

THE THERAN DISRUPTION:
THE MINOAN ERUPTION OF THERA AND ITS POSSIBLE IMPACT ON CIVILIZATIONS

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The volcano on the Cycladic island of Thera (now known as Santorini) has erupted many times throughout history, including a minor eruption in 1866 during construction of the Suez Canal.¹ This particular eruption prompted modern archaeologists to take notice of this volcano and its history, sparking a wave of excavations and discoveries. Evidence slowly emerged that pointed to a major volcanic event during the Late Bronze Age that buried the civilization on Thera, deposited ash and other debris throughout the eastern Mediterranean, and perhaps spread a large cloud of ash and volcanic gasses across the northern hemisphere. Occurring in the mid-second millennium BC, this eruption had a direct and devastating impact on the inhabitants of the island of Thera. It may also have had both a direct and indirect impact on civilizations throughout the Aegean Sea region, specifically the Minoans based on the nearby island of Crete. The “Minoan” eruption of Thera, as this particular eruption is often called, may have had a significant physical, cultural, economic, and political impact on people throughout the eastern Mediterranean, Egypt, Asia Minor, the Levant, and perhaps as far away as China and the Americas. Archaeological evidence, comparative modern volcanic events, ancient texts, numerous myths, cultural migrations, and trade pattern changes may point to the eruption of Thera as a catalyst for upheaval during the Late Bronze Age.

The island of Thera was one of the many islands in the Aegean Cyclades that formed part of Minoan civilization. The Minoans, based on the nearby island of Crete and named c. 1900 by archaeologist Sir Arthur Evans (1851-1941) after the Bronze Age king Minos of Knossos, had a cultural and economic influence throughout the Aegean Sea region and the eastern Mediterranean. As indicated by Minoan pottery and frescoes found in Egypt, Asia Minor, and

¹ Sturt W. Manning, *A Test of Time: The Volcano of Thera and the Chronology and History of the Aegean and East Mediterranean in the Mid Second Millennium BC* (Oxford: Oxbow, 1999), xxvii.

the Levant, Minoan products and ideas were widely distributed in a large Near Eastern trade network.² Archaeologists at Tell el Dab'a (site of the Hyksos capital Avaris) and at nearby Ezbet Rushdi have excavated numerous examples of Minoan pottery dating to Egypt's Twelfth Dynasty (c. 2000-1800 BC). While small amounts of additional fragments were found in sites attributed to successive dynasties, another extensive cache of Minoan pottery dating to the Eighteenth Dynasty (c. 1550-1300 BC) was discovered at Amarna.³ Wall paintings at Tell el-Dab'a dating to the reign of Tuthmosis III (mid-1400s BC) indicate a Minoan style, similar to those found at the buried cities of Akrotiri on Thera and Knossos on Crete.⁴ Jewelry found in King Tutankhamun's tomb (late-1300s BC) appears to have passed through the hands of Aegean merchants en route to Egypt from Syria and the Baltic.⁵ Archaeological finds at Alalakh on the Turkish-Syrian border just west of Aleppo contain ceramics and frescoes in the Minoan style, indicating both a trade presence and a cultural exchange in the northern Levant.⁶ In addition to its connections with Minoan Crete, the island of Thera itself is believed to have been involved in textile manufacturing and trade throughout the Aegean region. At Akrotiri, archaeologists found silk-moth cocoons preserved in tephra (volcanic ash, dust, rocks, and boulders) that were likely

² Cheryl A. Ward, "Seafaring in the Bronze Age Aegean: Evidence and Speculation," in *Political Economies of the Aegean Bronze Age: Papers from the Langford Conference, Florida State University, Tallahassee, 22-24 February 2007*, ed., Daniel J. Pullen (Oxford: Oxbow Books, 2010), 153.

³ Ibid.

⁴ Sturt W. Manning and L. Hulin, "Maritime Commerce and Geographies of Mobility in the Late Bronze Age of the Eastern Mediterranean: Problematizations," in *The Archaeology of Mediterranean Prehistory*, ed., E. Blake and A.B. Knapp (Malden, MA: Blackwell Publishing, 2005), 278.

http://www.academia.edu/363964/Manning_S.W._and_Hulin_L._2005._Maritime_commerce_and_geographies_of_mobility_in_the_Late_Bronze_Age_of_the_eastern_Mediterranean_problematizations._In_E._Blake_and_A.B._Knapp_ed._The_archaeology_of_Mediterranean_prehistory_270-302._Malden_MA_Blackwell_Publishing (accessed May 31, 2013).

⁵ Ward, 156.

⁶ Manning, *A Test of Time*, 349.

made from wild silk in the Aegean.⁷ This silk was processed and traded along the Minoan network.

While the Cretan city of Knossos served as the focal point of Minoan archaeology thanks to Evans's excavations in the early 1900s, the island of Thera became the focus of archaeologist Spyridon Marinatos (1901-1974), who worked with Evans at Crete and later excavated the buried Theran city of Akrotiri in 1967. Preserved in tephra similarly to Pompeii and Herculaneum in Italy, buildings in Akrotiri were found to contain frescoes depicting religious ceremonies and daily life on the island. Some of the frescoes show young people performing acrobatic feats on the backs of charging bulls as part of a dangerous bull-leaping ceremony. The bull-leaping frescoes found on Thera at Akrotiri are similar to bull-leaping artwork found on Crete at Knossos,⁸ as well as in Egypt at Tell el-Dab'a, in Asia Minor, and in Syria.⁹ Other frescoes unearthed at Akrotiri depict trade ships, towns, women gathering saffron, fishermen, youths boxing, and monkeys. The trade ship and monkey frescoes, in addition to the bull-leaping artwork in Egypt, Asia Minor, and Syria, indicate that the Therans were engaged in long-range travel as part of an extensive economic and cultural network.

