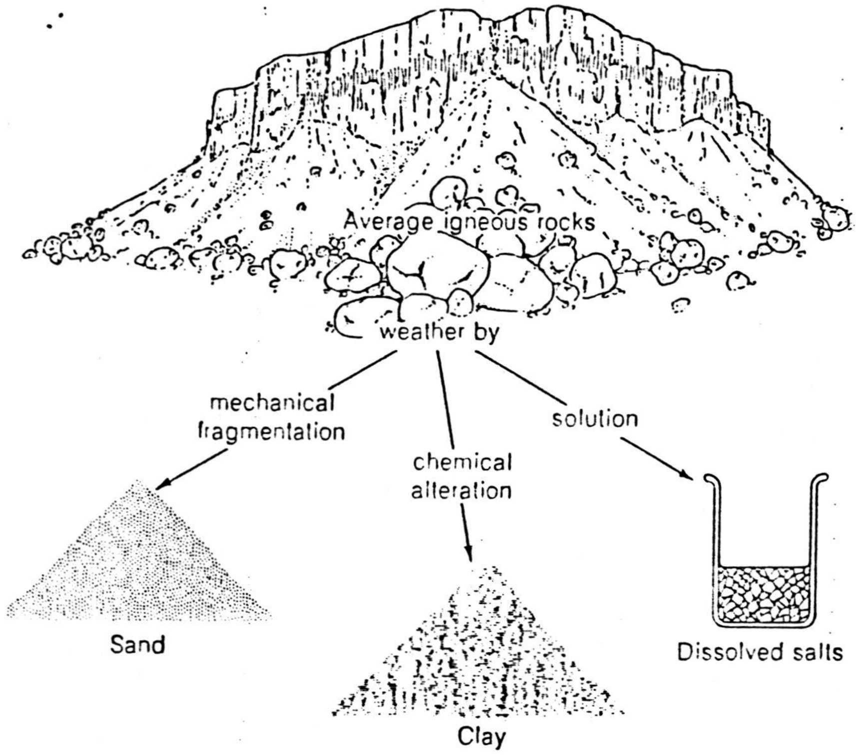


Fig. 3-3. Processes of weathering.

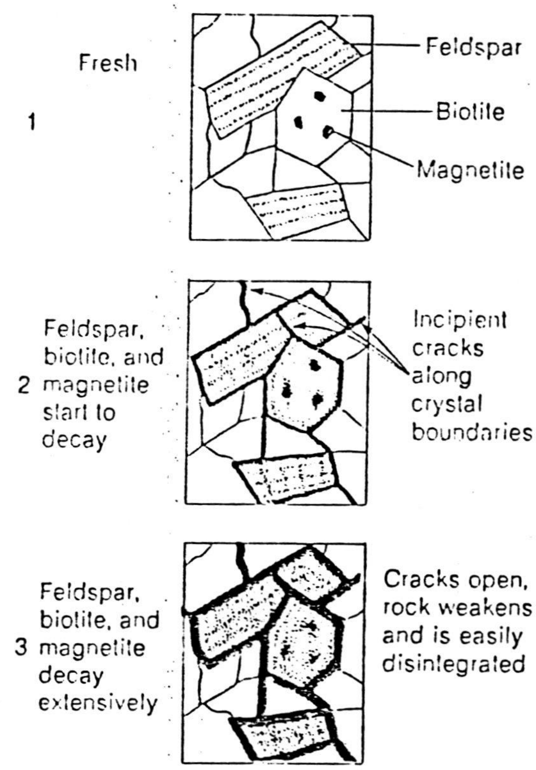


Fig. 3-4. Stages in the disintegration of granite.

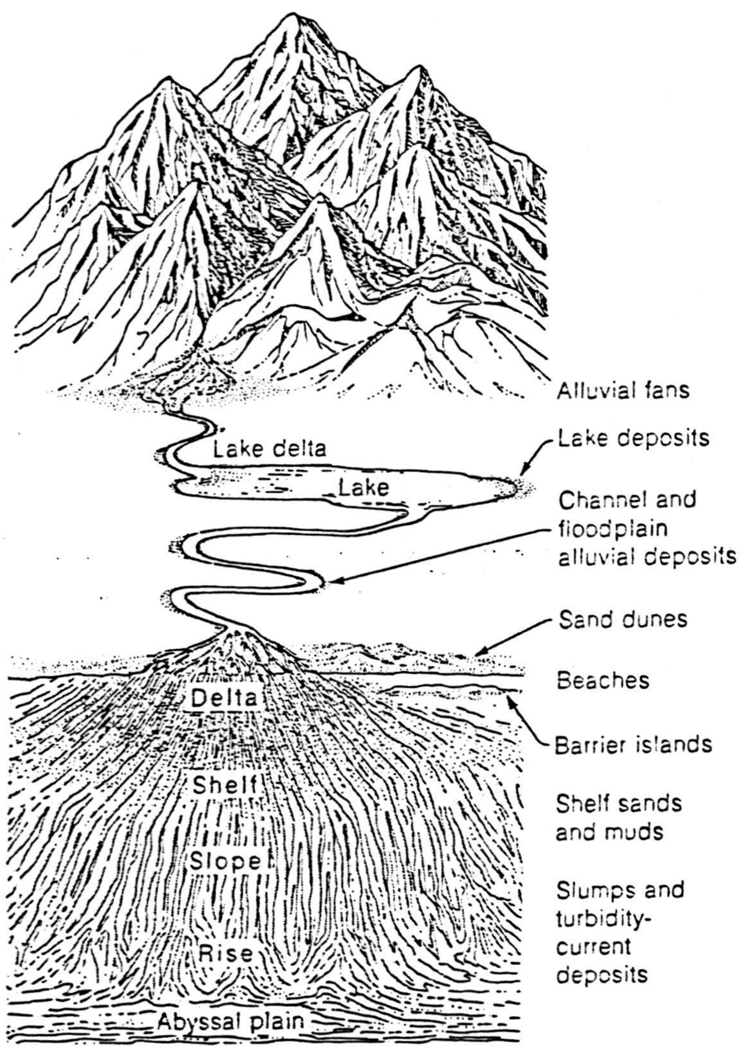


Fig. 3-5. Transportation and deposition of weathered material.

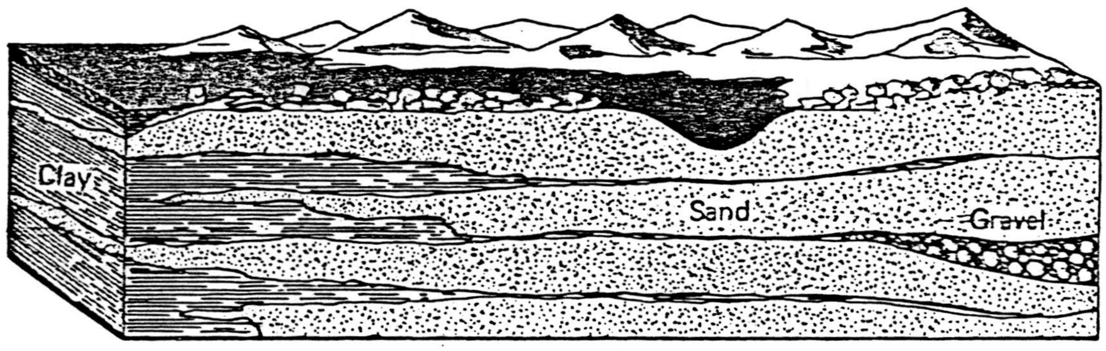


Fig. 3-6. Horizontal layers of sediments laid down on the sea floor.

The weathered materials -- mostly sand and clay, are carried down by gravity, running water and wind and deposited in lakes, lagoons, deltas, and flood plains on land and on the ocean floors as horizontal layers (Figs.3-5,3-6). Here they are burried under later sediments or carried down to depths where they are compacted into solid rocks such as sandstones, mudstones, shales. Limestones are a special class - made up of shell fragments or chemically precipitated.
Nearly all sedimentary rocks have parallel planes (called bedding) which seperate layers (called beds) of clay and sand and mixtures of the two.

