existence of a reef in the form of a barrier is evidence of subsidence in that region. On page 224 the existence of sand barriers of similar position is shown to be a common feature of coasts like that of eastern North America. In the cases of the barriers about the islands of the Pacific, however, there is no question on this point. Such barriers do not form about islands so small. Moreover, the great distances of the reefs from the shores, in many cases, and the existence of islands representing all the steps between that with a fringing reef and the true atoll, leave no room for doubt. The remoteness of the Australian barrier from the continent, and the great depth of water in the wide channel, show that this reef is unquestionable proof of a subsidence, — though it is not easy to determine the amount. Along the shores of continents, the question whether a barrier coral reef is evidence of subsidence or not must be decided by the facts connected with each special case.

In opposition to Darwin's theory of subsidence it is held by some writers that the sea-bottom may have been brought up toward the ocean's surface by deposits of other lime-secreting species, as those of the shells of Rhizopods, until they were near enough to become next a plantation of corals, and that, in this way, without any subsidence, atolls became common within the area of the tropical oceans. But the wide oceans are wonderfully free from such banks; and if they were used, the growing reef made over the submerged basement would fail of its deep lagoons. Excavation of lagoon basins has been attributed, by the opposing theorist, to the eroding action of the carbonic acid in sea water, carried by currents over the bank and through depressions that were likely to form about the center of the bank. But many large lagoons have no entrance, and generally there is only a shallow entrance; and currents have no power below the level of the entrance (or exit). J. Murray has proposed the theory that since the fringing reef widens outward by growth and wave-action, this process may be the sole cause of the width of reefs along shores. Against the opposing theories there are the positive facts, that elevated coral reefs and atolls exist, which have a thickness beyond 150 feet. Among the many facts there are the following: Metia, an elevated atoll, north of Tahiti, has a height of 250 feet, which is twice the depth of growing reef corals; Christmas Island, in the Indian Ocean, 1200 feet in height, has an exterior of coral-made terraces to its summit. For a full discussion of this subject reference may be made to the author's work mentioned in the note to the preceding page.

The following are the teachings of the coral reefs:

1. Beds of coral limestone and shell limestone are made (1) by accumulation through growth; 2) by the mechanical action of waves and marine currents; (3) by consolidation taking place as the work goes forward.

2. Limestones of the purest kind on a scale of great magnitude form in the *littoral* zone within seas not over 150 feet deep. The modern reefs in the midst of the ocean are narrow and have broad channels; but over a continental sea, the same methods would produce solid limestone formations of unsurpassed extent, fossiliferous or unfossiliferous, and also beach sand-rocks, conglomerates, and oölytes; and with the aid of the winds, wind-drift rocks of coral sand.

3. Great limestones are therefore not necessarily, or generally, of deep-water origin.

4. Limestones attain great thickness at the present time by means of a slow subsidence, as they have in all geological time.

5. Further: comparing littoral with abyssal conditions, we learn that the former make stratified deposits containing or consisting of remains of littoral life; the latter make unstratified deposits containing or consisting of