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Geomythology: geological origins of myths and legends

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Abstract: Myths and geology are related in several ways. Some myths are the result of man's attempts to explain noteworthy features of his environment, such as striking landforms or unusual smaller features, whereas others try to account for conspicuous natural processes, such as earthquakes, volcanic phenomena, and floods. Local myths have sometimes proved helpful in solving geological problems, and even the geological nomenclature is indebted to mythology. Examples of each kind of relationship are given.

As a child, I loved to read Greek and Roman mythology. Later, in my professional work, I was intrigued to encounter occasional references to these myths in geological papers, and I began to collect them just out of curiosity. Then, when the first papers linking Santorini and Atlantis appeared, I gave a review of that theory to the Department of Geology at Indiana University. A member of the Indiana University Press was present, and after the talk he said, 'Why don't you do a book on Atlantis?' I replied, 'There already have been many books written on Atlantis, but I could do one on the relationship between myth and geology'. At the time the book appeared (Vitaliano 1973), I did not realize that geomyths would prove to have very practical applications, and would be taken seriously enough to find a way into a scientific symposium at an International Geological Congress.

Myth and geology are related in several ways. First, man has always sought to explain his natural environment. A good example of this is Devil's Tower in the state of Wyoming (Fig. 1). Originally interpreted as a volcanic neck or plug, closer study revealed that it is the eroded remnant of a more extensive body, a laccolith. Two Indian tribes living in the vicinity have slightly different stories accounting for its unique shape (Mattison 1967), but both involve a group of people being pursued by a giant bear, appealing to their deity for help, and having the ground on which they stood uplifted beyond the reach of the animal (Fig. 2). The fluting of the columns, a classic example of columnar jointing, is explained as the claw marks made by the bear as it tried to reach them.

Another example of a myth inspired by unusual topography is the island of Mangaia, one of the Cook Islands in the South Pacific (Fig. 3). The central core of the island is an eroded volcano, which is surrounded by a moat-like depression, and this in turn is surrounded by a raised platform of eroded coral rock called the Makatea, 110–210 feet above sea level. A terrace at the base of this cliff slopes gently toward the sea, ending in a low cliff, and surrounded by a fringing reef of coral.

According to the myth, the island was once smooth and regular, with gentle slopes (Marshall 1927). One day the god of the sea and the god of rain had a contest to see which was more powerful. The sea god, aided by the wind god, attacked the island and eroded it to the height of the Makatea. Then the rain god caused it to rain for five days and nights, washing clay and stones into the ocean and carving deep valleys into the slopes, until only the flat top of the original surface remained. The inhabitants of the island took refuge on this peak, and as their situation became more and more precarious, their chief appealed to their supreme god, who ordered the others to stop the contest.

This myth explaining the island's unique shape reflects an appreciation of the role of running water and storm waves in shaping the landscape. In geological terms, the island was a volcano built up on the sea floor. After its activity had ceased, it was eroded down to sea level. Then it was elevated above sea level and subjected to weathering and erosion, while a fringing reef of coral grew around it. Gradual subsidence then allowed the coral to grow upward to become a barrier reef, separated from the land by a lagoon. Re-elevation of the land left the barrier reef high and dry, forming the Makatea, and the lagoon became the moat-like depression.

The Pacific islands have inspired many other landform myths, including a number of 'fishing-up' myths which explain the presence of certain islands (Nunn 2001, 2003). 'Fishing-up' myths generally tell of a god who, while fishing, hooks his line on the sea bottom and hauls up rocks and other features that assume the specific configurations of the islands in question.

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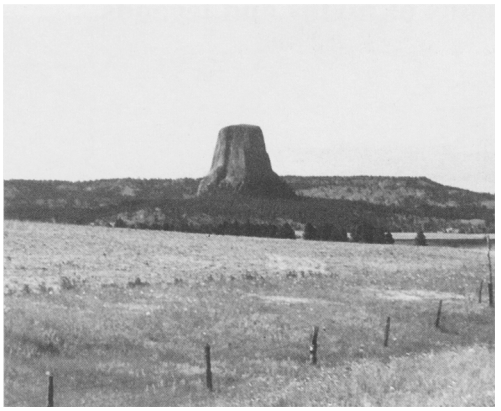

Fig. 1. Devil's Tower, Wyoming.

