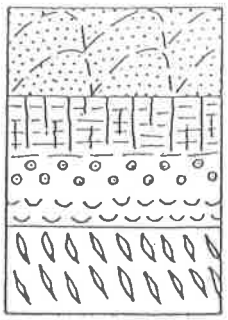
Table of Geological Formations and Statement of Earth History

Eras	Systems and Series	Maximum thickness of strata, ft	Approximate ages of base of System or Series
Caenozoic (*Recent Life*) The Age of Mammals, including Man in Quaternary, and of Flowering Plants	Quaternary	4,000	
	Recent		25,000
	Pleistocene or glacial		1,000,000
	Tertiary	63,000	70,000,000
	Pliocene		
	Miocene	Rise of Alpine Chain	
	Oligocene		
	Eocene		
	Palaeocene		
Mesozoic (*Intermediate Life*) The Age of Giant Reptiles and of primitive Conifers (Cycads)	Cretaceous	64,000	135,000,000
	Jurassic	20,000	180,000,000
	Triassic	25,000	225,000,000
	New Red Sandstone (Britain)	13,000	270,000,000
	Permian	Rise of Hercynian Chain	
Palaeozoic (*Ancient Life*) The Age of Extinct Races of Fishes, Amphibians and Early Invertebrates, and of Spore-bearing Plants	Carboniferous	40,000	350,000,000
	Coal Measures		
	Millstone Grit		
	Carboniferous limestone		
	Devonian or Old Red Sandstone	37,000	400,000,000
		Rise of Caledonian Chain	
	Silurian	15,000	440,000,000
	Ordovician	40,000	1,500,000,000
	Cambrian	40,000	1,600,000,000
Pre-Cambrian Eras	The probable age of the earth is about 4,500,000,000 years, but the oldest rocks found at the earth's surface are dated around 3,500,000,000. The pre-Cambrian is split into (*a*) relatively unaltered formations with primitive fossils (algae, spores, etc.) with strata in continuity with the Cambrian and known as the Riphean (in Russia), Sinian (in China) and Beltian (in America); (*b*) still older rocks known as Proterozoic, which are generally, but by no means invariably, younger than (*c*) highly-metamorphosed rocks referred to as Archaean. The oldest rocks containing any vestige of primitive life (calcareous algae) are Proterozoic formations in Southern Rhodesia dated at about 2,600,000		3,500,000,000



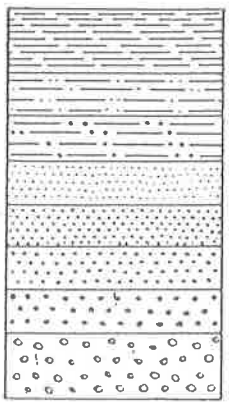
BLOWN SAND, FORMING DUNES TYPICALLY VERY FINE SAND WITH SPHERICAL GRAINS

PEAT AND OTHER ORGANICALLY-FORMED DEPOSITS,

E.G. DIATOMITE (SILICEOUS),

SHELL-SAND (CALCAREOUS).

TALUS: ROCK FRAGMENTS MOVED BY GRAVITY. TYPICALLY COLLECTS ALONG BASE OF A STEEP ROCK SLOPE AS "TALUS SLOPE"



CLAY: LESS THAN 0·01

SILT 0·01-0·05

COARSE SILT 0·05-0·1

FINE SAND 0·1-0·25

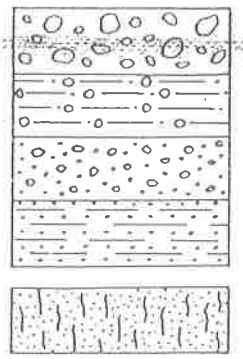
MEDIUM SAND 0·25-0·5

COARSE SAND 0·5-1·0

VERY COARSE SAND 1·0-2·0

GRAVEL: GREATER THAN 2·0

} ALLUVIAL DEPOSITS OF RIVERS, LAKES, SEA. DIAMETER OF GRAINS IN M M



TOUGH CLAY WITH STONES (BOULDER CLAY)

UNSORTED SILT, SAND AND BOULDERS (MORAINE)

