Chapter 11 Islands and Coral Reefs

An island is a piece of land surrounded on all sides by water. It may occur individually or in a group, in open oceans or seas. Smaller ones of only local significance are found even in lakes and rivers. Generally speaking all islands may be grouped under the following types.

1. **Continental islands.** These islands were formerly part of the mainland and are now detached from the continent. They may be separated by a shallow lagoon or a deep channel. Their separation could be due to subsidence of some part of the land or to a rise in sea level, so that the lowland links are submerged by the sea. Their former connection with the neighbouring mainland can be traced from the similar physical structure, flora and fauna that exist on both sides of the channel. In the course of time, modification by men and other natural forces may give rise to different surface features. But even then, the basic structural features will remain the same. Continental islands may appear as:

(a) Individual islands. These lie just outside the continent, very much associated with the characteristic features of the mainland of which they were once part. Some of the outstanding examples are Newfoundland, separated from the mainland by the Strait of Belle Isle; Madagascar, by the Mozambique Channel; Ceylon by the Palk Strait; Tasmania by the Bass Strait and Formosa by the Formosa Strait.

(b) Archipelagoes or island groups. These comprise groups of islands of varying sizes and shapes, e.g. the British Isles, the Balearic Islands of the Mediterranean and also those of the Aegean Sea.

(c) Festoons or island arcs. The islands form an archipelago in the shape of a loop around the edge or the mainland, marking the continuation of mountain ranges which can be traced on the continent, e.g. the East Indies, the Aleutian Islands, Ryukyu Islands, Kurile Islands and other island arcs of the Pacific coasts.

2. **Oceanic islands.** These islands are normally small and are located in the midst of oceans. They have no connection with the mainland which may be hundreds or thousands of miles away. They have a flora and fauna unrelated to those of the continents. The Galapagos Islands have many unique species of animals. Due to their remoteness from the major trading centres of the world, most of the oceanic islands are very sparsely populated. Some of them provide useful stops for aeroplanes and ocean steamers that ply between continents across vast stretches of water. Generally speaking, oceanic islands fall into one of the following groups.

Rarotonga in the Cook Islands, a rugged volcanic island in the Pacific *N.Z. High Commission Malaysia*

(a) Volcanic islands. Many of the islands in the oceans are in fact the topmost parts of the cones of volcanoes that rise from the ocean bed. Most of them are extinct, but there are also some active ones. The best known volcanic peak of the Pacific Ocean is Mauna Loa in Hawaii, which is 13,680 feet above sea level. Tracing downwards, Mauna Loa is found to have been built up from the ocean floor at a depth 18,000 feet below the water surface! Other volcanic islands have emerged from the submarine ridges of the oceans.

The volcanic islands are scattered in most of the earth's oceans. In the Pacific Ocean, they occur

in several groups such as Hawaii, the Galapagos Islands and the South Sea islands. In the Atlantic are the Azores, Ascension, St. Helena, Madeira and the Canary Islands. Those of the Indian Ocean are Mauritius and Reunion. In the Antarctic Ocean are the South Sandwich Islands, Bouvet Island and many others.

(b) Coral islands. Unlike the volcanic islands, the coral islands are very much lower and emerge just above the water surface. These islands, built up by coral animals of various species, are found both near the shores of the mainland and in the midst of oceans. Coral islands include the Marshall Islands, Gilbert and Ellice Islands of the Pacific; Bermuda in the Atlantic and the Laccadives and Maldives of the Indian Ocean.

Coral Reefs

In tropical seas many kinds of coral animals and marine organisms such as coral polyps, calcareous algae, shell-forming creatures and lime-secreting plants live in large colonies. Though they are very tiny creatures, their ability to secrete **calcium carbonate** within their tiny cells has given rise to a peculiar type of marine landform. They exist in numerous species of many forms, colours and shapes. Under favourable conditions, they grow in great profusion just below the water level. Taking coral animals as a whole, the **polyps** are the most abundant and also the most important. Each polyp resides in a tiny cup of coral and helps to form **coral reefs**. When they die, their limy skeletons are cemented into corallıne limestone. There are also non-reef-building species such as the 'precious corals' of the Pacific Ocean and the 'red coral' of the Mediterranean which may survive in the colder and even the deeper waters. As a rule they thrive well only in the warmer tropical seas.

The reef-building corals survive best under the following conditions.