SRI LANKA- Jaffna Limestone in the north and north-west
- Tabbowa Beds (150 m.y)
- Red Beds, gravels, sands and clays of the coastal areas. (2-3 m.y.) (Fig.3-7)

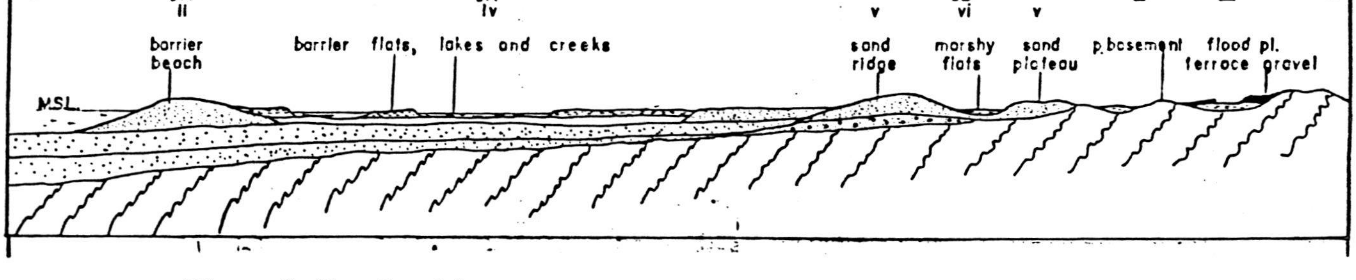


Fig. 3-7. Section across the N.W. coastal region of Sri Lanka.

3.4. METAMORPHIC ROCKS - crystalline rocks with interlooking minerals. Sedimentary and igneous rocks, when they become burried under hundreds and thousands of overlying rocks, are subject to great heat and pressures. This causes changes in the mineral composition and arrangement of minerals - called recrystallisation -- giving rise to metamorphic rocks. The commonest metamorphic rocks are slates, schists, gneisses and granulites. All these, except the last group, have the common property of their minerals being arranged in parallel fashion - gives rise to textures called schistosity or gneissosity (see Fig.3-1).

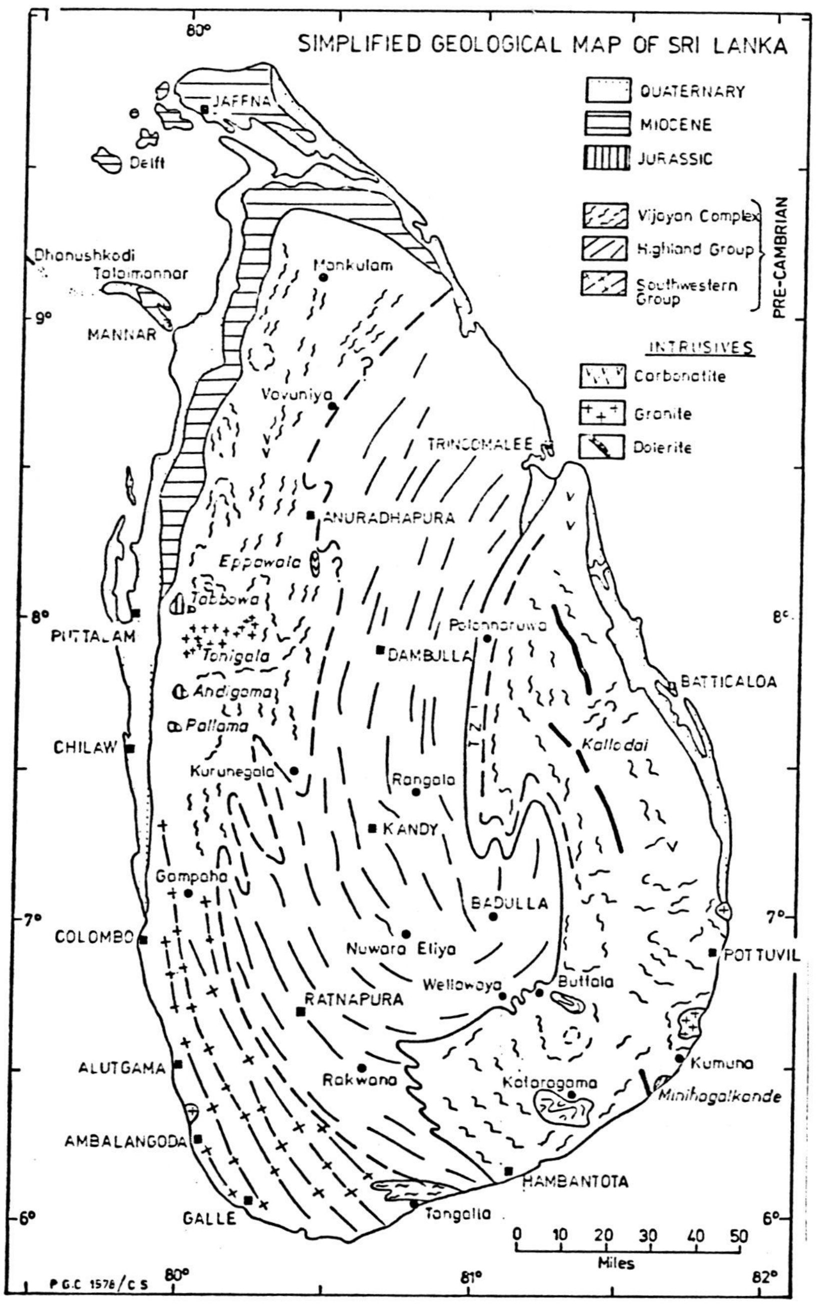


Fig. 3-8. Simplified geological map of Sri Lanka.

3.5. SRI LANKA - about four-fifths of the island is made up of metamorphic rocks which have been formed at high temperatures (600^0-800^0C) and high pressures (6-7 atmospheres) (Fig.3-8). They are also very old, most being more than 1000 million years old.
The commonest types are:
Quartzite and quartz schist - Trinco, Polonnaruwa
Marble - Talatu Oya, Digana, Matale
Garnetiferous quartz-feldspar gneisses - very common
Charnockitic gneisses - dark greyish rocks ("kalu gal"), also very common
Basic granulites and amphibolites - scattered, Kadugannawa
Granitic and migmatic gneisses - in most of the Dry Zone.

4. STRUCTURES OF ROCKS

4.1. The beddings planes of sedimentary rocks are generally horizontal, but when subjected to pressures, these layers and planes are bent into waves known as FOLDS. When metamorphic rocks are at depths of several kilometers, e.g. 10 or more, they are in a ductile state, and their stresses are also relieved by formation of folds which may be anticlines or synclines. Types of folds -- open, tight, upright, overturned, recumbent (Fig.4-1).

4.2. When rocks come nearer the surface, they become brittle, and stresses are then relieved by FAULTS, or surfaces along which movement has taken place.
Types of faults - normal, reversed, strike-slip, thrusts (Fig.4-2).

4.2. When rocks cool, then stresses are relieved by the formation of JOINTS or sets of partings (Fig.4-3). Joints may vertical, horizontal or inclined and generally occur in parallel 'sets'. Joints are important because they provide passages for the movement of fluids such as water and ore-bearing fluids, and weathering takes place along joints.

4.4. Rock structures are important for many reasons. For example, mineral concentrations such as oil and gas, are found at the crests of anticlines. Fault lead to the displacement of rock layers, so if one is following an ore-bearing layer or a layer of coal, its continuation on the other side of a fault depends on the kind of fault it is. Understanding folds and faults is essential when preparing the geological map of an area, as for example, when a dam is to be built as the presence of faults near a dam site raises many problems of engineering geology. Jointed rocks after suffer from landslides and rockfalls, causing blockage of roads and destruction of land, houses and lives.

