

**Encore Learning, Arlington VA -- Spring Semester 2020**

**Pompeii, Vesuvius, and All That – Tom Wukitsch, Instructor**



***Vesuvius eruption over Pompeii,  
early phase  
Discovery channel Reconstruction***

# Pompeii, Vesuvius, and All That

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Unit 1

## ***Vesuvius, Pompeii, Herculaneum, and Environs***

### **Unit 1 Introduction: The Catastrophic Event**



*Eruption of Vesuvius*

Joseph Mallord Turner (1817)

***The eruption began at about noon on 24 August of AD 79, its paroxysmal phase lasted until the next day but waning, small-scale activity may have continued for some time (at Pinatubo, in 1991, declining activity continued for more than 2 months). It erupted about four cubic kilometers of magma from a zoned magma chamber in less than 24 hours. Airfall tephra was blown South-Southeast and is traceable up to 74 km away, near Agropoli (at the bottom right of the isopach map on page 6). Several towns and villages were completely annihilated, mainly by burial under thick pumice fall deposits (up to 2.5 m thick in Pompeii) in the SE sector of the volcano, and by much thicker pyroclastic flow deposits (more than 20***

***m at Herculaneum) on the S and W flanks. At least 3600 people were killed. The number of those displaced or otherwise affected by the effects of the eruption is not known.***

## Before the Eruption

What did the Volcano look like before the 79 AD eruption?

That's still unknown. There are two extant pictures:

A picture in Pompeii shows a single peak.  
A picture in Herculaneum shows a double peak.

The difference may be a matter of angle of view -- it is possible that a pre-79 AD caldera wall was hidden from view by a more recent cone when seen from Pompeii. Patterns of pyroclastic flows in the 79 AD eruption support the idea that there may have been a large geologic barrier corresponding to the position of the Somma caldera wall that is there today

*In this wall painting from Pompeii, Bacchus is garlanded and clothed in a cluster of grapes, with a panther at his feet. Vineyards and trellises can be seen covering "those most famous slopes of Vesuvius and of Surrentum in Campania" (Columella -- De Rustica 1st century).*



*"Here is Vesuvius, viney and shade-green only yesterday; here, on these slopes that Bacchus loved more than Nysa's hills, the noble grapes outgave themselves time and again; on this mountain the Satyrs leaped and danced, for this was Venus's adopted home, dearer to her than Sparta, and here a proud town bore the name of Hercules. It's all drowned now by fire, sunk to drab ash. What won't the high gods permit themselves, they could well ask." Martial, Epigrams (IV.44)*

**The picture of a single-peaked Vesuvius found in Pompeii. The Standing figure is Bacchus, clothed in grapes -- Vesuvian wine was considered the best available. Above the mountain is a grape garland with two descending ribbons. The snake**



*in the foreground is a symbol of good fortune.*

**Population in the area --**

**Pompeii ca. 20,000 -- 8 km SSE of the summit**

**Herculaneum ca. 5,000 -- 6 km West of the summit**

**Stabiae more than 1000 -- 14 km SSE of the summit**

**Smaller towns, outlying villas probably 5,000+**

**Pompeii was commercial and middle class, but also somewhat touristy.  
Herculaneum was a resort.**

**Rich Romans (including the Emperor and the Aristocracy) had villas  
around the Bay of Naples and in the surrounding hills.**

**A naval base and commercial port facilities were at the northern end of the  
bay.**

**The hinterland was used for agriculture: grapes, olives, and truck farming.  
Big rich villas usually had a farm component, but there were also many  
small farmers. It is probable that many people who escaped the towns  
were caught and died in the hinterlands and have never been discovered**

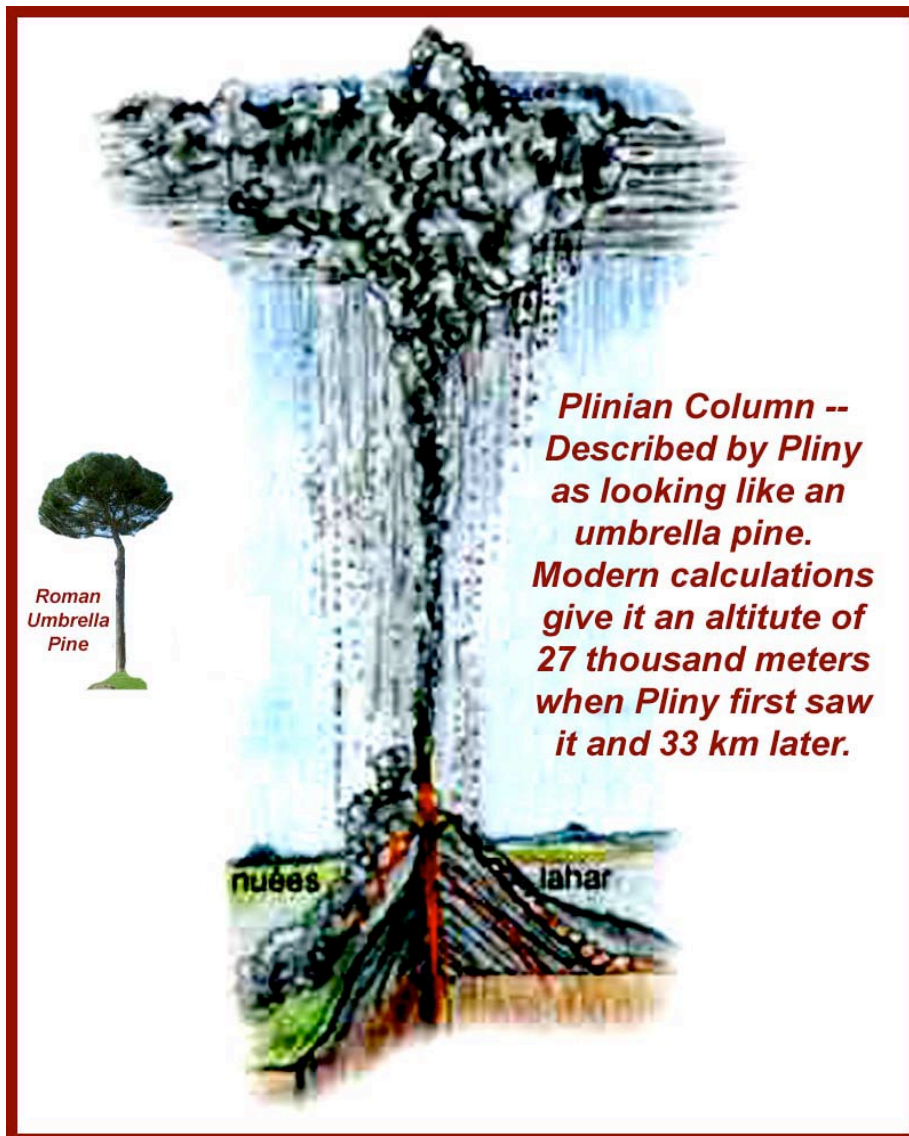
**Previous seismicity:**

**Major destructive earthquakes in AD 62 and 64. Frequent smaller quakes.  
Probably a regional seismic event that set up or triggered the AD 79  
eruption rather than an event caused by magma movement below  
Vesuvius. Repair work from these quakes was still under way at the time of  
the AD 79 eruption. (A similar destructive quake struck in 1980.)**

**Local seismicity for several months leading up to the AD 79 eruption.  
Ground uplift probable, but not documented.**

**The 79 AD Eruptions**

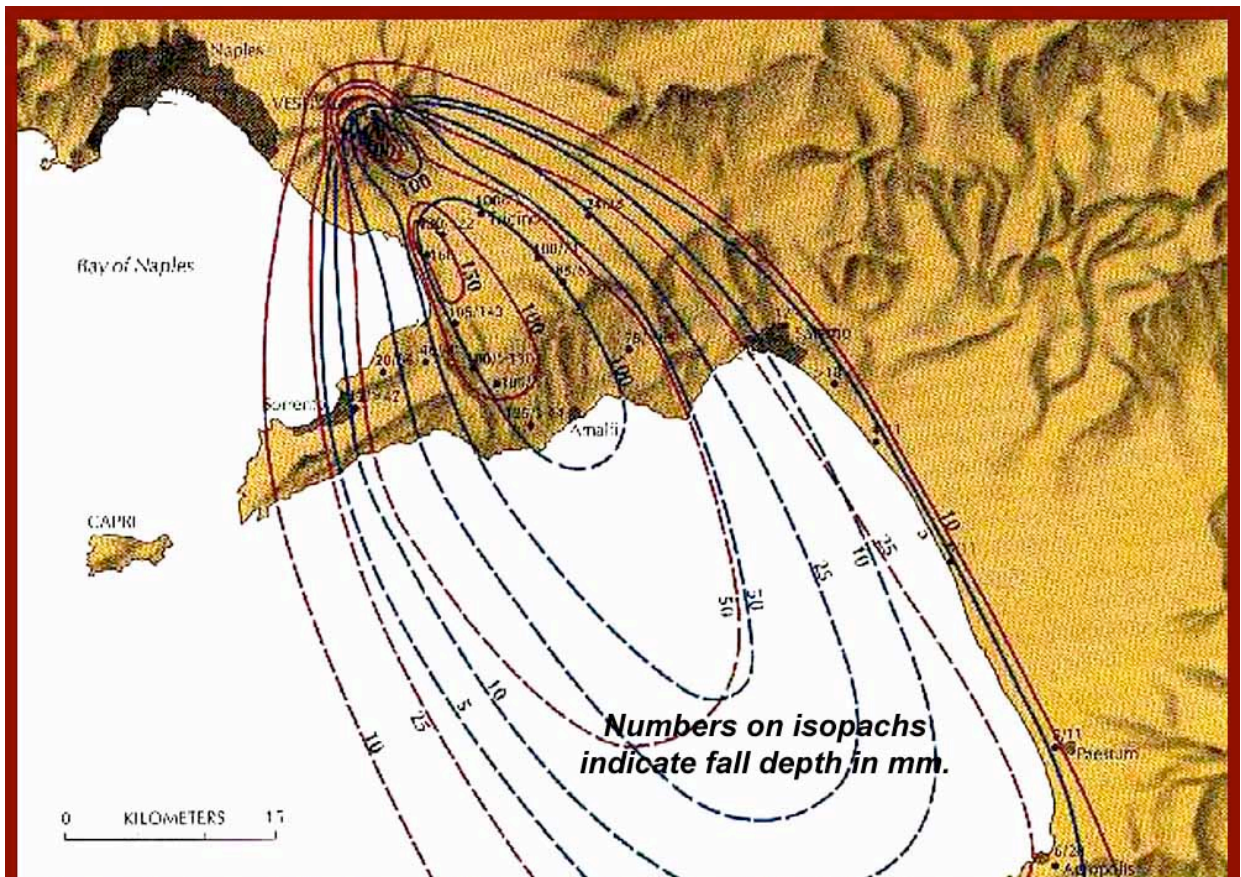
**Initial phreatomagmatic activity -- morning of August 24. : violent  
explosions (not mentioned by Pliny) deposited a few centimeters of ash  
east of the volcano. The east side may have blown out near the top and  
there may have been a small pyroclastic flow (surge). It probably alarmed  
nearby residents, but there is no evidence of any exodus of population.**



**Plinian phase and pumice fall -- started about noon on August 24. Pliny became aware of it about 1 hour into the process. Typical "Plinian" eruption column -- shaped like an umbrella pine. Wind blew SSE that day (usually it is ENE) and blew the cloud directly over Pompeii. Tephra fell on Pompeii at 12 -- 15 cm/hour (5-6 inches/hour) -- mostly (90%) in the form of small pumice clasts. (Pumice is essentially foamy glass, clasts are chunks. Most of the clasts were less than an inch in diameter.) The other ten percent were "lithics", that is, heavier rocks up to 2 inches in diameter. During the first seven hours, 1.4 meters of white pumice fell on Pompeii. Many people fled, but some thought their homes would be safer than the hot and dusty outside air where rocks were falling like snow. Although the individual clasts were light, the accumulated weight brought down many roofs.**

**Then the Plinian eruption evolved. It tapped into a lower portion of the magma chamber where the melted rock was less evolved, and the ejected pumice turned gray. The change was abrupt, indicating a sharp interface between the two types of magma in the chamber. At the same time, the force of the eruption increased dramatically, lifting the ejecta column to 33 km. The rate of fallout on Pompeii**

decreased because the increase of force made the particles much smaller and they were carried farther away to the SSE before they descended. Another meter and in some places two of this gray pumice fell on Pompeii over the next 5 to 6 hours gradually decreasing in the rate of fall. It must have seemed like the event was ending, and there is evidence that some folks went back -- either to retrieve valuables or to steal them. Footprints of military hobnail boots are found on the top of this layer, indicating that a rescue effort may have been under way. During the Plinian phase of the eruption, there was little effect outside the fallout zone to the south of the volcano.



**Isopach map of the August 79 pumice fall deposits. Blue lines are for the white pumice fall deposit, red lines for the overlying gray pumice fall deposit.**

**(from Sigurdsson et al., 1985)**

The Peleéan phase followed (named after the Mount Peleé eruption of May 1902 that killed 30,000 in Martinique). After about 12 hours of continuous Plinian activity, i.e. the sustained violent outburst of gas and magma, a change in the eruptive dynamics occurred that would be fatal to thousands of people around the volcano. Several factors probably contributed to the change: (A) the vent probably widened thus distributing the eruptive pressure over a wider area; (b) the mass eruption rate (the amount of molten stone coming out) increased and the weight of the Plinian column increased proportionately; and (c) the volatility (gas content) of the magma was being exhausted. The result was the collapse of the eruptive column.