1. The **water temperature** must not fall below 68°F. (20°C.). This virtually limits the areal distribution of corals to the **tropical, and sub-tropical zones**. Again they will *not flourish* where there are *cold currents* because of the upwelling of the cold water from the depths that cools the warm surface water. This explains why coral reefs are generally absent on the western coasts of continents. On the other hand the warming effect of the **warm currents**, e.g. the Gulf Stream, means that corals are found far to the north of the West Indies in the Atlantic Ocean. The Pacific and the Indian Oceans, however, have the most numerous coral reefs.
2. The **depth of the water** should not exceed 30 fathoms or 180 feet, because beyond this depth **sunlight** is too faint for photosynthesis to take place. This is essential for the survival of the microscopic **algae**, on which the coral polyps depend. Shallow water of less than 100 feet is ideal. But there should always be plenty of water as polyps cannot survive for too long out of water.

Atafu atoll in the Tokelau island group *N.Z. High Commission Malaysia*

3. The water should be saltish and free from sediment. Corals therefore survive best in the moving ocean water well away from the silty coasts or muddy mouths of streams. The corals are best developed on the seaward side of the reef, where constantly moving waves, tides and currents maintain an abundant supply of clear, *oxygenated water*. They also bring an adequate supply of food in the form of microscopic organisms.

A fringing reef on the Hong Kong coast

Types of Coral Reefs

There are three main types of coral reefs.

1. **Fringing reefs.** A fringing reef is a coralline platform lying close to the shore extending outwards from the mainland. It is sometimes separated from the shore by a shallow lagoon. It is widest when fringing a protruding headland but completely absent when facing the mouth of a stream. The outer edge grows rapidly because of the splashing waves that continuously renew the supply of fresh food. The reefs may be about a mile wide, lying just above the level of low water and sloping steeply downwards on the seaward side to a depth of about 100 feet (Fig. 88).

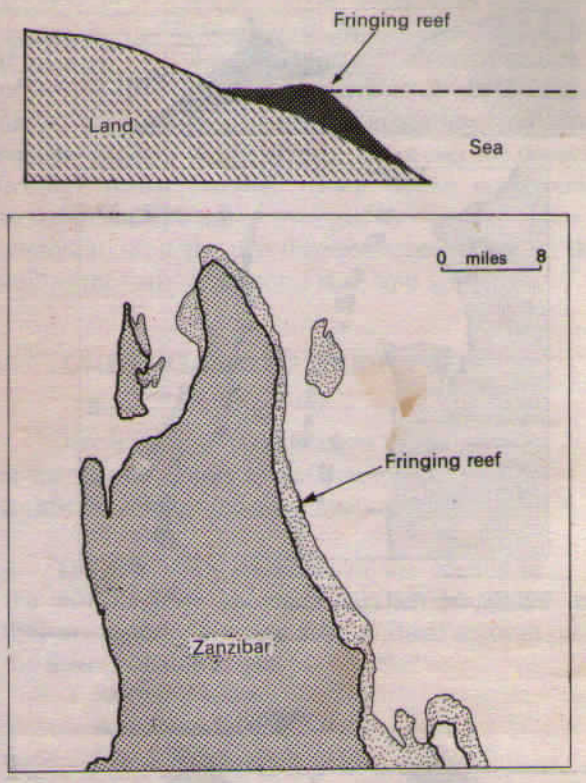


Fig. 88 Fringing reef

2. **Barrier reefs.** A barrier reef is separated from the coast by a much wider and deeper channel or lagoon (Fig. 89). The reef is partially submerged. Where it lies above the water level and sand can accumulate on it, a little vegetation is possible. The barrier reefs have narrow gaps at several places to allow the water from the enclosed lagoon to return to the open ocean. Such gaps are very useful for shipping and provide the only entrances for ships to enter or leave the lagoon. The best known barrier reef is the Great Barrier Reef off the coast of Queensland, Australia. It is 1,200 miles long, separated from the coast by a channel 100 miles wide in places and over 200 feet deep.