Because Thera was an integral part of the Minoan sphere of influence, its destruction due to the Minoan eruption catastrophe would almost certainly have had a negative impact on the Minoan trade network and, consequently, the economic and political stability of Minoan civilization. Before the eruption took place, scientists believe that the people of Thera and

⁷ E. Panagiotakopulu, P. C. Buckland, P. M. Day, C. Doumas, A. Sarpaki, and P. Skidmore, "A Lepidopterous Cocoon from Thera and Evidence for Silk in the Aegean Bronze Age," *Antiquity* 71, no. 272 (June 1997): 420-421. <http://search.proquest.com/docview/217551351?accountid=8289> (accessed April 29, 2013).

⁸ Richard Harrison, "The 'Bull-Cult' in Ancient Crete," *History Today* 28, no. 4 (April 1978): 214. *Academic Search Premier*,

EBSCOhost <http://ezproxy.apus.edu/login?url=http://search.ebscohost.com.ezproxy1.apus.edu/login.aspx?direct=true&db=aph&AN=4868771&site=ehost-live> (accessed May 6, 2013).

⁹ Manning, *A Test of Time*, 102-103.

possibly the surrounding islands began to flee the area due to the numerous earthquakes that would have preceded an eruption of such magnitude. This may account for the reason why there are no remains of bodies in the streets of Akrotiri as were found at Pompeii.¹⁰ These refugees as well as post-eruption refugees fleeing crop failures and contaminated drinking water in debris-covered lands would likely have overwhelmed the resources of surviving cities.¹¹ At first, cities spared from the destruction may have economically benefitted from the additional trade as they filled the vacuum left by Thera's loss. Moreover, the refugees would likely have provided a new labor force to assist with this increased trade volume. Unfortunately, the benefit of additional labor would likely have become a curse as food, water, and shelter resources became overburdened by the rapid increase in population. Furthermore, the initial economic boom of surviving trade centers due to the grab for market share would likely have faded as the diminished number of trade links struggled to manage the volume of trade that existed before the eruption. All of these circumstances may have created a "tipping-point" that put the region on a path toward economic decline.¹² Historians believe that events such as these may have led to migrations of cultures such as the Sea Peoples and ultimately to the "Dark Ages" that enveloped the region at the end of the Bronze Age.¹³ It is certainly possible that Thera's eruption created the conditions that led to such events.

¹⁰ Oppenheimer, 225.

¹¹ Sonia A. Buist and Robert S. Bernstein, "Health Effects of Volcanoes: An Approach to Evaluating the Health Effects of an Environmental Hazard," *American Journal Of Public Health* 76, no. 3 (March 2, 1986): 1. *Business Source Elite*, EBSCOhost
<http://ezproxy.apus.edu/login?url=http://search.ebscohost.com.ezproxy2.apus.edu/login.aspx?direct=true&db=bsh&AN=4692099&site=ehost-live> (accessed May 6, 2013).

¹² Carl Knappett, Ray Rivers, and Tim Evans, "The Thera Eruption and Minoan Palatial Collapse: New Interpretations Gained from Modeling the Maritime Network," *Antiquity* 85, no. 329 (September 1, 2011): 1014-1019. *Academic Search Premier*, EBSCOhost.
<http://ezproxy.apus.edu/login?url=http://search.ebscohost.com.ezproxy2.apus.edu/login.aspx?direct=true&db=aph&AN=66193254&site=ehost-live> (accessed April 30, 2013).

¹³ David Kaniewski, Elise Van Campo, Karel Van Lerberghe, Tom Boiy, Klaas Vansteenhuyse, Greta Jans, and Joachim Bretschneider, "The Sea Peoples, from Cuneiform Tablets to Carbon Dating," *Plos ONE* 6, no. 6 (June

Although evidence may suggest a link, decisively tying the destruction of Thera with the fall of Minoan civilization is problematic. While some historians and scientists directly link the eruption of Thera with the fall of Minoan civilization,¹⁴ other researchers claim that Crete was not completely destroyed in the eruption and Knossos continued trade activity, if in a diminished or altered capacity, for centuries afterward.¹⁵ Where most scholars agree is that when the city of Knossos was destroyed and abandoned at the end of the Bronze Age, Minoan civilization was devastated.¹⁶ It is only through an examination of available archaeological, historical, and cultural evidence that any link can be made between the eruption of Thera and its effects on the Minoans and other civilizations.

Archeological evidence of the eruption indicate that it was immense, perhaps one of the largest European eruptions in the past 100,000 years.¹⁷ The most obvious evidence its power is the crater that makes up much of the center of the island of Thera. Volcanologists can use modern eruptions such as Mt. St. Helens (United States, 1980), El Chichón (Mexico, 1982), Mt. Pinatubo (Philippines, 1991), Eyjafjallajökull (Iceland, 2010), and others to extrapolate that the Thera volcano spewed out clouds of fine ash and toxic sulphurous gasses twenty or more kilometers into the atmosphere. Magma flows and ejections of pumice, rocks, and boulders

2001): 1. *Academic Search Premier*, EBSCOhost

<http://ezproxy.apus.edu/login?url=http://search.ebscohost.com.ezproxy2.apus.edu/login.aspx?direct=true&db=aph&AN=74274525&site=ehost-live> (accessed May 6, 2013).

¹⁴ T. Novikova, G. A. Papadopoulos, and F. W. McCoy, "Modelling of Tsunami Generated by the Giant Late Bronze Age Eruption of Thera, South Aegean Sea, Greece," *Geophysical Journal International* 186, no. 2 (August 2011): 665. *Academic Search Premier*, EBSCOhost

<http://ezproxy.apus.edu/login?url=http://search.ebscohost.com.ezproxy2.apus.edu/login.aspx?direct=true&db=aph&AN=64115058&site=ehost-live> (accessed May 6, 2013).

