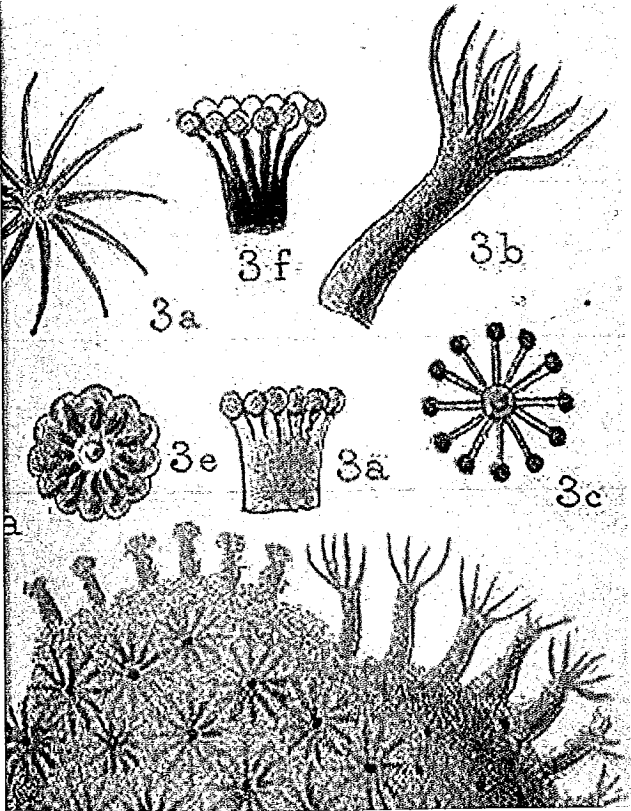


CORAL

Something Rich
and Strange



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14 Darwin's theory of coral reef formation

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Twenty years before Charles Darwin published his evolutionary theory he was already renowned for the elegant theory of coral reef formation he developed during his five-year voyage around the world (1831–36) on the British naval surveying ship HMS *Beagle*. This theory offered a new answer to a pair of well-known questions of the day: what was the origin of the low, ring-shaped reefs that we now call atolls, and why did they possess their characteristic form of a narrow reef encircling a shallow lagoon? Standing in the deepest parts of the ocean, hundreds or thousands of miles from high land, these reefs posed a great threat to navigation in the Pacific. Knowing why and how they formed where they did was a question of great practical significance for navigators, for it would aid in predicting their location and in gauging how quickly new reefs might form in areas that had already been charted.

The notion that the phenomena we call 'coral reefs' were created by coral animals dates to the late eighteenth century. Johann Reinhold Forster, the naturalist on James Cook's second Pacific voyage (1772–75), argued that these 'animalcules' possessed an instinct to erect structures from the floor of the ocean and to protect within them a calm inner lagoon where juvenile corals might flourish. Although Forster's claim that reefs were built by corals has been embraced ever since then, naturalists from the 1820s onward have doubted that reef-building corals could inhabit the deep waters of the ocean's floor. By 1831, the year Darwin departed England on the *Beagle*, a new theory had emerged to explain how shallow-water organisms could form a ring-shaped structure near the surface of oceans so deep as to be literally unfathomable using the lengths of rope most navigators carried on their ships. Indeed, the *Beagle's* Captain

FitzRoy was instructed by the British Admiralty to spend time during the voyage evaluating this 'modern and very plausible theory', which argued that atolls must be formed atop submarine volcano craters whose rims lay at the shallow depths in which corals could flourish.

