

# THE GEOLOGIC WORK OF MANGROVES IN SOUTHERN FLORIDA

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WITH SEVEN PLATES

The importance of mangroves in building shallow submarine banks into land and increasing the area of land of very low relief has been observed and described in more or less detail by several geologists who have studied the Florida coast and keys and the West Indian islands. Professor Louis Agassiz, in his report on the "Florida Reefs," has given a charming account of the origin of the mangrove islands; Mr. Alexander Agassiz has also written about them in his "Three Cruises of the Blake"; and Mr. Robert T. Hill has described them in his "Geology and Physical Geography of Jamaica." Although the activity of mangroves as geologic agents is well known, no series of illustrations showing the development of the plants and the successive stages in their formation of islands has, to my knowledge, been published. While studying the geology of the Florida keys and the corals of the reefs and flats of the region, under the auspices of the Carnegie Institution of Washington, I have had an opportunity to take a number of photographs, and they, with the information obtained in connection with those investigations, form the basis of these illustrations and notes. My thanks are due Dr. Alfred G. Mayer, Director of the Marine Biological Laboratory of the Carnegie Institution, for the privilege of visiting nearly all of the Florida keys.

Mangroves (*Rhizophora mangle* Linn.) are small trees or large shrubs, from 10 to 20 feet tall, limited in their distribution to tropical or semi-tropical regions and confined to low lands, growing either in the water or so near the water that the soil in which their roots are imbedded is perpetually saturated. These conditions—a tropical or semi-tropical climate and low land margining the sea or extensive flats only slightly below the level of the ocean—are realized in southern Florida, and mangroves are there abundant. They border the rivers near the ocean, margin most of the higher keys, and form



FIG. 80.—Young Mangroves. About one-sixth natural size.



FIG. 79.—Mangrove fruit and young shoots. The four smaller specimens on left are fruit. About one-sixth natural size.

islands or keys on which mangroves are practically the only vegetation. It is estimated that perhaps between one-half and one-third of the total key area is occupied by these plants.

The mangroves, where they are fully developed, form dense mats of vegetation, with interlocking branches above and interlocking roots below. The roots constitute an interesting and geologically important feature of the plant. Besides the single root or tuft of rootlets given off from the basal end of the young plants, there are other roots originating above ground, at higher levels from the plant stem. These grow downward and imbed their lower ends in the soil, thus adding to the support of the plants. The roots arising in the manner just indicated multiply and form a root tangle above the ground. The various stages of root development are illustrated by text figures 79 and 80, and by plates XLVII, XLVIII, figure 2, and XLIX, figure 1 (the illustrations are cited in an order to indicate a developmental series). The tangles of roots are geologically important in catching and holding débris washed among them by currents and waves.

The three modes of occurrence of mangroves—along the river banks, around the margins of keys having their land surface above water level, and the purely mangrove keys—are illustrated by the plates. Plates XLVI and XLVII represent the banks of the Miami River and illustrate the river mangroves. Plate XLVIII illustrates the shore of the western side of the cape east of Bay Biscayne; plate XLIX, figure 1, depicts Pigeon Key;<sup>1</sup> plate XLIX, figure 2, the Marquesas, and plate LII, figure 1, the southern end of Old Rhodes Key—all keys margined by mangroves. Plate LII, figure 2, represents a mangrove-covered key between Key Largo and Old Rhodes Key.

It has already been stated that these plants may initiate the formation of islands or they may be active in increasing land areas. The process may now be sketched as follows:

The fruit of the mangrove is an elongate body, from six inches to a foot long, about half an inch thick, with a pointed distal, and an enlarged and heavy proximal end, the calyx still adhering to the latter. These cigar-shaped bodies drop into the water and are carried hither and thither by the waves and currents, to settle on any soft bottom where the water at low tide does not exceed about one foot in depth. They sprout and quickly take root. Text figures 79 and 80 represent a series of young mangroves, ranging from pods plucked from the trees to specimens with a considerable development of roots and several young branches.

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<sup>1</sup> A small key north of the western end of Key Largo.

The manner in which they do their work in extending areas of land above water will be described first. Plate L, figure 1, shows a young mangrove growing in the water some feet away from shore, at Northwest Point, Virginia Key, Bay Biscayne. In many localities along the keys young mangroves may be seen with their terminal leaves protruding above the water at distances of only a few feet up to several hundred feet from the shore. An especially good example of this may be seen along the southern shore of the Marquesas. Plates XLVI, figure 2, and XLVII, figure 1, representing the Miami River, illustrate how the young mangroves extend into the water area. When they have grown sufficiently for the development of a tangle of roots, they catch and hold sediment and any floating débris, by the successive accumulation of such material ultimately bringing the level of the land above that of the water.