## **Peleéan phase results in AD 79:**

**Terminology:** These definitions are controversial within the volcanological community, so we have to define what we (or rather I, your humble servant) mean by them.

**Pyroclastic surges and flows** are hot clouds of volcanic ejecta that come down the sides of mountains at high speeds. Gravity causes the heavier stuff to stay closer to the ground and pick up a lot of speed as it goes.

This ground-hugging part/fraction, often called the "**pyroclastic surge**" follows the terrain and is often channeled down valleys. Speeds of hundreds of miles per hour are possible. Because the surge moves so fast, it can also arrive at a much higher temperature (starting at perhaps 1,000 degrees and cooling as it goes) than the slower moving part that follows. The surge carries along with it debris -- wood, rocks, roof tiles, masonry, etc. The surge knocks down walls and buildings if it is strong enough and leaves behind only a small deposit layer: it travels so quickly that it spreads itself far and wide, but thin. This is the phenomenon that killed exposed people in the AD 79 eruption. It knocked them down, battered them somewhat, cooked them, and suffocated them in a matter of seconds. There may be thousands of undiscovered victims in the countryside, still under layers of volcanic debris and lava flows from later eruptions. (There was no lava involved in the AD 79 eruption.)

During the descent, the lighter materials tend to get thrown up into the air as they come down the slope. This airborne fraction, often called the "**pyroclastic flow**" moves only slightly slower than the surge and arrives almost as hot. Because it is higher in the air, it is less susceptible to channeling by terrain features. Because they move more slowly and because they actually carry much more mass -- smaller particles, but tons more of them -- flows can leave behind massive thick deposits -- they left several meters in Pompeii and more than 20 meters in Herculaneum.

The Plinian column can, and, in this case, almost certainly did, pulse -- it partially collapses, and then, because it thereby loses mass, it then can again hang in the air for a while. The pulsing causes successive linked pairs of surges and flows. The first pyroclastic surge hit the walls of Pompeii within a ten minutes of the start of the collapse of the Plinian column. It does not appear to have breached the wall. Seconds later its linked flow came over the wall. Still moving at more than 100 km per hour and with a temperature of several hundred degrees, it was immediately fatal to anyone it touched. Those sheltered in buildings would die almost instantly from breathing superheated air. (This is technically not suffocation, but most folks call it that anyway.) Whether caught up in a surge or a flow, death would be almost instantaneous.

The first pyroclastic surge and flow pair struck Herculaneum within four minutes of the collapse of the column. Many folks had gone to the shore of the Bay of Naples hoping to escape by sea, but when they saw the flow coming -- a bright

glowing cloud-like mass hurtling down the mountain -- those who could dove into the arched boat sheds cut like caves into the low shoreside cliffs.

Hundreds actually made it into the sheds, but they still died almost instantly from breathing in superheated air that followed them inside as the surge/flow arrived. The folks in Herculaneum had watched the earlier ash-fall envelop Pompeii, but they were wiped out by that first surge that actually hit them before it hit Pompeii. Herculaneum was then overwhelmed by lehars -- pyroclastic flows mixed with mud mixed from the melt-down of the small glacier that had previously been on the slopes of Vesuvius and from rain that was wrung from the air by volcanic effects on the atmosphere.

Nuées ardente and pyroclastic flows and ignimbrite flows. This is where the controversies arise, not because volcanologists can not agree on what happens, but because they insist on fighting over the names they apply to what happens. As is often the case, we can blame the French. Because Martinique was French in 1902, the Peleé eruption was mostly observed and studied by Frenchmen. The French and some other volcanologists talk about *nuées ardente*, which are a subset of what some other volcanologists call pyroclastic flows. *Nuée ardente* means "glowing or fiery cloud". The *nuées ardente* crowd say that a *nuée ardente* is identical with a pyroclastic flow and, further, that a pyroclastic flow can only be caused by ejected material avalanching right down the slope (i.e., not the result of a collapsed Plinian column). They say that the result of a collapsing column is something different called an "ignimbrite flow", which leaves behind deposits of fused or loose ignimbrites -- fused if the deposit was hot enough to partially melt and stick together and loose or "unfused" if not. Almost all volcanologists call what is left behind by any of these events the same thing -- ignimbrites. Ignimbrite deposits are often surrounded by fringes of other debris including blocks of pumice that are pushed outward by the fast moving flows. To further confuse the issue, some volcanologists call the surge the flow and *vice-versa*.

There are film clips of pyroclastic flows available on the Internet. Two of them are at: <http://www.geo.mtu.edu/volcanoes/hazards/primer/images/mpegs/pf.flow.mpg> (Pinatubo, Philippines)

and at

[http://www.geo.mtu.edu/volcanoes/west.indies/soufriere/govt/images/051296/pf\\_s ea.mpg](http://www.geo.mtu.edu/volcanoes/west.indies/soufriere/govt/images/051296/pf_s ea.mpg) (Soufriere Hills, Monserat)

A computer simulation, which shows the pulsing of the Plinian column and the separation of the ground surge and the wave-like flow, is on the Internet at:

<http://urban.arch.virginia.edu/struct/pompeii/images/video/dobran-simulation.mpeg>

A pyroclastic flow animation is at:

[http://www.arp.sprnet.org/tech/tasa/volcano/anim\\_pf.mov](http://www.arp.sprnet.org/tech/tasa/volcano/anim_pf.mov)

Death and destruction

About 3500 people are known to have died in the AD 79 eruption. That number represents the number of remains actually found. It is assumed that many people were also caught in the countryside and perished. Occasionally a few more are found when a new archeological site or construction site is opened, and once in a while hundreds are found huddled together as was the case when the Herculaneum boat sheds were excavated a few years ago. It is unlikely that any accurate count will ever be possible. By carefully studying destruction patterns, modern volcanologists have determined that there were areas that were slightly cooler than others. Neither the "cooler" nor "hotter" areas, however, would have allowed survival, however.



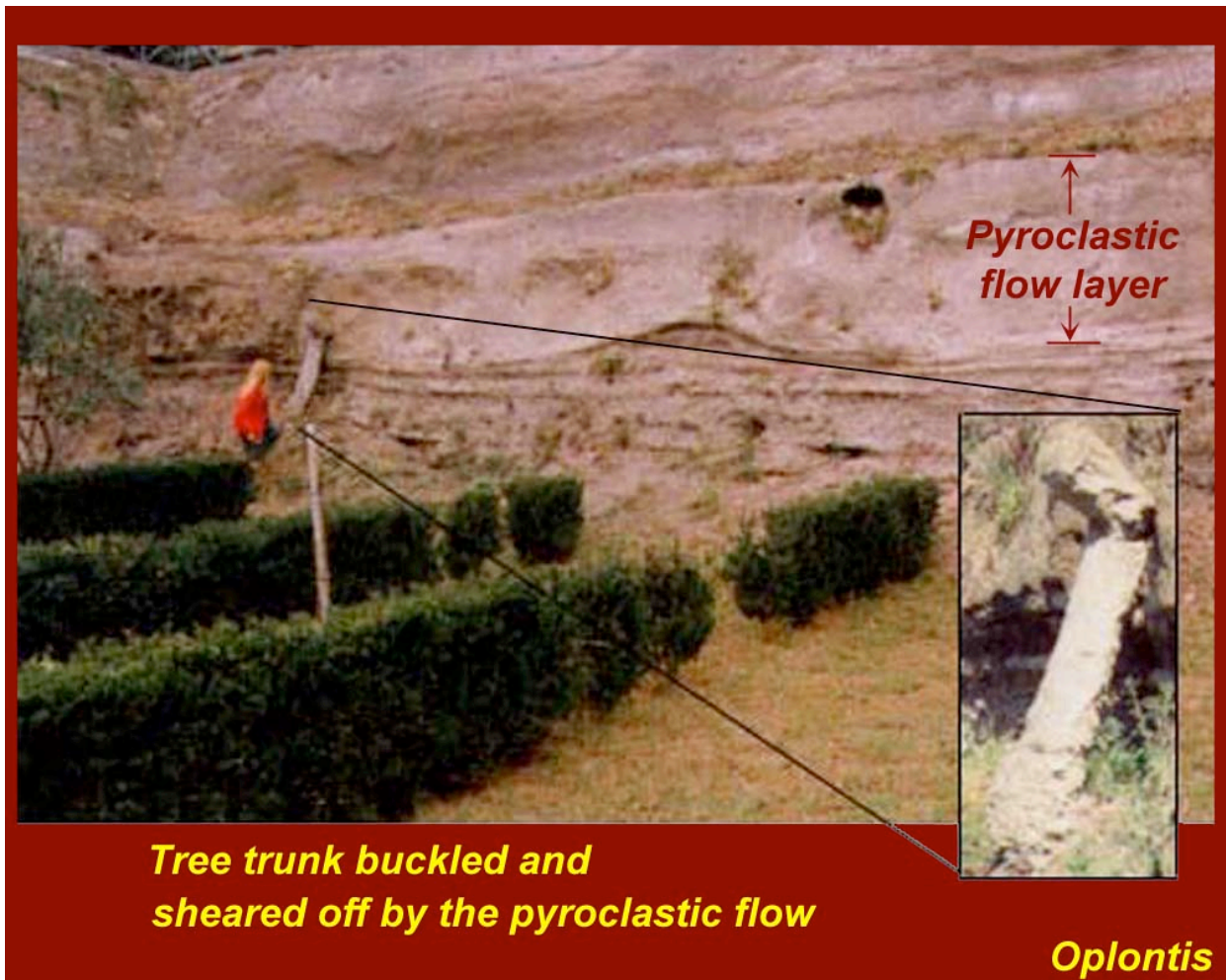
## *The human toll*

*Plaster casts from Pompeii (above) and human remains recovered from the Herculaneum boat sheds (right)*



Many more people were probably caught and buried in the hinterlands where they are unlikely ever to be recovered. Archeologists, like the treasure hunting diggers of the past, want to excavate the remains of towns rather than to dig in fields of ancient farmers, so the remains of urban evacuees that were overwhelmed in the countryside by volcanic debris have never been found.





Destruction was widespread at all known sites. Roofs and ceilings collapsed under the weight of the tephra. Walls that were perpendicular to the surges and flows were knocked down, and if they were strong enough to survive the blast they set up eddies that swirled around and inside. In Pompeii, many walls survived where there might already be two or three meters of tephra in place to support them. There are some clear examples of trees bent over or broken by the blast at precisely the level of the top of tephra falls. Organic materials were, in many cases, instantly carbonized by the extreme temperatures of the air in the surges and flows. Where this material was not completely blown away, it can still be seen in a carbonized state -- doors, furniture, grain, bread, and, most importantly, the thousands of scrolls in the house that the father-in-law of Julius Caesars had built more than a century before the eruption.

Unit 2

This Page is

<http://www.mmdtkw.org/ALRltkwVesUnit01Geology.html>

## Central Italian Geology -- It starts with Steno



# Steno

**Niels Steensen  
and his famous shark**

**Steno invented  
geology and  
laid down "laws"  
that are still used  
by modern  
geologists to determine  
the relative ages  
of strata.**



**Niels Steensen 1638 - 86 (Danish — born in Copenhagen).**

**Steensen's first fame was as an anatomist**

**He dissected a giant shark in 1666 and noted the similarity of the shark's teeth to "glossopetrae" — this led him to his theory of "fossils" (i.e., "dug up things") that didn't grow inside of rocks.**

**His book: *De Solido Ontra Solidum naruraliter Contentus Dissertationis Prodromus* ("Preliminary discourse to a dissertation on a solid body naturally contained within as solid") is usually just called the *Prodromus*.**

**Laws:**

- 1. Strata are naturally horizontal.**
- 2. Only outside causes can cause deviation (e.g.: upward pressure, folding, falls into voids, intrusions, etc.)**
- 3. Anything that forms inside of something else will take the shape of the void (and not vice-versa).**
- 4. Newer layers will take the shape of existing strata.**

**Without Steno there would be no science in geology.**

**Plate tectonics**

**Plates worldwide -- "Pangea" -- "Macro-geology"**

**European seismicity was fairly common – viz. the Alps, the Urals, and Italian volcanoes.**

**Earthquakes clustered along lines of plates and mini-plates:**

**European and African plates**

**Italian, Apulean, and Iberian mini-plates**

**Western European and Italian plate tectonics**

**What happens when plates collide?**

**Motivating force is convection**

**Rifts and trenches**

**Subduction (= leading under / channeling downward) and other terminology**

**Compression forces on the subducting asthenosphere cause it to melt (It is almost ready to melt — semi-plastic — even when not under compression.)**



Hot stuff rises through lithosphere faults.

Pooling at the bottom of continental crust — melts bottom of crust — forms crustal magma chamber above.

Eventually finds an exit route – or cools and solidifies.

Magma chambers can get to be huge -- the one under the bay of Naples has recently been measured at 400 cubic kilometers.

The local "supercaldera" = Campi Flegrei = Fiery Fields + Bay of Naples + equally large area of the adjacent Mediterranean Sea.