3. **Atolls.** Atolls are similar to barrier reefs except that they are circular in shape, enclosing a shallow lagoon without any land in the centre. The encircling ring is usually broken in a few places to allow the free flow of water (Fig. 90). On the inside of the reefs, sand and limestone debris collect and palm trees like coconuts may grow. Such palm trees

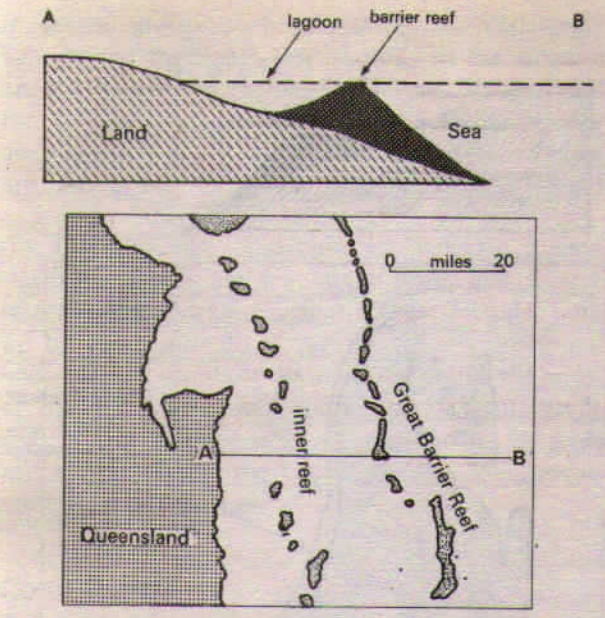


Fig. 89 Barrier reef

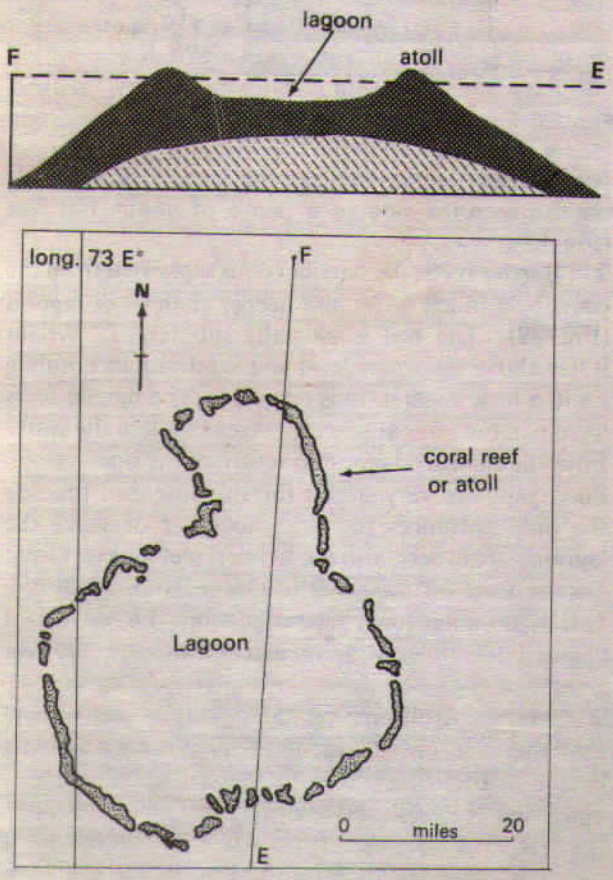


Fig. 90 Atoll

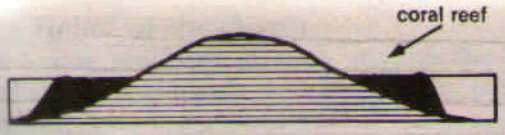
thrive well in the brackish water of the lagoon. The nuts fall into the water and are distributed widely by floating from one coral island to another. The calm waters are useful for fishing and canoeing. Some of the large atolls, e.g. Suvadiva in the Maldives, west of Ceylon, have a lagoon over 40 miles across. A number of them provide essential air bases for trans-Pacific aircraft.

The Probable Origin of Coral Reefs

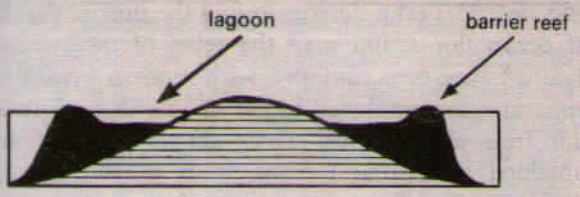
The subject of the origin of coral reefs has been studied and debated for over one and half centuries. Several theories have been suggested but none is universally accepted.