Nothing is too small to inspire geomyths. In volcanic eruptions, small droplets of molten lava can be blown by winds from the surface of a lava flow, or from a lava fountain, usually trailing a thread of spun glass. These can pile up (Fig. 4)

Fig. 2. The Indian legend explaining the shape of Devil's Tower, Wyoming. (Courtesy of the US National Park Service.)

into what the Hawaiians call Pele's hair (the threads)—Pele being the Hawaiian volcano goddess—and Pele's tears (the droplets). These terms have been adopted into the scientific nomenclature, and that fact constitutes yet another example of the relationship between myth and geology. For that matter, we are indebted to mythology for the very word volcano, from Vulcan, the Roman god of fire, whose forge was thought to be in Mt Etna.

The Hawaiians believed that Pele came to the islands because she was fleeing the anger of her older sister, whom she had somehow offended. First she came to the northwesternmost island, where she dug a pit in search of fire, but her sister chased her to the next island, and the next, and so on down the chain until she took up residence in Halemaumau, the fire pit on Kilauea volcano (Fig. 5). Then the sister gave up the chase, and there Pele and her relatives are said to live today.

This myth indicates that the Hawaiians were keen observers of their environment, for the volcanism becomes younger as one progresses down the chain, all activity in historic times being confined to the big island, Hawaii, except for the last eruption on its neighbouring island, Maui. That is because the island chain is passing over a hot spot in the earth's mantle. Submarine eruptions SE of the big island indicate that a new island is in the process of being created.

Myths have also been invoked to explain geological processes, particularly those manifested violently, such as earthquakes, volcanic eruptions and floods. In Japan it was believed that a giant catfish in the earth was responsible for earthquakes (Ouwehand 1964). This catfish was usually pinned down by the Kashima deity (Fig. 6), but when this god had to pay attention to other matters, the catfish was left free to wriggle and a quake resulted. The association of catfish with earthquakes may not be entirely fanciful. Unusual activity in catfish was long believed to portend a quake. Elsewhere in the world, unusual behaviour in various creatures has also been taken to be a sign of an impending shock, and it has been suggested that they might be sensitive to small changes in one of the Earth's force fields, such as the geoelectrical field. At Tohoku University in Japan, experiments were actually carried out to test this idea. A small stream was diverted to flow through a tank of catfish, and their response to a tap on the glass was recorded. It did seem as though the fish were more agitated by the tapping shortly before a shock, but the results were not definitely conclusive.

Some geomyths actually constitute a record of major geological events. Beautiful Crater Lake in the state of Oregon in the United States is a volcanic caldera (Fig. 7). It was created by an eruption of

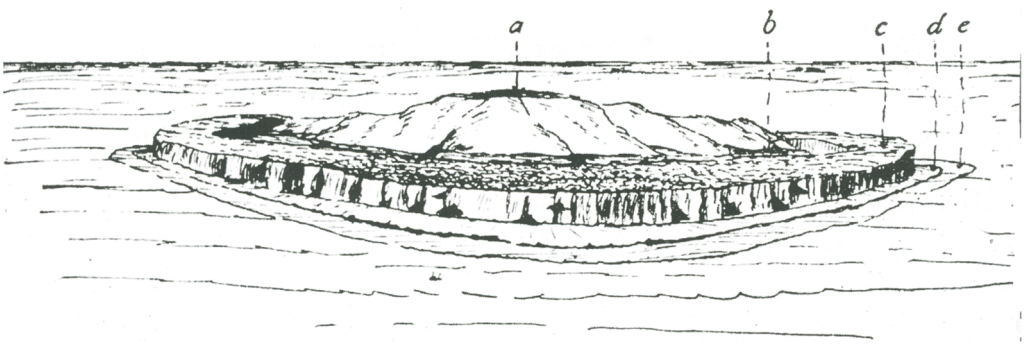

Fig. 3. The island of Mangaia in the South Pacific (after Marshall 1927).

