

After the Big Bang: Eruptive Activity in the Caldera of Greco-Roman Thera

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PALAEA AND NEA KAMENI, the two volcanic domes now visible in the caldera of Thera (Santorini), are vivid reminders that the immense Bronze Age eruption entombing Akrotiri did not mark the end of volcanic activity on the island. Almost immediately, at least in geological terms, the fragmented landmass began to rebuild itself, mainly by means of intermittent eruptions of lava that have today created a massive submarine volcanic edifice manifested on the surface of the caldera by the two Kamenis.¹

According to a wide variety of ancient sources, at least two of these subaerial eruptions took place in Greco-Roman antiquity. The problem facing historians and geologists is to determine not only when these events occurred, but also whether or not they have any relationship to the modern Kameni islands. On this latter problem, even after three international congresses on Thera, there is little consensus: some, following Fouqué,² believe that only one landmass thrown up by volcanic activity in antiquity still exists, though they disagree on which volcanic event is responsible; others, following the lead of Philippson,³ argue that none of the 'islands' created in the caldera in Greco-Roman times exist today. As a result, the 'birthdate' of Palaea Kameni, the older of the two (Nea Kameni emerged in 1707), has been placed as early as 198/197 B.C. and as late as A.D. 1573.

¹ N. ARVANITIDES, K. BOSTRÖM, S. KALOGEROPOULOS, S. PARITSIS, V. GALANOPOULOS, and C. PAPAVALASSILIOU, "Geochemistry of Lavas, Pumice and Veins in Drill Core GPK-1, Palaea Kameni, Santorini," in *Thera and the Aegean World*, III. *Earth Sciences* (London 1990: hereafter 'T&AW III') 266-79; W. Hildreth, "The Katmai Eruption of 1912: A Comparison with the Minoan Eruption of Santorini," *T&AW III* 455-62.

² F. FOUQUÉ, *Santorin et ses éruptions* (Paris 1879: hereafter 'Fouqué') 3-9.

³ A. Philippson, "Die Inselgruppe von Thera," in H. von Gaertringen, *Die Insel Thera I* (Berlin 1899) 62-66; cf. J. W. Sperling, *Thera and Therasia* (Athens 1973) 9.

At present, geologists are unable to solve this problem by scientific methods of dating, so it is up to historians to shed as much light as possible on post-Bronze Age eruptive activity within the Thera caldera. Given the number of ancient sources alluding to such activity, an analysis of what they say (and what they do not say) may help us come as close to the truth as we can.

198/197 B.C.: The First Event

The earliest source for volcanic activity leading to the creation of a new landmass within the caldera is Strabo (1.3.16):

For midway between Thera and Therasia fires broke forth from the sea and continued for four days, so that the whole sea boiled and blazed, and the fires cast up an island which was gradually elevated as though by levers and consisted of burning masses—an island with a stretch of twelve stadia in circumference. After the cessation of the eruption, the Rhodians, at the time of their maritime supremacy, were the first to venture upon the scene and to erect on the island a temple in honour of Poseidon Asphalios (Loeb translation).

From this account the scene of the eruption was clearly the Thera caldera; lava flows resulted in the subaerial appearance of an island with a perimeter of *ca* 2.2 km.; Rhodian sailors were present during or shortly after the event; and the new island was substantial enough for a shrine to be built upon it. Geologically, of course, what had happened was the elevation by additional lava of an already existing submarine edifice; there must have been a series of unrecorded submarine eruptions long before the event reported by Strabo.⁴

Although Strabo provides neither a name for the new landmass nor the exact date of its emergence, his reference to Rhodian supremacy at sea suggests the early second century B.C. Indeed, Livy, Strabo's contemporary, though not recording the volcanic event under scrutiny, may help fix the date between 200 and 197 B.C.: in his account of the Second Macedonian War, the Rhodians in 200 B.C. travelled from Aegina to Kea to Rhodes by way of the islands, taking into alliance all except Andros,

⁴ Hildreth (*supra* n.1) 461.

Paros, and Kythnos (31.15). Such a 'Rhodian presence' in the Aegean would explain why Rhodian sailors were the first to set foot upon the new Thera landmass, as reported by Strabo.