¹⁵ D. M. Pyle, "The Global Impact of the Minoan Eruption of Santorini, Greece," *Environmental Geology* 30 (1997): 61. <http://library.certh.gr/libfiles/PDF/GEN-PAPYR-4645-THE-GLOBAL-by-PYLE-in-EG-V-30-ISS-1-2-PP-59-61-Y-1997.pdf> (accessed May 6, 2013).

¹⁶ Manning and Hulin, "Maritime Commerce and Geographies of Mobility," 290.

¹⁷ Karen Polinger Foster, Robert K. Ritner, and Benjamin R. Foster, "Texts, Storms, and the Thera Eruption," *Journal of Near Eastern Studies* 55, no. 1 (January 1996): 2. <http://www.jstor.org/stable/545376> (accessed April 29, 2013).

would likely have been sustained for tens of hours or perhaps even a few days.¹⁸ The magma and other ejecta, which covered Thera in up to six meters of debris, buried the city of Akrotiri and made the entire island unlivable for many years.¹⁹ Sulfurous gasses, when ejected into the stratosphere, would have produced a sulphuric acid aerosol that would certainly have had a local effect, but may also have had a global climactic effect.²⁰ The collapse of the caldera is believed to have created pyroclastic flows up to 55 meters thick, which entered the Aegean Sea off Thera's coast and created powerful tsunamis that flooded coastal areas around the region. Evidence of tsunami inundation from the Minoan eruption has been found on the other Cyclades Islands, northern Crete, southwestern Asia Minor, Israel near Tel Aviv, Cyprus, and as far away as Sicily.²¹ Airwaves from the explosion would have thundered throughout the region, and the earth likely shook from the earthquakes that preceded, occurred during, and continued after the eruption.²²

To understand the impact of this event on civilizations around the region, it is critical to date the eruption accurately. Because civilizations rise and fall, and because their interactions vary over time, an accurate eruption date is the only way to understand who was affected, how it affected them, and what the consequences were. Dating this event is a challenge, however, due to the lack of written records from the period and the ambiguity of the few extant sources available. Therefore, archaeologists commonly turn to radiocarbon (carbon-14) dating, which dates organic

¹⁸ Clive Oppenheimer, *Eruptions That Shook the World* (Cambridge: Cambridge University Press, 2011), 24.

¹⁹ *Ibid.*, 228.

²⁰ W. J. Eastwood, J. Tibby, N. Roberts, H. J. B. Birks, and H. F. Lamb, "The Environmental Impact of the Minoan Eruption of Santorini (Thera): Statistical Analysis of Palaeoecological Data from Gölhisar, Southwest Turkey," *Holocene* 12, no. 4 (July 2002): 431. *Academic Search Premier*, EBSCOhost <http://ezproxy.apus.edu/login?url=http://search.ebscohost.com.ezproxy1.apus.edu/login.aspx?direct=true&db=aph&AN=6943033&site=ehost-live> (accessed May 3, 2013).

²¹ Novikova, Papadopoulos, and McCoy, 666-667.

²² Oppenheimer, 42.

materials trapped in tephra deposits. Using this technique, researchers have determined a date range for the eruption of c. 1670-1520 BC.²³ Archaeologist Sturt Manning, one of the most prolific writers on the subject of Thera eruption chronology, favors an “early date” for the eruption in the mid- to late-1600s BC.²⁴ Other archaeologists, such as volcanologist David Pyle, favor a “late date” in the 1500s BC based on a different interpretation of the radiocarbon samples.²⁵ Thus, two groups of scholars have coalesced, those who favor an early eruption date and those who favor a later date.²⁶ While c. 1670-1520 BC is the generally accepted radiocarbon date range in the scholarly community, there are a few archaeologists, notably P. E. LaMoreaux, who favor an even later date of c. 1450-1390 BC. According to LaMoreaux, Thera erupted several times, beginning c. 1628 BC and ending with its most cataclysmic eruption c. 1450 BC.²⁷ While refuted by Manning and Pyle, LaMoreaux’s late chronology and multiple eruption theory offers a possible answer to the debate over an “early date” and a “late date.” Certainly, radiocarbon dating alone is insufficient in dating the event.

In addition to radiocarbon dating, archaeologists often examine anomalies in tree-rings (a process known as dendrochronology) and in ice-cores. When volcanos spew sulfur dioxide into the atmosphere, the gas oxidizes into an aerosol layer that mixes with precipitation.²⁸ The acid rain and the lack of sunlight due to atmospheric ash leave a record in yearly layers of snow in

²³ Manning, *A Test of Time*, 23.

²⁴ *Ibid.*, 3.

²⁵ Pyle, 59.

²⁶ Sturt W. Manning and Bernd Kromer, “Considerations of the Scale of Radiocarbon Offsets in the East Mediterranean, and Considering a Case for the Latest (Most Recent) Likely Date for the Santorini Eruption,” *Radiocarbon* 54, no. 3-4 (2012): 449.

http://www.academia.edu/2286052/Sturt_W._Manning_and_Bernd_Kromer._2012._Considerations_of_the_Scale_of_Radiocarbon_Offsets_in_the_East_Mediterranean_and_Considering_a_Case_for_the_Latest_Most_Recent_Likely_Date_for_the_Santorini_Eruption._Radiocarbon_54_3-4_449-474# (accessed May 31, 2013).

²⁷ P. E. LaMoreaux, “Worldwide Environmental Impacts from the Eruption of Thera,” *Environmental Geology* 26, no. 3 (October 1995): 172. <http://link.springer.com/article/10.1007%2FBF00768739> (accessed June 27, 2013).