Darwin joined the voyage as a twenty-two year old enthusiast of marine zoology, and he spent a great deal of his time in the first three years of the voyage studying the various plant-like colonial organisms then classed as 'zoophytes', including the non-reef-forming corals of the Atlantic. In the final year of the voyage, when the *Beagle* passed rapidly through the Pacific and Indian Oceans and encountered several atolls as well as reefs encircling the shoreline of high islands such as Mauritius, Darwin was struck by a new explanation for how and why atolls were formed. He claimed that ring-shaped reefs encircling a shallow lagoon were caused by sinking of the ocean floor in an area where an island like Mauritius had reefs growing around it. As long as this subsidence proceeded slowly or intermittently, so that the living corals were never drawn below the depths at which they could flourish, the tops of the reefs would remain near sea level while the island they surrounded eventually disappeared beneath the surface of the lagoon. At an intermediate stage in this process, reefs would parallel a coast at some distance, just as they did in encircling the island of Tahiti and forming a barrier to the tropical coast of northeast Australia. Darwin called upon his knowledge of geology to argue that such subsidence was likely in the Pacific. He used his experience in marine zoology to determine that different types of corals inhabited the inner and outer parts of a reef, arguing that an atoll continued to have the shape of the sunken island's coastline rather

Figure 48: Josiah Wood
Whymper, *Coral Reefs*,
1843, wood-engraving
with hand-colouring and
letterpress, published by
the Society for Promoting
Christian Knowledge,
London. Courtesy V&A
London



PARACYATHUS CAVATUS Alcock.
with *Pyrgoma stokesii*.

Telegraph Cable. 30 fms. 60 Miles.
S. W. of Bushire. Persian Gulf.
A. *Pyrgoma Stokesii*. B. Vertical section of a
specimen.

E. H. Townsend

Figure 49: Coral (*Paracyathus cavatus*) with coral-inhabiting barnacle (*Pyrgoma stokesii*), Manchester Museum, Zoology collection. Photo: Paul Cliff.

These corals – encrustations encasing the Persian Gulf Telegraphic Cable laid between Britain and Karachi – were collected in the 1860s by F.W. Townsend, Chief of the Telegraph Staff of the Indo-European Telegraph Company and later Commander of a ship repairing the telegraph cable in the Persian Gulf and Gulf of Oman.

Eimeo

“The island ~~Haiti~~ is completely encircled by a reef, with the exception of one small gateway; at this distance a narrow but well defined line of brilliant white where the waves first encountered the wall of coral, was alone visible; Within this line was included the smooth glassy water of the lagoon, out of which the mountains rose abruptly. The effect was very pleasing & might be aptly compared to a framed engraving, where the frame represents the breakers, the marginal paper the lagoon, & the drawing the Island itself.”

Charles Darwin, ~~Journal of Researches (Voyage of the Beagle), 1839~~
Beagle diary

than becoming filled in because lagoon corals were not robust enough to form solid reef rock.

This theory of reef formation was one of Darwin's chief achievements during the voyage and it contributed to his meteoric rise in scientific circles after returning to England in 1836. He described the theory in his extremely popular travel narrative, the 1839 *Journal of Researches* (now often published under the title *Voyage of the Beagle*), and he made it the topic of his first scholarly book, the 1842 *Structure and Distribution of Coral Reefs*. As Darwin worked on his evolutionary theory from the late 1830s to the late 1850s before publishing it in the 1859 book *On the Origin of Species*, his ideas of how to frame a theory and when to publish it were shaped by the experience of producing his first great theory, that of coral reefs.

References

- Charles Darwin, *The Structure and Distribution of Coral Reefs: Being the First Part of the Geology of the Voyage of the Beagle, Under the Command of Capt. Fitzroy, R.N. During the Years 1832 to 1836* (London: Smith, Elder and Co., 1842).
- Brian Roy Rosen, 'Darwin, coral reefs, and global geology', *BioScience*, 32.6 (1982), pp. 519–25.
- David R. Stoddart, "'This Coral Episode': Darwin, Dana, and the Coral Reefs of the Pacific", in Roy M. MacLeod and Philip F. Rehbock (eds), *Darwin's Laboratory: Evolutionary Theory and Natural History in the Pacific* (Honolulu: University of Hawaii Press, 1994), pp. 24–48.
- David R. Stoddart, 'Darwin, Lyell, and the Geological Significance of Coral Reefs', *British Journal for the History of Science*, 9 (1976), pp. 199–218.