Mt Mazama in the Cascades Range (Fig. 8). According to the myth of the Klamath Indians, Llao, the chief of the Below World, standing on Mt Mazama, was battling Skell, the chief of the Above World, who stood on Mt Shasta in California, about a hundred miles away (Clark 1953). They hurled rocks and flames at each other, and darkness covered the land. The fight ended when Mt Mazama collapsed under Llao and hurled him back into his underworld domain. The large hole that was created then filled up to form Crater Lake.

This sounds like an eye-witness account of such an eruption, and it undoubtedly is, for Indian artifacts have been found buried in the Mazama ash. The eruption has been radiocarbon-dated to about 6500 years ago on the basis of Indian sandals found in the ash, but had no datable materials been found, this myth alone would have served to date the eruption as post-Pleistocene, because this part of the world was first inhabited by people who crossed the Bering Land Bridge and migrated down through Alaska and Canada into the northwestern United States.

A myth also helped to solve a geological problem for the German volcanologist Jörg Keller. He was able to date the last eruption in the Lipari Islands, off the coast of Italy, on the basis of a local legend (Keller 1970). Ash from that eruption overlies Roman ruins on Vulcano that date from the fourth and fifth centuries AD (Fig. 9). According to a local tradition, a hermit named Calogero, who lived on Lipari and was later made a saint, was credited with having driven the devil and his fires from Lipari (Fig. 10) to Vulcanello, and as that was still too close for comfort, on to Vulcano. As St Calogero is known to have lived from AD 524–AD 562, Dr Keller inferred that the eruption must have occurred some time between AD 500 and 550.

Flood legends appear in the mythology of so many cultures that a universal flood has often been invoked to explain their prevalence. Many of them, however, appear to be purely of local origin. The myth of the Makah Indians on the Pacific coast of the state of Washington is such a one (Andree 1891). The sea is said to have risen and fallen several times in the course of a few

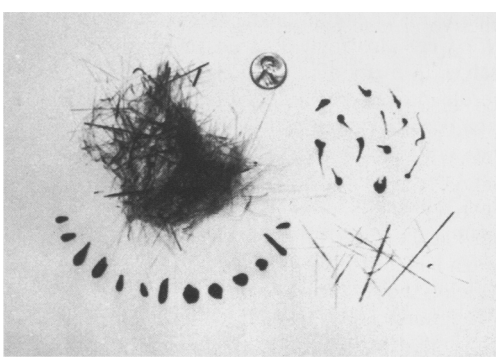

Fig. 4. Pele's hair and Pele's tears, formed from wind-swept molten lava. (Photo by C. J. Vitaliano.)

Fig. 5. Halemaumau, the 'fire pit' of Kilauea volcano. (Photo by C. J. Vitaliano.)

Fig. 6. The Kashima deity immobilizing the catfish believed to cause earthquakes. (Drawing by Kenzo Yagi.)

days. The people took to their canoes and rode it out safely, though some of them were carried far to the north and stayed there. Such a rise and fall of the sea is typical of tsunamis, and the west coast of Canada and the United States is very susceptible to tsunamis resulting from Alaskan earthquakes, such as the one recorded at Crescent City in northern California in 1964.

Noah's flood is a story so compelling that for centuries it has demanded a scientific explanation. The story clearly refers to an inundation so large that its survivors assumed that the whole world had been affected. People have long sought to tie the Flood to a specific event and location, but only recently has a plausible explanation, based on sound scientific research, been proposed. Ryan & Pitman (1999) hypothesize that postglacial melting elevated sea levels to the extent that the Mediterranean broke through into the Black Sea depression, drowning out so many settlements that a universal flood legend resulted. I am not only convinced that this is the true explanation of the Flood, but I am also impressed with how quickly and effectively these two scientists have brought this long-elusive story into the realm of science-based geomythology.