²⁸ Manning, *A Test of Time*, 268.

polar areas such as Greenland and Alaska, as well as in the growth rings of long-living trees such as California's bristlecone pine and the European oak. Data from ice-cores taken in Greenland in 1980 showed a "significant acid layer" at c. 1390 BC, indicating a possible late date for Thera, a date in line with LaMoreaux's findings. However, a different method of examination of the same samples in 1987 rejected the late date in favor of an early date c. 1644 BC.²⁹ According to dendrochronologist Mike Baillie, ring data from trees in Ireland, England, and Germany show evidence of a significant atmospheric event c. 1628 BC consistent with volcanic activity.³⁰ According to Manning, Baillie's dendrochronological findings corroborate the early date indicated by radiocarbon results and exclude the late date originally found in ice-core data because the tree-ring anomaly of c. 1628BC is found "nowhere else within a couple hundred years."³¹ While "a couple hundred years" after 1628 BC might exclude the 1520 BC late date as a likely candidate for Thera, it allows the possibility of LaMoreaux's 1450-1390 BC date or the 1390 BC date recorded during the 1980 ice-core study. In fact, ice-core data sampled in a date range from c. 1740-1440 BC (the generally accepted scientific date range for Thera) show three rather large sulfate deposits, one c. 1715 BC, another c. 1624 BC, and a third c. 1450 BC.³² While the 1715 BC deposit is of unknown origin and does not fit other evidence for Thera, certainly the 1624 BC deposit matches the radiocarbon and dendrochronological evidence supported by Manning and Baillie. The 1450 BC deposit may also indicate a Theran eruption as it matches evidence supported by LaMoreaux and other late date advocates.

²⁹ M. G. L. Baillie, "Volcanoes, Ice-Cores and Tree-Rings: One Story or Two?" *Antiquity* 84, no. 323 (March 2010): 210-211. <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=48874301&site=ehost-live> (accessed May 23, 2013).

³⁰ *Ibid.*, 212.

³¹ Manning, *A Test of Time*, 264.

³² *Ibid.*, 277.

The dating discrepancies between radiocarbon results, ice-core data, and dendrochronology highlight some of the problems with dating the Thera eruption. First, researchers often reach alternate conclusions despite examining the same samples. This is sometimes due to the varying methods of testing and sometimes due to interpretation of the findings. Second, the possibility of multiple eruptions at Thera makes it unlikely that researchers can conclusively identify any particular absolute date for the Minoan eruption. Finally, it is entirely possible that another, yet unidentified and unrecorded, volcanic eruption elsewhere in the world could be responsible for the ice-core and tree-ring anomalies. There is no guarantee that the evidence is from Thera.

It is clear by the scientific dispute over the Thera date that one must also consider other evidence, specifically historical evidence such as written records, myths, legends, migration patterns, and changes in trade. Written records, such as provided by Pliny the Younger regarding the AD 79 eruption of Mt. Vesuvius, are absent regarding the Minoan eruption of Thera. An eruption of Thera's magnitude might make one expect to find eyewitness accounts from Egypt, Mesopotamia, or the Levant, but direct records of the Thera eruption have yet to be discovered. One reason to explain this phenomenon could be Thera's island geography. Because most of Thera's residents are believed to have abandoned the island prior to the eruption due to earthquakes, there would have been few people remaining to see the eruption as it happened. Those remaining residents would certainly have perished in the pyroclastic flows and would have been buried in the thick tephra. Residents of islands in the immediate vicinity would likely also have perished due to the toxic gasses in the ash cloud, the raining debris, and the likely tsunamis. The further removed from Thera itself, the less clear observers would be as to what was happening. Certainly, people on nearby Crete would have been affected by raining debris

and a tsunami, but would they have known that those catastrophes were caused by a volcanic eruption? Most people affected by the Thera eruption would likely have experienced associated effects such as daytime darkness, thunderous noises, mysterious clouds, flooding, earthquakes, and atmospheric anomalies, without connecting these occurrences with a volcanic eruption. This phenomenon is corroborated by studies of the eruptions of Mt. Tambora (Indonesia, 1815), Krakatau (Indonesia, 1883), and a more recent eruption of Thera (1707).³³

Without written historical evidence that unquestionably describes the Thera eruption, historians must examine writings that instead may provide an indirect description of the event. Ancient Chinese writings attributed to the fifth century BC philosopher Mozi (Mozes) as well as records in the *Bamboo Annals* describe phenomena that could be attributed to Thera. According to Mozi, “Heaven” ordered the destruction of the Xia Dynasty (c. 2100-1600 BC). He stated, “Ice came in the summer ... The five grains appeared in mutation.” He continued, “When it came to King Jie of Xia, Heaven gave severe order. Sun and moon did not appear on time. Winter and summer came irregularly. The five grains were dried up to death.”³⁴ The *Bamboo Annals*, which record the earliest legends of ancient China, also describe similar events. According to the *Bamboo Annals*, “In [king Jie’s] 10th year, the five planets went out of their courses. In the night, stars fell like rain. The earth shook.”³⁵ Later in the text, the *Bamboo Annals* state, “The sky was overspread with mists for three days.” The mists occurred during the reign of king T’ae-K’eh (T-ae Che or Tai Jia), the fourth ruler of the Shang dynasty, who was enthroned

³³ Foster, Ritner, and Foster, 4.

³⁴ Yibao Mei, ed., “Condemnation of Offensive War (III),” book 5, ch. 19 of *The Ethical and Political Works of Mozi* (Westport, CT: Hyperion Press, 1973).
http://saintjoehigh.enschool.org/ourpages/auto/2007/8/5/1186366635989/The_Ethical_and_Political_Works.pdf (accessed May 24, 2013).