In fact the testimony of Strabo and Livy suggests that Rhodians carried an account of the Thera eruption back to Rhodes, thus ensuring the survival of the tale. Indeed, Strabo, just after relating the Thera event, continues: "And in Phoenicia, says Posidonius, on the occasion of an earthquake, a city situated above Sidon was swallowed up, and nearly two-thirds of Sidon itself was engulfed too." That Posidonius (*ca* 135–51 B.C.) was also Strabo's source for the Thera event will be confirmed later in Seneca's account of the same eruption (see below). Posidonius lived in Rhodes for most of his life. We can thus be reasonably certain of a 'Rhodian tradition' for this volcanic event on Thera, begun by those venturesome sailors who first walked upon the newly-created landmass and returned home to tell the tale.

Strabo's account, however, is also important for something he does not say: he makes no mention of an eventual 'disappearance' of the new island despite reference, as noted above, to a Phoenician city being "swallowed up." Had the newly created Thera landmass also been "swallowed up" before Strabo's account was written, the author probably would have alluded to that event. Only one conclusion is possible: the new island still existed in Strabo's time (66 B.C.–A.D. 24). Thus it is difficult to accept Fouqué's statement that "le cône de l'éruption de l'an 197 avant J.-C. étant dans l'origine peu élevé au-dessus du niveau de la mer [*cf.* Strabo], paraît avoir été *promptement* [emphasis mine] tronqué par les flots."⁵

Seneca, the second source to record this Thera eruption (*QNat* 2.26.4ff), reports that

According to Posidonius, an island arose in the Aegean Sea, in the tradition of our forefathers [*maiorum nostrorum memoria*]. The sea foamed during the day and smoke was carried up from the depths. Finally night brought forth fire, not a continuous fire but one that flashed at intervals like lightning, as often as the heat below overcame the weight of water lying above. Then rocks and boulders were hurled up.

⁵ Fouqué 9. An anonymous reader points out that Fouqué may have meant that any unconsolidated deposits that lay atop the lava could have been removed by wave action, leaving the solidified lava.

The air had expelled some of them before they were burnt, and so they were undamaged while others were corroded and changed to light pumice. Finally, the top of a burned mountain [*cacumen usti montis*] emerged. Afterwards, the rock gained height and grew to the size of an island. (Loeb translation).

This account not only generally agrees with that of Strabo, but importantly confirms the rôle of Posidonius in transmitting knowledge of the event. As with Strabo, however, the new island is not named, nor is a precise date offered, only *maiorum nostrorum memoria*, i.e., before Seneca's time (4 B.C.–A.D. 65). On the other hand, Seneca speaks as if the island still existed and may even hint at its name—"burnt island" (*cacumen usti montis*), a phrase in keeping with the modern name Kameni (from *kekaumene*).

Pliny, a third source for this volcanic event, is, unfortunately, chronologically chaotic. At *HN* 2.202 in recording the emergence of islands from the sea, he mentions such 'examples' as Delos, Rhodes, Anaphe, Neae, Halone, and "Thera and Therasia among the Cyclades in the 4th year of the 135th Olympiad; also in the same group Hieria, also known as Automate, 130 years later...." The assertion that Thera and Therasia emerged from the sea in 237 B.C. is patently absurd. Yet this 'event' is said to have been followed by the emergence of "Hieria-Automate" in 107 B.C.

Editors of Pliny have attempted to alleviate this confusion by emending the "4th year of the 135th Olympiad" to the "4th year of the 145th Olympiad,"⁶ thereby having Thera and Therasia 'emerge' in 197 B.C. Although this is still nonsensical, it does have the virtue of introducing the date of 197 B.C. into Pliny's narrative. It thus becomes possible to salvage something from the text: for one can argue that Pliny was indeed aware of the emergence of a landmass in this region of the Cyclades in 197 B.C. but pointed incorrectly to Thera and Therasia, leading him to misdate the emergence of Hieria-Automate, which is more probably the landmass that emerged in the Theran caldera *ca* 197 B.C. This explanation seems supported by *HN* 4.70, in which Pliny writes of Thera, called Calliste when it first emerged, Therasia, which afterwards was torn away from it, and *inter duas*

⁶ E.g. H. Rackham's Loeb edition, 332f.

the soon born Automate, also called Hiera. The general sequence of events seems correct, even if the dates are not; thus Pliny's text, despite its chronological problems, is valuable for providing the actual name of the first island to rise out of the caldera: Hiera, or Automate. Moreover, like Strabo and Seneca, Pliny leads his reader to believe that this island still existed in his own day, as Plutarch confirms.

