

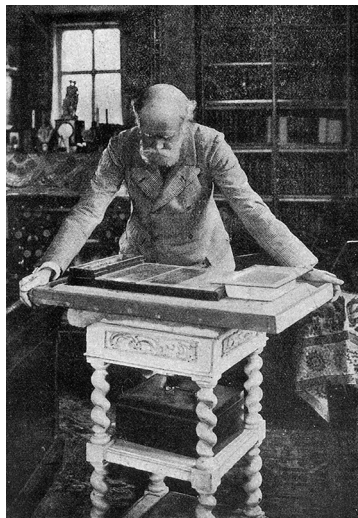
Chapter 2

Seeing Corals with Darwin's "Eye of Reason": Discovering an Image of a Tropical Atoll in the English Countryside

Richard Milner

In the leafy town of Orpington, at the southeastern edge of London's suburban sprawl, and about 5 m from Charles Darwin's home in Downe Village, there sits a medieval stone hall called the Priory, which is now the Bromley Museum. Among its local-history memorabilia, the Priory contains a treasure trove of nineteenth-century watercolors that were commissioned in 1869 by Darwin's wealthy neighbor: the banker-scientist John Lubbock (1834–1913), later Lord Avebury, who lived up the hill in his father's 22 room mansion called High Elms. Their relationship was a special one, with Lubbock being Darwin's one and only student, his "apprentice."

John Lubbock, Darwin's neighbor and "apprentice," studied captive colonies of social insects in his mansion, c. 1880s. Photo Courtesy of the Lubbock Family.



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When I visited the Priory about 20 years ago, I was introduced by then curator Adrian Green to the 19 Ernest Griset (1844–1907) paintings from around 1870—almost all of which depict scenes from human prehistory. At the time I first viewed them, they had never been on public display and had been archived in a tiny stone storeroom in back of the museum. Spear-toting hunters chased bison, woolly mammoths, or seals in some of the paintings, while others depicted tribal life during the Paleolithic and Neolithic—both terms coined by Lubbock in his 1865 book *Pre-historic Times*. I had sought out the opportunity to see these paintings, which are some of the first serious attempts at paleoart—a genre in which a scientist and artist collaborate to combine the latest archeological data with imaginative reconstructions of the remote past (Fig. 2.1).

My heart raced when Green pulled out an unexpected oceanic image among the hunting scenes. We had been looking at depictions of hunters in boreal wilderness, but suddenly here was a triptych of a placid, enchanting coral island encircling a blue lagoon, fringed by palm trees, ringed with white sand, and devoid of human inhabitants.

“This one is signed and dated 1871 by the same artist, Ernest Griset,” Green explained, “but we don’t have any idea what it is about, or why a detailed depiction of an uninhabited tropical coral atoll is archived here with Lubbock’s pictures of prehistoric Europe.”

I noticed that the artist had sketched a familiar-looking sailing ship near the horizon of the central panel. Here was an important clue: Was it meant to be Darwin’s ship, HMS *Beagle*, approaching the island? (Fig. 2.2)

Darwin loved coral lagoon islands. He theorized about their origins and provoked bitter controversy when, in 1842, he published his *first* scientific book, *The Structure and Distribution of Coral Reefs*. In it, Darwin described three types of coral reefs: *barrier reefs*, which rise like walls out of the sea, separated from land



Fig. 2.1 Ernest Griset’s dramatic watercolor of a Paleolithic bison hunt was commissioned by Sir John Lubbock, one of the leaders of the “Prehistoric Movement” in Victorian anthropology.



Fig. 2.2 Central panel of Ernest Griset's triptych of a tropical atoll, perhaps intended to be Keeling Island (now in the Cocos group), the only coral island personally explored by Charles Darwin and Captain Robert Fitzroy in 1836.

by a channel: *fringing reefs*, which stretch along a shoreline; and *atolls*, which are circular islands that enclose a lagoon, like the one in Griset's painting.

Could this be a long-lost representation of one of his favorite atolls, intended by Lubbock as a gift for the 62-year-old Darwin in 1871—with the approaching *HMS Beagle*—to surprise and delight his lifelong mentor? (Fig. 2.3)

Long before Darwin became interested in coral reefs and atolls, sailors and explorers had wondered how they originated. Some had seriously suggested that fish—working together by the thousands—had built the structures by carrying grains of sand in their mouths. Others realized that the reefs had been built by billions of tiny soft-bodied polyps (which Darwin and his grandfather Erasmus had called “coral insects”) that secreted cells of calcium carbonate around themselves (Gilman 1899: 210). But why were such huge geometrical forms created, and how did they take on their circular shapes? Some naturalists considered coral reefs to be communal homes, like wasp nests or beehives, only on a much grander scale. No one yet had any idea of how deeply these structures were anchored in the sea, or how long it might have taken to produce one.