[superplumes — research has indicated that there is no superplume under Italy. In the 10th unit, we'll talk more about superplumes and supercalderas]

## Type of volcano structures

Vesuvius is a stratovolcano / somma volcano on the edge of the caldera

Tephra — what falls from the sky — ash, pumice clasts, stones, blocks, and bombs

Pumice — exploded, expanded glass — can come down in tiny (ash) or large (block) pieces

Tufa — what comes down in flows — pretty much the same as pumice, but often is hot enough to be "fused" — if it's a flow product it might be called ignimbrite

Lava — flowing or not, depends on temperature and density — none in our 79 AD eruption but it does occur in the historical Vesuvius record (the layers of pumice, lava, tufa, etc. are the strata in the stratovolcano.)

Lahars — water mixed with other volcanic products: mud flows, etc. — can be driven by explosive forces, collapse forces, etc.

"Lahars hit Herculaneum but not Pompeii." -- false

Contrary to what was first thought, lahars weren't the killers in Herculaneum -- six or more very hot surge/flow pairs buried Herculaneum

Most of central Italy has deep and old tufa deposits

Central Italy has two huge "fields" — dividing line appears to be the western course of the Tiber/ Rome

Northern field through which the Tiber flows south before turning west toward the coast.

**Tiber's turning point appears to be determined by the northern edge of the slightly harder southern tufas.**

### **Tufa / Ignimbrite around the Bay of Naples**

**Two major eruptions of the Campi Flegrei part of the Caldera  
37,000 years ago  
25,000 years ago**

**Often together called the "Campanian Ignimbrite" (but sometimes divided into the "Campanian" and "Yellow" ignimbrites)**

**Depth of ignimbrite from the two eruptions:**

**1500 meters deep in the center of the caldera**

**Bradyseism has lowered the southern part below water.**

**The sea has eroded the western edge.**

**450 meters in circling area and to east**

**Note: there is a quick decrease of ignimbrite depth around northern fringe due to a pre-existing caldera wall blocking flows northward.**

**Terrain determined spread of ignimbrite — note above**

**But there are "Campanian ignimbrites on the southern slopes of the Amalfi Peninsula. The Peninsula is topped by the Lattari Mountains a pre-existing limestone ridge that is over 1000 meters high.**

**The pyroclastic flow crossed the bay and overtopped the Lattari Mountains ridge.**

### **Vesuvius**

**12,000 years ago, Vesuvius formed on the edge of the big caldera.**

**Eruptions before and after AD 79: (All dates approximate) 6,000 BC, 3500 BC, 1750 BC, pre-800 BC, pre 600 BC, Sept 29-Oct 6, 1538 (and many more after, including 1631, a sub-phreatic explosion that killed more than 4000).**

### **Area Volcanoes**

**Vesuvius (1500 crater diameter 1,281 meters high)**

**Monte Nuovo (1000 meter diameter, 134 meters high)**

## **Solfatara**

**Lake Avernus (1300 meters diameter)**

**Connected to the sea by the Grotto (water tunnel) of Cocceius — more than a kilometer long.**

**Built by Cocceius for Agrippa about 35 BC**

**Built to make Lacus Avernus a naval base, but soon obsolete and Misenum took over.**

**(Same time as Naples-Pozzuoli (land) tunnel, also built by Cocceius for Agrippa.)**

**Grotto of Cocceius was severely damaged by allied bombing in WWII because it was being used by the Germans -- closed to visitors since then (but I got in years ago with a US/Italian military scavenging expedition.)**

**Thoroughly excavated.**

**Two additional lakes — semi-craters that are eroded and then coastal debris washed up to cut them in half.**

**Solfatara (500 meter crater diameter, semi-collapsed walls) (The word “solfatara” is now also a generic term for places and fumaroles like the ones here)**

**A local phreatic "hot spot" — about 200 degrees C. (392 degrees F.)**

**Sulfuric-Arsenic gasses and crystals.**

**Boiling mud, 200 degree C. hot spring.**

**Occasional hot sulphurous eruptions.**

**Carefully controlled pathways — doomed if you step off. (Slide 20)**

**Mostly German and Scandinavian campers.**

## **Bradyseism**

**A long-continued, extremely slow vertical instability of the crust, as in the volcanic district west of Naples, Italy, where the Flegreian bradyseism has involved up-and-down movements between 6 m below sea level and 6 m above over a period of more than 2,000 years.**

**We'll see more about this in the unit in which we cover the Baia Bay area.**



## **Phreatic**

**Explosive -- Gasses and water dissolved in the magma suddenly released. Caused by landslides or plug-popping.**

**Produces ash, but mostly "blocks", which are chunks of what formerly was the top of the volcano, and "bombs", which are molten blobs of lava that are shot up into the air.**

**Blocks can be huge!**

## **Plinian (named after Pliny the Younger who described the AD 79 Vesuvius eruption)**

**Often preceded by one or more phreatic explosions — this was the case with the AD 79 eruption.**

**Produces a tall mushroom cloud — described by Pliny as looking like an Umbrella Pine — which is supported by the continuing ejection of highly gaseous magma through a constricted volcano throat.**

**Fallout in the form of ash, pumice clasts, and lapili. In the AD 79 eruption the fallout over Pompeii was 1.4 to 2 meters of which 90% was pumice clasts, mostly under 4 centimeters in diameter. None on Herculaneum**

**Eventually the gasses that generate the force supporting the column is expended and/or the throat of the volcano erodes and widens. The column then collapses and a new, Peleean phase begins.**

## **Peleean (named after Mt. Pelee on Martinique)**

**St. Pierre on Martinique was destroyed (29,000 deaths) by a Peleean eruption, May 7 and 8, 1902 (For more info, <http://www.mount-pelee.com/welcome.htm>).**

**Peleean eruptions generate pyroclastic surges and flows.**

From the BBC Internet site at

[http://www.bbc.co.uk/history/ancient/romans/pompeii\\_portents\\_01.shtml](http://www.bbc.co.uk/history/ancient/romans/pompeii_portents_01.shtml)

## **Pompeii: Portents of Disaster**

*By Professor Andrew Wallace-Hadrill*

***The people of Pompeii were quite unprepared for the eruption of Vesuvius - getting on with their busy lives, in total ignorance of what was to come. The signs of impending disaster, though, were there - why did no-one pick up on them?***

**The unexpected catastrophe**

**It is certain that when the eruption of Vesuvius started on the morning of 24 August, AD 79, it caught the local population utterly unprepared. Although at the same time, as we now know in retrospect, all the tell-tale signs were there to warn them.**

**It is mainly thanks to the vivid eye-witness account of the younger Pliny (a Roman administrator and poet, whose many vivid letters have been preserved), that we have some understanding of what happened. And it is through him that we can gain insight into the reactions and feelings of the people caught up in the drama of this natural catastrophe.**

**Pliny's account leaves no doubt that everyone was caught unprepared. His uncle, known as Pliny the Elder, was stationed in command of the imperial naval base at Misenum, on the north-west extremity of the Bay of Naples. He was not only the senior military officer in the district, but possibly the most well informed living Roman on matters of natural science. His 37-volume *Natural History* is the longest work on science in Latin that has survived from antiquity.**

**But for all his science and his seniority, his nephew tells us that the elder Pliny was relaxing, after a bath and lunch, when Vesuvius started to erupt. And the sighting of a column of smoke 'like an umbrella pine' on the far side of the Bay triggered a response more of curiosity than of alarm in him. He and his companions were evidently not anticipating such an event.**

**The same account reveals, however, that the signs were there. Pliny's casual reference to earth tremors 'which were not particularly alarming because they are frequent in Campania' reveals the Roman's comprehensive ignorance of the link between seismic activity (earth tremors) and volcanic activity.**

**The volcanologists of today constantly monitor any changes in levels of seismic activity from the observatory on Vesuvius, because they know that the same increase of activity in the deep reservoir of magma (molten or partially molten rock beneath the Earth's surface) causes both earth tremors and volcanic eruptions. Through measuring seismic activity, these scientists expect to predict an approaching eruption months in advance.**

They also know that the activity of Vesuvius is recurrent, and that the longer the intervals between one eruption and another, the greater the eventual explosion will be. The frequent but low-level activity of Vesuvius in recent centuries has relieved the build-up of pressure in the magma chamber. The catastrophic magnitude of the eruption of AD 79 was connected with the extended period of inactivity that preceded it. A long interval combined with mounting seismic activity is a sure sign of impending disaster.

Of course, the Romans could not know this, and our own knowledge owes much to the care of Pliny's description. The long inactivity of the volcano naturally lulled the people of the region into a false sense of security, though they were aware of the signs of burning at the peak of the mountain.

They were not the first to be so lulled: recent excavations at the site of the new NATO base at Gricignano, on the north of the Bay, have revealed two catastrophic eruptions that preceded that of 79, and wiped out the populations of a densely occupied territory. The most important earlier eruption, known as that of the 'Avellino pumice' occurred around 1800 BC; several sites, especially one near Nola, reveal the destruction of Bronze Age settlements, with their huts and pots and pans and livestock. But of this the Romans knew nothing.

### Signs and portents

The irony of this is that the Romans were extremely interested in predicting the future, and they had a range of ways to detect what they saw as the approaching wrath of the gods. They were adept, for example, at observing 'portents' in the shape of strange sights and sounds, or unusual births.

Even in these terms, there were warnings of the eruption of Vesuvius. Earthquakes in themselves counted as portentous, and the historian Cassius Dio, writing over a century later, reports repeated sightings of giants roaming the land. This was a bad portent indeed, given that one standard explanation for the volcanoes of south Italy was that, when the gods defeated the rebellious giants and brought peace to the universe, they buried them beneath the mountains, and that it was their stirrings that caused the eruptions.

But while the ancient imagination doubtless conjured up giants in plumes of gas from fumaroles (vents from which volcanic gas escapes into the atmosphere), the earthquakes that Pliny described so casually were more than just portents. Current thinking, however, had not yet caught up with their significance. We know this because, by an extraordinary coincidence, the philosopher Seneca, advisor to the emperor Nero, wrote a discussion of the scientific causes of earthquakes only a few years before the eruption.

Seneca's treatise on the causes of natural phenomena included an entire book on earthquakes, and at the time he was writing, the news was coming in freshly of the catastrophic earthquakes in Campania of AD 63, which caused extensive damage to both Pompeii and Herculaneum.

Seneca writes that he regarded it as likely that earthquakes in different parts of the world were interconnected, and even that they were linked to stormy weather,



but he draws no link with volcanic activity. Indeed, he goes so far as to reproach the landowners who were deserting Campania for fear of further earthquakes.

### Response to earthquakes

The earthquake of AD 63 caused extensive damage to both Pompeii and Herculaneum, as we can see from repairs made to the buildings. Some areas seem to have been worse affected than others - there are cases where entire houses were demolished and reduced to agricultural land. Upper floors would have been particularly badly affected - and indeed some buildings do have blocked-up doors at the top, indicating that the higher floors had been abandoned.

But more impressive than the signs of damage are the signs of the resilience of the local population. Damaged houses were being extensively repaired and redecorated at the time of the AD 79 eruption, and there was a comprehensive programme of restructuring of public buildings in the Forum of Pompeii.

The evidence points to a continuous process of repairs and rebuilding from AD 63 onwards. It used to be assumed that the earthquake described by Seneca was the only cause of damage, and that signs of incomplete work suggested that it took the cities a long time to recover from the first catastrophe. But we now know from volcanological research that a series of seismic episodes immediately preceded the eruption, causing further damage to structures that had already been repaired.

So, in the house of the Chaste Lovers at Pompeii, archaeologists discovered that the oven of a bakery had suffered major cracking; it had been repaired and plastered over, but had then been damaged again - and building work was already in progress to mend this new damage. In the same block, three cesspits in the street, which linked to latrines in the houses, had been dug out immediately before the eruption, presumably to restore them to full functionality.

Outside in the main street, an open trench was found, cutting the entire length of the walkway as far as a water-tower at the crossroads: seismic activity had interrupted the water supply, but people had been hard at work repairing it. A frequent sight in the excavated houses of Pompeii is that of heaps of plaster, which must have been brought in ready for new decoration. Sometimes even the pots and compasses of the decorators are in position.

The Pompeians in August 79, far from abandoning their city, or fretting about earthquakes as portents of future destruction, were thus tenaciously repairing their city, and trying to carry on with life as usual. There was every reason to: the economy of the Bay was booming, with the great port of Puteoli as one of the biggest nodes of Mediterranean trade, and the holiday villas of the rich bringing constant investment.

### The eruption

Taken unawares by the eruption, the population of the towns and villas that

circled the Bay could only respond with panic. Pliny depicts his uncle as a model of Stoic fortitude: calmly sailing directly into the danger zone (where he subsequently died), and taking a bath, dinner and sleep while the catastrophe unfolded. But all around him is panic - Rectina in her villa, Pomponianus in his.