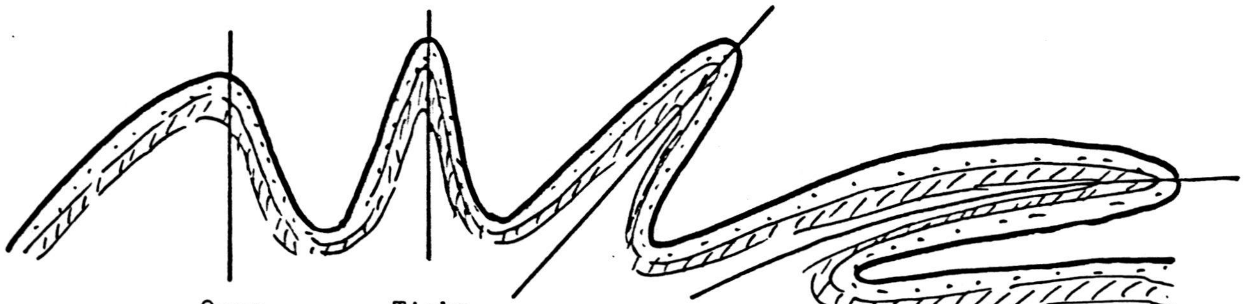


Fig. 4-1. Types of Folds

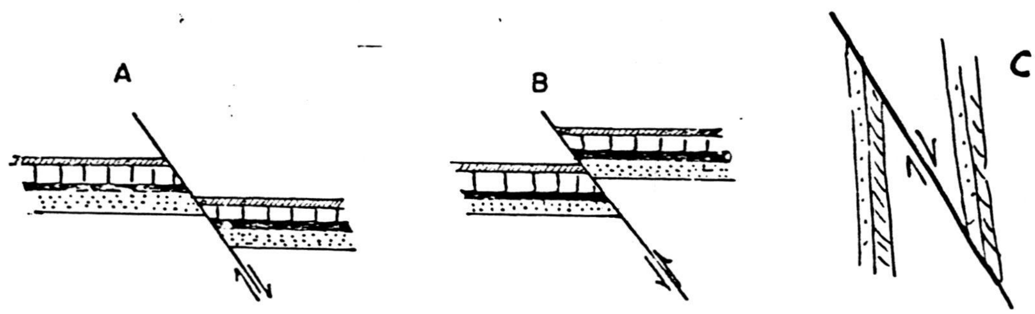


Fig.4-2. Types of Faults. A - Normal, B - Reversed, C - Strike-slip

Fig.4-3A. Columnar joints in basalt.

Fig.4-3B. Vertical joints

5. ROCK WEATHERING

5.1. Weathering of rocks has many important effects such as
- release of economic minerals of crystalline rocks (gemstones, heavy minerals)
- landscape sculpture
- soils and soil profile.

5.2. Soils result from the interaction of climate and rocks.

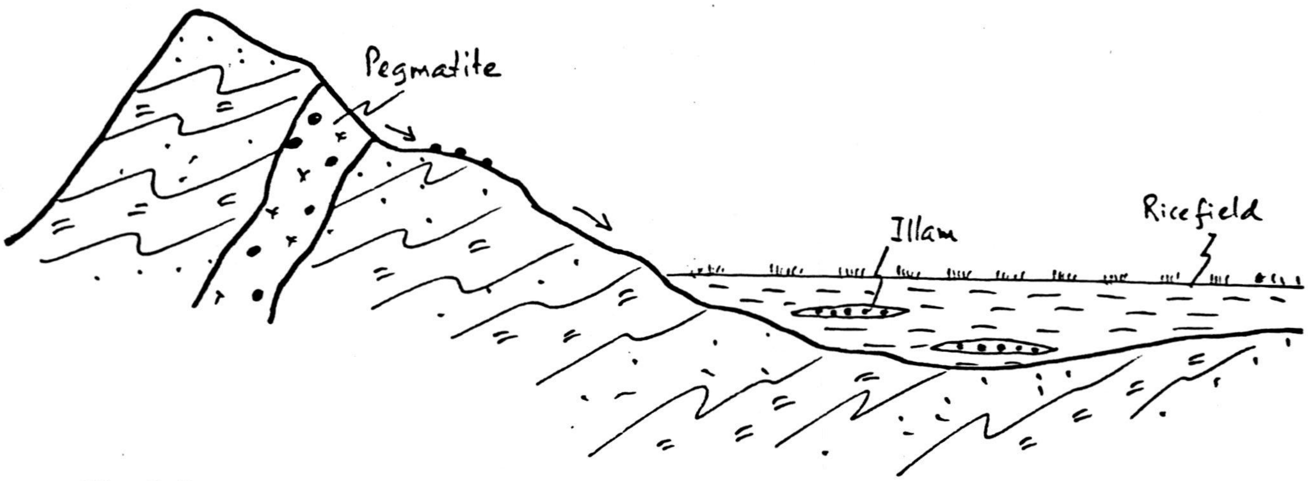
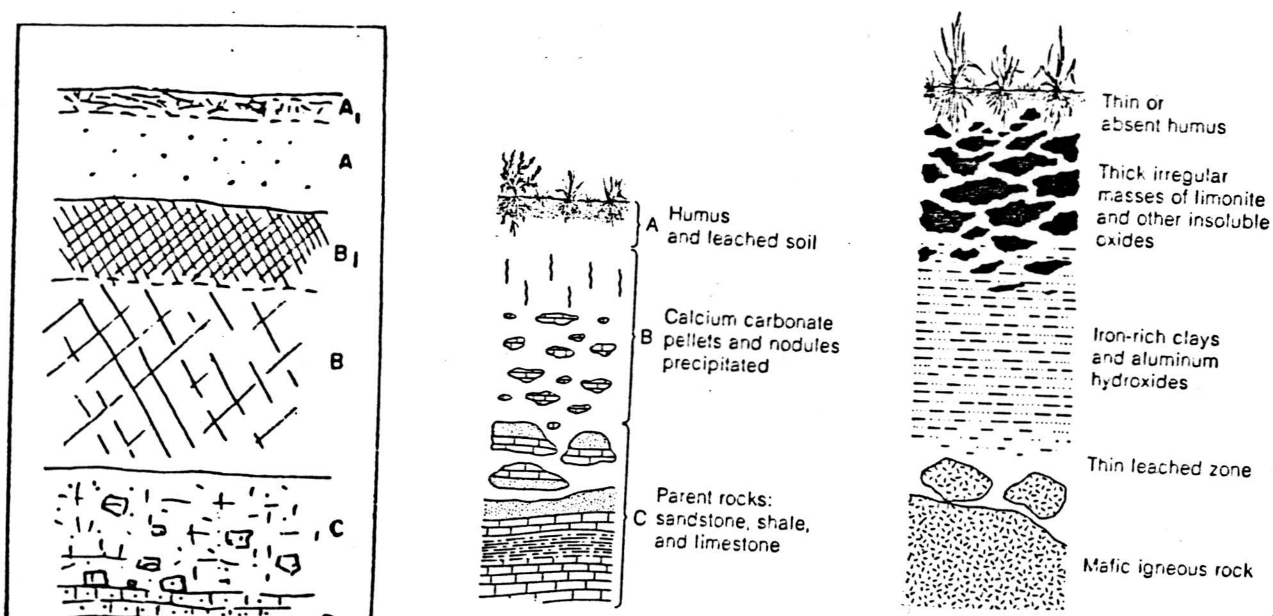


Fig.5-1. Generalized Section showing origin and occurrence of gemstones



a. Diagrammatic sketch of the soil profile (*Modified from A. Holmes, 1965.*)

A. Zone of leaching, covered by layer of humus (A_1).

B. Zone of accumulation, especially of iron and aluminium; location of *hardpans* and of *kankar* in B_1.

C. Decomposed bedrock, parent material of soil.

D. Fresh bedrock.

b. Pedocal soil developed in a region of low rainfall on sedimentary bedrock. The A-zone is leached; the B-zone is enriched in calcium carbonate precipitated by evaporating soil waters.

c. Laterite soil profile developed on a mafic igneous rock in a tropical region. In the upper zone, only the most insoluble precipitated iron and similar oxides remain, plus occasional quartz. All soluble materials, even including relatively insoluble silica, are leached; thus the whole soil profile may be considered to be an A-zone directly overlying a C-zone.

Fig. 5-2. Types of soil profile.