As the *Beagle* sailed off the Chilean coast in early 1835, Darwin witnessed a volcanic eruption in January and got caught in a major earthquake on land in February. He realized that these earth movements exemplified the doctrine advanced by the geologist Charles Lyell in his newly published *Principles of Geology*: that given enough time the small, steady, continuous action of natural forces can produce major geological features. He had taken Lyell's books along on the voyage, and found them quite liberating from the biblical dogma he had been studying at

Fig. 2.3 Medium blowup detail of the ship in Earnest Griset's watercolor shows a striking resemblance to HMS *Beagle*. Courtesy of the Bromley (Priory) Museum, Orpington, and the Lubbock Family.



Cambridge. Invoking supernatural or Divine forces driving cataclysms would no longer be necessary to explain how major geological features were formed.

Exploring inland and along the coast, Darwin and Captain Robert Fitzroy found clear evidence of very recent uplift of the land. Mussel beds rotting 10 ft above the waterline, still adhering to the raised rocks, reminded Darwin of marine shells he'd seen near Valparaíso fully 1300 ft above sea level—plausibly, the legacy of eons of relatively small incremental upthrusts. Darwin later wrote to Scottish geologist Leonard Horner in 1844, that even “when seeing a thing never seen by Lyell, one yet saw it partially through his eyes.” (Burkhardt and Smith 1988: 55)

And so, too, was Darwin now able to theorize about things he had not yet seen—coral reefs, for instance. He concluded that “successive small uprisings, such as that which accompanied or caused the earthquake” were lifting up the land, as were oceanic volcanoes—which he observed in the Galapagos. Such uplift, however, ought to be counterbalanced by oceanic subsidence. If so, it would explain reefs and atolls, and seemed to suggest that many areas of the ocean floor in the Pacific were indeed sinking. As Darwin put it, “we must look at a Lagoon Island as a monument raised by myriads of tiny architects, to mark the spot where a former land lies buried in the depths of the ocean.” (*Beagle* Diary 1839: 418)

Since coral need to live at a depth where they can receive sunlight, they keep growing toward the light seeking optimal conditions for survival, while the mountaintop around which they were anchored keeps sinking. As marine geologist, William Menard put it in a 1920 reissue of Darwin's coral reef book, "At times, Darwin seems to be concerned with the origin of coral reefs only insofar as it gives evidence for regional subsidence of the seafloor."

From April 2nd through 12th, 1836, Darwin and Fitzroy explored the Cocos, or Keeling, Islands in the northeast Indian Ocean, which was the first time Darwin actually set foot on a coral island. He noted in his diary "such formations surely rank high among the wonderful objects of this world."

Historian of science Randal Keynes—Darwin's great-great grandson—wrote me that he rates Darwin's account of his time on the Keeling Islands as one of the key passages in the whole *Journal of Researches*. "What makes the importance of the view for him particularly clear is the language of his first account of it in his diary entry for 6 April 1836. [In her book on Darwin as a geologist, Sandra Herbert also remarks on it.] He was already using his highest word, the one he eventually chose to start the last sentence of the *Origin*, together with another that resonates with it in a very special way: 'I can hardly explain the cause, but there is to my mind a considerable degree of grandeur in the view of the outer shores of these Lagoon islands. There is a simplicity on the barrier-like beach.'" (Darwin, *Beagle Diary*, Keeling Islands, 6 April, 1836) Keynes finds this usage strikingly reminiscent of the famous last sentence of *On the Origin of Species*:

There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved. [Underlines added.] [Darwin, *On the Origin of Species*, 1859]

Darwin's admiration for the Keeling atolls spurred him to complete a theory of coral reef formation, which he had conceived after experiencing the earthquakes in Chile, and developed further after seeing the spectacular, reef-ringed volcanic island of Moorea (then called Eimeo), near Tahiti, in November 1865. (Mysterious-looking Moorea, now part of French Polynesia, was said to be lyricist Oscar Hammerstein's model—though not originally novelist James Michener's—for the fictional island of Bali H'ai in the classic musical *South Pacific*; it is not far from Teiaroa, the atoll that Marlon Brando purchased in the 1960s.) Although the *Beagle* did not land on Moorea, Darwin got a very good view of it by climbing a Tahitian mountain to a height of over 2000 ft. He was greatly impressed by the island's skyline of jagged volcanic peaks rising abruptly from the mirror-still lagoon sheltered by its encircling barrier reef. He was seeing direct evidence that vast areas of the ocean floor—not just larger landmasses—were seething with activity, both seismic and generated by the activities of organisms. In the *Beagle Diary* for April 12, 1836, he wrote:

I am glad we have visited these [Keeling] Islands; such formations surely rank high amongst the wonderful objects of this world. *It is not a wonder which at first strikes the eye of the body, but rather after reflection, the eye of reason.* [Italics added] We feel surprised when travelers relate accounts of the vast piles & extent of some ancient ruins; but how insignifi-

cant are the greatest of them, when compared to the matter here accumulated by various small animals. (*Beagle* Diary, 12 April 1836: 418)

Upon his return to England, Darwin could not wait to explain his theory of coral reefs to Lyell. Less than a month after the *Beagle* docked, the two men met for the first time. Lyell later wrote to Darwin, “I could think of nothing days after your lesson on coral reefs, but of the tops of submerged continents. It is all true, but do not flatter yourself that you will be believed, till you are growing bald, like me, with hard work & vexation at the incredulity in the world.” (Ch. Lyell, letter to CD, 13 Feb 1837)

Darwin’s theory, according to coral expert and historian of science David Stoddart, differed from Lyell’s. Stoddart says, “Lyell had suggested that the corals colonized the rims of slightly submerged volcanic craters. Darwin on the other hand proposed a sequential transformation of fringing reefs into barrier reefs and then into atolls as the corals continued to grow upwards through repeated slight movements of subsidence of the usually volcanic reef foundations.”

Darwin starts with the fact that live reef-building corals grow only in shallow water. He combines that with the observation that reefs seem to be associated with seamounts, or submerged volcanoes that are subsiding. Accretions build up as millions of coral animals secrete calcium carbonate atop the accumulated skeletons of old colonies. As the “basement” on which all are resting continues to settle, the “live areas” thrive only near the surface, where they can receive sufficient light to generate food. In other words, colonies keep reaching upwards to receive sunlight, while the ocean floor beneath them keeps sinking. This process, by which the tiny “coral insects” can create great reefs miles long and thousands of feet thick, filled him with awe and admiration:

The naturalist will feel this astonishment more deeply after having examined the soft and almost gelatinous bodies of these apparently insignificant [creatures,] and when he knows that the solid reef increases only on the outer edge, which day and night is lashed by the breakers of an ocean never at rest. (Darwin 1844. *Geology of the Beagle*, Coral Reefs. Keeling Island: 2/4)

He was further amazed to find that one species of corals thrived only in the calm, clear waters of the lagoon, while another, much hardier species inhabited the edges, where they were not disturbed by the violent poundings of the crashing waves (Fig. 2.4).

Another contributing factor to Darwin’s fascination with coral reefs was that his grandfather Erasmus, as in many other subjects, had influenced his thought. Erasmus died 7 years before he was born, but Charles grew up with his grandfather’s innovative books always close at hand. A physician, philosopher, botanist, inventor, and poet, Erasmus Darwin was the first naturalist in Europe to publish a coherent theory of evolution, anticipating many of Charles’s ideas by 70 years—and he wrote much of it in verse.

The Darwin family’s ancestral coat of arms consisted of three scallop shells in a row. Erasmus flamboyantly added the motto *E conchis omnia* (“everything from

Fig. 2.4 In extreme close-up, Griset's deft rendering of the ship with a few brushstrokes confirms its resemblance to the sloop-brig HMS *Beagle*, complete with dots along the hull to represent its gun ports.



shells”) to the family escutcheon. In 1770 he had it painted on his carriage, but later removed it when the local cleric’s accusations of blasphemy threatened his medical practice. It had been the eighteenth-century equivalent of displaying an evolving “Darwin fish” bumper sticker on an Alabama ambulance. The clergyman lambasted Erasmus in verse for “renouncing his Creator”:

And forms all sense from senseless matter.
Great wizard he! by magic spells
Can all things raise from cockle shells (King-Hele 2007: xv)

Throughout the nineteenth century, Darwin’s theory of reef formation remained contentious. Alexander Agassiz, son of the anti-evolutionist Harvard zoologist Louis Agassiz, spend 40 years and his considerable fortune visiting hundreds of the world’s reefs, but died before he could write out his own contradictory theory. For some decades, around the turn of the twentieth century, Darwin’s coral reef theory, like his evolution theory, fell out of favor with scientists, but eventually both rebounded with renewed vigor. The saga of the controversies it engendered has been beautifully told in *Reef Madness: Charles Darwin, Alexander Agassiz, and the Meaning of Coral* (2005) by David Dobbs.

