

before they make their final contribution to the reef height. Boring and encrusting organisms frequently stop the growth of the colony or of a part of it. Eventually the entire colony may be broken loose by wave action and rolled down the side of the reef to a lower level.

In addition to this sort of delay in reef growth, complete stoppages occur. Each stoppage of the reef's growth leaves its mark in what is called an "unconformity" in the substance of the reef mass. Unconformities are thus caused by major disturbing factors such as a drastic change in sea level,¹³ the development of muddy or other unfavorable environmental conditions in the water of the area, and volcanic eruption. In many such cases, the fossil remains which are found on the unconforming surface in the reef mass are abruptly different from those above. At least one such unconformity was observed by Hoffmeister and his associates when they made core drillings into the reefs in the Florida Keys;¹⁴ and many such unconformities were observed in the (far deeper) drillings made in the Marshall Islands by the U. S. Geological Survey.

Thus it is seen that it would be absurd to think that the length of time which was required for the formation of a large reef could be calculated by merely dividing the depth of the reef by the average growth rate of healthy coral colonies. The upward growth of the reef is always much slower than the growth of the colonies. In fact, this phenomenon is self-evident in the observation that most of the numerous coral reef-flats in the Pacific which have been studied during the past 75 or more years are wearing down at about the same rate that they are being built up.¹⁵ Of course we are not saying that no material is permanently added to the entire reef-flat each year, but rather, that the leveling forces spread the deposited skeletal matter out over a wider area, broadening the entire reef as time progresses. This broadening can be compared to what we see when truckloads of gravel are spread upon the top of a large heap of crushed stone. The mass of gravel in the truck bed may be 4 feet in depth, but because it is being spread out on the top of the heap, it will add only a few inches to the total height of the heap.

There have been at least two very careful calculations made, of the total amount of coral skeletal material added per year to a given surface of reef, in areas where normal growth is going on. It is significant that none of the research on growth of corals which we are citing was carried out for the purpose of demonstrating that the reefs are of great age. These research projects were done with a view to showing the rate at which corals can be expected to build up barrier reefs which are of value in protecting harbors.

Mayor made a very careful series of observations to determine the amount of actual mineral (skeletal matter) which was being secreted and deposited per square yard on one of the typical, normally growing reef-flats. An extended period of observation and measurements made during the Carnegie expeditions of 1917 to 1920, to the Samoan Islands, under Mayor's supervision, revealed that the total thickness added to the reef flat per year was approximately 8