At *De Pythiae oraculis* 11 (= *Mor.* 399C), in the context of the Second Macedonian War, Plutarch records an oracle pertaining to an island that the sea cast up in front of Thera and Therasia:

Ocean shall blaze with an infinite fire, and with rattling of
thunder
scorching blasts through the turbulent waters shall upward
be driven;
with them a rock, *and the rock shall remain firm fixed in the
ocean* [emphasis mine],
making an island by mortals unnamed (Loeb translation).

Not only is this new island "firm fixed in the ocean," it is also "unnamed" by mortals—an assertion that would support reference to the island as Hiera (the holy island), as Pliny claims.

If Pliny's account posed serious chronological problems, that of Pausanias, the next source to mention an island called Hiera, presents equally serious textual problems. At 8.33.4 Pausanias discusses formerly great places reduced to nothing (ταῦτα μὲν δὴ ἐποίησεν ὁ δαίμων εἶναι τὸ μηδέν), as well as places of recent origin that have risen to prosperity because of favoring fortune (e.g. Alexandria). He then states:

The following incident proves the might of fortune to be greater and more marvellous than is shown by the disasters and prosperity of cities. No long sail from Lemnos was once an island Chryse, where, it is said, Philoctetes met with his accident from the water-snake. But the waves utterly overwhelmed it, and Chryse sank and disappeared in the depths. Another island, called Hiera ... was not during this time (νησον δὲ ἄλλην καλουμένην Ἰερὰν * * * τόνδε οὐκ ἦν χρόνον). So temporary and utterly weak are the fortunes of men (Loeb translation).

Not surprisingly, this passage is of crucial importance for those who argue that the Thera Hiera disappeared in antiquity, and

thus has no relation to present-day Palaea Kameni. Yet Pausanias provides a weak foundation for this theory because of the crucial lacuna in his text. Since we do not know how much text has been lost here, we cannot even connect with any degree of certainty the phrase τόνδε οὐκ ἦν χρόνον with the earlier νῆσον δὲ ἄλλην καλουμένην Ἱεράν. All that can be said with confidence is that something affected an island called Hieria, an island that may or may not be the Hieria associated with Thera and Therasia. In fact, the volcanic Aeolian island known today as Vulcano was one of several islands called Hieria in antiquity⁷ and, moreover, was very active from the second century B.C. to the sixth century.⁸ Even Fouqué (5), who believed that the Thera island of ca 197 B.C. had disappeared under the waves, ‘translated’ Pausanias’ text as “un envahissement de la mer a plongé l’île de Chryse sous les flots, tandis qu’ une autre île, nommée Hiéra, a surgi du sein des eaux,” thus interpreting the passage as a reference to the appearance, not the destruction, of the Thera Hieria.

After Pausanias we come to Justin 30.4.1: in 198/197 B.C. in the context of the Second Macedonian War and the consulship of T. Quinctius Flamininus, there was an earthquake between the islands of Thera and Therasia, *in quo cum admiratione navigantium* [most likely Rhodians, of course] *repente ex profundo cum calidis aquis insula emerit*. Moreover, we are told that on the very same day an earthquake struck Rhodes and many other states in the East.⁹ It seems that once again a Rhodian tradition is the author’s main source for these events.

In close agreement with these earlier sources is the *Chronicle* of Eusebius-Jerome (ed. Helm). For the emergence of Hieria, the Latin version of the Armenian text records that in the second year of Ptolemy Epiphanes and the fourth year of the 144th Olympiad [*i.e.*, 201 B.C.] *iuxta Theram apparuit insula, quae vocantur Hera (Iera)*. Jerome’s Latin edition similarly notes that *iuxta Theram apparuit insula quae vocatur Hieria*, but places the event three years later in the 145th Olympiad [198 B.C.].

⁷ W. Smith, *Dictionary of Greek and Roman Geography* (London 1854) 51, 1063; cf. J. Weiss, “Hieria (8),” *RE* 8 (1913) 1397.

⁸ R. B. Stothers and M. R. Rampino, “Volcanic Eruptions in the Mediterranean Before A.D. 630 From Written and Archaeological Sources,” *Journal of Geophysical Research* 88 (1983) 6363f.

⁹ Cf. G. Shipley, *A History of Samos* (Oxford 1987) 193.