³⁵ James Legge, *The Chinese Classics: Vol. III, Part I* (London: Trübner & Co, 1865), 125.
<http://books.google.com/books?id=ZkxkAAAAMAAJ&oe=UTF-8> (accessed May 28, 2013).

c. 1530 BC.³⁶ The reign of king Jie of Xia, which ended in approximately 1600 BC, and the reign of king T'ae-K'eah of Shang, which occurred nearly seventy years later (based on the chronology offered in the *Bamboo Annals*) both occurred within the c. 1670-1520 BC radiocarbon date range of Thera and the ice-core and tree-ring range of c. 1740-1440 BC. Furthermore, Thera could certainly have affected China in the ways described by Mozi and in the *Bamboo Annals*. As the 1991 Mt. Pinatubo eruption exemplified, volcanic gasses and ash circumnavigated the globe within twenty-two days.³⁷ Stratospheric aerosol veils effect light and heat radiation, leading to global temperature anomalies such as summer cooling and winter warming.³⁸ This may explain why winter and summer came irregularly and why frost came in the summer as the records indicate. Mt. Pinatubo created a global cooling effect of 0.5 °C that lasted more than two years.³⁹ Thera, a much stronger eruption than Pinatubo, may have created a more intense and longer lasting global temperature effect, perhaps long enough to bridge the seventy-year gap between Jie of Xia and T'ae-K'eah of Shang.

Another ancient text that may provide evidence of Thera's impact on civilizations is an Egyptian stele from the reign of pharaoh Ahmose I (mid- to late-1500s BC). Known as the Tempest Stele, it describes a great storm with mist-filled winds and terrible flooding that destroyed temples and other buildings. According to the text, the storm produced bellowing noise, darkness, torrent so that no torch could be lit, houses washed into the river and bobbing like boats, and damaged or destroyed temples.⁴⁰ While it is all but impossible to conclusively link such catastrophic events with the Theran eruption, these events certainly could be describing

³⁶ Ibid., 130.

³⁷ Oppenheimer, 56.

³⁸ Ibid., 64.

³⁹ Ibid.

⁴⁰ Foster, Ritner, and Foster, 5.

a volcanic sound wave, an ash cloud, and the effects of a tsunami. Ahmose's reign (estimated to fall within a range of 1550-1514 BC based on high and low archaeological chronologies) is well within the radiocarbon, ice-core, and tree-ring date ranges.⁴¹ Sometime between 1539 BC and 1524 BC, Ahmose destroyed the Hyksos palace, a time in Egyptian history containing very few written records. Archaeologists excavating the site found signs of inundation such as rounded pumice, shells, and snails, suggestive of inundation. Nearby, researchers found deposits of volcanic material corresponding to likely ejecta from Thera.⁴² Based on this evidence, Karen Foster, Robert Ritner, and Benjamin Foster claimed in their 1996 article that the Tempest Stele is "an eyewitness account of the Thera eruption."⁴³ Malcolm Wiener and James Allen refuted this claim in 1998, stating that the pumice deposits excavated from the site were Thera in origin, but were secondary deposits gathered for an industrial purpose.⁴⁴ Because pumice was, and is currently, used as an abrasive, it is difficult to know the circumstances of the Hyksos palace pumice with certainty. However, pumice found in some Egyptian tombs, placed with the dead for cosmetic use in the afterlife, may provide a resolution to the debate over the Tempest Stele. Pumice in tombs at Kahun (near Faiyum) and at Amarna have elemental concentrations consistent with samples from Thera in the Minoan eruption tephra layer.⁴⁵ Furthermore, these tombs contain weapons, heirloom scarabs, and other items that date them to no earlier than the mid-1500s BC.⁴⁶ This could indicate that the pumice is in fact from the Minoan eruption of

⁴¹ Ibid., 3.

⁴² Ibid., 9.

⁴³ Ibid., 10.

⁴⁴ Malcolm H. Wiener and James P. Allen, "Separate Lives: The Ahmose Tempest Stela and the Thera Eruption," *Journal of Near Eastern Studies* 57, no. 1 (January 1998): 25. <http://www.jstor.org/stable/545324> (accessed April 29, 2013).

⁴⁵ Johannes H. Sterba, Karen Polinger Foster, Georg Steinhauser, and Max Bichler, "New Light on Old Pumice: the Origins of Mediterranean Volcanic Material from Ancient Egypt," *Journal of Archaeological Science* 36, no. 8 (2009): 1743. http://publik.tuwien.ac.at/files/PubDat_176233.pdf (accessed April 30, 2013).

⁴⁶ Sterba, Foster, Steinhauser, and Bichler, 1739.

Thera and that Theran tephra reached Egypt, further increasing the possibility of a link between the Tempest Stele and Thera. If such a link does indeed exist, it would certainly indicate that Thera had a major impact on ancient Egypt, possibly assisting Ahmose in overthrowing the Hyksos. Much as Europe experienced the Renaissance after the calamity of the Black Death and the United States became a superpower after rising out of the depths of the Great Depression, so might Egypt have entered its New Kingdom period after its recovery from the devastating Theran eruption.

Unfortunately, the lack of written records during the likely Theran date range of c. 1740-1440 BC makes historical research of the eruption difficult. Akkadian and Sumerian omen texts describe phenomena such as fiery red sunsets, lunar and solar halos (which could indicate atmospheric ash), pervasive darkness, and violent storms. However, these texts are of uncertain date and are all but impossible to conclusively link with Thera or any other specific event.⁴⁷ Therefore, due to the lack of written records, historians have turned to ancient stories, legendary accounts, and mythological tales to find clues to date the Theran eruption, establish a united chronology of the various civilizations at the time, and to better understand Thera's effect on those civilizations.