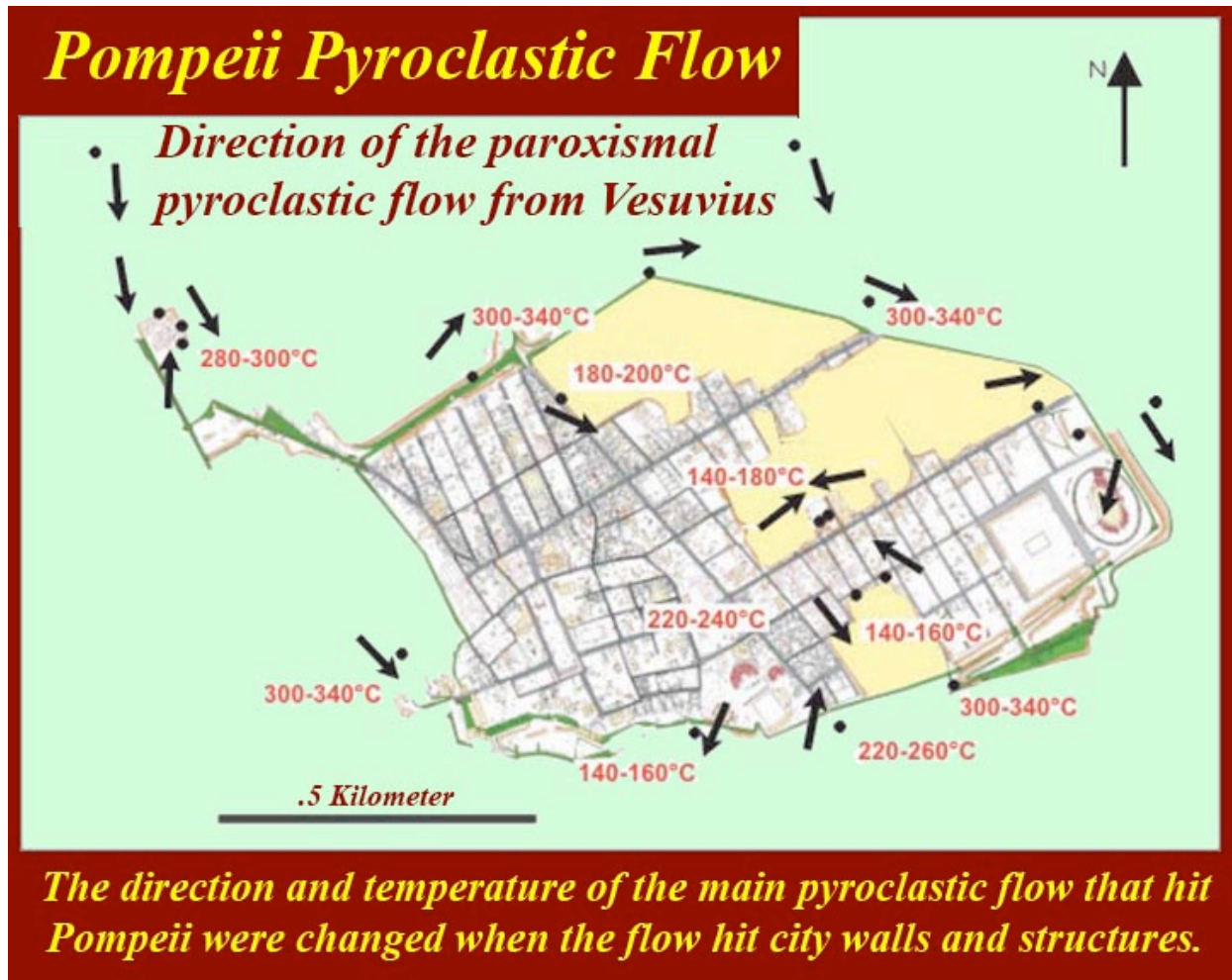
The young Pliny too stays calm, but his mother weeps and implores, and by the time they set out to flee northwards, a dense black cloud of ash has blotted out the light, and the crowds of screaming people fleeing around them are in terror. The skeletons found in Pompeii and Herculaneum give us an equally eloquent testimony of panic and uncertainty.

The eruption lasted for more than 24 hours from its start on the morning of 24 August. Those who fled at once, unburdened by possessions, had a chance of survival, for the rain of ash and pumice, mixed with lithics that descended for several hours was not necessarily lethal. It is clear that many, like the elder Pliny, thought their best chance was to take shelter and weather the storm.

It was not until around midnight that the first pyroclastic surges and flows occurred, caused by the progressive collapse of the eruptive column, and these meant certain death for the people of the region. (A pyroclastic flow is a ground-hugging avalanche of hot ash, pumice, rock fragments and volcanic gas, which rushes down the side of a volcano as fast as 100 km/hour or more.)

The hundreds of refugees sheltering in the vaulted arcades at the seaside in Herculaneum, clutching their jewelry and money, met their end swiftly - from the intense heat of the first surge that reached the city.

Subsequent waves reached Pompeii, asphyxiating those who had survived the fall of 3m (10ft) of pumice, and were fleeing across the open in the dark, or hiding beneath roofs. The waves that followed smashed flat the upper floors of houses, and left the corpses encased in successive blankets of gaseous surge and pumice fall.



It is impossible to tell what proportion of the inhabitants died, but the Romans were accustomed to losses mounting to tens of thousands in battle, and even they regarded this catastrophe as exceptional. The corpses found by archaeologists in Pompeii or Herculaneum should be regarded as only a small sample: the destruction encompassed the entire landscape south of Vesuvius to the Sorrentine peninsular. As many died in the countryside or at sea as in the cities. Even as far north as Misenum, the ash lay deep in drifts.

#### After the eruption

The effect of the eruption was evidently totally traumatic, as is shown by the failure to reoccupy the sites of the cities destroyed. It was normal practice to rebuild the cities of this region after even the most massive earthquakes; but neither Herculaneum nor Pompeii was reoccupied.

Instead, the site of Pompeii was riddled with tunnels by explorers, not by modern explorers as is often imagined, but by the Romans themselves after the eruption. Room after room of the city's buildings had holes hacked through the walls by tunnellers, and though Pompeii has richer finds than any other Roman site, it is a city already extensively sacked by looters.

The cities on the north of the Bay swiftly recovered, and Puteoli continued to be a



significant commercial centre. The Bay of Naples continued to attract rich holidaymakers, but never again regained the massive levels of popularity of the two centuries before the disaster, the time when it had been the playground of many rich senators and emperors.

It was not until the 18th century, when Naples flourished under the Bourbon kings, that the villas of the rich courtiers and ambassadors of that time brought a new flowering to the region. It was at this period that the aristocrats of Europe, as they progressed on their Grand Tours, made the Bay of Naples and its hidden Roman treasures a focus of international fascination.

Find out more

### Books

*Houses and Society in Pompeii and Herculaneum* by A Wallace-Hadrill (Princeton University Press, 1994)

*Unpeeling Pompeii* edited by J Berry (Electa, 1998)

*Pompeii: Guide to the Lost City* by SC Nappo (Weidenfeld & Nicolson, 1998)

### About the author

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This Page is <http://www.mmdtkw.org/ALRItkwVes02Excavations.html>

## Excavation History



Maiuri was a long term and influential Director of the Excavations at Pompeii, Herculaneum, and surrounding areas -- served as director from 1924 - 1961.

Pompeii and Herculaneum were thoroughly buried by the eruption of 79 AD. Pompeii appears to have been abandoned except by scavengers -- either owners returning to try to recover items of special value, or looters on similar missions. A new town was eventually built over the ruins of Herculaneum, but Pompeii was not resettled until it became the tourist attraction that it is today.

There had been warnings in advance of the 79AD eruption:

## Literary and historical references

"Scientific" analysis of the igneous products

Legend and myth

1. Vitruvius in *De Architectura* (date uncertain, but he died in 20 BC) had written: ".....Not less also let it be recorded that heats in antiquity grew and abounded under Mount Vesuvius, and thence belched forth flame round the country....." (Book II, Chapter 6, Para 2) Vitruvius described both the characteristic "pozzulana" (i.e., Puteuli = Pozzuoli) sand, which he found good for making hydraulic cements and the pumice found in the area, both of which he ascribed to volcanism.
2. Virgil, in 19 BC, included in his *Aeneid* the long-standing myth that the giant, Mimas, was buried under Vesuvius by the god Hephaistos (Vulcan) and the brother of Mimas, Enceledus, was buried under Etna in Sicily. Earthquake were his struggles to rise, rumblings his plaintive voice, and eruptions his flaming breath. Like today, Etna was perennially active in ancient times, so there could be no mistaking the meaning of the ancient myth: Vesuvius was also a Volcano.
3. The Greek historian Strabo, in 9 AD, that Vesuvius "possesses craters of fire that go out only when they lack fuel".

In addition, there had been numerous earthquakes including big quakes in 62 and 64 AD.

These two major quakes virtually knocked down Herculaneum and Pompeii.

Both cities were undergoing large-scale reconstruction at the time of the 79 AD eruption.

Three things to note:

Most damaged temples were not rebuilt by 79 AD, but the Isis temple was quickly rebuilt and sumptuously decorated. (Similarly, "Egyptian" mythological representations were widely represented in private and public buildings.) Isis was on the rise and Roman "pagan" religion was waning, and that could have been one reason why the Greco-Roman Mimas myth might have been unknown or ignored.

The rebuilt structures, including the Isis temple, were in mint condition when they were entombed, giving us a snapshot of building methods, decoration, and lifestyles.

**Maiuri -- the long-term site director (1924 –1961) maintained that the earthquakes upset the social order in the cities and that a new middle-class displaced the Patrician elites, even to the extent of taking over many of their houses. Very recently, Maiuri's "social" interpretation and many others of his conclusions have been persuasively challenged. More on this later.**

## **What did the looters, excavators, and archeologists have to dig through?**

**Burial of the cities was quick and deep.  
Pompeii**

**2.4 meters of ash mixed with small pumice clasts fell during the Plinian phase.**

**Then a few inches of mixed debris -- tiles, bricks, broken masonry, etc. from the first pyroclastic surge. This was the layer in which the victims who were outside were found -- knocked down and killed instantly by the extreme high temperatures.**

**Then another 2.5 -- 3 meters of ignimbrite deposited by one or more pyroclastic flows. People who were inside were killed rapidly (unconscious in a few seconds) by the extreme high temperatures. The flows arrived only a few seconds after the surges: most volcanologists, as we have seen, talk about linked surge/flow pairs -- you can't get one without the other because they are, in fact gravity-differentiated aspects of the same phenomenon..**

**Interestingly, it appears that the first surge/flow pair stopped against the walls of the city of Pompeii -- not because the walls were especially strong but because the surge/flow just came that far.**

**Because the ash-fall had already buried things up to 2.4 meters deep, it was at that level that everything was broken off and destroyed by the surge that swept over the city. That meant that buildings lost upper stories if they had any. Walls that were perpendicular to the direction of the surge were knocked down, but some few walls that happened to be parallel to the direction of the surge survived. The surge and flow acted like a liquid (i.e., fluid mechanics determined where it went) so they did eddy around structures: it wasn't at all safe to hide behind something or inside a structure. And also, of course, the ambient temperature could have instantly risen to as much as 1000 degrees F. depending on how close you were to the origin of the surge/flow.**

**No later lava flows from effusive eruptions of Vesuvius reached as far as Pompeii, and only thin layers of ash reached that far.**



## **Herculaneum**

**The ash fallout missed Herculaneum because the wind was blowing the other way.**

**Contrary to what you might have heard elsewhere, Herculaneum was not just buried by Lahars (mud flows).**

**There are at least five surge/flow pairs everywhere at the Herculaneum site, and six pairs at most places. The first pair reached almost to the old coastline and the next five overwhelmed the whole city. Since only the area near the old coastline has been excavated, it's possible that additional pairs might exist further inland.**

**It appears that part of the population of Herculaneum made their way to the shoreline during the Plinian (ash-fall) period of the eruption (the first 10 -- 12 hours, which almost completely missed Herculaneum) in the hopes of escape by sea. They would have been at the water's edge below the lip of a previously existing ignimbrite cliff. It's possible that some could have survived the first surge/flow pair, which barely reached the shoreline. Shortly thereafter, the second much bigger and more energetic pair would have overwhelmed everyone, even those who had sheltered in the boat storage areas cut into the cliffs -- fluid mechanics (and the Coanda effect?) would have ensured that the storage areas would have filled with pyroclastic material.**

**The shoreline at Herculaneum was extended outward by more than half a kilometer by the accumulated volcanic matter from the 79AD eruption. At the old shoreline (where most of the actual excavation, as opposed to tunneling has taken place) there is an overlay of 20 meters.**

**Herculaneum was originally built on a layer of ignimbrite from a previous eruption -- probably from the Campi Flegrei rather than from Vesuvius. The site of the city actually ramped upward slightly toward the seacoast. That upward ramping, along with the 20 meters of 79 AD deposits, makes the site higher than surrounding areas, so lavas from later effusive eruptions of Vesuvius have flowed around the site. Minor ash falls from later Vesuvius eruptions overlay the 79 AD ignimbrite layers.**

**Why dig at all?**

Archeology is popular today mainly because of the movies.

Indiana Jones!!!!!!!!!! -- appeals to girls and guys who want to attract girls

Lara Croft -- Tomb Raider!!!!!!!!!! -- appeals to geeks and guys

[Coincidentally, it's now possible to make a good living as an archeologist.]

There was another peak of popularity in the 1920s, associated with King Tut

In the 1800s there was a huge interest in Pompeii -- and it began just as modern archeology and, more importantly, modern tourism was being born. The continued appeal of the subject is clear from the many movies and TV shows made about Pompeii and Vesuvius. (This is an isolated phenomenon, not just because of disaster and casualties: there have been other bigger catastrophes that have been forgotten

*Last Days of Pompeii* -- Edward Bulwer Lytton's 1834 good luck: August Eruption and September Publication

Pompeii in popular art

Mark Twain's *Innocents Abroad* and Clemens on the lecture circuit

The Vesuvius Funicular and its song

## Excavation History

### Early digging

Sites were not unknown

### Early publicity

Everyone knew what had happened -- the sound was loud enough to be heard in Rome, and the Plinian column was visible from Rome.