Ammianus Marcellinus in the late fourth century refers to a Hieria in a discussion of earthquakes (17.7.13): "Now earthquakes take place in four ways; for they are either *brasmatiae*, or upheavings, which lift the ground from far within, like a tide, and force upward huge masses, as in Asia Delos came to the surface, and Hieria, Anaphe, and Rhodes...." (Loeb translation). The juxtaposition of Hieria with Anaphe here makes it likely that Ammianus is indeed dealing with the Thera island.

Ammianus next examines "*chasmatiae*" earthquakes, which swallow up landmasses, and offers as examples of this phenomenon Atlantis, Helice, Bura, and the Italian town of Saccumum; there is no mention made here of Hieria having so subsided, and so, once again, one concludes that Hieria still existed above water in the late fourth century.

The existence of Hieria as late as the eighth century is clearly attested by authors concerned with the famous eruption of 726 in the Thera caldera (Nicephorus, Theophanes, Muratorius, Cedrenus, and Anastasius)—an eruption that in fact increased the size of Hieria. These sources generally agree that during the course of the eruption a new island arose that soon united with Hieria.¹⁰ According to Theophanes (*Chron.* 339), the new island τῆ Ἱερᾶ λεγομένη νήσω συνήφθη; similarly, Nicephorus (*Brev.* 64) speaks of the new landmass joining τῆ γῆ τῆ Ἱερᾶ καλουμένη νήσω. Likewise, Muratorius writes (*Rerum Italicarum Scriptores* I 151): "in medio autem tanti ignis [*i.e.*, the eruption] insula ex terrae congerie facta, insulae, quae Sacra [*i.e.*, Hieria in Greek] dicitur, copulata est, nondum prius existens." A consistent account is also found in Cedrenus (*Compendium Historiarum* 795; *cf.* Anastasius, *Chronographia Tripertita* 212): *in medio ignis huius insula in terram constipata Hieraeque insulae aggesta est.* There can thus be no doubt that an island called Hieria still stood in the Thera caldera in the eighth century.

The data provided by the ancient sources suggest the following reconstruction of the history of Hieria: its birth was marked by a subaerial eruption that took place in the caldera in the 145th Olympiad, perhaps in 198 or 197 B.C.; over the four days of this eruption the island grew into a landmass with a perimeter of *ca* 2.2 km; Rhodian sailors were eye-witnesses to this event, and not only erected a shrine to Poseidon on the new

¹⁰ All sources listed in H. Reck, *Santorin* (Berlin 1936) I xv.

island, but also carried the news of its existence back to Rhodes; the island continued to exist into the eighth century, when it was in fact enlarged by another eruption. There is no reliable ancient evidence that Hieria was submerged or disappeared in Greco-Roman antiquity.

In light of the above, there seems to be no reason to reject the identification of modern Palaea Kameni with ancient Hieria. Even the dimensions of the former are compatible with those of an island with an original perimeter of twelve stades—or *ca* 2,240 m.—later augmented by an eighth-century addition (Palaea Kameni presently has a perimeter of *ca* 3,600 m.). Moreover, Palaea Kameni displays on its northern end the so-called Hagios Nikolaos lavas, which differ from those of the rest of the island, thus suggesting at least two distinct eruptive events.¹¹ It is even possible that the present chapel of St Nicholas on the island is the Christian descendent of the shrine to Poseidon erected by the Rhodians: pagan temples to Poseidon were commonly replaced in early Christian times by churches of St Nicholas, both regarded as protectors of sailors. A simple equation of Palaea Kameni with Hieria cannot, however, be accepted without duly noting that at least one other island seems to have been created in the caldera by eruptive activity in the first century. Fouqué and others believe, in fact, that the origin of modern Palaea Kameni is to be found here, and not in the events of 198/197 B.C.¹²

Event(s) of the First Century

Seneca (*QNat* 2.26.4ff) attests that at least one other volcanic landmass appeared in the Thera caldera during the Julio-Claudian period: immediately after describing Posidonius' second-century B.C. event, Seneca adds that "the same thing happened again in our own time [*nostra memoria*] during the second consulship of Valerius Asiaticus" (in 46). This assertion is

¹¹ M. Fytikas, N. Kolios, and G. Vougioukalakis, "Post-Minoan Volcanic Activity of the Santorini Volcano. Volcanic Hazard and Risk, Forecasting Possibilities," in *T&AW* III 183–98 (note map on 185); S. Paritsis, A. Liati, V. Galanopoulos, N. Arvanitides, and K. Boström, "Petrology of the GPK-1 Drill-hole Lavas, Palaea Kameni Hot Springs, Santorini Volcano, Greece: Constraints on the Low-T Lava Fluid Interaction," in *T&AW* III 261–65 (note map on 262).

