a swamp through subsequent floods that may up the lake. It becomes marshy and eventually s up.

(iii) **Delta**—When a river reaches the sea, the materials it has not yet dropped are deposited ts mouth, forming a fan-shaped alluvial are ed a delta. (a word which originated from the ek letter Δ which closely resembled the ngular delta of Nile).

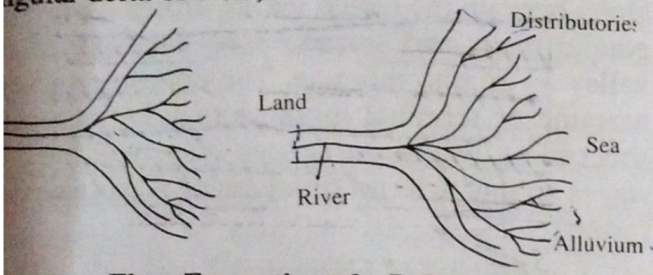


Fig. : Formation of a Delta

This alluvial tract, is in fact, a seaward exten- of the flood-plain. Due to the obstruction ed by the deposited alluvium, the river may harge its water through several channels called butories. Some deltas are extremely large. Example—Ganga delta.

Deltas differ much in their size, shape growth importance. A number of factors such as the of sedimentation, the depth of the river and ea-bed, and the character of tides. Currents waves greatly influence the eventual forma- of deltas. The different types of delta are—

a) **Bird's foot Delta**—It is with several main hes like the foot of a bird. For example— ssippi Delta.

b) **Arcuate Delta**—These are just like an arc circle. For example—The Nile, the Ganges Mekong Delta.

c) **Estuarine Delta**—These deltas are partly erged in the coastal area. For example—The on, Ob and Vistula deltas.

d) **Cuspate delta**—Deltas having tooth-like ctions are called cuspate delta. For example e Ebro of Spain.

itions favourable for the Formation of s :

) Active vertical and lateral erosion in the course of the river to provide extensive ents to be eventually deposited as deltas.

i) The coast should be preferably tideless.

ii) The sea adjoining the delta should be w or else the load will disappear in the deep

(iv) There should be no large lakes in the river course to filter-off the sediments.

(v) There should be no strong current running at right angle to the river mouth, washing away the sediments.

Landforms Associated with Glacial Cycle :

Glaciers generally gives rise to erosional features in the highlands and depositional features on the low lands, though these processes are not mutually exclusive because a glacier plays a combined role of erosion, transportation and deposition throughout its course. A glacier erodes its valley by two processes plucking and abrasion. By **plucking** the glacier breezes the joints and beds of the underlying rocks, team out individual blocks and drags them away. By **abrasion** the glacier scratches, scrapes, polishes and scours the valley floor with the debris frozen into it.

The characteristic features of a glaciated highland are as follows—

(i) **Corrie, Cirque or cwm**—The downslope movement of a glacier from its snow-covered valley-head and the intensive shattering of the upland slopes, tend to produce a depression where the firm or neve accumulates. The process of plucking operates on the back-wall, steepening it and the movement of the ice abrades the floor,

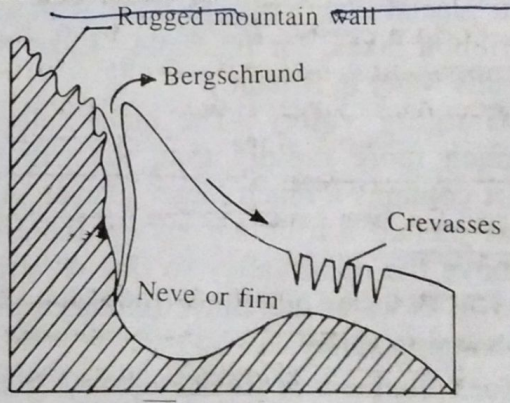


Fig. : Development of a Corrie

deepening the depression in to a steep, horse-shoe-shaped basin called cirque (in French). A corrie (in Scotland) and a cwm (in wales). There is a rocky ridge at the exit of the corrie and when the ice eventually melts, water collects behind this barrier, to form a corrie lake or tarn.