The most widely accepted theory is that put forward by the great scientist Charles Darwin, after his voyage to the Pacific islands in 1842. It is known as the subsidence theory. Darwin assumed that all coral reefs began as fringing reefs around an island or the topmost portions of extinct volcanoes that stood above the ocean bed. Due to a general downwarping of the earth's crust, the islands gradually subsided. The corals continued to grow upwards to keep pace with the subsidence. The growth was more vigorous at the outward edge than the landward edge because of the more favourable living conditions for corals, so the encircling reef widened. It then formed a barrier reef with a lagoon between the island and the reef. Eventually, when the land completely submerged, only the outer rims of the reefs were seen, forming an atoll. The submerged island was covered by a layer of sediment so that the characteristic circular lagoon is generally shallow. Thus atolls mark the position of the former islands (Fig 91a). More recent researches by oceanographers have revealed that the ocean floor has, in fact, been subjected to subsidence especially in the Pacific. Darwin's explanation was therefore generally correct.

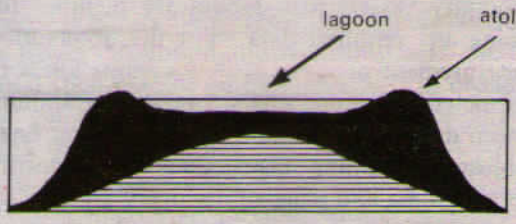
Amongst the other theories, perhaps the American geographer, R.A. Daly's glacial control theory put forward in 1910 is worth consideration. During his visit to Mauna Kea in Hawaii, he noticed the close relationship between glaciation and the development of coral reefs. He believed that during the height of the Ice Ages, the water was too cold for any coral growth to take place. With the absence of a coral barrier, marine erosion was able to attack and lower the islands. With the return of the warmer climate, the water that was locked up in the ice sheets melted. Consequently, there was a rise in the sea level which in some cases submerged these lower islands. On these wave-planed platforms, corals



(i) A fringing reef

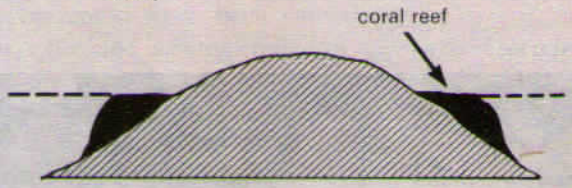


(ii) Subsidence of the land leads to a barrier reef developing.

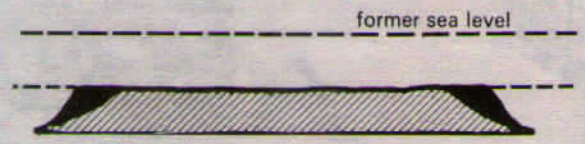


(iii) Further subsidence matched by the growth of coral leads to an atoll

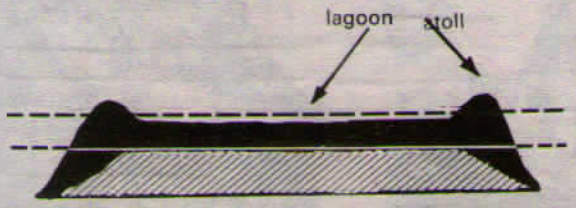
Fig. 91 (a) Darwin's theory of subsidence (coral reef growing upwards and outwards to keep pace with subsiding island, passing from fringing reef, to barrier reef and eventually atoll)



(i) A fringing reef



(ii) Island is planed when sea is at a lower level



(iii) Sea level rises and coral grows upwards forming atoll.

Fig. 91 (b) Daly's Glacial Control Theory

began to grow upwards at the rate of a foot in a decade to keep pace with the rising water level (Fig 91b). Coral reefs, where islands still project above sea level, and atolls were thus formed. Recent evidence of boring through coral formations seems to favour Daly's explanation of a change in sea level and consequent erosion of the islands. However the deepest borings reveal basaltic rocks. These correspond to the subsided islands envisaged by Darwin. Thus a combination of the two theories accounts for all the important features of coral reefs and atolls.

QUESTIONS AND EXERCISES

1. Give a concise classification of the islands of the world. Quote actual examples of islands to justify your proposed classification.

2. The following are some of the islands of the world. State in which part of the globe they are found. For any *three* of them account for their probable origin.

Sakhalin Island
Andaman Islands
Maldive Islands
St. Helena
Hawaiian Islands
Crete

3. What are the three general types of coral reefs formed by coral animals. Point out the distinct differences between them.

4. Explain clearly how coral reefs are formed. Under what conditions do corals thrive best?

5. With the aid of examples and diagrams, explain any *three* of the following terms connected with islands and coral reefs.

(a) continental islands
(b) archipelagoes
(c) oceanic islands
(d) coral polyps
(e) fringing reefs
(f) atolls