¹² Fouqué 8; Fytikas *et al.* (*supra* n.11) 185.

indeed repeated a second time at *QNat* 6.21.1: “Does anyone doubt that air brought Thera and Therasia into the light of day, as well as that island which in our own time was born before our very eyes [*spectantibus nobis*] in the Aegean Sea?”¹³ Although Seneca does not provide a name for this new island, he clearly speaks with great certainty about an event that took place during his own lifetime.

Whereas Seneca seems clear and precise, another source for this eruption, Pliny’s confused text (*HN* 2.202), places the emergence of an island he calls Thia 110 years after the creation of Hieria (in 67 B.C), *i.e.*, in A.D. 43; he then contradicts himself by placing the emergence of Thia in the consulship of M. Junius Silanus and L. Balbus, *i.e.*, in A.D. 19. Pliny’s text, in fact, gives rise to the theory that two distinct volcanic events took place in the caldera during the first century—one in 19, the other in the reign of Claudius.¹⁴

The evidence for an event in 19, however, is extremely weak. Not only is its source the garbled text of Pliny, but Pliny even seems to contradict himself again by stating that the emergence of Thia took place “in our age” [*in nostro aevo*], a rather curious assertion for a person who lived from A.D. 28 to 79. In fact, Pliny repeats this assertion at *HN* 4.70, where he writes that Thia “emerged near the same islands [*i.e.*, Thera, Therasia, and Automate/Hiera] in our own time [*in nostro aevo*],” a statement that would make much more sense if referring to an event during the reign of Claudius.

Though Pliny’s text is chronologically nonsensical if taken at face value, there is a noteworthy mathematical progression to be found in it. If one counts the years elapsing between the Thera island of *ca* 197 B.C. and that of *ca* A.D. 46, one arrives at a figure of *ca* 243 years—a figure very close to the 240 years (130 + 110) recorded by Pliny (*HN* 2.202). It is thus plausible to argue that Pliny was aware that (1) two volcanic islands had emerged in the Thera caldera, and (2) approximately 240 years had separated these events. The mistaken need to include the ‘emergence’ of

¹³ Loeb translation. This passage is possibly responsible for the chronological confusion about Thera eruptions already seen in Pliny, who could have misinterpreted it as a statement that Thera and Therasia emerged from the sea in the recent past, hence assigning the erroneous date of 197 B.C. to that ‘event’.

¹⁴ Cf. N. Delibasis, S. Chailas, E. Lagios, and J. Drakopoulos, “Surveillance of Thera Volcano, Greece: Microseismicity Monitoring,” in *T&AW* III 200.

Thera and Therasia, however, threw his overall chronology to the winds.

Chronology aside, Pliny does in fact provide the information that Thia was to be found two stades (*i.e.*, *ca* 370 m.) from Hiera, thus clearly within the Theran caldera. Moreover, he agrees with Seneca in implying that this new landmass was still in existence in his own time.¹⁵

Cassius Dio and Philostratus are also pertinent. Dio notes (61.29.7) that “this year [apparently A.D. 47] a small islet [νησίδιον], hitherto unknown, made its appearance close to the island of Thera.” This unnamed νησίδιον is apparently the same island mentioned by Philostratus VA 4.34: Apollonius was in Crete when an earthquake and seismic sea wave struck the coast at Leben; to calm the populace, Apollonius told them to be of good courage, “for the sea has given birth and brought forth land.” Philostratus then goes on to record: “After a few days some travellers arrived from Cydoniatis and announced that on the very day on which this portent occurred and just at the same hour of midday, an island rose out of the sea in the firth between Thera and Crete” (Loeb translation). Given that Philostratus next refers to Apollonius moving on to Rome during the reign of Nero, it seems likely that the unnamed island born near Thera must that of *ca* 46.

Eusebius provides the additional information that, during the reign of Claudius, an island of thirty stades (σταδίων λ΄) arose between Thera and Therasia. The Armenian version likewise records that in the fifth year of the reign of Claudius *inter Theram et Therasiam exorta est insula fere stadiis XXX*; similarly, Jerome refers to the emergence of an island *habens stadia XXX* during the reign of Claudius. Here, for the first time, the size of the new landmass is recorded, and the figure of thirty stades will be repeated in such later sources as Oros. 7.6, Cassiod. *Chron.* 656, Syncellus *Ec. Chron.* 630, and Cedrenus *Ann.* 347.