The Aegean Sea region is home to many myths and legends that could possibly relate to the Theran eruption. One such legend, that of Theseus and the Minotaur, tells the story of a terrible half-man and half-bull beast that was slain by the Greek hero Theseus in a labyrinth under the palace of king Minos at Knossos. This story could be a mythological reflection of Thera's involvement in the fall of the Minoans and the rise of the Mycenaeans.⁴⁸ King Minos of

⁴⁷ Foster, Ritner, and Foster, 7.

⁴⁸ Jelle Zeilinga de Boer and Donald Theodore Sanders, *Volcanoes in Human History: The Far-Reaching Effects of Major Eruptions* (Princeton, N.J.: Princeton University Press, 2002), 66-67.

Crete attempted to exert bloodthirsty tyranny over the Greek mainland by sacrificing Athenian children to the ferocious Minotaur that lived in a maze under his palace. Theseus killed the Minotaur, freed the Athenian children, and ended Minoan dominance over Athens. While the story is steeped in mythology, the children sacrificed to the Minotaur may represent the youths who performed dangerous acrobatics on the backs of bulls, as discussed earlier. Another possible explanation for the myth centers on a mass of children's bones discovered at a house in Knossos. These bones contained "cut-marks characteristic of deliberate removal of flesh."⁴⁹ One possible explanation is that the bones provide evidence of human sacrifice or ritual cannibalism as part of regular Minoan religious practices. Another explanation is that these children were sacrificed after the eruption of Thera by a "crisis cult" that arose to make sense of the chaos following the disaster.⁵⁰ Yet another theory is that the children were sacrificed prior to the eruption in a futile attempt to satisfy Poseidon, the Greek god of earthquakes, who was believed to have caused earthquakes while taking the form of a bull. Clearly, the possibility exists that the bull-leaping frescoes, the child sacrifice, and the Minotaur myth may all have a connection with the Thera eruption and its pre-eruption earthquakes.

Volcanic eruptions and other traumatic natural phenomena have been shown to exert overwhelming stress on the people affected, as the potential evidence of a "crisis cult" on Crete illustrates. As was evident in a study involving survivors of the Mt. St. Helens eruption of 1980, West Virginia's Buffalo Creek flood of 1972, and other disasters, survivors can suffer long-term emotional consequences such as "traumatic neurotic syndrome" or "posttraumatic stress disorder" (PTSD) which can include symptoms such as survivor shame, impotent rage, and

⁴⁹ Oppenheimer, 237.

⁵⁰ Ibid.

hopelessness.⁵¹ As the study further showed, there was a dramatic increase in emergency room visits, crisis calls, domestic violence, and police arrests among disaster survivors.⁵² Perhaps “survivor shame” from the Thera eruption is a reason why the fall of the Minoans, as possibly mythologized as Theseus’s slaying of the Minotaur, was blamed on the ruthlessness and bloodthirstiness of king Minos. Just like king Jie of Xia, whose dynasty’s fall was blamed on dissipation and cruelty,⁵³ Minos received divine retribution for his evils. Survivors, who otherwise might be left wondering why they were allowed to live while others were not, could at least take solace in the fact that those who died were being punished for their sins.

The legend of Atlantis, as described by Plato c. 350 BC in *Timaeus and Critias*,⁵⁴ offers another example of catastrophe seen as divine retribution for iniquity. Once peaceful and prosperous, with an immense palace and technological advances, Atlantis became corrupt and disappeared into the sea.⁵⁵ The palace mentioned in the myth, which was believed to have had flush toilets and other advances,⁵⁶ was perhaps a legendary reflection of the immense palace of Minos at Knossos. If so, the fall of Atlantis into the sea could be a mythologized account of the fall of Minoan civilization on Crete. Another theory suggests that the Atlantis legend referred to Thera, which was nearly obliterated by the Minoan eruption. Yet another theory, a blend of the previous two, suggests that the Egyptians responsible for conveying the Atlantis story to Plato may have heard about the destruction of Thera from Minoan sailors and confused islands of

⁵¹ James H. Shore, Ellie L. Tatum, and William M. Vollmer, “Evaluation of Mental Effects of Disaster, Mount St. Helens Eruption,” *American Journal Of Public Health* 76, no. 3 (March 2, 1986): 77. *Business Source Elite*, EBSCOhost <http://ezproxy.apus.edu/login?url=http://search.ebscohost.com.ezproxy2.apus.edu/login.aspx?direct=true&db=bsh&AN=4692390&site=ehost-live> (accessed May 6, 2013).

⁵² *Ibid.*, 78.

⁵³ Legge, 125.

⁵⁴ Pierre Vidal-Naquet and Janet Lloyd, “Atlantis and the Nations,” *Critical Inquiry* 18, no. 2 (Winter 1992): 300-301. <http://www.jstor.org/stable/1343786> (accessed April 29, 2013).

⁵⁵ Zeilinga de Boer and Sanders, 71.

⁵⁶ Oppenheimer, 227.

Thera and Crete.⁵⁷ The lack of a reliable way to transmit accurate news in ancient times may have had the “telephone game” effect in which information passed from merchant to merchant over a period of years became altered until it was almost unrecognizable. There may be historical truth in the Atlantis legend that links it with the Thera volcano, but too little evidence about Atlantis exists to link it with any specific historical event. Thera certainly offers, however, a convenient explanation for the origin of the Atlantis legend.