The Historian Tacitus wrote about the eruption -- but his description is lost to us. We know he researched the subject because of Pliny's letters, which have been preserved. He may have had other eyewitness accounts.

There were people digging around in the rubble in ancient times

"Looters" holes are not uncommon, although we are not really sure whether they were made by looters, or rescuers, or owners trying to recover their buried property. It also has been suggested that some might have been made by people trying to escape, but that explanation doesn't take into account the speed of death that accompanies superheated flows.

**But in the "Dark Ages" the sites were genuinely forgotten**

### **Renaissance digging:**

**Domenico Fontana (end of the 1500s)**

**The Fontanas were the favorite architects of Pope Sixtus V (Felix Peretti, Pope from 1585-90).**

**Major projects in Rome -- erecting the Egyptian Obelisks, including the one in front of St. Peters undertaken by Domenico.**

**His brother Giovanni made the Aqua Felice ("Felix's aqueduct") work after other architects had botched the job by mis-figuring the slopes of the water channels.**

**Domenico was hired by Count Muzziu Tutavilla to bring clean water down from the hills to family lands and towns on the Bay of Naples. Tunnels for the Sarno/Foce aqueduct passed right through the Pompeii site (right over the top of the amphitheater) and through the ruins of the city. Apparently nothing of value was seen, so no digging was undertaken. Locals called the site "La Civita" or "La Citte" but did not know it was Pompei -- it was known that there were ancient Roman ruins -- mostly villas -- scattered about.**

**The top, i.e., the outside of the stones that were put in to support the top of the tunnel, can still be seen in Pompeii, where the volcanic debris was later removed.**

### **Well digging, 1689**

**Inscriptions were turned up, one of which mentioned "decurios Pompeiis". A noted Neapolitan architect, Francesco Piccheti, mis-identified the site as the villa of Pompey the Great, Julius Caesar's opponent in the Civil War of 51 -- 47 BC.**

**Another scholar, Francesco Bianchini, correctly identified the site as Pompeii, and four years later, Giuseppe Macrini did some exploratory digging and found the outer walls of the city -- clearly city walls of a type that would not have been around a villa.**

**Nonetheless, Piccheti's views won out, and academia did not believe the Pompeii identifications.**

### **More well digging, 1709**

**Workers dug right into the seats of the Herculaneum amphitheater.**

**The local Prince, Emmanuel-Maurice duc d'Elbeuf, got wind of the**

discovery and within a few years was mining the site to build and decorate his Villa on the Bay of Naples, first for marble (amphitheater seats) and the for statuary and frescoes -- beginning of a long tradition of looting by the nobility. Most of this was concentrated at Herculaneum.

**Pompeii, 1748, Roque Joachim de Alcubierre, a Spanish military engineer working for Charles III (VII) Bourbon y Farnese, King of Naples.**

The Herculaneum "mine" was playing out, so Alcubierre looked elsewhere -  
- investigated local lore and came up with the idea of digging in "La Citta".

Alcubierre's work was heavy handed and destructive, and, of course, not documented (Although the ancient Romans had dug and documented (and collected and looted) the documentation tradition had been lost.) Alcubierre only recorded important finds (that were literally "noteworthy" -- and threw almost everything else back into the pits, which he promptly backfilled with debris from his next excavation.

Digging in the loose overlay of Pompeii was much easier but also was much more dangerous than in the consolidated overlay at Herculaneum -- landslides, cave-ins, and poison gas pockets ("mofeta") took their toll.

**Pompeii, 1750, Karl Weber, a Swiss military engineer, arrives -- "co-Director" with Alcubierre for Charles III.**

Weber attempted to rationalize and document, but the artistic and architectural (and precious metals and stones) "treasure" was what Charles really wanted to collect, so Alcubierre could often over-ride Weber whose efforts seemed to be slowing down the discovery of valuables.

Weber, nonetheless, sometimes had his way and even dragged the King out to the digs on occasion.

At any rate, Weber's maps, plans, and documentation survive.

Charles was, of course, a very successful collector of Pompeian and Herculaneum art and artifacts. His collection was the basis for the National Archeological Museum in Naples.

(That museum, continues to be the main repository for what comes out of the Pompeii and Herculaneum digs. The Capodimonte Royal Palace houses the Renaissance collection s, which are also splendid.)

Weber died in 1764 after working with Alcubierre for fifteen years

**Francesco La Vega, 1764**

La Vega was Weber's worthy replacement -- worthy because he was the first to understand the tourism value of Pompeii.

Excavated areas were preserved and documented, guides were published,

and the great art of Pompeii and Herculaneum was illustrated into scholarly volumes. It's clear that there was even advertising, and distinguished visitors -- popes, princes, scholars -- started to show up.

An early triumph of La Vega (1764) was the discovery and excavation of the Temple of Isis -- it had been one of the few Pompeian temples reconstructed after the 62/64 earthquakes and it was in a very good state of preservation. It had been brand new when buried.

The decoration of the Isis temple and the clothing shown in the temple frescoes (and in other Egyptian/Isis influenced decoration in Pompeii) had a great influence in Europe. When Napoleon came to power in France (he was born in 1769 and reached the height of his power around 1800) Napoleon, who fancied himself as the new Roman Emperor, emulated the (Egyptianised) décor of Pompeii and the women of his court wore the "Empire" style copied from the Isis temple frescoes.

## **Napoleonic Period at Pompeii**

Napoleon's forces took Naples in 1798 and Joseph Bonaparte became King of Naples. He was interested in the archeological sites and hires Michele Arditi to create an excavation plan -- essentially to uncover the city walls and work inward toward the center. This plan stayed pretty much in effect until recently when the current director decreed that there would be no new digging (except downward) until already-exposed material was consolidated -- more on that later.

Joseph was eventually pulled out to take over the Monarchy in Spain, and the Kingdom of Naples was given to Marshal Joachim Murat (Marshal 1804, King of Naples 1808-15). Murat married Caroline, a Farnese heiress. (The mother of Charles III had also been a Farnese -- Elizabeth -- so Caroline brought some continuity to the Neapolitan throne). More importantly, Caroline brought old and real money to the Kingdom's treasury, and she had some influence on how it was spent.

She financed extensive digs at Pompeii and was the patroness of the Charles Francis Mazois *Les Ruines de Pompei*, a three volume set book on everything that was then known about the city.

Caroline also brought many of the Farnese treasures -- art and statuary of ancient Rome from the Farnese family collections -- to Naples where they still remain in the National Archeological Museum. Her marriage to Murat did lead to some legal complications concerning the return of art works that were transferred from Naples to Paris during Napoleonic period.

The Congress of Vienna ended Murat's reign and the "golden age" of Carolinian Patronage.

The digging continued unabated, but not at the rate she had sponsored.



## **Alexandre Dumas, Garibaldi, 1860**

In 1860 Garibaldi conquered the Kingdom of Naples and almost immediately turned it over to the united Kingdom of Italy. Garibaldi was left in charge of the Neapolitan province, and he appointed Alexandre Dumas, the author, as Director of Excavations.

Dumas had, by that time produced over 250 books and 15 plays, but he had no experience with archeology (Yes, 250!, But Isaac Asimov produced over 500 books in the 20<sup>th</sup> century.) Dumas acknowledged 73 "assistants", who helped him write.

Dumas's major accomplishment was to organize and publicly display the collection of Pompeian erotic art in the National Museum. The erotica had been locked away "the Secret Cabinet" in Royal times (1819) to protect the morals of the Neapolitans. The "Cabinet" was locked up again later in more prudish times by Mussolini's fascists. The Secret Cabinet was ostensibly only opened for scholars, but for a few thousand Lira (a couple of dollars) almost anyone could get in. It was finally officially open to everyone again in 2000, a move that was condemned by the Church. (All of this stuff is now available, of course, on the Internet. A representative sample is at <http://www.answers.com/topic/erotic-art-in-pompeii>.)

## **August Mau 1860 – '85**

Mau was never site director, but his 25 years of archeological campaigns in Pompeii had a great impact on how the site and Roman art history in general have been interpreted.

The division of Pompeian art into four "styles" is usually considered his most important contribution.

We'll look at this in detail in a later unit on Pompeian art and architecture.

## **Giuseppe Fiorelli, 1863**

Fiorelli was appointed in 1863 (under Dumas) to head the dig at Pompeii. He already had wide experience at Pompeii and elsewhere.

Fiorelli introduced modern archeological principles: stratigraphy, in particular, enabled him to deduce the presence and uses of upper stories, which had collapsed.

Fiorelli developed the locator system of naming locations by "regions, blocks, and doorways", the system still in use today.

Less importantly, but much more famously, he developed the "Fiorelli method" of flowing plaster of Paris into cavities where objects and people had decomposed. This method produced the famous "plaster people", but

it has also enabled archeologists to record such things as food, furniture, and plant material. [My project was casting grapevine root structures at a suburban villa. -- tkw]

Fiorelli was promoted and transferred to national archeological responsibilities in Rome in 1875, but he had established a working regime that has lasted in most respects until the present time.

### **Vittorio Spinazzola, 1910**

Spinazzola's major accomplishment was the initiation of restoration and preservation projects carried out simultaneously with new digs.

He has been criticized for digging out only the front facades of buildings along major streets without supporting them. This procedure did, however yield a good deal of new knowledge about ancient building methods, town planning, and, in particular, the uses to which second stories were put.

He was removed in 1924, apparently because he would not kowtow to Mussolini's nationalist and ideological interpretations of the Roman Empire -- he thought and said that Mussolini was a fool.

### **Amedeo Maiuri 1924-1961.**

You either love him or hate him. Maiuri started with two strikes against him: he had replaced an efficient and popular director, and he was considered to be Mussolini's man. In fact, only the first was of any consequence at the time that he took over the job: it was very popular, at the time, to be Mussolini's man. We will never know whether Maiuri really was a fascist ideologue, as his detractors say, or whether, like so many others, he simply did what was needed to get his job done.

In terms of sheer mass, Maiuri certainly moved more dirt than any other Pompeian excavator.

From the beginning, his methods were modern and scientific, especially in stratigraphy, context, and record keeping.

He was often (even after Mussolini) under great pressure to produce impressive finds, and his critics claim that this became habitual -- that he wanted great finds even when the pressure eased off.

Maiuri had what some critics called a Fascist economic agenda, which amounted to demonstrating that the old Roman patrician faction of Pompeii had been displaced by a new mercantile class by the time of the 79 AD. The reason for this change was the destructive series of earthquakes in 62 - 64 AD from which, Maiuri maintained, the upper class never recovered. The symptoms of the change were many, but two were most easily detected.

First was a supposed change in decorative art styles in homes and public buildings, the advent of the "fourth style" -- actually a

conglomeration of the "second" and "third" styles (much more about the four "styles" in a separate unit). Maiuri considered the fourth style degenerate and said that its advent indicated that a degenerate class had taken over.

Second was the supposed conversion of living space to commercial space in Pompeian houses after the earthquakes. (We'll also go into this question more in a later unit.)

Other criticisms of Maiuri include:

His high estimate of Pompeii's population at the time of the eruption: that 20,000 figure that is often used was his. Many recent scholars have gone toward the lower end, around 6000.

His overestimation of the number of houses that had upper floors and the assumptions about uses for those rooms: he thought many were rented apartments.

The connection between the number of doors and stairways in large houses with the number of families living in the house.

His views on the use of living space by the ancient Pompeian *familia* or extended family, which would include relatives, slaves, freedmen, employees, candidates for adoption, and possibly others. The presence of transient or permanent guests as well as the daily obeisance of clients was also a factor.

Maiuri also stands accused of selective publication and even selective preservation of artifacts and structures. This criticism, however, is more a function of changing priorities (and to some extent "political correctness") than of "bad archeology" by Maiuri. The latest fad in archeology is to discover and publish what all classes and levels of ancient society were up to, and that's very different from what was considered important in earlier days.

[I tend to sympathize with Maiuri on this last point: it's nice to know (actually conjecture) what the lower classes did and how they lived, but, because they were "unimportant" in their own time, evidence about them is harder to find and, therefore, accurate deductions about them are harder to make. Also, the lower classes, especially in ancient times, seldom had much effect on "history", i.e., on the events and circumstances that had effects and set parameters for later days, including our own. For example, our own founding fathers, in setting up the American Republic, worked from the upper class pattern of power sharing of republican Rome (before the tumult of republican Rome's last century). They might not have had an accurate perspective on Roman life, and they certainly were not "politically correct", but the historical fact remains that they worked from the upper class pattern.