5.3. The Soils of Sri Lanka

Fourteen Great Soil Groups have been recognised in Sri Lanka (1), and the interplay of various soil-forming factors can be seen to some extent in their distribution (Fig. 14 — 2). It is clear that the major factor influencing soil formation is climate, parent material being generally a subordinate factor; the boundaries of the major soil groups follow closely the main rainfall

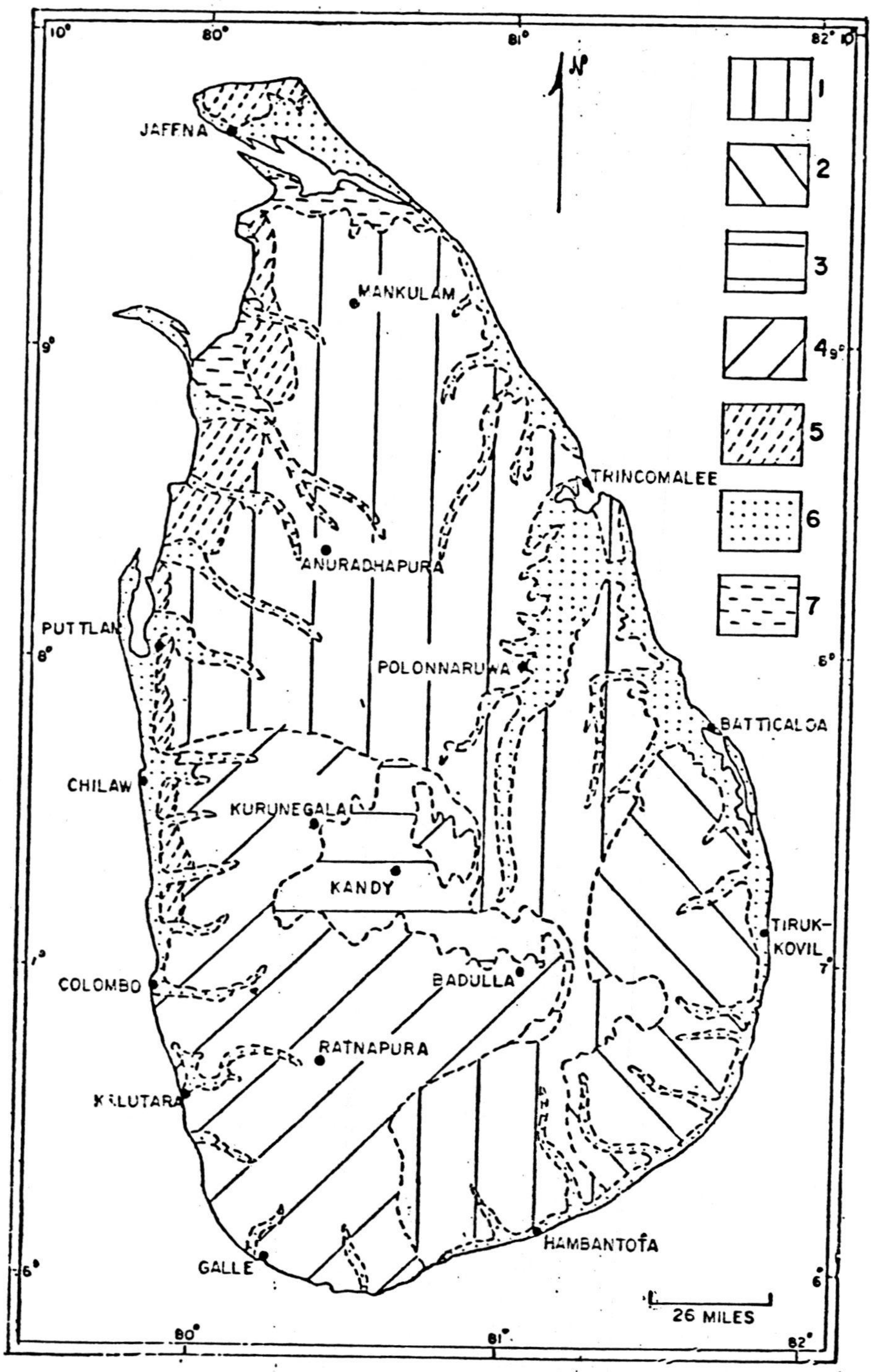


Fig. 14 — 2. Simplified map of the Great Soil Groups of Sri Lanka

(*Modified from F. R. Moorman and C. R. Panabokke*, 1961)

(1) Reddish Brown Earths, (2) Non-calcic Brown Soils, (3) Reddish-brown Lateritic Soils, (4) Red Yellow Podzolic Soils, (5) Red Yellow Latosols, (6) Regosols and alluvial soils, (7) Solodised solonetz and solonchaks.

divisions in the island. The soils in the Dry Zone, for example, are distinctly different from those in the Wet Zone, even when developed on the same type of parent material such as charnockitic gneiss. The influence of the other factors cannot be so easily recognised, except by a trained observer, but there are appreciable differences between soils on a stable landscape and an unstable one, or between soils on the crests of a ridge and those at the bottom of the slope.

Of the fourteen Great Soil Groups found in Sri Lanka, only the following eight need be considered here:

(1) Reddish Brown Earths
(2) Non-Calcic Brown Soils
(3) Red Yellow Podzolic Soils
(4) Red Yellow Latosols
(5) Reddish Brown Lateritic Soils
(6) Regosols
(7) Alluvial Soils
(8) Solodized Solonetz

1. *Reddish Brown Earths.* This is one of the Great Soil Groups of the semi-humid tropics and is best developed in the Dry Zone where the annual rainfall is less than 75 inches. Although these soils are developed on a variety of parent rock materials, such rocks must have a sufficiency of the ferromagnesian minerals mica, hornblende, pyroxene, or garnet. The Reddish Brown Earths are best developed over the lowest peneplain, that is, in most of the Northern, North Central, Eastern, and Southern Provinces, where biotite/- and hornblende-bearing gneisses of the Vijayan Complex are present, but they also develop on Highland Series rocks in the area between Polonnaruwa and Trincomalee which lies in the Dry Zone. The commonest vegetation on these soils is dry mixed evergreen forest.

2. *Non-Calcic Brown Soils.* These soils develop within the same areas as the Reddish Brown Earths but only where there is a deficiency of ferromagnesian minerals in the parent rock. They are specially prominent in the Eastern Province, on the highly acid, quartz-rich gneisses with little biotite and hornblende that are common in the area.

3. *Reddish Brown Lateritic Soils.* Within the Central Hill Country, where the rainfall is over 100 inches annually, is a region where the rainfall is between 75 and 100 inches per year. This is the Kandy Plateau, physiographically made up of sharply rolling country which appears to have been recently uplifted. As a result of this uplift there has been rapid erosion and dissection of the land, both processes having resulted in the removal of the earlier formed soil; insufficient time has elapsed since then for the development of new, mature soils. The Reddish Brown Lateritic Soils found within the Kandy Plateau contain remnants of the early mature soils and side by side with them are reddish brown loams which are full of weathereable minerals, a sign of their comparative youthfulness.

4. *Red Yellow Podzolic Soils.* These soils are predominant in the Wet Zone, that is, in the Hill Country and the south-west region of the island, where the annual rainfall is over 110 inches. Metasediments and charnockitic gneisses of the Highland Group are the main rock types. Rainfall is the overriding factor in the formation of the Red Yellow Podzolic soils; they develop equally on a variety of crystalline schists and gneisses, quartzites, and marbles.

5. *Red Yellow Latosols.* The Red Yellow Latosols are found within a belt which runs along the north-west of the island, a few miles inland from the coast. This belt stretches from Puttalam to Poonery̆n and parts of the Jaffna Peninsula are also included within it. The occurrence of the Latosols corresponds roughly with the distribution of the Older Quaternary formations, namely, the Red Earth and the ferruginous gravels (see p. 139). The soils are bright red in colour and appear to have developed under previously existing climatic conditions different from those of the present. They are called 'old' or 'relic' soils which have been preserved from erosion by the relative stability of the existing landscape. The parent material of these soils are of sedimentary origin (either wind-borne or river deposits) and have undergone previous cycles of weathering: the soils are thus poor in weatherable minerals but rich in quartz.

6. *Regosols.* Regosols are soils which are so young that a recognisable soil profile has hardly had time to develop. Such soils are found extensively on the unconsolidated sands and sand dunes found round the coasts. Included in this group are the shallow, stony or gravelly soils present on rock outcrops; they are sometimes known as *lithosols.*

7. *Alluvial Soils.* A variety of soils found in the river valleys and flood plains of the island fall within this group. The development of soil profiles in alluvial material is not strong, largely because there is constant addition of new layers of alluvium to those recently laid down. Alluvial soils are younger than all other soils except the regosols.

8. *Solodized Solonetz.* These soils occur along the sea coast in the Dry Zone and on the more clayey parts of tidal flats and estuaries. They are characterised by the presence of salts in the parent material. The typical vegetation on such soils is grass or halomorphic plants; bare patches are common.

6. MINERAL RESOURCES

6.1. We mentioned earlier one group of minerals, the rock-forming minerals. The other important group is the economic minerals; classed as

- metals
- energy minerals
- industrial rocks and minerals.