The Minoan eruption of Thera also offers a convenient explanation for some of the many flood stories from civilizations around the Mediterranean region. Certainly, an eruption of Thera’s magnitude would have generated powerful tsunamis due to rapid pyroclastic flows, as evidence from the 1883 eruption of Krakatau suggests.⁵⁸ Earthquakes, which can also coincide with volcanic eruptions, have been known to generate powerful tsunamis in the Mediterranean Sea throughout history, causing severe flood damage and death.⁵⁹ The biblical flood of Noah,⁶⁰ perhaps the world’s most well-known flood story, is the subject of speculation by some researchers as a possible link with a Thera tsunami.⁶¹ The story of Noah is an unlikely candidate for a link with Thera, however, because of its many similarities to earlier flood accounts, namely the stories of Ziusudra, Atrahasis, and Utnapishtim (the flood survivor from the Sumerian *Epic of Gilgamesh*).⁶² These three Mesopotamian flood stories likely reference a

⁵⁷ Ibid., 72.

⁵⁸ Fukashi Maeno and Fumihiko Imamura, “Tsunami Generation by a Rapid Entrance of Pyroclastic Flow into the Sea During the 1883 Krakatau Eruption, Indonesia,” *Journal of Geophysical Research: Solid Earth* 116, no. 9 (2011): 22. <http://search.proquest.com/docview/1026770220?accountid=8289> (accessed May 6, 2013).

⁵⁹ Stefano Lorito, Mara M. Tiberti, Roberto Basili, Alessio Piatanesi, and Gianluca Valensise, “Earthquake-generated Tsunamis in the Mediterranean Sea: Scenarios of Potential Threats to Southern Italy.” *Journal of Geophysical Research* 113 (2008): 1. <http://pro.unibz.it/staff2/fzavatti/corso/lorito-tsunami.pdf> (accessed May 6, 2013).

⁶⁰ Gen. 6:9-8:19 NIV.

⁶¹ Zeilinga de Boer and Sanders, 69.

⁶² Siam Bhayro, “Noah’s Library: Sources for 1 Enoch 6—11,” *Journal For The Study Of The Pseudepigrapha* 15, no. 3 (May 2006): 165. *Academic Search Premier*,

cataclysmic flood that occurred long before the Minoan eruption of Thera, perhaps many hundreds or a few thousand years before.⁶³ The biblical story of Noah's similarities to these stories as well as the likely date for Noah based on biblical chronology, which is calculated to be no later than 2300 BC,⁶⁴ place Noah's flood much too early to be connected with the Minoan eruption of Thera. Another flood, known as Zeus's Flood or the Deucalion is similar to the story of Noah in that a god (Zeus in this case) exerts wrath over humanity because of sin. What makes a link between the Deucalion flood and Thera likely is that the story is of Greek origin and its date aligns with possible Thera eruption dates. Deucalion "escaped the rains" in 1529 BC based on the chronology of the *Parian Chronicle*, an ancient Greek chronology.⁶⁵ This 1529 BC date certainly falls within the scientific Thera date range of c. 1740-1440 BC, matches the year T'ae-K'eah of Shang China observed three days of "mists" and unseasonable weather, and matches the approximate year of the Ahmose Tempest Stele. Given the dating similarities, Thera is a likely cause of all three events.

In recent years, scholars have attempted to connect the Minoan eruption of Thera with the biblical story of the Exodus.⁶⁶ According to this theory, the Ten Plagues of Egypt can be linked

EBSCOhost <http://search.ebscohost.com.ezproxy1.apus.edu/login.aspx?direct=true&db=aph&AN=21319609&site=ehost-live> (accessed July 3, 2013).

⁶³ Ryan, William B. F., and Walter C. Pitman. *Noah's Flood: The New Scientific Discoveries About the Event That Changed History*. New York: Simon & Schuster, 1998.

<http://books.google.com/books?id=nPiuWaZgI60C&lpg=PP1&dq=Noah's%20Flood%3A%20The%20New%20Scientific%20Discoveries%20About%20The%20Event%20That%20Changed%20History&pg=PA15#v=onepage&q=Noah's%20Flood:%20The%20New%20Scientific%20Discoveries%20About%20The%20Event%20That%20Changed%20History&f=false> (accessed July 3, 2013).

⁶⁴ Paul H. Seely, "Noah's Flood: Its Date, Extent, and Divine Accommodation," *Westminster Theological Journal* 66, no. 2 (Fall 2004): 293. *Academic Search Premier*, EBSCOhost

<http://search.ebscohost.com.ezproxy2.apus.edu/login.aspx?direct=true&db=aph&AN=15603892&site=ehost-live> (accessed June 17, 2013).

⁶⁵ Joseph Robertson, *The Parian Chronicle, or the Chronicle of the Arundelian Marbles; with a Dissertation Concerning Its Authenticity*, (London: printed for J. Walter, 1788), 24.

<http://books.google.com/books?id=MjEVAAAAQAAJ&pg=PA24#v=onepage&q&f=false> (accessed July 10, 2013).

⁶⁶ Exod. 7-14.

to aftereffects of the Thera eruption. Attributing these events to the power of the Hebrew god, the Egyptian pharaoh released his captives, allowing the Exodus to occur. Thunderous noises, fire and brimstone raining from Heaven, unusual darkness, and contaminated river water as described in the Exodus account could all be signs of a volcanic eruption.⁶⁷ The theory further contends that the Nile turned blood red when contaminated with ash and volcanic chemicals, resulting in dead fish as described in the *Bible*.⁶⁸ Frogs would have escaped the contaminated water, leading to the plague of frogs. The dead fish and the dying frogs would have created a gnat and fly infestation. Livestock that relied on the waters of the Nile would undoubtedly have become sick due to the toxic ash and chemicals, as well as the dead fish and frogs. Humans, bitten by flies, would have developed boils and other skin lesions. Hail, an unusual occurrence blamed on volcanism's climactic effects or perhaps a reference to falling pumice, would have ruined the crops and displaced the locusts of the fields. The plague of darkness undoubtedly represents the ash cloud according to this theory, and matches the mists and darkness in the ancient Chinese texts and the Ahmose Tempest Stele. Finally, the firstborn child may have fallen victim to the same "crisis cult" human sacrifice that is believed to have happened at Knossos on Crete.⁶⁹ In addition to the plagues, another possible connection between Thera and the Exodus is the "pillar of cloud to guide them on their way and by night in a pillar of fire to give them light, so that they could travel by day or night."⁷⁰ Certainly, a volcanic eruption would provide a pillar of smoke and of fire. A volcano may also help explain the phenomenon of a burning bush and the unusual wind (or perhaps a tsunami) that parted the Red Sea.