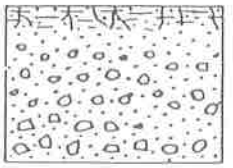
SAND AND GRAVEL, IN MOUNDS AND RIDGES

LAMINATED CLAYS OF LAKES AND ESTUARIES

LOESS, VERY FINE, BLOWN SILT AND CLAY

} GLACIAL, FLUVIO-GLACIAL AND WIND-BORNE DEPOSITS

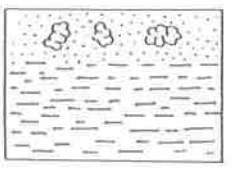
SOILS OF THE AGRICULTURIST



TOP SOIL, WITH HUMUS

SUB-SOIL, DERIVED FROM VIRGIN MATERIAL BY WEATHERING, EITHER ROCK OR SOME DRIFT DEPOSIT

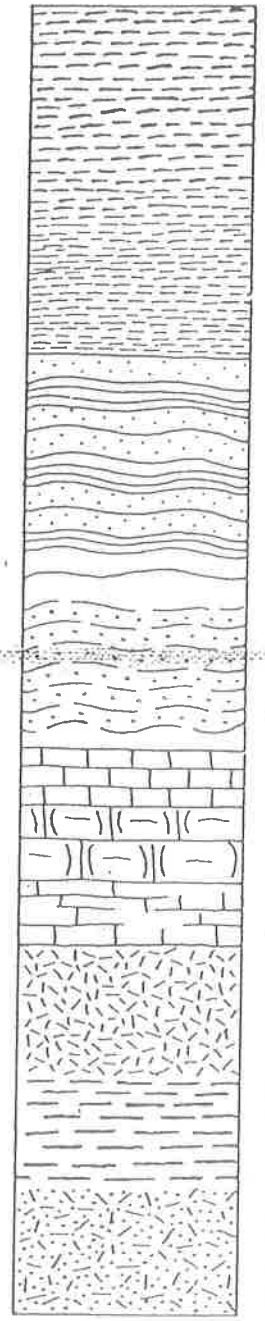
} DUE TO WEATHERING IN TEMPERATE CLIMATES



RED UPPER SOIL, WITH WHITE NODULAR LIMESTONE, DUE TO DEPOSIT OF $CaCO_3$ FROM SOLUTION; AND LOWER, OFTEN GREENISH SOILS (LATERITE)

} DUE TO DEEP WEATHERING IN TROPICAL CLIMATES

FIG. 1.8. THE SUPERFICIAL DEPOSITS—THE INCOHERENT "SOILS" OF THE CIVIL ENGINEER; MAINLY DRIFT DEPOSITS



SCHISTS, ETC.
FISSILE ROCKS, OWING TO PARALLELISM OF FLAKY MINERALS, CHIEFLY WHITE OR BROWN-GREEN MICA. VARIETIES ARE: GARNETIFEROUS MICA-SCHIST, PHYLLITE (FINELY CRYSTALLISED MICA-SCHIST), SLATE (VERY FINELY CRYSTALLISED MICA-SCHIST)

DERIVED MOSTLY FROM ARGILLACEOUS ROCKS; ALSO FROM VOLCANIC TUFFS

FOR HORNBLENDE-SCHIST, SEE BELOW

GNEISS
BANDED ROCKS, MOSTLY OF GRANITIC COMPOSITION OFTEN WITH ALTERNATING LIGHT (QUARTZO-FELSPATHIC) AND DARK (HORNBLENDIC, ETC.) BANDS

THE BANDS ARE OFTEN SCHISTOSE, WITH PARALLEL MINERALS

ANOTHER BANDED TYPE IS QUARTZ-MICA-GRANULITE, A RECRYSTALLISED SANDSTONE OR ARKOSE

QUARTZITE, ORIGINALLY AN ALMOST PURE QUARTZ-SANDSTONE, OFTEN WITH SOME FELSPAR

MARBLE, RECRYSTALLISED LIMESTONE

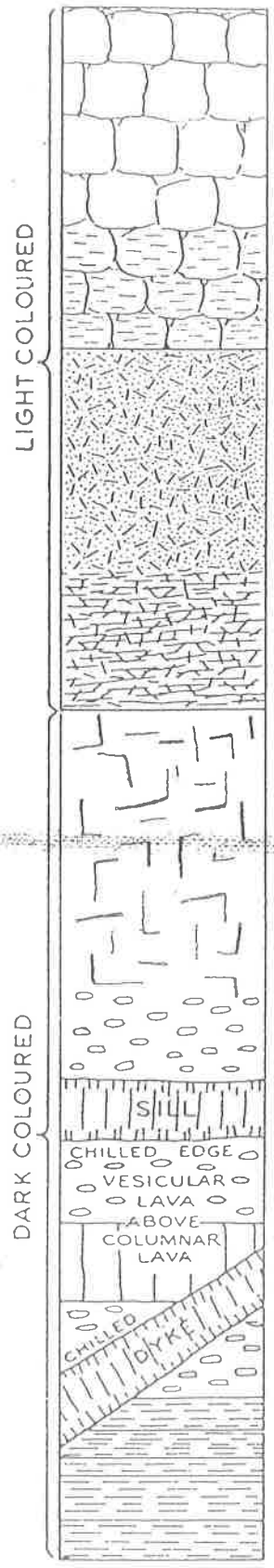
CALC-SILICATE ROCKS, OFTEN INTERBEDDED WITH MARBLE; RECRYSTALLISED LIMY SHALES, ETC.