Metals are the minerals of iron, copper, lead, zinc, tin etc. They occur in different forms and originate in different ways - some sedimentary (iron ores), some igneous (copper), some metamorphic.

Energy Minerals are peat, coal, oil, radioactive minerals. Peat and coal are sedimentary formations, formed from organic materials. Oil is also derived from organic materials. Radioactive minerals are uranium, thorium, which are of igneous origin.

Industrial rocks and minerals are a very large group and include sands, clays, limestones, beach sands, gemstones, graphite, mica, and fertilizer minerals.

6.2. SRI LANKA - We have iron ores at Panirendawa and Seruwila - both are found at depth, are structurally complex, and not in large enough quantities to be mined. Copper is also found at Seruwila. No oil or coal have been found so far, but we have a peat deposit at Muthurajawela, north of Colombo. We have radioactive minerals such as thorianite, monazite and zircon, but these are not being used at present for energy production.

6.3. Sri Lanka is rich in industrial rocks and minerals, and we are making good use of many of them.

Clays - bricks, tiles, crockery, porcelainware.
Sands - glassware, building.
Limestone - cement, building lime.
Beach sands - ilmenite, monazite, zircon, rutile.
Marbles - building lime, ornamental, fertilizer.
Apatite - fertilizer.
Graphite, Mica, Gemstones.
Crystalline rock - building and ornamental stone, road metal.
Jaffna Limestone, 'kabook' - building stone.

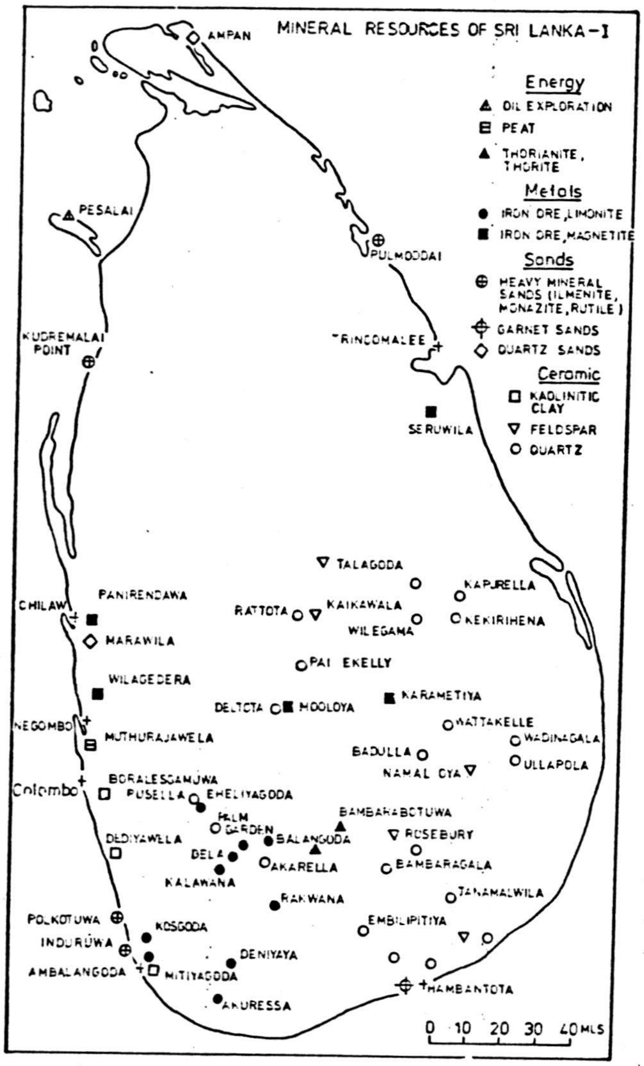


Fig. 6-1. Map of Mineral Resources of Sri Lanka: I — Energy Minerals, Metals, Mineral Sands, Ceramic Materials.

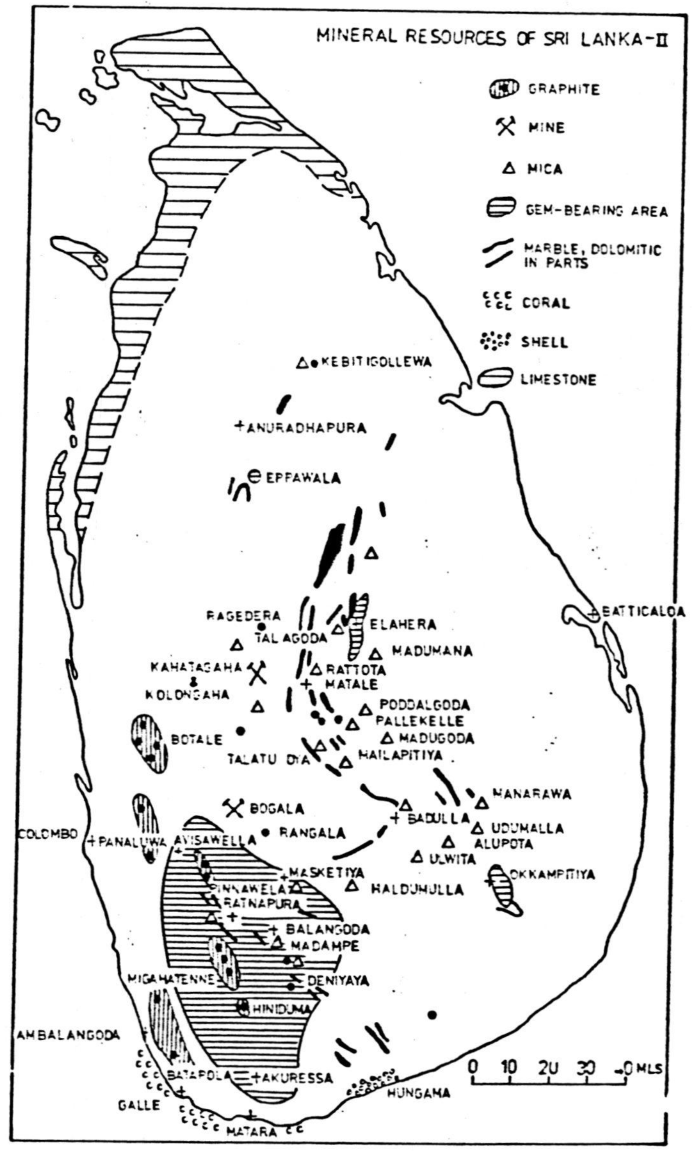


Fig. 6-2. Map of Mineral Resources of Sri Lanka: II — Construction Materials, Fertilizer Minerals, Graphite, Mica, Gemstones.

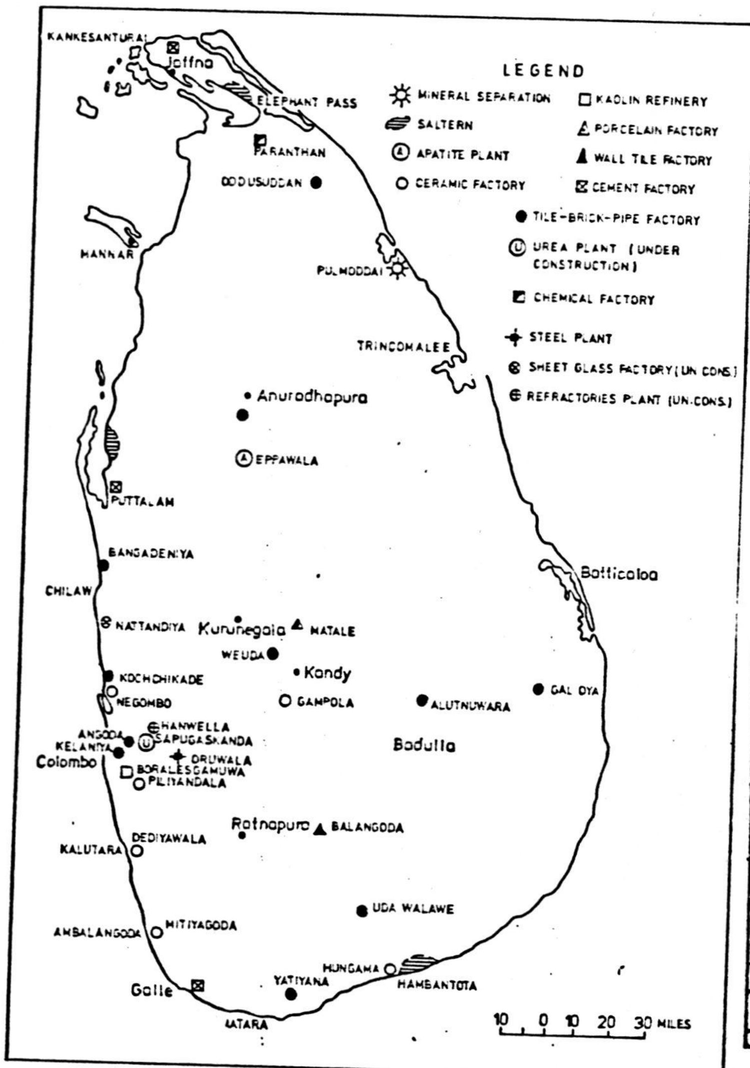


Fig. 6-3 Locations of factories using local mineral raw materials. (*After Herath*, 1977).