The correct interpretation of the thirty-stade figure, however, is open to debate. If that figure refers, for example, to the diameter of a vaguely circular island, the resultant area of over twenty-eight km.² would dwarf the present-day area of Nea

¹⁵ This is apparently confirmed by Pomponius Mela (*ca* 50) 2.7, where he lists the Sporades islands as including “Thia, Thera,” although this is in fact an emendation of the manuscript’s *thyatira*; moreover, the peculiar omission of Therasia leads one to suspect serious textual corruption here.

Kameni (3.4 km.²); a landmass of this size would certainly not agree with Cassius Dio's comment that a νησίδιον arose near Thera during the reign of Claudius (61.29.7; see above). Hence it seems more likely that, as in the case of the twelve stades of Hieria, we are dealing with a perimeter of thirty stades, or approximately 5,600 m. (cf. Nea Kameni's perimeter of ca 7,400 m., or roughly 37 stades). Although this seems rather large for a νησίδιον, it is not an impossible size for a Thera calderic island.

Aurelius Victor provides another new piece of evidence about the event of 46 (*Caes.* 4): in the reign of Claudius *in Aegaeo mari repente insula ingens emersit nocte, qua defectus lunae acciderat*. As usual, the new island is not named, but the adjective *ingens* seems to agree with Eusebius' thirty stades (perhaps influenced by that source), and the island is said to have emerged during a lunar eclipse. We do know that such an eclipse took place during the night of 31 December 46 (Fouqué 6)—an explanation of why the dates of 46 and 47 both appear in our ancient sources.

All in all, we are left with the following data about this first-century island: it arose in 46/47 during the reign of Claudius; its emergence was accompanied by at least one earthquake and seismic sea wave that struck Crete; it was located two stades from Hieria island; it was possibly thirty stades in perimeter; and it may have been called Thia. Finally, in none of our ancient sources is there any hint that this new landmass subsequently disappeared. Thus some scholars argue that Thia is to be equated with the modern Palaea Kameni.¹⁶

Hence our present dilemma: what is the relationship of the two ancient islands of Hieria and Thia to the present-day Palaea Kameni? The theory that both these ancient islands disappeared and thus have no relation to Palaea Kameni is totally unsupported by the ancient sources; it is therefore possible that one or both of these landmasses make up part of the modern island. At this point the geological history of Nea Kameni can come to our rescue.

Fortunately, the development of Nea Kameni has been well documented, and geologists believe that the present-day island is the result of a series of eruptive events.¹⁷ Successive lava flows from 1707 to 1711 raised this landmass above sea level for

¹⁶ Fouqué; Fytikas *et al.* (*supra* n.11).

¹⁷ Cf. G. C. Georgalas, *Catalogue of the Active Volcanoes of the World*, Part XII: Greece (Rome 1962) 17–21.

the first time; additional lava flows during 1866–70 created the so-called “Georgios” lavas to the south of Nea Kameni. The eruption of 1925–26 then united Nea Kameni both with the Georgios lavas and with an earlier lava dome (created *ca* 1570) known as Mikra Kameni. Further lava flows ensued in 1928, 1939–41, and, finally, in 1950, the end result of which was the creation of Nea Kameni as we know it today: a single, complex volcanic dome, presently in a state of solfataric and fumarolic activity (Georgalas [*supra* n.17] 21).

It is a geological axiom that “the present is the key to the past.” It seems very likely that Palaea Kameni experienced the same type of gradual development seen in its neighbor: that is, the eruptions of 198/197 B.C. and A.D. 46 and 726 (probably with the addition of smaller events that escaped recording) all united in the end to create a single landmass. Philippson (*supra* n.3: 63) recognized that Palaea Kameni was indeed the end result of a series of successive lava effusions: “Palaea-Kaïmeni ist nicht durch eine Eruption aufgebaut, sondern durch eine ganze Anzahl über einander gelagerter Lavaergüsse.”

To further confirm this conclusion, however, it is necessary to consider the dimensions of the landmasses created by the Greco-Roman eruptions. As mentioned above, the event of 198/197 B.C. created a landmass with a perimeter of twelve stades, or *ca* 2,240 m., whereas the eruption of 46 created a landmass with a perimeter of *ca* 5,600 m. In comparison, the present-day perimeter of Palaea Kameni is approximately 3,600 m., that is, larger than Hieria but smaller than Thia. Is it possible to reconcile these figures?