The process by which they build new land is as follows: Behind the keys, in the regions of slack water, deposition of sediment is taking place, forming banks of soft calcareous ooze. After these shoals have been built to within about a foot of the water-level (at low tide), young mangroves begin to catch and grow. Plate L, figure 2, represents a single young mangrove growing on a shoal north of Pigeon Key in water about one foot deep. Plate L, figure 3, represents two young plants from the same locality, held up by the boatman. Plate LI shows a further stage in the development of a mangrove key, the young plants being more numerous and larger in size. The plants become still more numerous, further increase in size, and ultimately form a mat of interlocking roots and branches resulting in keys such as those represented on plate LII. When the plants become thick they catch and retain sediment and ocean drift, and are a constructive agent in the formation of land.

After a time, whether it be a newly formed key or the margin of a land area, the mangroves, by the accumulation of sediment and drift, form land, and thus cut off their roots from the necessary supply of sea water, causing their own death. The land surface then acquires another vegetation. But the marginal fringe of mangroves persists to protect the young island from the erosive action of the ocean waves, and young mangroves spread seaward to add new land to that already formed.

Thus these plants are among the most important constructional geologic agents of southern Florida.



Fig. 1.--MIAMI RIVER BETWEEN MIAMI AND THE EDGE OF THE EVERGLADES



Fig. 2.--YOUNG MANGROVES ALONG NORTH BANK OF MIAMI RIVER MIAMI





Fig. 1.--MANGROVES ALONG SOUTH BANK OF MIAMI RIVER, MIAMI



Fig. 2.--ADULT MANGROVES ALONG NORTH BANK OF MIAMI RIVER MIAMI





Fig. 1.--MANGROVES AT NEW CUT, EASTERN SIDE OF BISCAYNE BAY, OPPOSITE MIAMI

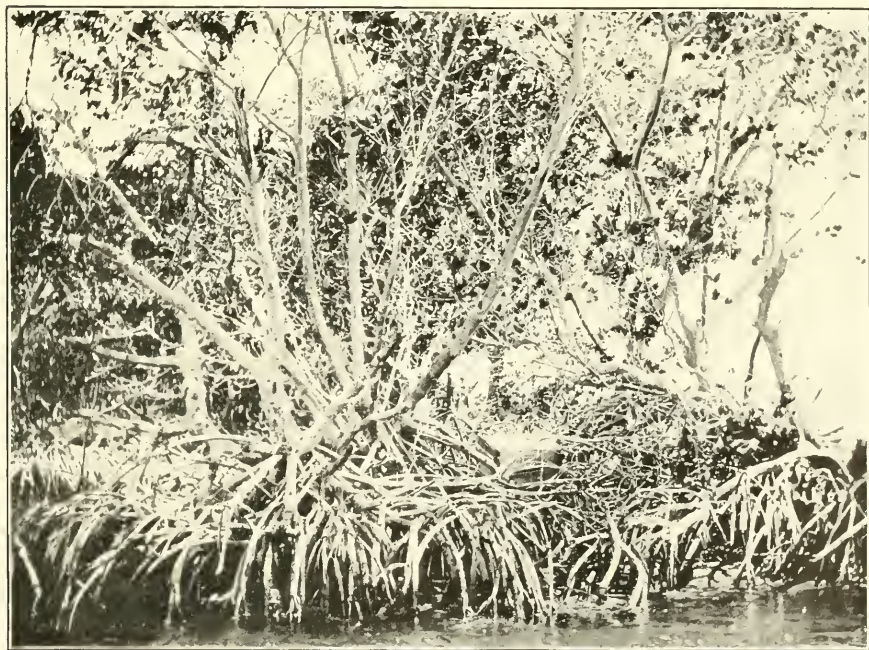


Fig. 2.--MANGROVE ROOTS SAME LOCALITY





Fig. 1.--MANGROVE ROOTS AT PIGEON KEY



Fig. 2.--MANGROVES ALONG THE SOUTH SHORE OF THE MARQUESAS





Fig. 1.--YOUNG MANGROVE ON SOUTHWEST SIDE OF BEAR CUT, NORTHWEST POINT, BAY BISCAIYNE



Fig. 2.--YOUNG MANGROVE ON SHOAL TWO MILES NORTHEAST OF PIGEON KEY, WATER ABOUT ONE FOOT DEEP



Fig. 3.--TWO YOUNG MANGROVES FROM SHOAL ABOUT TWO MILES NORTH OF PIGEON KEY WATER ABOUT ONE FOOT DEEP





Fig. 1.--YOUNG MANGROVES ON SHOAL, UPPER END OF LONG ISLAND, WATER ABOUT ONE FOOT DEEP



Fig. 2.--YOUNG MANGROVES, OAR BY THEIR SIDE. NEAR VIEW SAME LOCALITY





Fig. 1.--ELEVATED CORAL REEF ROCK AND VEGETATION AT SOUTHERN END OF OLD RHODES KEY, DETACHED KEY



Fig. 2.--MANGROVE KEY, BETWEEN LARGO AND OLD RHODES KEYS