[It's also important to remember that the source of most criticism of earlier

**scholarship , including Maiuri's, comes from non-representative leftist academia, and to remember the old adage, "Those who can't do, teach." (This shows signs of becoming a rant, so I'll stop -- but you get the point.)]**

**A final note on Maiuri: It has been asked whether Maiuri reached an accommodation with the Camorra, the Neapolitan criminal organization, which is akin to but more institutionalized than the Mafia. The answer, of course, is another question: "You are talking about Naples, aren't you?"**

## **After Maiuri**

**"Quick succession" (by the standards of the long-running Maiuri) of Directors, although the titles fluctuate:**

**Alfonso de Franciscis, 1961 - 76. Superintendent of Archeology for the Provinces of Naples and Caserta**

**Fausto Zevi, 1977 -- 81. Superintendent of ... etc. A major earthquake shakes the region doing great damage to Pompeii and Herculaneum. Both sites were closed for safety surveys, and Pompeii requires extensive structural repairs before reopening. Some areas are still closed to the public today.**

**Giuseppina Cerulli Irelli, 1981 -- 84. Superintendent for Pompeii**

**Baldassare Conticello, 1984 -- 95. Superintendent for Pompeii**

**Pietro Giovanni Guzzo, since 1995 (unless the changed since this was written). Superintendent for Pompeii**

**There was, of course, ex post facto sniping after each change took place.**

**In the modern Italian fashion, Conticello was actually indicted for his "crimes" of favoritism and not following procedures.**

## **Vicissitudes :**

**The big problem is always money. There is never enough, and there is always what is quaintly known as wastage -- some of it disappears.**

**Natural disasters -- another eruption in 1944 and a big earthquake on Nov 23, 1980.**

### **Man-made disasters**

**Both Pompeii and Herculaneum were bombed in the two 20<sup>th</sup> century World Wars.**

**Looting and vandalism continues.**

**It's still Naples, so there's still corruption.**

## **Controversies:**

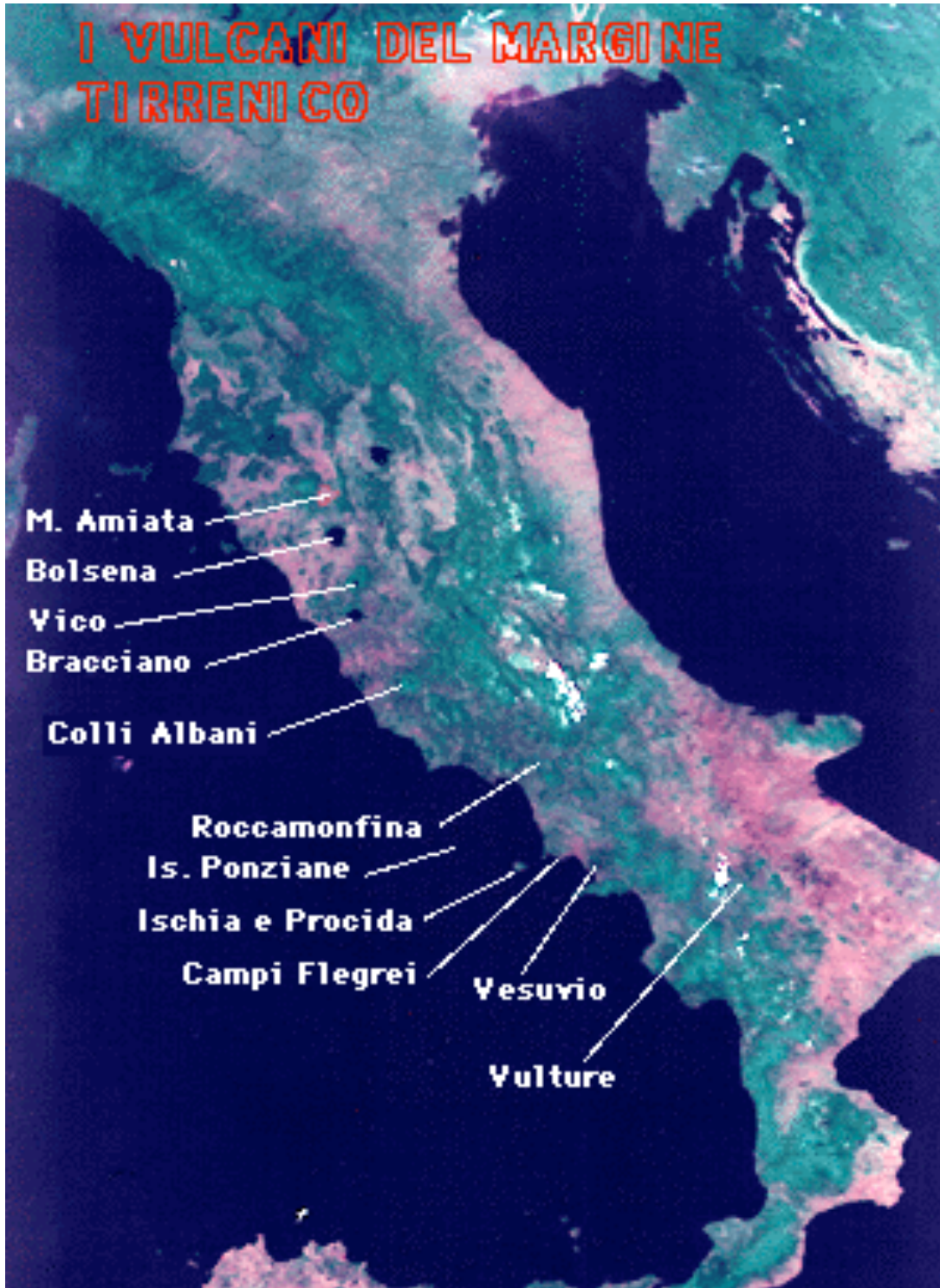
**All major expansion of the exposed area (two-thirds to three-fourths of the city, depending on who's counting) has been stopped while conservation, preservation, documentation, cataloguing, etc. is supposed to catch up.**

**Herculaneum's Villa dei Papiri -- should there be more digging?**

**The state of the Volcano -- when will it pop again, and how devastating will it be? How should predictions determine the pace of excavations (i.e., "Shouldn't we get as much out of the ground as we can before the next burial layer is added to the top of the heap?")**



# Somma-Vesuvius



Location: 40.821°N, 14.426°E Summit elevation: 1281 m

*This description is mostly based on the Excursion guidebook to Neapolitan Volcanoes by Scandone and Giacomelli distributed at the International Lavcei Conference "Napoli 91" and the paper by Scandone, Giacomelli and Gasparini (1993)*

The most recent activity of the Campanian plain is that of the Somma-Vesuvius volcano, which spans the period between 25000 years ago, and the recent. Its first dated products, overlie the products of the so-called "Campanian Ignimbrite" (34000 years ago), and belong to the Codola pumice formation dated at 25000 years ago (Alessio et al, 1974).

The most important Plinian eruption of Vesuvius occurred at about 17000 years and is called the "Pomici Basali or Sarno eruption". A series of other 8 Plinian or Subplinian eruptions occurred after 17000 years, the last three of which occurred in 79 AD, (the eruption which destroyed Pompei and Herculaneum) in 472 and 1631 (table 1).

<b>Name of the Eruption</b>	<b>Age (years before present or AD)</b>
<b>Codola</b>	<b>25000</b>
<b>Basal Pumices ( Sarno)</b>	<b>17000</b>
<b>Greenish Pumices</b>	<b>15500</b>
<b>Mercato (Ottaviano)</b>	<b>7900</b>
<b>Novelle</b>	<b>no date available</b>
<b>Avellino</b>	<b>3750</b>
<b>Pompei</b>	<b>1900 (79 AD)</b>
<b>Pollena</b>	<b>472 (AD)</b>
<b>1631</b>	<b>1631 (AD)</b>

**Table 1 Main Plinian and Sub-Plinian eruptions of Somma-Vesuvius**

### **Vesuvius before 79 AD**

Greek and roman scholars (Strabo, Diodorus Siculus, Vitruvius, Vergil) already knew the volcanic nature of the mountain before the eruption of 79 AD.

Diodorus Siculus (80-20 BC) reports that the Campanian plain was called "Phlegrean ("fiery") from the mountain which of old spouted forth a huge fire as Aetna did in Sicily; at this time, however, the mountain is called Vesuvius and shows many signs of the fire which once raged in those ancient times." Vitruvius, active between 46 and 30 BC, reported in his "The Architectura" that "once fires burnt below Vesuvius and sometimes it spouted flames on the surrounding fields". Strabo (64 BC-25 AD) gives the most accurate description of Vesuvius of his times: "Above these places lies Mt. Vesuvius, which, save for its summit, has dwellings all round, on farm-lands that are absolutely beautiful. As for the summit, a considerable part of it is flat, but all of it is unfruitful, and looks ash-coloured, and it shows pore-like cavities in masses of rocks that are soot-coloured on the surface, these masses of rock looking as though they had been

eaten out by fire; and hence one might infer that in earlier times this district was on fire and had craters of fire, and then, because the fuel gave out, was quenched."

The most famous and destructive eruption of Vesuvius occurred in AD 79. It destroyed many towns around Vesuvius. A detailed description was made by Pliny the Younger who observed the eruption from Cape Misenum at a distance of about 20 km from the volcano. During the eruption the uncle of Pliny the Younger (Pliny the Elder), admiral of the roman fleet based in Misenum, went to the rescue of the people endangered by the eruption and lost his life.

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## **Precursors of the 79 AD eruption**

Vesuvius entered the history of volcanology with the eruption of 79 AD, described by Pliny the Younger. The eruption destroyed Pompeii, Herculaneum, Oplontis and Stabiae and caused the death of Pliny the Elder among many other people.

Before the eruption of 79, earthquakes occurred for some time, but were disregarded by local inhabitants because of their familiarity with the phenomenon. Seneca reports that an earthquake occurred on 5 February of 62 (according to Tacitus) or 63 AD.

The earthquake laid down Pompeii, made great ruins in Herculaneum, and caused minor damage in Nuceria and Naples, where the emperor Nero was performing in the theatre.

According to Seneca, the earthquakes lasted for several days ("*non desiit enim assidue fremere Campania*") until they became milder "but still caused great damage".

We presume that this earthquake swarm occurred at a shallow depth in the Vesuvian area, given the distribution and the area extent of damages.

In the last sentences of this writing, Seneca asked himself if this disaster in Campania had not "made every man strengthened and resulted (resolved) against all catastrophes."

The reply to his question probably came 17 years later, when Pliny the Elder went to the rescue of the people staying in the area that had been shaken for several days.

As the younger Pliny testified, "for several days before (the eruption) the earth had been shaken, but this fact did not cause fear because this was a feature commonly observed in Campania" (*praecesserat per multos dies tremor terrae, minus formidolosus quia Campaniae solitus*).

Repair work was underway in some houses at Pompeii and Oplontis Villa when the eruption occurred. This can be considered evidence of intensive seismic shaking of the buildings.

Dio Cassius (150-235 AD) also reports some precursors of the eruption. He tells that for several days before the eruptions there were earthquakes and subterranean rumblings and giants were seen wandering on the earth (giants are a common feature associated with earthquakes and volcanic eruptions; Scandone, 1987).

## THE ERUPTION

Pliny the Younger's letters to Tacitus have been frequently recalled as the first vivid description of an explosive eruption.

We do not know if the description made by Pliny the Younger of the eruption of 79 AD is reliable or not (he explicitly mentions in the end of the first letter that other persons reported to him most of the facts); we will however recall some of the more important points in his account.

We make use of the text of the letters of the "Scriptures Classicum Bibliotheca Exogenesis" translated into Italian by Marcello Gigante (1980). When necessary we made a literal translation into English.

### The first letter

The beginning of the eruption is uncertain: the two Plinys observe the cloud at the seventh hour of the day (1 PM, Sigurdsson et al, 1985). We must presume that the eruption began sometime earlier to allow the arrival, at about the same hour, of a messenger sent from the Vesuvian area.

Sigurdsson et al (1985) suggest that the event prompting Rectina, wife of Tascus, to send the messenger, was a phreatic explosion at the very beginning of the eruption.

The eruptive column was directly observed by Pliny the Younger from a distance of 21 km, so that he could fully appreciate its total extent and behavior. Subsequent scholars of Vesuvius eruptions have frequently used the same description for other eruptions. The description gives us the idea of the typical explosive eruption

"It resembled a pine {Mediterranean pine} more than any other tree. Like a very high tree, the cloud went high and expanded in different branches. I believe, because it was first driven by a sudden gust of air (*recenti spiritu eiecta*), then, with its diminution or because of the weight, the cloud expanded laterally, sometimes white, sometimes dark and stained by the sustained sand and ash (*pondere suo victa in latitudinem vanescebat, candida interdum, interdum sordida et maculosa prout terram cineremque sustulerat*)."

### The route of Pliny the Elder

Pliny the Elder, on his course to the endangered area, has the wind blowing at his back, from the north-west. We do not know where he intended to land, but he

changed his mind because a new shoal formed by the eruption prevented the landing.

At this moment he observes red-hot stones and pumice falling on the ships, so he must already be at the south-east of the volcano as suggested by the area distribution of pumice (Lirer et al, 1973).

We may infer that he was trying to reach the Pompeii port and that he could not land because of the floating pumice, so, he changed his mind and sailed toward Stabiae to reach the friend, Pomponianus, who could not leave because of the opposing wind.

The decision of reaching Stabiae was a fatal one because brought the rescuers to a place where sea escape was impossible. Stabiae was separated by the center of the gulf where the shore made a gentle arc and the waves rushed in ("*Stabiis erat diremptus sinu medio (nam sensim circumactis curvatisque litoribus mare infunditur*" ). The ancient coastline formed probably a more pronounced gulf than nowadays.

The northwestern wind favoured the entrance into the gulf ("*Quo tunc avunculus meus secundissimo invectus*" - most favourable to the route of my uncle-) but prevented the escape on the next day during the paroxysmic phase of the eruption ("*Placuit egredi in litus, et ex proximo adspicere, ecquid iam mare admitteret; quod adhuc vastum et adversum permanebat*" - They decided to reach the shore and look if the sea permitted the escape. But the sea was still stormy and did not allowed the departure-).