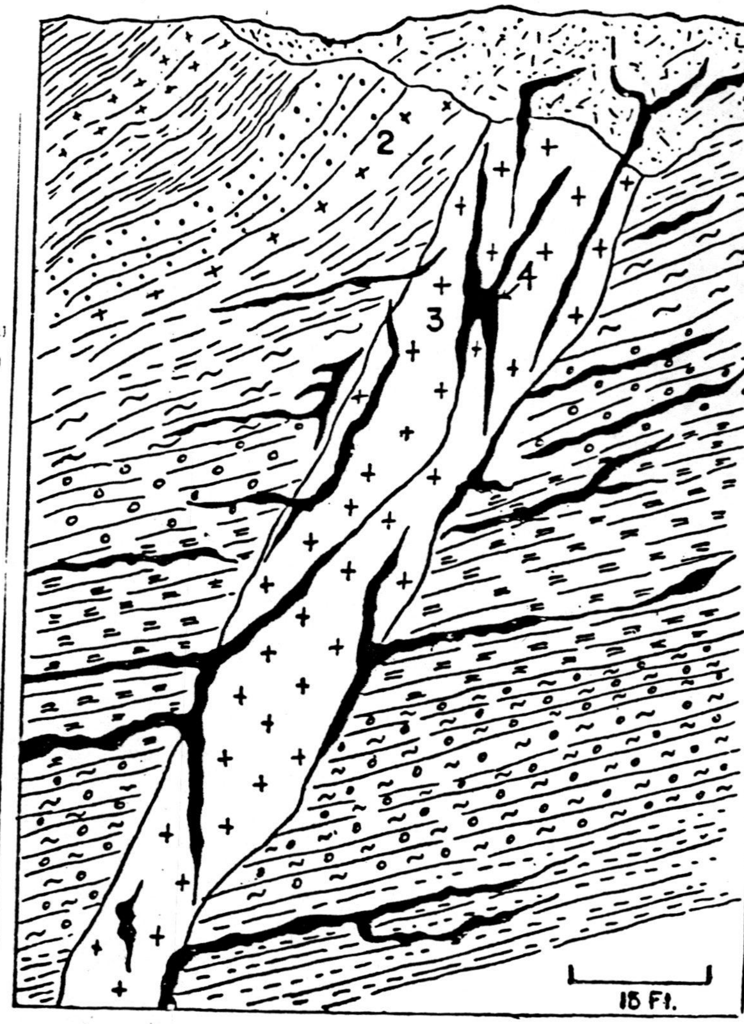


Fig. 6-4. Sketch section showing common types of graphite veins in Sri Lanka. (*D. N. Wadia*, 1945)

(1) laterite, (2) country rock, (3) pegmatite dyke, (4) graphite veins.

7. GROUNDWATER

7.1. Groundwater is also a mineral but of a special kind. It is essential for life, and the search for water, especially groundwater, and its exploitation, are a major human activity.

Wet Zone -- groundwater appears in the form of springs.
Dry Zone -- springs in some places, but mostly it has to be located below the surface. In recent years, the location of groundwater resources using different tools has led to an extensive tube-well drilling programme which has been of great benefit to people living in the Dry Zone of Sri Lanka.

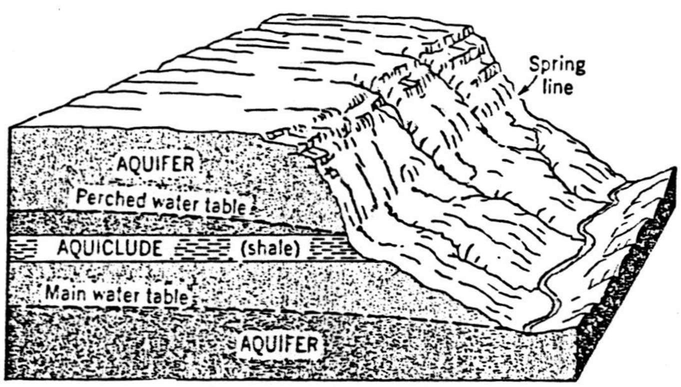


Fig. 7-1.A perched water table.

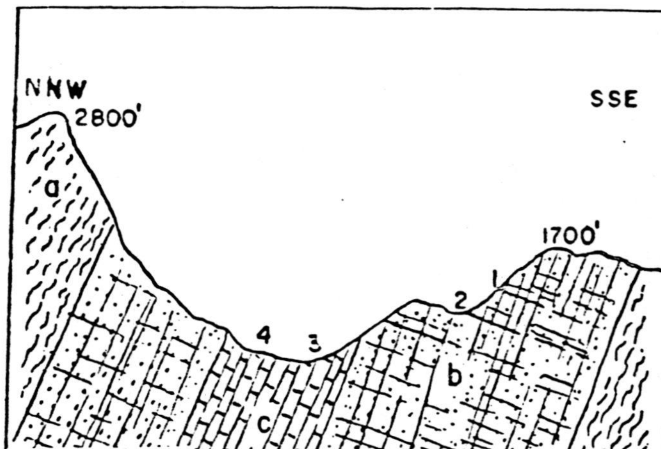


Fig. 7-2. Section across the Matale Valley between Wiltshire Estate (2800') and Bandarapola Estate (1700') showing positions of springs in bands of quartzites (*b*) and marble (*c*). Note absence of springs in gneiss (*a*). Yields of springs: (*1*) 50,000 gallons per day, (*2*) and (*3*) 100,000 g.p.d., (*4*) 30,000 g.p.d (*After D. B. Pattiaratchi*, 1956)

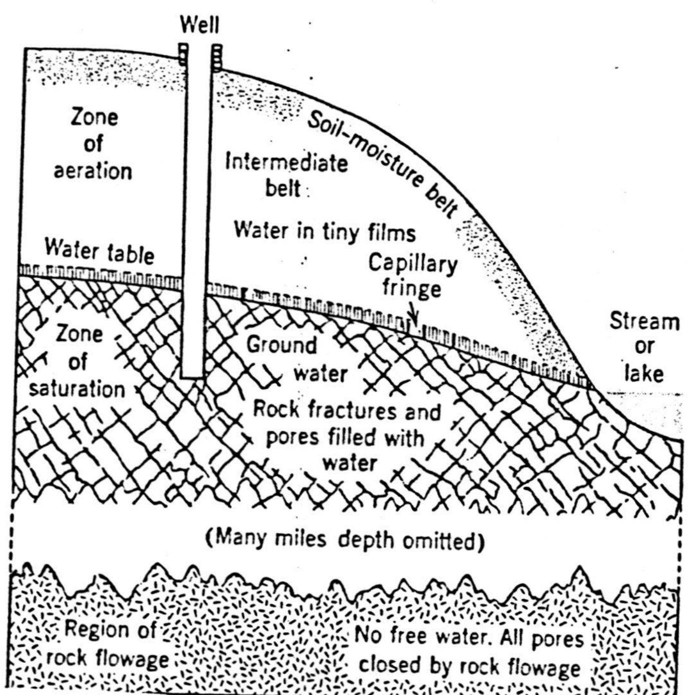


Fig. 7-3. Schematic diagram of zones of subsurface water. (After Ackerman, Colman, and Ogrosky.)