First of all, the figure of thirty stades for Thia (Eusebius) appears relatively late, unlike the twelve-stade figure for Hieria from Strabo, our earliest source. Thus the thirty-stade figure may in fact reflect the size of a composite island that existed as the result of (unrecorded) unifying lava flows by the fourth century, or it may simply be incorrect. While it is tempting to assume the latter, it is not fatal to our hypothesis to accept the former: although our theoretical composite island with a perimeter of 5,600 m. is *ca* 2,000 m. larger than the present-day Palaea Kameni, there is strong evidence that Palaea Kameni lost a significant amount of land in 1457.

An inscription of 1457, as recorded by Ross,¹⁸ reads

*Magnamine Francisce, heroum certissima proles,
Crispe, vides oculis clades quae mira dedere
Mille quadringentis Christi labentibus annis
Quinquies undenis, istis jungendo duobus,
Septimo Calendas Decembris, murmure vasto
Vastus Therae sinus immanis saxa Camenae
Quum gemit, avulsit, scopulusque e fluctibus imis
Apparet, magnum gignit memorabile monstrum.*

This inscription, addressed to Duke Francesco Crispo II, attests that in 1457 a large portion of Palaea Kameni collapsed into the caldera bay. The site provides evidence of this catastrophe, for the island features a steep cliff in its southern half, facing Nea Kameni (PLATE 3); in general appearance this cliff looks very much like a collapse structure, and was so considered by Reck: "Aber heute ist die Gestalt der Insel sicher nicht mehr die alte, sondern ihr ganzer Südteil ist 1457 an der schroffen Felswand, die jetzt den südlichen Küstenabsturz Palaea Kamenis bildet, bis unter das Meer abgesunken."¹⁹

After this collapse, volcanic activity within the Thera caldera seems to have shifted to the northeast of Palaea Kameni, with the emergence of Mikra Kameni *ca* 1570. As we have seen, this small island would in turn be amalgamated with the growing landmass of Nea Kameni in 1925–26. Thus, Mikra Kameni may well have repeated the history of Hiera: at first an independent island, it eventually became subsumed into a larger landmass as volcanic activity continued within the caldera.

At the Third International Congress on Thera, a paper presented by Arvanitides *et al.* seems to offer 'hard' evidence for the hypothesis of this paper. Based on the results of a drill hole to the southwest of St Nicholas' Church on Palaea Kameni, three distinct lava 'units' were identified: in the stratigraphy, the oldest ("A") lavas are mixed with pumiceous material "which represents erosion products from the caldera walls, which started to fill the caldera depression very soon after the last Minoan eruption and the concomitant caldera formation" (*T&AW* III 273); the next higher level, the "B" lavas, must be

¹⁸ L. Ross, *Reisen auf den Griechischen Inseln* (Stuttgart 1840) 95.

¹⁹ H. Reck, "Das erdgeschichtliche Werden Santorins und das Antlitz seiner Landschaft," in Z. Durazzo-Morosini, *Santorin* (Berlin 1936) 51.

younger in age, and should belong, according to our hypothesis, to the eruption of 198/197 B.C.; the upper element, or "C" lavas, should thus date either to the event of 46 or to an unrecorded later eruption that united Hiera and Thia. Arvanitides *et al.* do not come to this particular conclusion (preferring to date the C and B lavas to the event of 197 B.C.), but they do support the hypothesis of this paper in stating that these distinct flows "represent different eruptive cycles evolving from a common magma chamber rather than being differentiated from a single eruptive cycle" (*T&AW* III 273).

That the present-day Palaea Kameni resulted from at least two eruptions in Greco-Roman antiquity thus seems a reasonable thesis, supported by both the ancient sources and some recent geological work. It remains to be seen if further geological studies will be able to shed more light on this contentious issue.²⁰

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February, 1993

²⁰ A possible event in 1458 is recorded by P. Faure, "A Santorini Eruption Unknown to Historians," in *Thera and the Aegean World* I (London 1978) 817; in the same volume (819–23), C. Doumas, "Eruptions of the Santorini Volcano from Contemporary Sources," provides sources for the 1650 Coloumbo event (outside the caldera).

I am grateful to the anonymous referees for their helpful comments. I would also like to thank Dr S. L. Ager of the University of Waterloo.



Caldera bay at Palaea Kameni (Palaea Kameni to left, Nea Kameni to right)