## The second letter

During the time of the eruption, Pliny the Younger stayed in the proximity of Misenum from where he observed the eruption along with his mother (Pliny the Elder's sister). In the second letter, he describes what occurred there.

Earthquakes - During the night of the first day of the eruption, and for most of the morning of the next day, the houses of Misenum where shaken by earthquakes that caused much panic. Pliny the Younger and his mother escaped; they reached a place from which Vesuvius, Capri and Cape Misenum were visible.

The only place where such view is possible is the "Monte di Procida" hill. On the top of the hill, wheeled-charts on flat land were shaken back and forth even if chocks were placed against the wheels. Given the distance from Vesuvius, we may presume that the seismic activity, or a strong seismic tremor, ranged in magnitude between 4 and 5.

Tsunami - ("*Praeterea mare in se resorberi et tremore terrae quasi repelli videbamus*" - Further on, we saw the sea retreating as if pushed by the earthquakes-) The retreat of the sea observed in Misenum is probably related with a tsunami associated with the climax of the eruption. A similar occurrence has been described during the eruption of Vesuvius of 1631.

**Black clouds at Misenum - "*Ab altero latere nubes atra et horrenda, ignei spiritus tortis vibratisque discursibus rupta, in longas flammaram figuras dehiscibat*" - From the other side, black and horrible clouds, broken by sinuous shapes of flaming winds, were opening with long tongues of fire).**

The description suggests strong explosions that - After a little while descended onto the land, opened the sea, covered Capri and prevented the sight of Misenum- ("*Nec multos post illa nubes descendere in terras, operire maria; cinxerat Capreas et absconderat, Miseni quod procurrat abstulerat*").

The clouds reached the place where Pliny the Younger and his mother were ("*densa caligo tergis imminebat, quae nos torrentis modo infusa terrae sequebatur. (...) et nox non qualis inlunis aut nubila, sed qualis in locis clausis lumine extincto.*" - A dense haze was impending at our backs, following us like a stream flowing on land (...) and the night fell on us, not like a night with clouds or without stars, but like the night in a closed place without a lamp)-.

After a while they were reached by another cloud - Again the obscurity, again the ash, dense and heavy. We took some time to shake away the ash as we could have been covered and choked by its weight- ("*Tenebrae rursus, cinis rursus, multus et gravis. Hunc identidem adsurgentes excutiebamus; operti alioqui atque etiam oblisi pondere essemus*").

We can exclude that these phenomena can be ascribed to air-fall ash. The distribution of the pumice driven by stratospheric winds is toward the south-eastern side of Vesuvius (Lirer et al, 1973, Sigurdsson et al, 1985). Low altitude winds were blowing from north-west (as the course of Pliny the Elder testifies).

We have to conclude that the phenomena in the proximity of Misenum were due to a pyroclastic surge as also suggested by Sigurdsson et al (1985). If such description is truthful, it raises however some new questions about the extent of damage caused by the eruption. Any pyroclastic surge reaching Misenum, causing breathing difficulties and obscuration of the sky must first have passed the city of Naples.

In the proximity of the volcano these phenomena caused severe damages and deaths. Most people living in the area probably escaped during the first phase of the eruption when the high eruption column deposited in the proximity of Pompei about 4 meters of pumice lapilli's.

In the towns remained mostly animals like horses unable to walk in the thick cover of lapilli's or dogs left to watch the unguarded houses. Only a few individuals probably died because of this.

The arrival of pyroclastic flows and surges caused instead the total destruction of that part of the houses that emerged above the pumice layer. Many people that were still in the towns or had come back were caught by surprise by this second phase and their bodies are found above the fall-pumice layer within the surge deposit.



## The Damages

We do not have any evidence of extensive damages in Naples although the contemporary roman authors were rather obscure about the true extent of damages. We know (from Suetonius) that Emperor Titus appointed two ex-consuls (*Curatores Restituendae Campaniae*) to supervise the work of restoration of the damaged region and to solve the legal questions raised by the death of so many people.

We also know that the import to Rome of Campanian wine suffered a drastic decrease after the eruption (Videmann, 1987). We find an echo of such occurrence in a poem of Martial (40-104 AD) who describes Vesuvius, once covered by green grapes, now submerged under flames and lapilli.

Pliny the Younger does not mention any damages other than those suffered by himself or the uncle. However a record of the destruction of Herculaneum and Pompei is found in Marcus Aurelius (121-180 AD) and in Dio Cassius (AD 150-235). This last author also reports that the ashes of the eruption reached Africa (the modern Libya), Syria and Egypt, and caused pestilence.

Similarly the poet Papinius Statius (40- 96 AD) made many references to the ruins caused by Vesuvius in his collection of poems "Silvae". The poet lived in Naples for long time and was possibly there during the eruption, as he got a poetry premium in the town in 78 or 80 AD. Soon after he left and lived in Rome until 92. On that date he had to write a poem (Silvae III, 5) "Ad Claudiam Uxorem" to convince his wife to come back to Naples (Paratore, 1992).

In this poem we find information on the state of the town at that date: "*Non adeo Vesuvius apex et flammae dirimontis hiems trepidas exhausit civibus urbestant populisque vigent* (The summit of Vesuvius and the fire-storm did not made the anxious cities empty of men, they still live full of men); *Hic auspice condita Phoebos tecta, Dicarchei portusque et litora mundi hospita*; (Here you will see the temple of Phoebus and the port of Pozzuoli and its hospitable shores) (...) *Nostra quoque et propriis tenuis nec rara colonis Parthenope* (Full of citizens and colonists is our dear Parthenope (Naples) (...)) *Has ego te sedes (...) transferre laboro, quas et mollis hiems et frigida temperat aestas, quas imbelle fretum torpentibus adluit undis* (I want to bring you to these places where the winter is sweet and the summer is fresh, where the sea lightly touches the land with lazy waves).

According to these verses, we get the impression that Naples and all the region of Campi Flegrei had completely recovered from the damages of the eruption. Different was the condition in the immediate surrounding of Vesuvius. Possibly only Stabiae had recovered at the time of Statius (Renna, 1992).

Renna (1992) suggests that the important road connecting Nuceria to Stabiae, covered by the deposits of the eruption, was restored already in 121 AD; this same author suggests that the areas of Portici and Torre del Greco were

occupied between the II and IV-V century AD, and those of Pompei and Herculaneum between the III and V century AD.

The memory of the lost cities lasted for centuries. The vestiges of a lost town called "La Civita" (from the Latin Civitas=town) were commonly found by farmers. The systematic excavation of Pompei started only in the XVIII century by the order of Charles III, King of the Two Sicilies.

## **The period between 79 AD and 1631**

We have no information on the state of Vesuvius immediately after the eruption of 79. The first account of continuing activity is from Galenus (c.172 AD) who testifies that "the matter in it (Vesuvius) is still burning " .

Dio Cassius in 203 AD reports a violent eruption heard in Capua, some 40 km from the volcano. The same eruption is reported by another source (Manuele) referred to by Gasparini and Musella (1991).

Two large eruptions occurred in 472 and 512. Marcellinus Comes reported that, on the 6th of November, 472, "Vesuvius (...) erupted the burning interiors, caused night during the day and covered all Europe with fine ash ". This eruption is also confirmed by Manuele (Gasparini and Musella,1991).

Information about the eruption of 512 is more detailed. Cassiodorus, an officer of king Teodoricus, wrote a letter to ask the exemption of taxes for the people affected by the eruption; in his letter he reports that " a burnt ash flies in the sky, and, forming ashy clouds, it rains with ash droplets also in the provinces beyond the sea (...). It is possible to see ash rivers flowing like liquid, bringing hot sands and (...) the fields grow suddenly up (the fields are covered with sand)to the top of the trees (.....) and are ravished by the sudden heat. " .

Several other eruptions are reported in 685 (Paulus Diaconus), 787 and 968.

Gasparini and Musella (1991) suggest that the first testimony clearly referring to a lava flow is for the eruption of 968. Leo Marsicanus reports in a chronicle of the Cassino Monastery that "Mount Vesuvius exploded with flames and emitted a great amount of gluey and sulphurous matter that formed a river hurriedly flowing to the sea " . Several authors report other eruptions in 991, 993 and 999 (see in Alfano, 1924) but they must be regarded as suspicious because of the belief of the end of the world in 1000 AD.

Leo Marsicanus refers of another eruption on the 27 of January, 1037, that lasted for six days. The chronicle of the Cassino monastery records an explosive eruption between 1068 and 1078 (Gasparini and Musella, 1991).

The last eruption before a long quiescent period occurred on the 1st of June, 1139. Several sources refer to it as a strong explosive eruption (Falcone Beneventano, the Chronicle of the Monastery of Cava dei Tirreni, John of Salisbury). It lasted eight days and ashes covered Salerno, Benevento, Capua and

**Naples. No reliable report of volcanic activity is available until 1500, when Ambrogio di Nola reports a small explosion. From 1500 until to 1631, no eruption occurred on Vesuvius. Records are good during this period, and none mention volcanic activity.**

## **The activity between 1631 and 1944**

**The great eruption of 1631 is the largest explosive eruption of Vesuvius since those of 472 and 512 AD. It occurred after 131 years of quiescence. Large trees covered the Gran Cono, the cone within the Somma Caldera, and local people did not remember it being a volcano. The mountain was called "La Montagna di Somma" (the Mountain of Somma, a small town on its northern side).**

**Several months before the beginning of the eruption, people near the volcano felt some earthquakes (Braccini, 1632). They were not particularly scared because earthquakes from the nearby Apennine chain were often felt in the area (a large one had occurred three years before in Apulia, in 1628). The seismic activity became more severe in the few days before the eruption. Nevertheless, the awakening of Vesuvius in 1631 surprised the inhabitants. A strong explosive eruption started in the night between 15 and 16 December of 1631 and its paroxysmal stage lasted two days. We will not deal with the details of this eruption as Rosi et al discuss it specifically in this issue.**

**The eruption started a period of persistent activity that lasted, with a few breaks, for more than three centuries until 1944. After the violent eruption of 1631, the inhabitants living at the base of the volcano, became accustomed to its activity and were inclined to record only the most notable events.**

**After the violent eruption of 1631 the volcano entered a stage of almost persistent activity with numerous effusive-explosive eruptions. During this period the main explosive eruptions (table 2) were of limited magnitude (VEI&ap; 3) but displayed a peculiar trend.**

**The eruptions always began with an effusive phase with lava outpouring from a fracture in the cone or from the rim of the cone. After a few days of such activity, accompanied by mild strombolian explosions, a more explosive phase followed with lava fountaining up to 2-4 km height. The last phase, characterized by the formation of a sustained eruption column, 5-15 km high, was followed by a collapse in the central crater and a period of quiescence lasting several years. Quiet lava emissions characterized the new outbreak of activity. The last eruption occurred in 1944, and the still lasting quiescent period is much longer than the repose observed in the period 1631-1944.**

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## ***Notes and Comments on the 79AD Eruption of Vesuvius***

[http://urban.arch.virginia.edu/~km6e/tech\\_pres/pompeii/pompeii-home.html](http://urban.arch.virginia.edu/~km6e/tech_pres/pompeii/pompeii-home.html)

### **Physiography and Eruptive History of Somma-Vesuvius**

The modern volcano is a composite of two major cones, with the younger Vesuvius nested within the remains of the Somma caldera. Mt. Somma "blew its top" in a cataclysmic eruption roughly 17,000 years ago that far exceeded all events associated with the younger volcano. The remains of Mt. Somma are manifest in the large base of the volcano, and also in the arcuate rim preserved on the northern side of the modern volcano (Sigurdsson et al 1985).

In addition to the explosive eruption that decimated Pompeii and Herculaneum, Vesuvius had a major event in 1631 that destroyed the region between Torre del Greco and Torre Annunziata (and surrounding communities; figure 1). This event removed roughly 500 meters from the top of the volcano, leaving the modern summit crater.

Thus, while the 79AD eruption was extremely damaging, it is a minor example of the available strength of the volcanic system. Recent models of pyroclastic flows from Vesuvius indicate that modest eruptive activity (i.e., on the scale of the known modern events) could cause complete destruction within a radius of 7 km in less than 15 minutes. The actual destruction is dependent upon the prevailing winds, the direction of the blast, and the possible shielding effects of the Somma rim, but the pattern of behavior is clear (Dobran et al 1994; figure 2).

### **Mechanics of the 79AD Event**

The eruption of 79AD was characterized by extensive pumice-fall (roughly 2.5 meters in Pompeii), followed by a series of six pyroclastic surge deposits of varying strength. The height of the eruptive column was 15-26 km during eruption of the white pumice (lower layer), and rose to a maximum of 32 km during eruption of the grey pumice (upper layer; figure 3). Pumiceous material was ejected from the volcano at speeds between 325 m/sec (white pumice) and 400 m/sec (grey pumice).