⁶⁷ Zeilinga de Boer and Sanders, 69.

⁶⁸ Exod. 7.

⁶⁹ Riaan Booysen, *Thera and the Exodus: The Exodus Explained in Terms of Natural Phenomena and the Human Response to It* (Winchester, U.K.: O-Books, 2013), 289-300.

⁷⁰ Exod. 13:21.

If Thera could be tied to the events of the Exodus, as these numerous examples suggest, the story would offer a link between the Thera eruption and one of the world's most well known stories. Furthermore, such a link would provide an example of Thera's direct impact on Egyptian and Hebrew civilizations. Unfortunately, the effort to link Thera and the Exodus is hampered by the lack of extra-biblical information about the Exodus. Without the ability to compare the *Bible's* account to other sources, the events of the Exodus could be considered no less legendary than Plato's story of Atlantis or the account of the Deucalion flood. Establishing a reliable date for the Exodus is one way historians have attempted to overcome the lack of corroborating sources. The chronology contained within the *Bible* offers one method of dating the Exodus events. Solomon (son of David) began to build the Temple in Jerusalem "In the four hundred and eightieth year after the Israelites came out of Egypt."⁷¹ Solomon's temple was later destroyed "in the nineteenth year of Nebuchadnezzar king of Babylon,"⁷² which is generally accepted to have been in c. 586 BC. While the date of the Temple's destruction is known, the date of its construction is not, posing a challenge to researchers. According to the biblical account, Hiram of Tyre assisted Solomon in constructing the Temple.⁷³ King Hiram of Tyre is generally believed to have ruled in the early 900s BC, though there is some debate over the exact years of his reign. Using 975 BC as an estimate for the date Hiram assisted Solomon in constructing the Temple and dating back 480 years as stated in 1 Kings 6:1, the Exodus may have occurred in c. 1455 BC. After the Exodus, the *Bible* states that the Israelites wandered in the deserts for forty years before entering Canaan.⁷⁴ Once in Canaan, the first military campaign

⁷¹ 1 Kings 6:1.

⁷² Jer. 52:12-13.

⁷³ 1 Kings 5:1.

⁷⁴ Exod. 16:35.

was against the city of Jericho.⁷⁵ Some radiocarbon samples from Jericho indicate that it was destroyed c. 1420 BC, almost exactly matching the biblical chronology based on the c. 1455 BC date.⁷⁶ These dates place the Exodus long after the 1628 BC ice-core and dendrochronological date proposed by Manning and Baillie, as well as the radiocarbon date range of c. 1670-1520 BC. However, it does fall within LaMoreaux's c. 1450-1390 BC radiocarbon date and within the scientific date range of c. 1740-1440 BC previously established. The c. 1455 BC Exodus date may also add further support to LaMoreaux's theory that there were two major eruptions of Thera. Other radiocarbon samples from Jericho indicate a destruction date within a range from 1601-1524 BC, supporting Manning's tree-ring and ice-core date of 1628 BC.⁷⁷ Certainly, this evidence supports a possible link between Thera and the Exodus. If such a link indeed exists, the Theran eruption may have helped ensure the survival of the early Jews, a people who formed the foundation of the Judeo-Christian tradition upon which western civilization is based.

Unquestionably, a great deal of evidence exists which shows that the Theran eruption had a substantial impact on many civilizations, including Minoans and the Egyptians. This impact extended to civilizations beyond the Aegean Sea region, throughout the eastern Mediterranean, to Egypt, the Levant, and perhaps to other areas around the world, such as China. The disruption caused by the Theran eruption likely also gave rise to numerous myths and legends, such as Plato's Atlantis. While the Theran volcano's connection to these myths and legends is all but completely unsubstantiated by concrete evidence, comparisons between Thera and other major historical eruptions indicate that natural disasters of this magnitude leave a lasting cultural impact. Theran survivors in the eastern Mediterranean would likely have suffered crop failures

⁷⁵ Josh. 2-6.

⁷⁶ Booyesen, 238.

⁷⁷ Ibid.

from ash deposits and the lower temperatures created by a “volcanic winter.” The psychological impact, such as increased stress, would have had severe implications. The devastation would likely have forced some survivors to migrate, creating a refugee situation in neighboring civilizations. The Mycenaeans and the Sea Peoples are perhaps examples of this phenomenon. While the influx of people likely generated economic activity in the short term, this event disrupted the Aegean trade network, in which Thera played a substantial role. This disruption may have ultimately led to an unbalancing of power that led to the eventual decline and fall of Minoan civilization, economic instability throughout the region, and a power shift that benefitted mainland Greece. The rise of Greece eventually led to the philosophical ideas upon which western civilization is based. Additionally, the Judeo-Christian tradition, which may have been preserved by Thera's aftereffects, makes Thera's importance event greater. The cataclysm which no doubt accompanied the Minoan eruption of Thera may have had long-term positive consequences that continue to influence civilizations to this day.

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