The Flood is a prime example of a famous story that has generated a powerful demand for scientific explanation, a process that appears to be driving much current geomythological research. Another one is the Atlantis story, which has probably given rise to even more speculation as to its origin than the Flood. There are very few parts of the world that have not been proposed as the location of Atlantis, but not until 1960, when the Bronze Age eruption of Santorini in the Aegean Sea was suggested as the cause of the demise of Minoan Crete (Galanopoulos 1960), did there seem to be a truly plausible geological basis for the idea. True, it was not a whole continent that disappeared, only most of a small island, but a great empire appeared to have declined quite suddenly.

My late husband and I became involved in that problem as a result of our having been invited to the first Santorini congress in 1969, and the two subsequent congresses in 1978 and 1989. Because no artifacts were found on Santorini which represented the latest Minoan period, the time when they were at the very peak of their power, the ash layers deposited in that eruption were initially interpreted as the result of a three-stage eruption (Fig. 10): first, a violent phase which frightened the inhabitants away, then a period of intermittent minor eruptions, during which time they returned to recover their possessions (Fig. 11), and finally another violent stage, which drove them away and left nothing for them to return to.

The first congress was convened by Professor Spyridon Marinatos, who was excavating Santorini, to bring archaeologists and geologists together in the hope that they could determine the duration of the middle stage of the eruption to see if it fitted with this interpretation of the archaeological data (Marinatos 1971). To make a long story short, having observed that there was considerable misunderstanding among the archaeologists concerning the preservation of ash deposited in such an eruption, my husband and I offered to examine samples collected in archaeologically dated levels. We were also invited to do such collecting ourselves in many digs on Crete and on Melos. The results proved conclusively that the Santorini eruption occurred about two generations before the collapse of Minoan Crete, enough of a time lag to rule out cause-and-effect (Vitaliano & Vitaliano 1978). So, reluctantly, we had to recognize that the Santorini–Atlantis theory does not have a scientific basis and that the entire Atlantis story itself may ultimately prove to be nothing more than a fiction, made up by Plato to prove a philosophical point.

These and other important myths and stories, many of classical or biblical origin, are stimulating current scientific research in geomythology because previous explanations have generally failed to