(ii) **Aretes and Pyramidal Peaks**—When two corries cut back on opposite sides of a mountain, knife, edged ridges are formed called aretes (a French word). Example—Striding Edge on Helvellyn in Britain. When three or more cirques cut back together, they will form pyramidal peak. Example—Matterhorn of Switzerland.

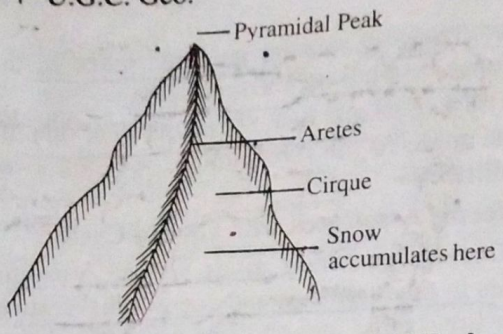


Fig. : Cirque, Arete and Pyramidal Peak

(iii) **Bergschrund**—At the head of glacier, where it begin to leave the snow field of a corrie, a deep vertical crack opens up called a bergschrund (in German) or timaye (in French). This happens in summer when ice moves out and there is no new foundation to replace it. Further down where the glacier negotiates a bend or a precipitous slope, more crevasses or cracks are formed.

(iv) **U-shaped valley**—The glacier on its downward journey, fed by ice from several corries like tributaries that join a river, begins to wear away the sides and floor of the valley down which it moves. It stretches and grinds the bedrock, removing any rock debris and surface soil. A valley which has been formed by glacial erosion has characteristic U-shaped with a wide, flat floor and very steep sides. After the disappearance of the ice, the glacial trough may be filled with water forming ribbon lakes, for Example—Lake Ness and Lake ulls water in Britain.

(v) **Hanging valley**—The main valley is eroded much more rapidly than the tributary valley as it contains a much larger glacier. After the ice has melted a tributary valley, therefore, 'hangs' above the main valley so that its stream plunges down as water fall. Such tributary valleys are called hanging valley.

(vi) **Rock Basins and Rock Steps**—A glacier erodes and excavates the bed rock in an irregular manner. The unequal excavation gives rise to many rock basin later filled by lakes in the valley trough, where a tributary valley joins a main valley, the additional weight of ice in the main valley cuts deeper into the valley floor at the point of convergence forming a rock step.

(vii) **Moraines**—Moraines are made up of the pieces of rock that are shattered by frost action, imbedded in the glaciers and brought down the valley. Those that fall on the sides of the glacier are called lateral moraines. When two glaciers converge, they unite to form a medial moraine. The rock fragments which are dragged

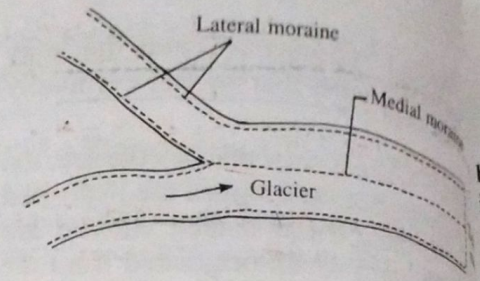
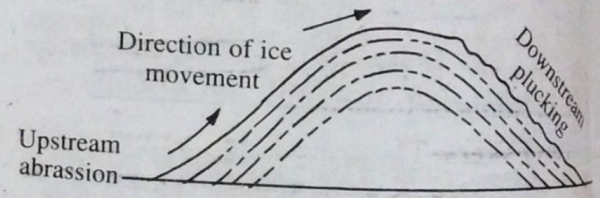


Fig.: The Glacial Moraine

along beneath the frozen ice are dropped when glacier melts and spread across the floor valley as ground moraine. The deposition moraine or terminal moraine may be in succeeding waves, as the ice may melt stages so that a series of recessional morain formed.

Landforms of Glaciated Lowlands—T are mainly **depositional** in nature, brought by both valley glaciers and continental ice sh Most of the glaciated lowlands have deposit features, but where rock masses project abov level surface. They result in striking feature erosion, such as the roche moutonnee and and tail.