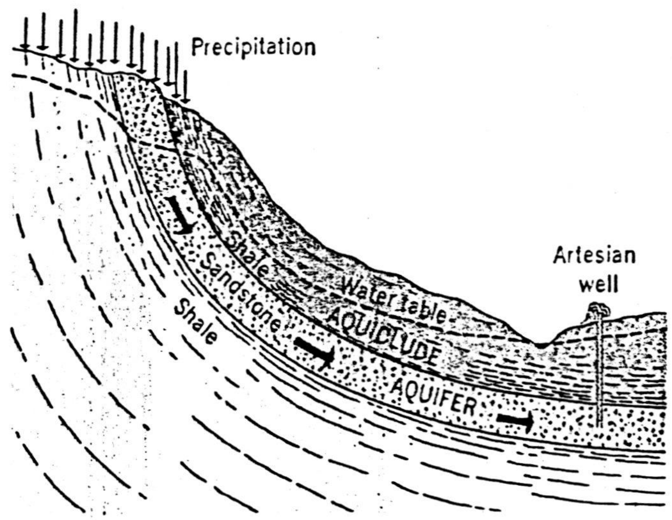


Fig. 7-4. Geological conditions for artesian flow.

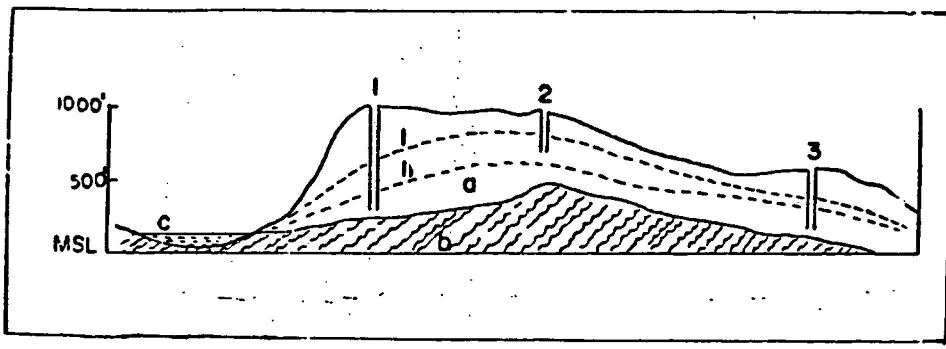


Fig. 7-5. Groundwater conditions in typical laterite at Ragama. (*C. H. L. Sirimanne*, 1952)
(*a*) laterite, (*b*) gneiss, (*c*) alluvium, (I) wet-weather water-table, (II) dry-weather water table;
(1) and (3) permanent wells, (2) seasonal well, runs dry in dry weather.
Length of section about 2 miles.

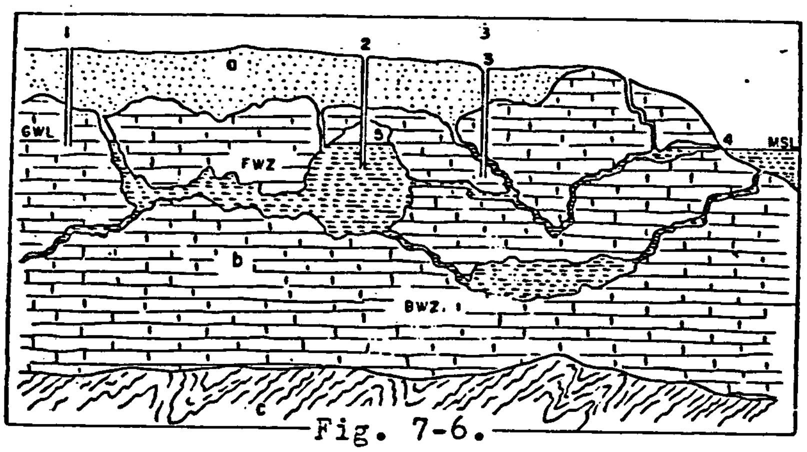


Fig. 7-6.

Groundwater conditions in the Jaffna Peninsula. (*After C. H. L. Sirimanne*, 1952)
(*a*) Red Earth, (*b*) Jaffna Limestone, (*c*) granitic gneiss, (MSL) mean sea level, (GWL) ground water level, (FWZ) zone of fresh-water saturation, (BWZ) probable zone of brackish water; (1) dry well, (2) well of Puttur type, (3) ordinary successful well, (4) spring of Keerimalai type, (5) solution cavern.

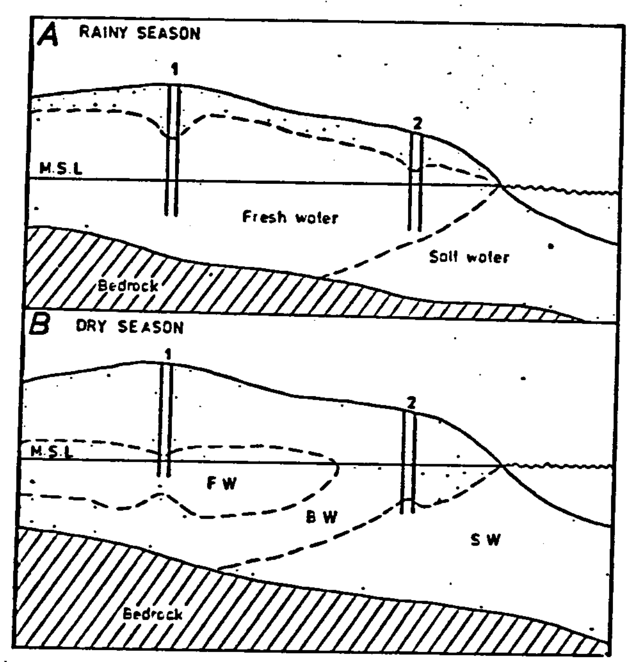


Fig. 7-7. Groundwater conditions in coastal sands.
1, fresh water well; 2, brackish water well; BW, brackish water zone.

7.2. However, groundwater is easily polluted by the infiltration of human, animal and industrial waste; that is why about 65% of the rural population of the island suffers from bowel diseases -- by drinking contaminated water from wells.

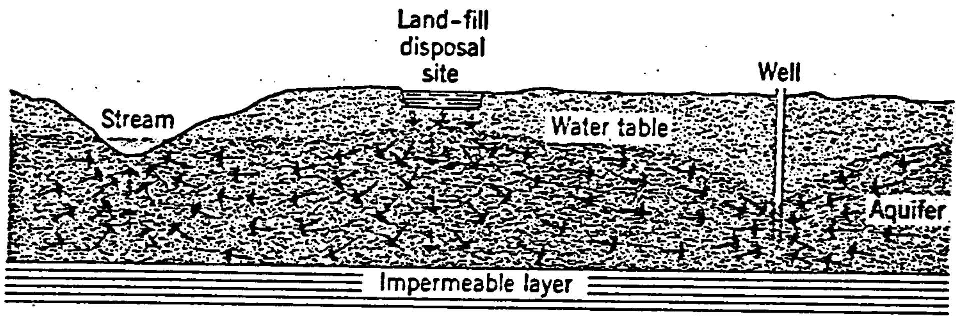


Fig.7-8. Contamination of stream and well from waste disposal site

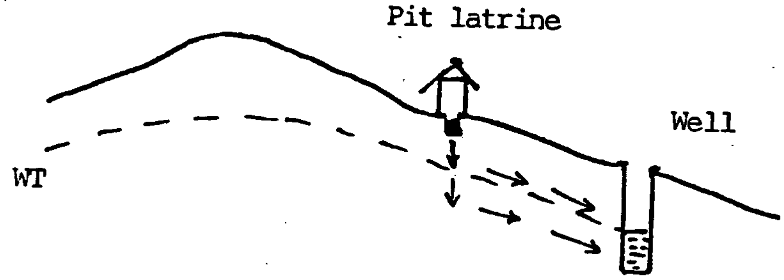


Fig.7-9. Contamination of well water from an up-slope pit latrine.

8. ENVIRONMENTAL CARE AND PROTECTION

8.1. We have seen that geoscience teaches us about the earth around us -- of the environment in which we live. It is up to us to see that this environment is protected and well looked after, because it provides us with our living conditions and our livelihood. If we use our environment badly, then we can destroy it, and ultimately we will be the losers. But if we look after it, protect it from misuse and destruction by others, and use it sensibly and carefully, then it will continue to provide us and those who come after us with the necessities for living.

8.2. Misuse of the environment

- cutting down of the forests - reduction of rainfall - drying up of springs, rivers, streams - lowering of water levels in reservoirs and loss of electric power (Fig.8-1).