EPIDIORITE
RECRYSTALLISED DOLERITE, ETC., WITH AUGITE ALTERED TO HORNBLENDE

HORNBLENDE-SCHIST-EPIDIORITE WITH PARALLEL CRYSTALS (HORNBLENDE AND BROWN MICA), AND SO FISSILE

HORNFELS. TYPICALLY FINELY CRYSTALLINE, VERY HARD ROCK, ORIGINALLY SHALES, ETC. FORMED CLOSE TO GRANITE (CHIEFLY), AND ALTERED BY THE HEAT DERIVED FROM SUCH INTRUSIONS

FIG. 1.7. THE METAMORPHIC ROCKS; MAINLY REGIONALLY RECRYSTALLISED, TO VARYING DEGREES



GRANITE INCLUDING GRANITE PROPER, GRANODIORITE, SYENITE, DIORITE. COARSE TO MEDIUM GRAINED CRYSTALLINE, SOMETIMES VERY COARSE (PEGMATITE)

MINERAL COMPOSITION: ALKALI-FELSPAR (K OR Na), QUARTZ (SiO_2), MICA OR OTHER FERROMAGNESIAN MINERAL, E.G. HORNBLENDE

WELL JOINTED. SOMETIMES WITH DIRECTIONAL GRAIN DUE TO PARALLEL ELONGATE MINERALS

FELSITE AND PORPHYRY

MINERAL COMPOSITION AS GRANITE, BUT FINELY CRYSTALLINE EXCEPT IN PORPHYRY IN WHICH LARGER, PORPHYRITIC CRYSTALS OF QUARTZ, FELSPAR, ETC., ARE SET IN A FINE MATRIX

OTHER TYPES ARE RHYOLITE, TRACHYTE. SOMETIMES WITH DIRECTIONAL GRAIN DUE TO PARALLELISM OF FELSPAR, BIOTITE, ETC., CRYSTALS

GABBRO INCLUDING GABBRO PROPER, OLIVINE-GABBRO (COMMON), QUARTZ-GABBRO (INFREQUENT), PICRITE (INFREQUENT)

COARSE TO MEDIUM GRAINED CRYSTALLINE

MINERAL COMPOSITION: CALCIC FELSPAR AND ONE OR MORE DARK FERROMAGNESIAN MINERALS (TYPICALLY AUGITE). ALSO OLIVINE

JOINTS USUALLY WIDELY SPACED AND SELDOM ARRANGED REGULARLY

RARELY FISSILE, OWING TO PARALLELISM OF FELSPAR CRYSTALS

DOLERITE AND BASALT

INCLUDE OLIVINE- AND QUARTZ-DOLERITE, ANDESITE, THOLEIITE, OLIVINE-BASALT.

CRYSTALLISATION MEDIUM IN DOLERITES TO FINE IN ANDESITE, THOLEIITE AND BASALT

BASALTIC TYPES OFTEN PORPHYRITIC (C F. PORPHYRY ABOVE)

MINERAL COMPOSITION SAME AS GABBRO.

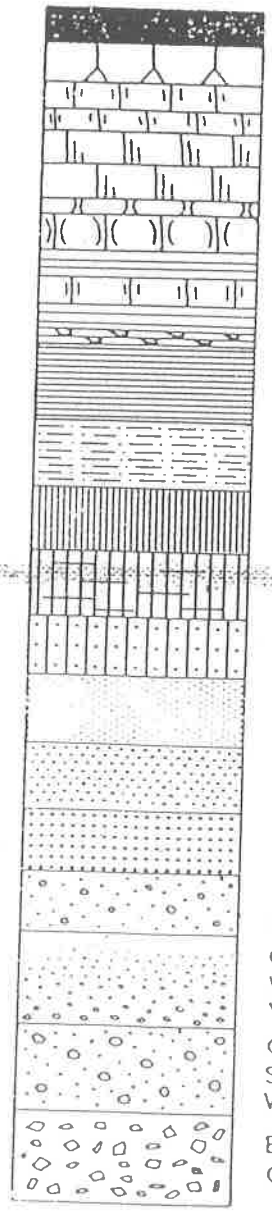
CROSS-JOINTING IN LAVAS, DYKES AND SILLS USUAL