(i) **Roche Moutonnee**—This is a resu residual rock hummock. The surface is striated ice movement. Its upstream side is smoothed abrasion and its downstream side is roughened



plucking and is much steeper. The term roch moutonnee is used to describe such a featu because it resembles a sheep-skin-wig once wor in France.

(ii) **Crag and Tail**—The Crag is a mass hard rock with a precipitous slop on the upstrea side, which protects the softer leeward slop fro

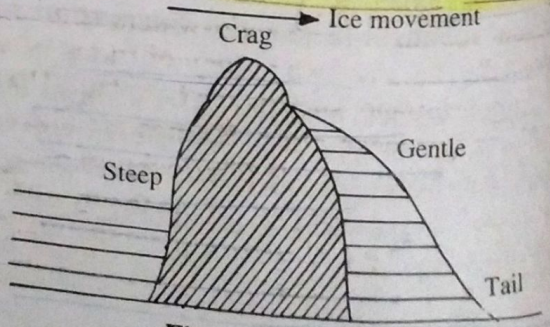


Fig. : Crag and Tail

being completely worn down by the on coming ice. It, therefore, has a gentle tail, strewn with the eroded rock debris.

Example—The Castle Rock of Edinburgh, Scotland.

(iii) **Boulder clay or Glacial till**—This feature is depositional in nature. This is an unsorted glacial deposit comprising a range of eroded materials—boulders, angular stones, sticky clay and fine rock flour. It is spread out in sheets and not in mounds and forms gently undulating till or drift plains.

(iv) **Erratics**—There are boulders of varying sizes that were transported by ice. They come with the advancing glaciers or ice sheets but when the ice melted, they were left 'stranded' in the regions of deposition. They are called erratics because they are composed of materials entirely different from those of the region in which they are found. These are very helpful in tracing the source and direction of the ice movement.

(v) **Drumlins**—These are swarms of oval, elongated 'Whale-back' hummocks composed wholly of boulder clay with their elongation in the direction of the ice flow, that is on the downstream side. They are low hill like and may vary from a few yards to 400 feet in height and may be one or two mile in length. They are arranged diagonally and so are commonly described as having a 'basket of eggs' topography. Large number of Drumlins are found in courty down in Northern Ireland.

(vi) **Eskers**–These are long, narrow, sinuous ridges composed of sand and gravel which mark the former sites of sub-glacial melt-water streams. They vary from a few feet to 200 feet in height and may be several mile long. They are very numerous in Scandinavia, Maime U.S.A. and parts of Finland.

(vii) **Outwash Plain**—These are made up of fluvio-glacial deposits washed out from the terminal moraines by streams and channels of the stagnant ice mass. The melt-waters sort and redeposit the material in a variety of forms from the low hilly heartland, such as the Luneburg Heath of the North European plain. **Kames** are also found which are small rounded hillocks of sand and gravel and may cover part of the plain, where the deposition takes place and form alternating ridges and depression, the depression may contain kettle lakes in the outwash plain.

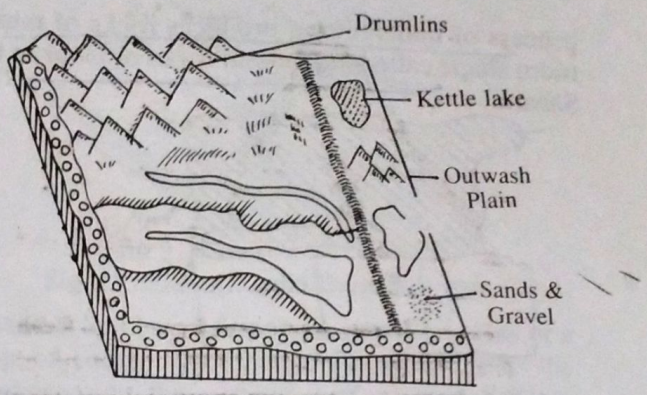


Fig. : Glacial Depositional Features of Outwash Plain

Landforms Associated with Arid Cycle—Wind erosion may be carried out in the following ways—

(i) Deflation
(ii) Abrasion
(iii) Attrition

(i) **Deflation**—This involves the lifting and blowing away of loose materials from the ground. Such unconsolidated sands and pebbles may be carried in the air or rolled along the ground depending on the grain size. Deflation results in the lowering of the land surface to form large depressions called deflation hollows.