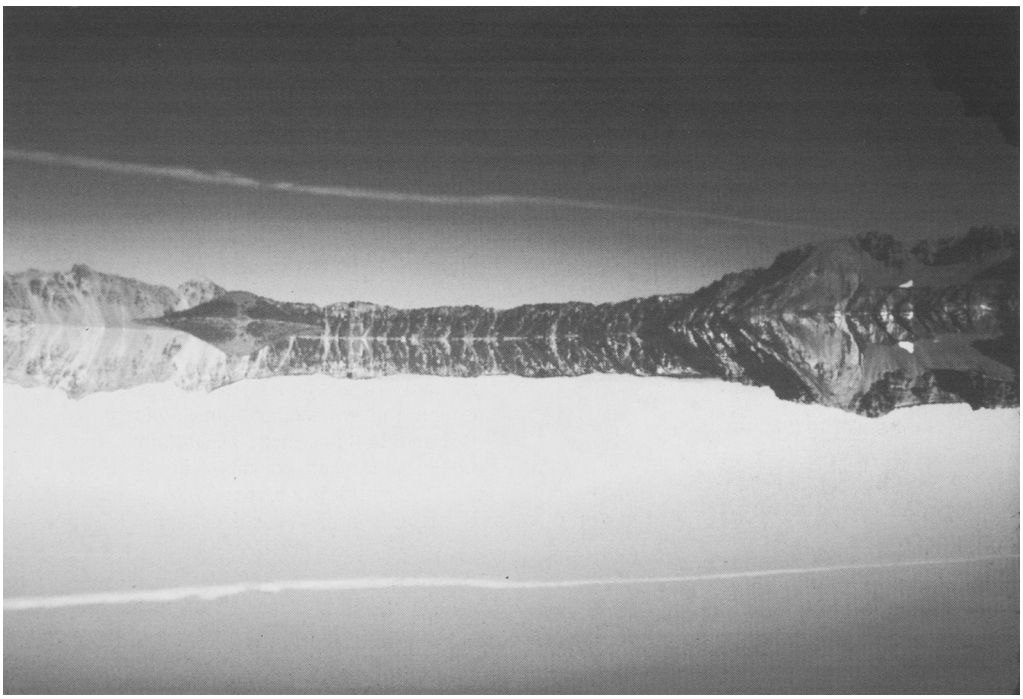

Fig. 7. Crater Lake, Oregon. (Photo by C. J. Vitaliano.)

withstand scientific scrutiny. Others include the Oracle of Delphi, the parting of the Red Sea, the destruction of Sodom and Gomorrah, and the Loch Ness monster.

It is interesting to compare the various outcomes of geomythological research aiming to shed light on these famous stories. Whereas Noah's Flood appears finally to have found a sound explanation, Atlantis now seems unlikely to find one. Interestingly, the Oracle of Delphi may have a geological explanation that confirms ancient accounts of intoxicating gases emanating from underground fissures (Piccardi 2000; De Boer *et al.* 2001), following an interim where early modern scientists had concluded that there was no such explanation for the Oracle's prophecies. As for the parting of the waters before the fleeing Israelites, the destruction of the sinners in Sodom and Gomorrah, and the

Fig. 8. Artist's concept of Mt Mazama in eruption whose collapse created the Crater Lake caldera. (Painting by Paul Rockwood on exhibit at headquarters of Crater Lake National Park.)

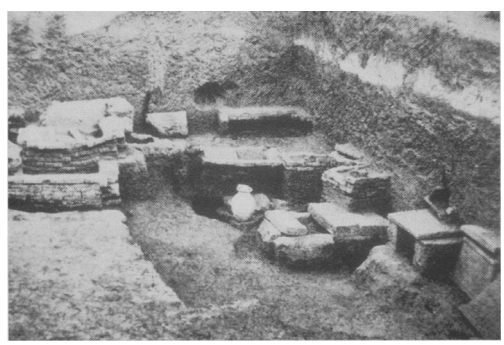

Fig. 9. Roman ruins on Vulcano, overlain by ash from the last eruption of Vulcanello.

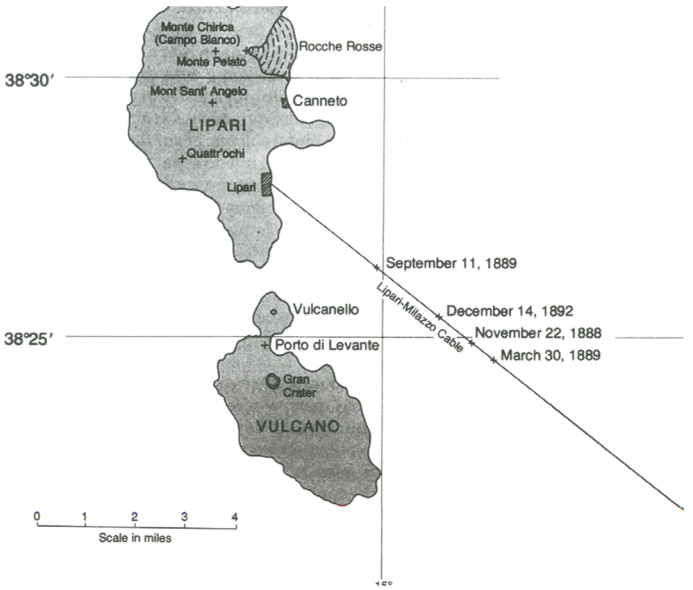

Fig. 10. Map of the Lipari Islands, showing geographical relationships of Lipari, Vulcanello and Vulcano.