BASALT RARELY FISSILE, WITH PARALLEL CRYSTALS OF FELSPAR

LAMPROPHYRES, DARK MEDIUM-FINE GRAINED ROCKS IN INTRUSIVE SHEETS WITH BIOTITE (BLACK BROWN) MICA AND/OR HORNBLENDE. OFTEN FISSILE, AND EASILY WEATHERED

NOTE: VOLCANIC FRAGMENTAL ROCKS (ASHES OR TUFFS, AND AGGLOMERATES) OMITTED. ALSO GLASSY ROCKS (OBSIDIAN AND PITCHSTONE)

FIG. 1.6. THE IGNEOUS ROCKS; TYPICALLY OF UNIFORM COMPOSITION THROUGHOUT INDIVIDUAL MASSES, WHICH ARE LARGE AND SMALL



COAL (LIGNITE, BITUMINOUS COAL, ANTHRACITE)

FIRECLAY

PURE LIMESTONE (LST.) E.G. CHALK
ARGILLACEOUS AND SILICEOUS LST.
MAGNESIAN LST. AND DOLOMITE ($CaCO_3.MgCO_3$)

LIMESTONE COMMONLY INTERBEDDED WITH CALCAREOUS SHALE

CALCAREOUS SHALE OFTEN WITH SHELLS

BLACK TO GREY SHALES, FISSILE (SH.)

SANDY SHALES (GREY)

MUDSTONE (NOT FISSILE)

MARL (CALCAREOUS MUDSTONE)

SILTSTONE (SANDY MUDSTONE)

FINE, MEDIUM AND COARSE GRAINED SANDSTONE — OFTEN WITH WHITE MICA. USUALLY (IF CEMENTED) WITH SILICEOUS, CALCAREOUS, FERRUGINOUS OR CLAY CEMENT BETWEEN SAND GRAINS (USUALLY QUARTZ) PARTINGS OF SANDY SHALE COMMON

ARKOSE - A FELSPAR-RICH VARIETY, TYPICALLY REDDISH COLOURED (ALKALI-FELSPAR)

GREYWACKE - A DARK IMPURE VARIETY TYPICALLY WITH CALCIC FELSPAR. GRAIN VARIES FROM VERY FINE TO COARSE OR FINELY PEBBLY GRIT

CONGLOMERATE WITH ROUNDED PEBBLES (HARD) SET IN A MATRIX OFTEN SST OFTEN MASSIVE WITH BEDDING OBSCURE

BRECCIA, WITH ANGULAR ROCK FRAGMENTS OF VARIOUS SIZES

CALCAREOUS

ARGILLACEOUS

ARENACEOUS

RUDACEOUS

FIG. 1.3. THE SEDIMENTARY ROCKS; TYPICALLY BEDDED (IN LAYERS)

SEDIMENTARY ROCKS

Sediments are laid down in zones of different materials in seas bordering the coast-line, and in general become progressively finer in grain

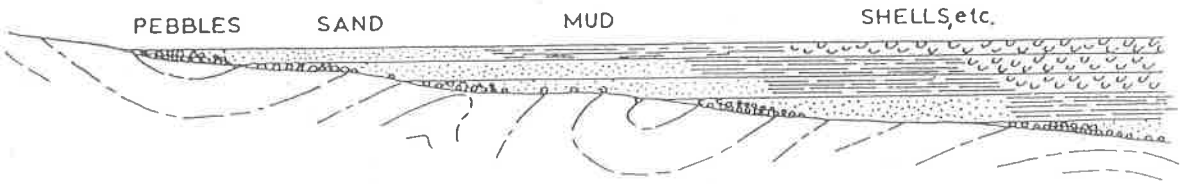


FIG. 1.2. DIAGRAM SHOWING, IN SECTION, BELTS OF DIFFERENT SEDIMENTS OFF A COAST, AND THEIR OVERLAP AGAINST A SUBSIDING SHORE-LINE

seawards (Fig. 1.2). Sediments and the related sedimentary rocks are classified as follows—

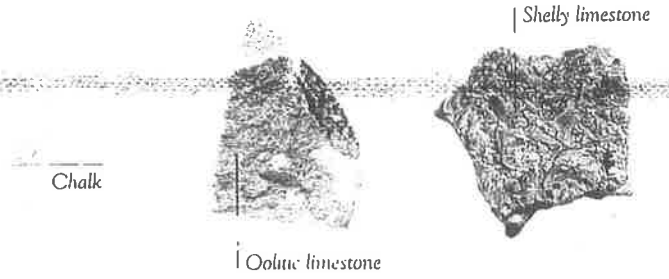
Sediment	Sedimentary rock
Cobbles, pebbles and angular rock fragments, often interspersed with sand	Conglomerate, and breccia, with angular fragments
Sand	Sandstone
Clay in thin beds (laminae)	Shale, varying from sandy varieties to clay shale
Clay in thicker beds	Mudstone, varying from sandy to clay
Accumulations of calcareous hard parts of animals, preserved entire as fossils especially where enclosed in mud, or more usually comminuted to form a calcareous mud	Limestone and calcareous shale