(ii) **Abrasion**—The sand-blasting of rock surfaces by winds when they hurl sand particles against them is called abrasion. The impact of such blasting results in rock surface being stratched, polished and worn away.

(iii) **Attrition**—When wind-blown particles roll against one-another in collision they wear each other away so that their sizes are generally reduced and grains are rounded into millet seed sand, the process is called attrition.

The Landforms associated with wind erosion are—

(i) **Rock Pedestals or Mushroom rocks**—The sand blasting effect of winds against any projecting rock masses wears back the softer layers so that an irregular edge is formed on the alternate bands of hard and soft rocks. Grooves and hollows are cut in the rock surfaces. Carving them into fantastic and giant looking pillars called rock pedestals.

Such Rock pillars will be further eroded near their bases where the friction is greatest. This

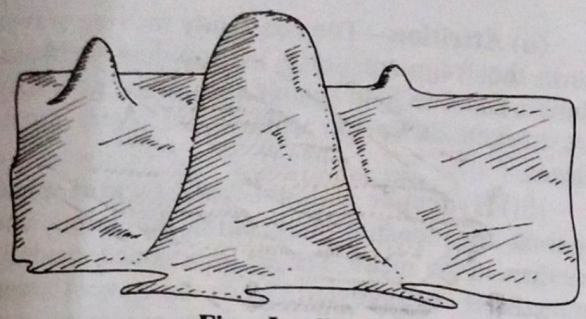


Fig. : Inselbergs

(vi) **Ventifacts or Derikanter**—These are the pebbles faceted by sand blasting. They are shaped and thoroughly polished by wind abrasion to shapes resembling Brazil Nuts. Rock fragments, mechanically weathered on the windward sides. If the wind directions changes another facet is developed with sharp edges. Three wind-faceted surfaces are called derikanter. These wind-faceted pebbles form the desert pavement, a smooth, mosaic like region closely covered by the numerous rock fragments and pebbles.

(vii) **Deflation hollows**—Winds lower the ground by blowing away the unconsolidated materials and it may lead to the formation of small depressions. Similarly minor faulting can also initiate depressions and the eddying action of winds may wear-off the weaker rocks until the water table is reached. Water then seeps outs forming oasis or swamps, in the deflation hollows or depressions. For example—Faiyum Depression in Egypt lies 130 feet below the sea level.

Land forms associated with wind deposition—The finest dust particles travels enormous distances in the air and then come to rest. The following are some of the major features of wind deposition—

(i) **Dunes**—Dunes are infact hills of sand formed by the accumulation of sand and shaped by the movement of winds. They may be active on live dunes constantly on the move, or inactive fixed dunes, rooted with vegetation. Dunes are well represented in the desert where a sea of sand is being continuously moved, reshaped and redeposited into a variety of features. Following two types of dunes are most commonly found—

(a) **Barchan**—These are cresentic or moon shaped dunes which occur individually or in groups. They are like dunes which advance steadily before winds that come from a particular prevailing direction. They are most prevalent in the deserts of Turkistan and in Sahara. Barchans are initiated probably by a chance accumulation

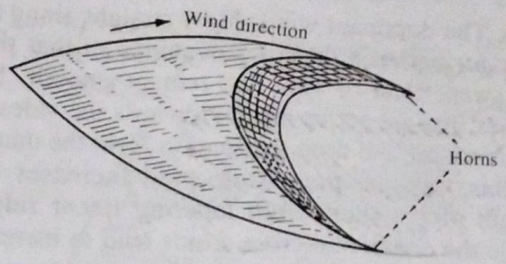


Fig. : Crescentric sand Dune-Barchan

of sand at an obstacle, such as a patch of grass or a heap of rocks. They occur transversely to the wind, so that their horns thin out and become lower in the direction of the wind due to the reduced frictional retardation of the winds around the edges. The windward side is convex and gently-sloping while the leeward side, being sheltered; is concave and steep. The crest of the sand dune moves forward as more sand is accumulated by the prevailing wind. The sand is driven up the