Agassiz and others thought they had found reefs forming in areas where the seafloor was lifting rather than sinking. Some geologists even blasted Darwin’s method of doing science. Rather than seeking patterns of coral reef distribution from charts and maps, they argued, he needed to visit more reefs first-hand, as they had done. However, Darwin thought that more visits to reefs were pointless unless “some double rich millionaire” could be induced to make deep core drillings that would reveal their structure and history.

Not until 1950—while preparing to test nuclear bombs on Eniwetok, a remote coral atoll in the Marshall Islands, near the equator in the Pacific Ocean—did science find definitive answers. Prior to testing a hydrogen bomb there, the US Government sent geophysicists to drill test cores of the coral deeper than anyone had previously attempted. Dobbs relates that finally, at 4200 ft, the drills hit bedrock, which turned out to be:

a greenish basalt, the volcanic mountain on which the reef had originated. Dating of the tiny fossils in the bottommost layer of coral showed that the reef had gotten its start in the Eocene. For more than thirty million years this reef had been growing—an inch every millennium—on a sinking volcano, thickening as the lava beneath it subsided. Darwin was right, Agassiz wrong (Dobbs 2005: 255).

Over the next few years, many more drillings and echo soundings confirmed that with rare exceptions reefs had formed only in areas of sea floor subsidence all over the Pacific and Caribbean. Darwin's 1842 model fit perfectly with the new understanding of plate tectonics, which only developed in the 1960s. In Dobbs' words, "the movement of the earth's huge plates explains the subsidence of the Pacific and many other reef areas... Darwin's theory was astoundingly correct."

Neither Darwin nor Lubbock ever used any of Griset's paintings to illustrate their books. By the mid-twentieth century, the artworks had been removed from High Elms. That was fortunate because in August 1967 the great mansion burned down (oddly, on "St. Lubbock's Day," as a grateful populace had dubbed the secular bank holiday Lubbock instituted), and the grounds are now a public park and nature reserve.

In 1869, when Lubbock commissioned Griset to create the "prehistory" series of early humans, as well as the triptych of the coral atoll, Darwin was preparing to reissue a revised and updated edition of *The Structure and Distribution of Coral Reefs* on the 30th anniversary of its initial publication. The timing makes it plausible that Lubbock planned to surprise Darwin with the atoll painting to commemorate this significant milestone. An enlargement of the little detail of the sailing ship is reproduced here. It is unmistakably meant to be a classic brig-sloop of the Cherokee class, even bearing a characteristic horizontal stripe and gun ports along the hull—all identifying characteristics of HMS *Beagle*.

When understood in historical context, Griset's lovely image of the coral lagoon island makes perfect sense. It has nothing to do with prehistory but a great deal to do with Lubbock's affection and admiration for his teacher, who opened his "eye of reason" to human prehistory, evolution, and the structure of coral reefs and atoll islands (Fig. 2.5).

In Griset's rendering, the beautiful coral island appears isolated in the ocean beneath a vast sky—desolate, jewel-like, unsullied, and mysterious. Locked away for many English winters in its stone-brick storeroom at the Bromley museum, the Darwin-inspired watercolor of a dreamlike tropical lagoon has survived since 1871. During the past few years, the paintings have been exhibited to the public and loaned out for various shows. For anyone who sees it, or a reproduction, the atoll triptych delights new generations with its unpretentious beauty—as well as its subtle commemoration of the familiar sailing vessel that is fast approaching the "fairy" island.



Fig. 2.5 Full extension of Ernest Griset's 1871 watercolor triptych of a tropical atoll, which languished for a century in a museum storeroom among a cache of "paleoart" commissioned by John Lubbock. The paintings were made shortly before Darwin's 1874 reissue of his 1842 treatise on *Coral Reefs*. Courtesy of the Bromley (Priory) Museum, Orpington, and the Lubbock Family.

The painting seems to hint that the spectacular and complex natural marvel eternally awaits the arrival of Captain Fitzroy's brig-sloop, with its young "man of enlarged curiosity" aboard who seeks to elucidate its mysteries.

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