

XI. SUBMARINE EFFECTS OF THE TYPHOON

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With only minor variations, the coral reefs of Jaluit Atoll are generally similar to those of other atolls. On the ocean side of the windward islets the seaward margin of the reef flat is serrate with surge channels; however, the algal ridge, so often prominent on windward reefs, was not seen in any of the sectors examined. Behind the outer front of the reef, the gradually sloping reef flat, exposed at low tides, is smooth; its surface is composed to a large extent of encrusting coralline algae. Landward the flat gives way to the eroded beach rock formation that reaches to near high tide level.

On the lagoon side of the windward islets the beach is composed of beach rock, coral shingle, or sand, depending upon exposure to prevailing winds, waves, and currents. At the low tide level there is a sandy terrace, either a reef flat covered by sand or a deeper sand deposit or apron, bearing scattered living corals; this terrace may slope off gradually to water ten or more feet deep, or it may abruptly change from a shallow shelf to a steep slope into deeper water. This lagoon slope is also of either sand or coral gravel, but has a greater abundance of growing coral, often in massive groupings of many species.

On the lagoon side of the leeward islets the conditions are somewhat similar to those of the lagoon side of the windward islets, but with more extensive sand flats. On the ocean side of the lee islets the reef is markedly different from that of the windward side, being broader, with the surface of the reef flat less smooth, and with the outer edge sloping more gradually into deep water without any definite development of surge channels.

All of these areas were examined except the front and foreslope of the windward reef. In all areas examined very few changes due to the storm were noted.

There was evidence, however, that the area not examined suffered rather extensive damage from the storm. Because of the high waves during the visit of the group it was dangerous to venture to the outer edge of the windward reef and impossible to explore the surge channels. Presumably that portion of the reef was originally similar to the windward reefs on other atolls: from the outer reef flat the surge channels would be separated by buttresses; in the actual surf region there would be almost nothing but encrusting coralline algae; from the depth of about five feet and down there would be an ever-increasing covering of living and dead corals including Pocillopora meandrina and shelf-like species of Acropora (for example A. spicifera) both on the buttresses and in places on the walls of the surge channels. Both the buttresses and the surge channels would level off at a shelf about fifteen or twenty feet deep; the shelf would be in the neighborhood of one hundred or more feet wide, sloping to about 40 feet deep; there the bottom would drop abruptly away to the greater depths. Scattered on the shelf would be many heads of living corals, again predominantly species of Acropora; among the bases of these

heads and massive coral growths would lie a thick layer of dead coral fragments broken from the growing reef front during normal storms.

Lacking direct observation of this section of the reef, the damage to it must be deduced from the bars of boulders and gravel lying on the reef flat. This bar has been described in detail earlier (See p. 39); here it will suffice to state that it is a new feature along the windward beaches examined. In a typical section near Jabor it was about 60 feet wide, up to 8 feet high, and about 100 feet from the reef edge and 30 feet from the beach rock.

The composition of the bar varied from place to place, but the bulk of its components appeared to come from the reef front and foreslope. Evidence of this origin includes the following:

1. The presence of many fresh pieces of coral with the calices uneroded, and in some instances with the branches unbroken. These corals, including Pocillopora meandrina and Acropora spp. occur normally only in the surf zones of reefs.
2. The presence of the remains of surf inhabiting organisms, such as the rock oyster, Chama, and the slate-pencil sea urchin, Heterocentrotus. The shells of the oysters were not beach-worn but fresh with the nacre of the surface unweathered. Numerous fresh, uneroded spines of the urchin were found, and in one case a section of the test with spines attached was seen.
3. The presence, on old dead fragments of coral and over-grown coral heads, of fresh bright red patches of colonial Foraminifera, a form that grows abundantly upon the fragments found on the outer shelf of the reef.
4. The presence of the largest coral boulders on the reef at the seaward edge of the bar, while the landward edge was composed of the smallest fragments.
5. The report by the Marshallese that for a period after the typhoon the bars gave off a strong stench of decomposing organic material, a condition which could not obtain were the bars composed of long-dead corals from the boulder ridge.

However, not all of the material in the bar originated in the outer reef area. On Jabor and Mejatto, where the bar was most carefully examined, the following were found:

1. Old blackened coral fragments that had obviously been buried in the soil of the islet.
2. Coral, usually old and partially overgrown but, in some instances, fresh and recently killed, of species characteristic of lagoons, for example Fungia scutaria.
3. Rounded basaltic rocks with calcareous deposits on the

surface, brought by man to the atoll either as ballast or as ornamentation, and pieces of iron and cement (several of which had fresh tubes of marine worms attached), that would most logically be found in the lagoon where ships anchored, not off the turbulent windward reef.*

The bulk of the material in the bar was not recognizable as to source; however, as, of the pieces that could be so recognized, most were from beyond the outer edge of the reef flat, it is logical to conclude that most of the bar was from there.