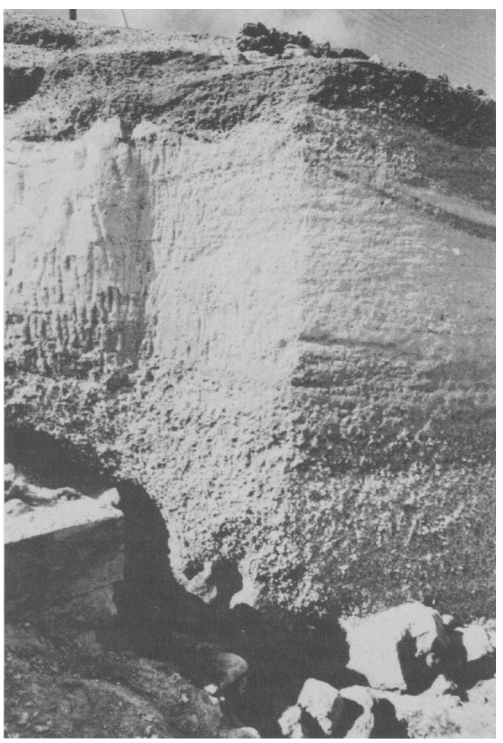

Fig. 11. Volcanic ash deposit on Santorini, showing evidence of a three-stage eruption coincident with the decline of Minoan civilization.

Loch Ness Monster, on the other hand, I think that more research is needed before we can be confident that these have found convincing geomythological explanations.

I am honoured to have been invited to deliver the keynote address for the Myth and Geology symposium at the 32nd International Geological Congress. Please allow me to feel just a little responsible for, and proud of, the progress made in this field and the status it has now achieved in the geological profession. It was exciting, and at the same time humbling, for me to see the variety of topics offered at that session and to survey the recent scientific literature in the field. It is one of the major satisfactions of my professional life to have been part of such a fascinating undertaking.

References

ANDREE, R. 1891. *Die Flutsagen, enthnographisch betrachtet*. Friedrich Bieweg und Sohn, Braunschweig.

CLARK, E. E. 1953. *Indian Legends of the Pacific Northwest*. University of California Press, Berkeley.

DE BOER, J. Z., HALE, J. R. & CHANTON, J. 2001. New evidence of the geological origins of the ancient Delphic oracle (Greece). *Geology*, **29**, 707–710.

GALANOPOULOS, A. G. 1960. On the location and size of Atlantis (in Greek with English summary and captions). *Praktika tis Akademias Athenon*, **35**, 401–418.

KELLER, J. 1970. Datierung der Obsidiane und Bimstoffe von Lipari. *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte*, 90–101.

MARSHALL, P. 1927. *Geology of Mangaia*. B. P. Bishop Museum, Honolulu.

MARINATOS, S. 1971. *Acta of the 1st International Scientific Congress on the Volcano of Thera, Greece*. 1969, Athens.

MATTISON, R. H. 1967. *Devil's Tower National Monument—A History*. Devil's Tower Natural History Association.

NUNN, P. D. 2001. On the convergence of myth and reality: examples from the Pacific Islands. *The Geographical Journal*, **167**, 125–138.

NUNN, P. D. 2003. Fished up or thrown down: the geography of Pacific Island origin myths. *Annals of the Association of American Geographers*, **93**, 350–364.

OUWEHAND, C. 1964. *Namazu-e and Their Themes: An Interpretative Approach to Some Aspects of Japanese Folk Religion*. E. J. Brill, Leiden.

PICCARDI, L. 2000. Active faulting at Delphi: seismotectonic remarks and a hypothesis for the geological environment of a myth. *Geology*, **28**, 651–654.

RYAN, W. B. F. & PITMAN, W. C. 1999. *Noah's Flood: The New Scientific Discoveries about the Event that changed History*. Simon and Schuster, New York.

VITALIANO, D. B. 1973. *Legends of the Earth: Their Geological Origins*. Indiana University Press, Bloomington.

VITALIANO, C. J. & VITALIANO, D. B. 1978. Volcanic tephra on Crete. *In*: MARINATOS, S. *Acta of the 2nd International Scientific Congress on the Volcano of Thera, Greece*. 1978, Athens.