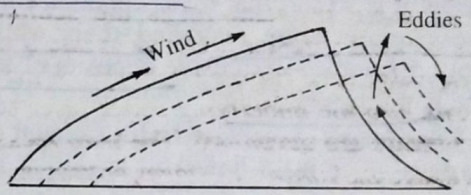


Fig. : Future position of the Barchan

windward side and on reaching the crest, slips down the leeward side so that the dune advances.

(b) **Seif or Longitudinal dunes**—Seif is an Arabic word meaning sword. They are long, narrow ridges of sand often over a hundred miles long lying parallel to the direction of the prevailing winds. The high serrated ridges may attain a height of over 200 feet. The crest line of the seif rises and falls in alternate peaks and saddles in regular succession like the teeth of monstrons

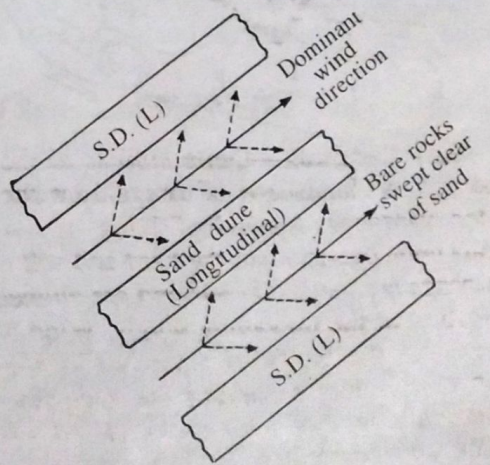


Fig. : Longitudinal dunes-seifs

process of undercutting produces rocks of mushroom shape called mushroom rocks or Gour in the Sahara.

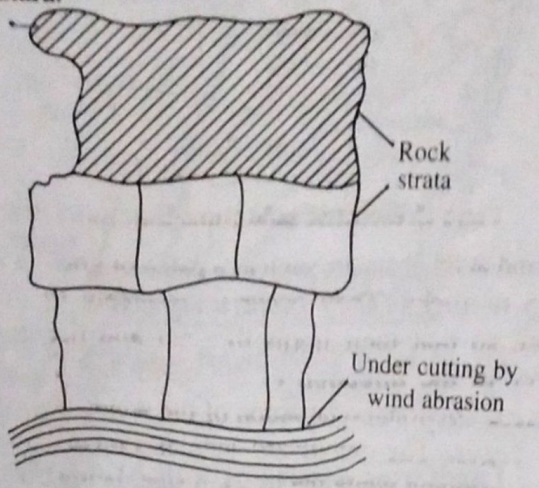


Fig. : Rock Pedestals

(ii) **Zeugen**—These are tabular masses which have a layer of soft rocks lying beneath a surface layer of more resistant rocks the sculpturing effects of wind abrasion wear them into a weird-looking 'ridges and furrow landscape. Wind abrasion eats into the underlying softer layer so that deep furrows are developed. The hard rocks then stand above the furrows as ridges or zeugen.

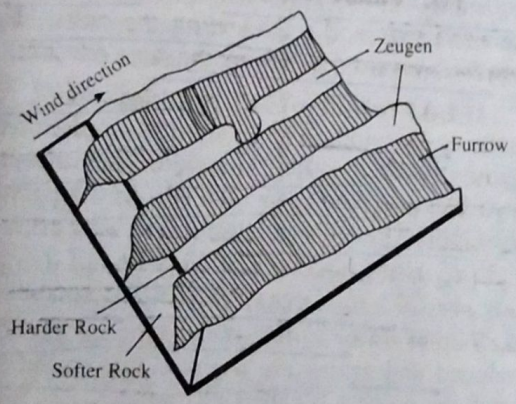


Fig. : Zeugen

(iii) **Yardang**—Quite similar to the 'ridge and furrow' landscape of zeugen are the steep-sided yardangs. Instead of lying in horizontal strata upon one-another, the hard and soft rocks of yardangs are vertical bands and are aligned in the direction of the prevailing winds. Wind abrasion excavates the bands of softer rocks into long, narrow corridors, separating the steep-sided overhanging ridges of hard rocks called yardangs. They are commonly found in the Atacama desert, Chile.