- overcultivation and destruction of vegetation cover e.g. Nuwara Eliya area - soil erosion and loss of fertile top soil. Silting up of lakes and reservoirs (Fig.8-2).

- cultivation of steep slopes, inadequate drainage, absence of terracing of slopes -- landslides (Fig.8-3).

- excessive use of chemical fertilisers, insecticides, pesticides -- increase of nitrates in the soil, damage to health.

8.3. In recent years, many new branches of geoscience have developed. These are mainly in the application of geoscience to community life and to the environment.

- <u>agrogeology</u> or the search for rocks and minerals that can be applied directly to soils to improve fertility.
- <u>medical geology</u> - study of the relationships between soils and water chemistry and diseases.
- <u>urban geology</u> - the problems associated with large populations living in restricted areas, leading to over-extraction of groundwater, elimination of fertile agricultural lands for building, waste disposal, sources of water for domestic use.

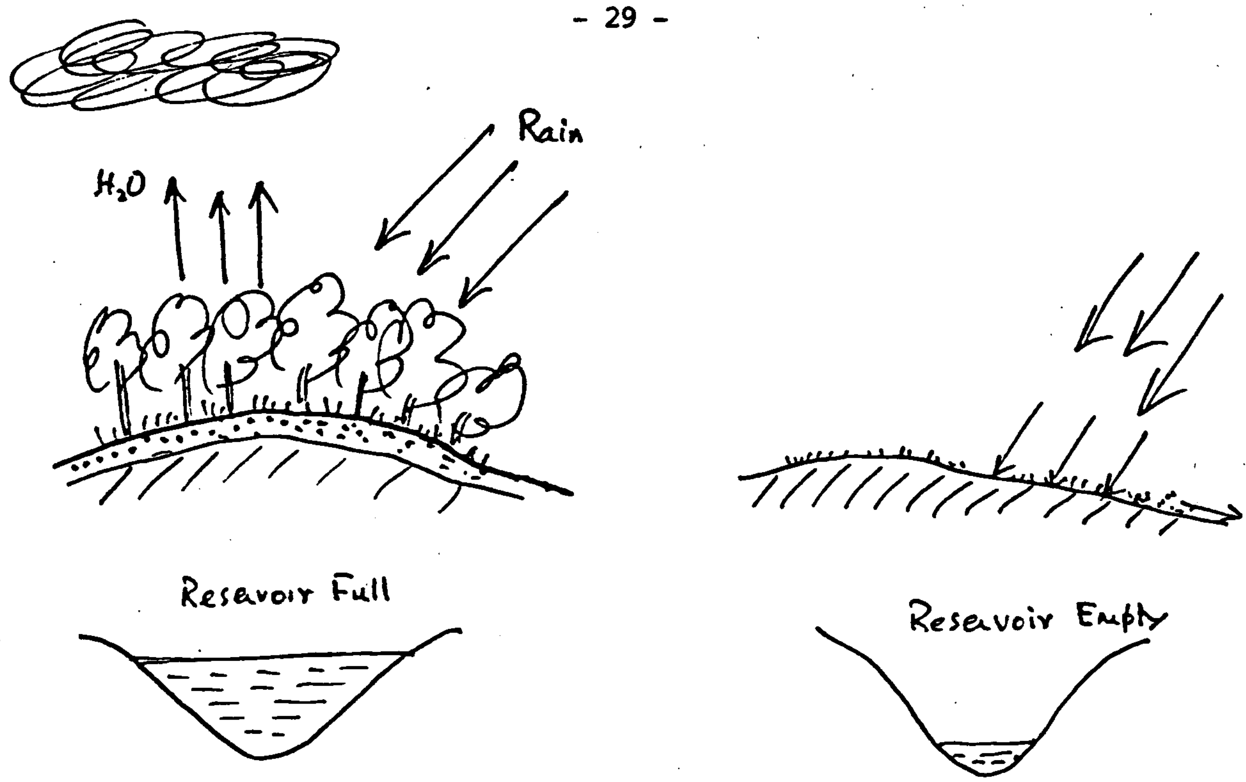


Fig.8-1. Results of deforestation

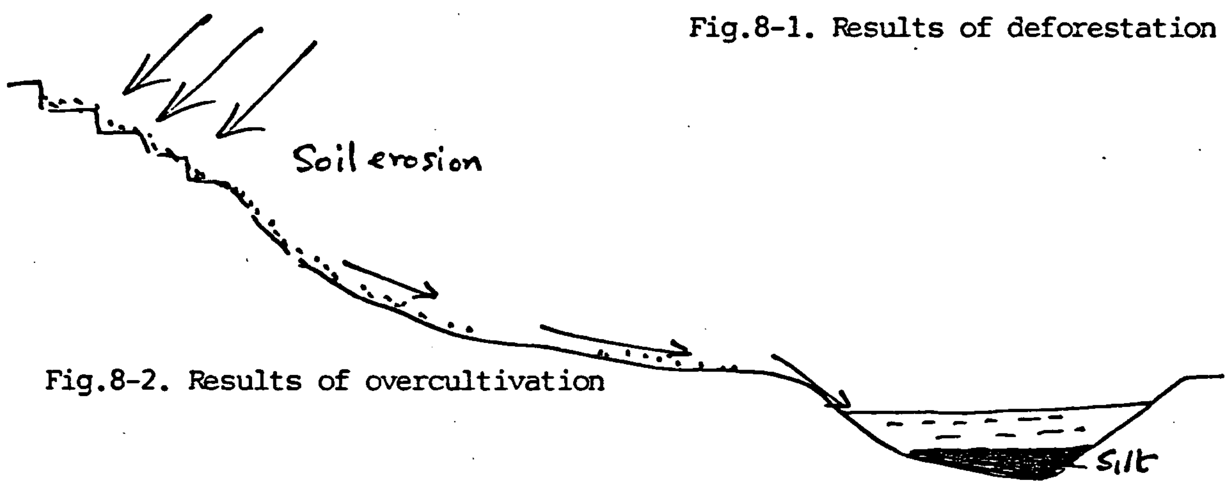


Fig.8-2. Results of overcultivation

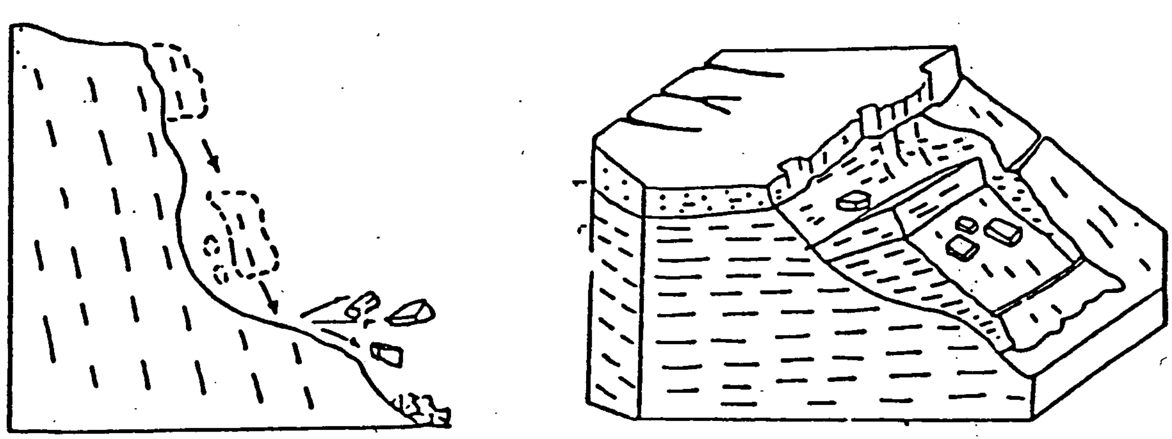


Fig.8-3. Types of Landslides

9. SUMMARY

9.1. Geoscience (or geology) teaches us about the earth and the resources it provides us with.

9.2. It teaches us about the landforms, the rocks and the mineral resources that surround us.

9.3. It teaches us about the soils beneath us which we cultivate.

9.4. It teaches us that we should make better use of these resources and take better care of our environment if we wish to survive.

9.5. These are the traditional branches of geoscientific activity but there are many new branches in the exciting world of geoscience. They are calling out to be studied, and we should be involved in these branches, professionally, for the development of our country.

P.G. Cooray
April 1989