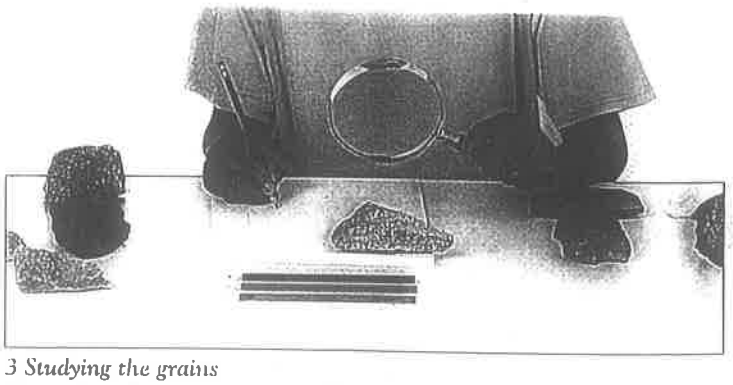
1 Is it limestone?

If the rock fizzes when tested with acid it is likely to be a kind of limestone. GO TO STEP 2 *to find out which. It could also be marble, however, so check the panel on the right. If the rock does not fizz, even in stronger acid* GO TO STEP 3

2 What kind of limestone?

If limestone crumbles to a white powder, it is chalk. If it has tiny grains, it is oolitic limestone. If hard and mottled, it may be shelly limestone.





3 Studying the grains

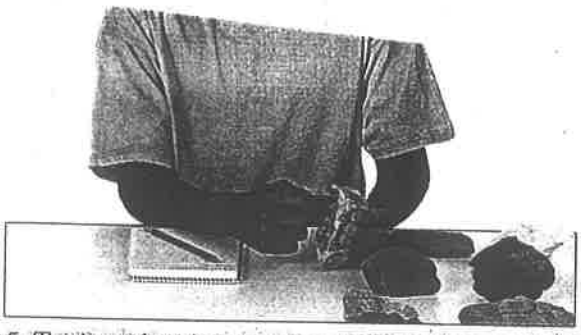
Now look at the grains in the rock. If it has stones as big as your fingernail, GO TO STEP 4 *. If it consists of fairly coarse grains, like those in demerara sugar,* GO TO STEP 6 *If you can only see the grains under a magnifying glass, then* GO TO STEP 5

4 What kind of rudite?

Rocks that are embedded with large stones are sedimentary rocks known as rudites . If the embedded stones are round, the rudite is known as a conglomerate. If they are angular, it is known as breccia.

Conglomerate

Breccia

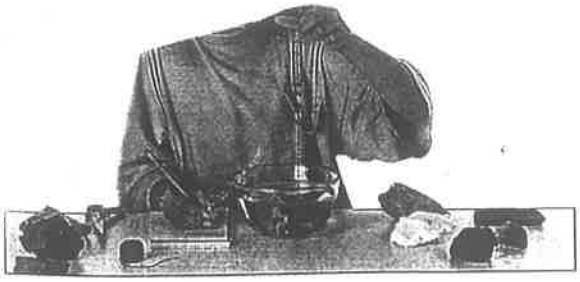


5 Testing soft rocks

If you can scratch it with a nail or copper coin, the rock may be sedimentary Coal is black; fine bands suggest shale; or it could be mudstone or clay. If it is too hard to scratch, GO TO STEP 8

6 Testing hard rocks

If a knife can scrape grains off, GO TO STEP 7
*Otherwise, if whitish in colour, it is quartzite. If banded, it is gneiss or schist. If neither, it may be gabbro, granite, or dolerite (*STEP 9



7 What is the relative density?
Try measuring the relative density . If your measurement is greater than 3, it is probably ironstone; otherwise it is a sandstone.

8 What kind of hard rock?
Fine-grained igneous rocks and metamorphic rocks (see below), are hard to break and hard to identify. A very dark rock could be basalt or hornfels. Hornfels is often almost black; rhyolite and andesite are a little lighter.

9 Coarse-grained rocks
Coarse-grained igneous rocks are hard to tell apart. Granite is lighter overall than gabbro. Dolerite has a slightly finer grain. Pegmatite always contains very large crystals.