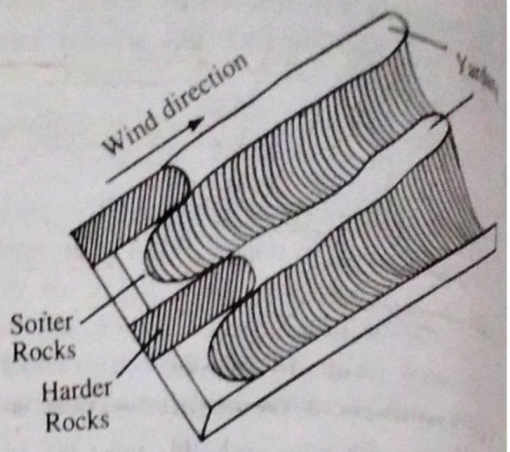


Fig. : Yardang

(iv) **Mesas and Buttes**—Mesa is a Spanish word meaning 'table'. It is a flat table-like land mass with a very resistant horizontal top layer and very steep sides. The hard stratum on the surface resists denudation by both wind and water, and thus protects the underlying layers of rocks from being eroded away. Mesas may be formed in canyon regions *e.g.*, Arizona, or on fault blocks *e.g.*, the table mountains of cape-town.

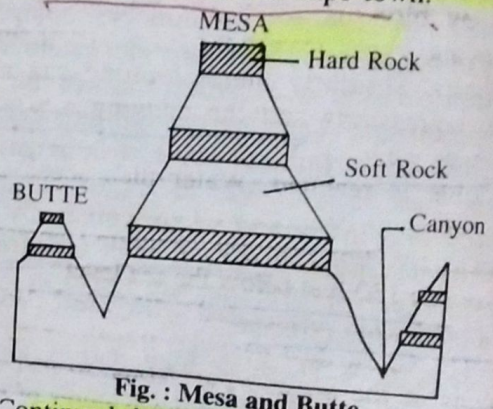


Fig. : Mesa and Butte

Continued denudation through the ages may reduce mesas in area such that they become isolated flat-topped hills called Buttes. Many of them in arid regions may be separated by deep gorges or canyons.

(v) **Inselbergs**–It is a German word meaning 'Island mountain'. These are isolated residual hills rising abruptly from the level ground. They are characterized by their very steep slopes and rounded tops. They are composed of granites or gneiss and are probably the relics of an original plateau which has been almost entirely eroded away.

Inselbergs are typical in many desert and semi-arid landscapes in old-age, *e.g.*, those of Northern Nigeria, Western Australia and the Kalahari Desert.

saw. The dominant winds blow straight along the corridor between the lines of dunes so that they are swept clear of sand and remain smooth. The eddies that are set up below towards the sides of the corridor, and drop the sand to form the dunes. In this way the prevailing wind increases the length of the dunes into tapering linear ridges while the occasional cross winds tend to increase their height and width. Extensive seif dunes are found in Sahara desert. Thar desert and the West Australian desert.

(ii) **Loess**—The fine dust blown beyond the desert limits is deposited on neighboring lands as loess. It is yellow, friable material and is usually very fertile. Loess is in fact, fine loam, rich in lime, very coherent and extremely porous. Water sinks in readily so that the surface is always dry. Streams have cut deep valleys through the thick mantle of soft loess and badlands topography may develop. It is so soft that roads conducted through a loess region soon sink and their walls rise steeply. Example—Extensive deposits of loess is found in north-west China.