

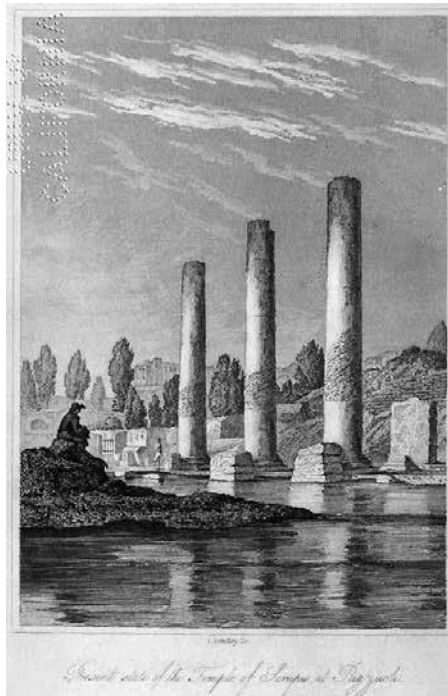
The columns of pozzuoli—reading

Mediterranean clams and limestone columns built by the Roman Empire in Pozzuoli, Italy, played an unexpected role in the 19th-century's emerging field of geology. Observations of the columns supported the idea that large landscape features—like mountains, canyons, and plains—could result from slow, everyday processes operating over long periods of time. This Italian site played such an important role in Charles Lyell's principle of uniformitarianism that a picture of the columns found its way to the frontispiece of his influential book *Principles of Geology*, first published in 1830 by John Murray (see Figure 9.2).

The key mystery of the marble columns was the origin of holes drilled into the rock. The pattern of the holes made a dark wide ring on each of the 40-foot-tall columns. Each ring extended from about 12 feet above the base to about 21 feet above the base, as seen in Figure 9.2. The character of these holes matches the borings of the marine clam *Lithodomus*, and some of the holes still have shells in them. Today, this

Figure 9.2

Illustration of the columns of Pozzuoli



Source: Reprinted from frontispiece of *Principles of Geology*, Vol. 1, by Charles Lyell (London: John Murray, 1832). Available at https://en.wikipedia.org/wiki/Macellum_of_Pozzuoli#/media/File:Charles_Lyell_-_Pillars_of_Pozzuoli.jpg.

clam lives in seawater (not freshwater) and bores into stones, piers, and boat moorings below low tide. The mystery was, How did the borings of a marine clam get into stone columns that were nearly 600 feet from the shoreline?

Charles Lyell believed that this feature showed that sea level had changed through time, not suddenly by some catastrophic event but gradually. Clearly, the columns were built above sea level, and are above sea level today, but in between the sea must have partly covered them.

The fact that there were no borings in the lower part of the columns puzzled people. If the middle of the columns was below sea level, then wouldn't the bottom of the columns also be below sea level and also bored by the clams?

When the columns were excavated in the 1700s, information about the sediment that had been around them was lost. However, Lyell and others proposed that the lowest part of the columns had been covered by sediment or volcanic ash at the time of the sea-level rise. Thus, the bottom of the columns did not get bored by the clams because this variety of clam did not live within the sediment.

Other people had different ideas about what the holes in the columns meant. Some people argued that convulsions of the Earth significant enough to change sea level would have toppled the columns. In response, Lyell noted that other buildings were submerged beneath the sea without being destroyed. He gave the example of houses of the fort of Sindree on the Indus River

delta, which were covered with seawater when the ground of the delta subsided (lowered) in 1819.

Other people proposed that the sediment that covered the bottoms of the columns may have dammed up the outlet to the sea, causing rainwater to pond around the columns. If so, they argued, then the observations could be explained without a gradual sea-level change.