At low-low tide level and below on the lagoon side of the windward islets few storm effects could be seen. Those few that were observed include the new offshore bars, either exposed at low tide or a few feet below the surface; the presence of storm-carried trees on the reef flats and on the slopes beyond the reef flats; and the presence of fine organic sediments in a few restricted areas.

Those familiar with Jaluit Atoll state that the offshore bars along the lagoon reef flat were built during the typhoon. The highest and most conspicuous of these was found near the outer edge of the lagoon reef flat off the northeast end of Jabor. The bar started in the north close to shore on the slope leading to the depths of the pass and continued southward, swinging away from the islet and lying near the outer edge of the reef flat, and finally curved back towards shore near the anchorage of Jabor in a rough "C"-shape. Its base rested on the reef flat slightly below the low-low tide level, and its top rose two to three feet, the top thereby being exposed at mid-tides. The slope towards the lagoon was gradual; the slope towards the islet was abrupt, being at the approximate angle of repose. The bar was usually about 50 feet wide. It was composed of rubble derived from long dead coral and other calcareous debris mostly of small size, an inch or less in diameter, several inches long; scattered about its surface were some larger pieces, up to about 6 inches in diameter. The source of the bar material was questionable, for all was old and discolored; however it would be logical to presume that some, at least, came from the northwestern tip of Jabor, which was cut away in the typhoon, and other portions, probably the bulk, came from the channel slope where similar pieces may still be found. The shape of the bar, no matter what the source, indicates it was formed by onshore waves from the lagoon.

It should also be noted that on the reef flat behind the bar, and at some spots in the bar, there were occasional larger heads of dead coral, up to several feet in diameter. These must have been carried on to the reef flat by previous storms, for all examined were found to be surrounded by delicately branching and unbroken live coral.

A bar, about 450 feet from shore, was found in the lagoon south of the anchorage at Jabor. It was similar in size, shape and composition to the one north of the anchorage, but differed in that its base was lower, and its top, about two feet higher than the base, lay near low-low tide level.

* Pieces of glass were also found (see pp. 12, 23).

Aerial inspection showed that the reef was an off-shore feature of most of the length of the long isthmus connecting Jabor with Jaluit. The source of the material in the bar could not be ascertained, but it is likely that it came from the detritus of the gradual slope into the depths of the lagoon.

No offshore bars were noted off the northern and leeward islets.

Along the shore, in the high intertidal zone, and continuing out to deep areas of the lagoon, were found storm-carried trees with their root masses intact. Most of the trees were either coconut or pandanus. Near shore most were lying on their sides, but some near shore, and all in the deeper water, were standing erect; the ones in deeper water were obviously buoyed by the trunks and sunk by the rocks captured in the root mass. Off the southern portion of Jabor, the only deep water inspected, they were found up to a thousand feet from shore, resting on a bottom eighty feet deep.

In only a few places were sediments composed of organic matter observed. They were most conspicuous in the lagoon off the middle of Mejatto. Here, on a ripple-marked sand bottom in ten to twenty feet of water, the depressions between the ripples contained thin deposits of loose black sediment, so low in specific gravity that it was stirred by the slight currents. Identifiable fragments of the sediment appeared to be decomposed plant material. No similar deposits were seen in gravel portions of the bottom.

Aside from these features and the bars built out from land, no observable change was found below the low-low tide level in the lagoon. In the zone of extreme low water even the delicately branching lagoon corals were unbroken. In none of the sectors examined were there any deposits of fresh sand, as indicated by the absence of recent sediment burying the lower portions of coral heads or lying between the bases of the dense coral patches on the reef flats, as for example within the new bar off the northern end of Jabor.

Similarly, inspection of both the ocean and lagoon sides of the leeward islets showed no obvious damage below low-low tide level. The gradually sloping flats on the lagoon side were of sand and had isolated massive complexes of many genera of corals, and these, including the fragile staghorn coral (Acropora grandis), were not broken. On the ocean side beyond the edge of the reef flat the gradually sloping bottom, covered with a continuous layer of growing coral, also showed no signs of damage. It is true that on the ocean reef flat there were scattered boulders of dead coral and that in the depressions on the flat there were coral fragments; but all of the former appeared to have rested long in their present locations, and fragments of coral, often rather fresh, are a common feature of such depressions.