During an explosive volcanic event, most particles are too small to be ejected from the summit along ballistic trajectories. They are instead carried high into the eruptive column by convection. Individual particles ascend to a height where their convective ascent velocity is in equilibrium with their gravitational settling velocity (i.e., they reach a stable height, and spread out laterally in the atmosphere). Convecting columns of this nature result in pumice fallout, as with the first day of the 79AD eruption. Dangerous and destructive pyroclastic surges (nuée ardents, or "glowing clouds") result from the collapse of the convecting column. An individual column may collapse when the particle exit velocity decreases or when the vent radius increases. These two parameters may be

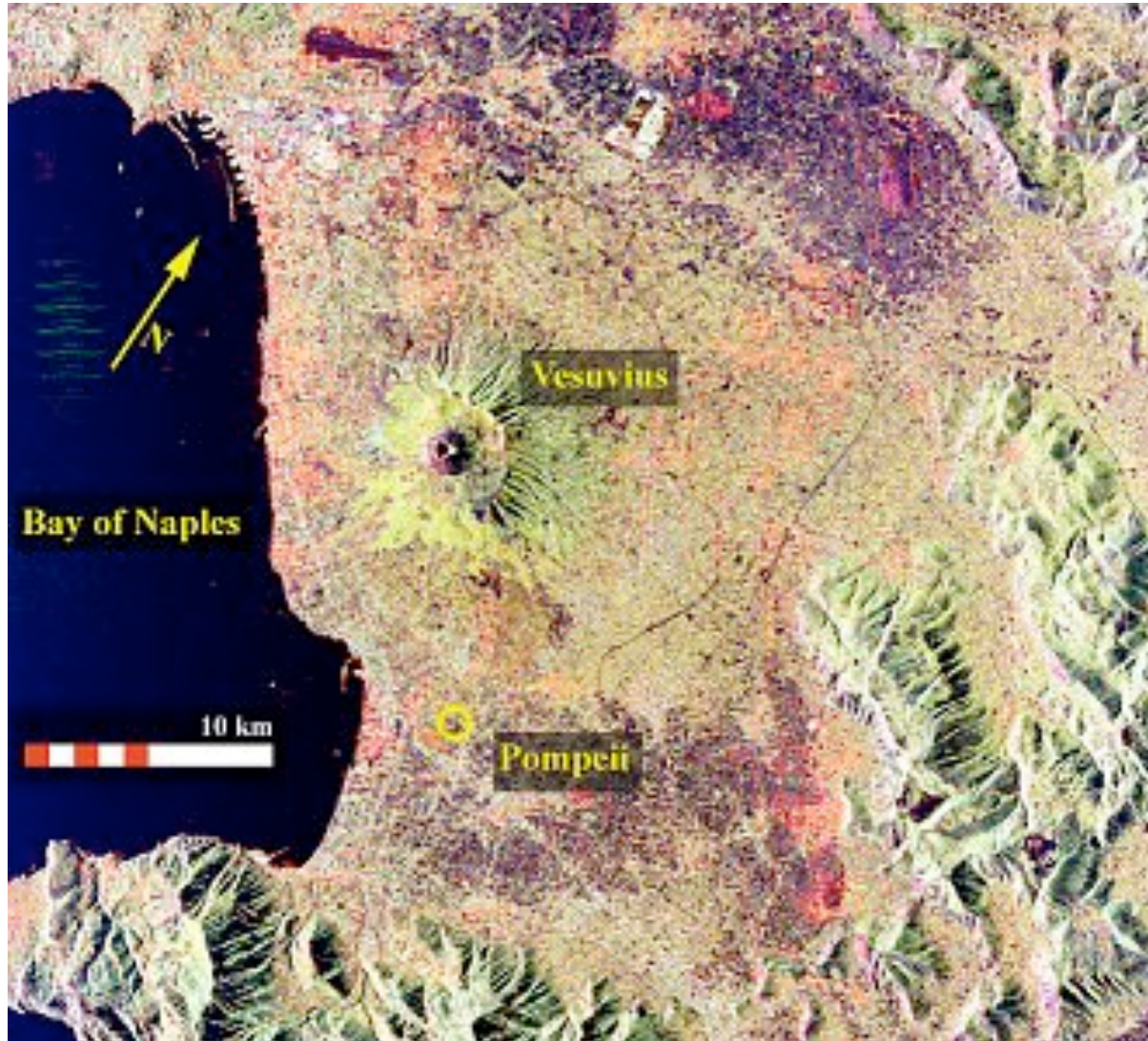
**causally related: in some eruptions, erosion of the vent walls during repeated blasting causes the exit velocity to decrease even though the "eruptive power" remains constant. Commonly, however, the eruptive power fluctuates during the course of the event.**

**Three of the surges (S-4, S-5, S-6; Sigurdsson et al 1985) reached Pompeii (figure 4); it is likely that the first of these was most damaging to people, whereas the last was most damaging to buildings. In contrast, it appears that the S-1 surge was responsible for the destruction of Herculaneum. The S-4 surge may have been ejected at temperatures up to 800°C, although values of ~400°C are perhaps more likely for the temperature upon arrival in Pompeii. Victims likely suffocated on volcanic ash in the cloud, and were also scorched by the heat of gases within the flow. The S-6 surge was likely significantly cooler, and owes its great power to the abundant presence of lithic clasts (pieces of limestone and volcanic material carried in the flow). A modern example of this activity is Mt. Pelee (1902), where a ground surge similar to the S-6 event took down masonry walls 1 meter thick, and carried a 3-ton statue for 16 meters (Sigurdsson et al 1982).**

**From: <http://urban.arch.virginia.edu/struct/pompeii/volcanic.html>**

# ***Volcanic Phenomena at Pompeii***

## ***Brief Chronology of the 79 Eruption***



***A satellite image of the region surrounding Mt. Vesuvius.***

The chronology of volcanic events on 24 and 25 August 79 AD at Vesuvius and its surroundings has been thoroughly investigated and documented by Sigurdsson [1982, 1985], who combined information from written accounts and geologic deposits to reconstruct the sequence of events. This chapter reviews that chronology and identifies potential consequences on the buildings of Pompeii.



The 79 eruption of Vesuvius had two distinct phases: first a *Plinian* phase, where material was ejected in a tall column, spread in atmosphere and fell to earth like rain; followed by a *Peléan* phase where material flowed down the sides of the volcano as fast-moving avalanches of gas and dust, called *pyroclastic flow* (*pyroclasts* are rock fragments formed by a volcanic explosion or ejected from a volcanic vent). The term *Plinian* derives from the name of Pliny the Younger, whose written observations of the 79 eruption form an important part of the historic record of Pompeii. The term *Peléan* derives from the name of Mount Pelée on the island of Martinique, where the phenomenon of pyroclastic flow was first documented in a 1902 eruption. The pyroclastic flows of the Peléan phase at Pompeii were the primary cause of volcanic damage to walls, however the air-fall pumice and ash fall during the Plinian phase was also significant since the deposits collapsed roofs and buried low structures, shielding them from the effects of the pyroclastic flow that followed.

A Plinian eruption ejects a column of tephra high into the atmosphere (tephra refers to any material that is ejected from a volcano into the atmosphere), creating a form similar to the mushroom cloud of a nuclear explosion. A Plinian eruption of Vesuvius began at midday on 24 August 79 AD created a Plinian column approximately 20 km (66,000 feet) high. This phase created a rain of ash and pumice over a broad area primarily to the south of Vesuvius, carried by prevailing winds. This phase lasted approximately eighteen hours, when approximately 2.5 meters (8.2 feet) of pumice stones fell on Pompeii, an initial layer of 1.3 to 1.4 meters (4.3 to 4.6 feet) of white pumice, followed by 1.1 to 1.3 meters (3.6 to 4.3 feet) of denser gray pumice. The average diameter of the pumice fallout was 1 cm (0.4 in), and posed little direct threat to human life.

Sigurdsson [1985, p. 351] estimates that roofs began to collapse with an accumulation of approximately 40 cm (16 inches) of pumice. Carey [1987, p. 309] measured the density of the white pumice layer as ranging from 0.58 to 0.67 g/cm<sup>3</sup> (36 to 42 lb/ft<sup>3</sup>), and the density of the grey pumice layer at 1.1 g/cm<sup>3</sup> (69 lb/ft<sup>3</sup>), so that a 40 cm (16 inch) layer of white pumice corresponds to a distributed load of approximately 250 kg/m<sup>2</sup> (51 lb/ft<sup>2</sup>). Although some stoutly-built timber roofs might have been able to sustain this load, it is very reasonable to assume that any timber roof structure would have collapsed under the full weight of the white pumice layer, corresponding to a load of approximately 844 kg/m<sup>2</sup> (172 lb/ft<sup>2</sup>). The full weight of the white and grey pumice layers corresponds to a load of approximately 2330 kg/m<sup>2</sup> (476 lb/ft<sup>2</sup>); this load is nearly double that prescribed by modern building codes for a heavy storage structure [UBC 1994, p. 2-29], such as a reinforced concrete warehouse, so it is reasonable to assume that any timber roof or floor structure would have collapsed at some point during the Plinian phase.

By the morning of 25 August, it is clear that all covered buildings in Pompeii were uninhabitable due to collapsed floors and roofs, and it is likely that there was a mass exodus from the city; of Pompeii's estimated 20,000 residents, only about 2,000 have been found in excavations, and the majority of those have been found on top of the pumice layer [Sigurdsson 1985, p. 352]. The Plinian phase created a nearly deserted city of buildings without roofs or floors, where the bottom story

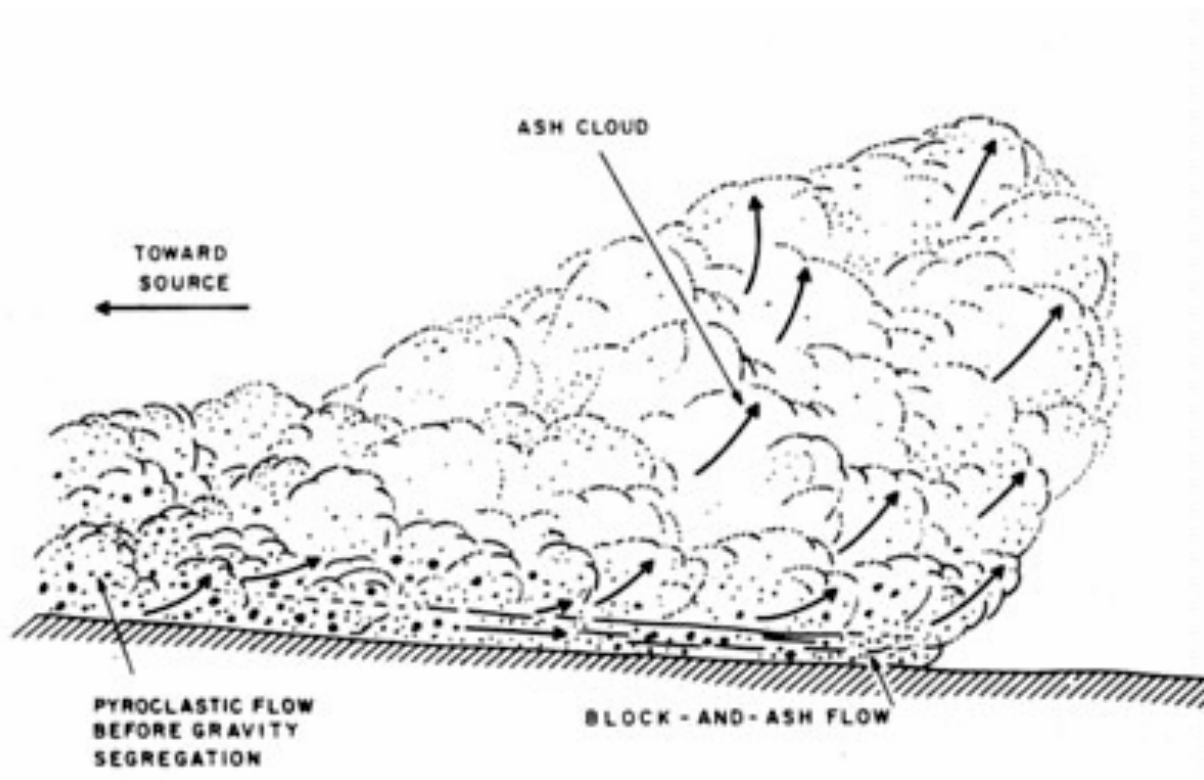
level was submerged in a layer of pumice; this set the stage for the pyroclastic flow of the Peléan phase that began on the morning of 25 August.

The Peléan phase brought a much more damaging eruption, in the form of high-temperature avalanches of gas and dust hugging the ground at high velocity. There are several terms in volcanology to describe various types and aspects of this type of eruption. Although some researchers apply the terms somewhat differently, most agree on two broad categories of ground flow eruption, defined by Sigurdsson [1982, pp. 40-41] as follows:

\* **Pyroclastic Flow:** A hot, chaotic avalanche of pumice, ash, and gasses. Pyroclastic flows can move at high speeds along the ground and pass over substantial obstacles. Their distribution is, however, strongly controlled by topography.

\* **Pyroclastic Surge:** A turbulent cloud of volcanic ash and hot gasses, which hugs the ground and travels at speeds often exceeding 100 km per hour. Surge deposits are more widely distributed than pyroclastic flow deposits, although not as widespread as air-fall pumice layers.

The key basis for distinction is the amount and nature of the pyroclastic material included in the mixture of volcanic solids and gas. Denser mixtures, which include larger fragments at higher solid concentrations, are typically categorized as pyroclastic flow, while less dense mixtures where the pyroclasts are primarily fine dust and ash are categorized as pyroclastic surge. The term "glowing avalanche" is sometimes used to describe pyroclastic flow, while the terms

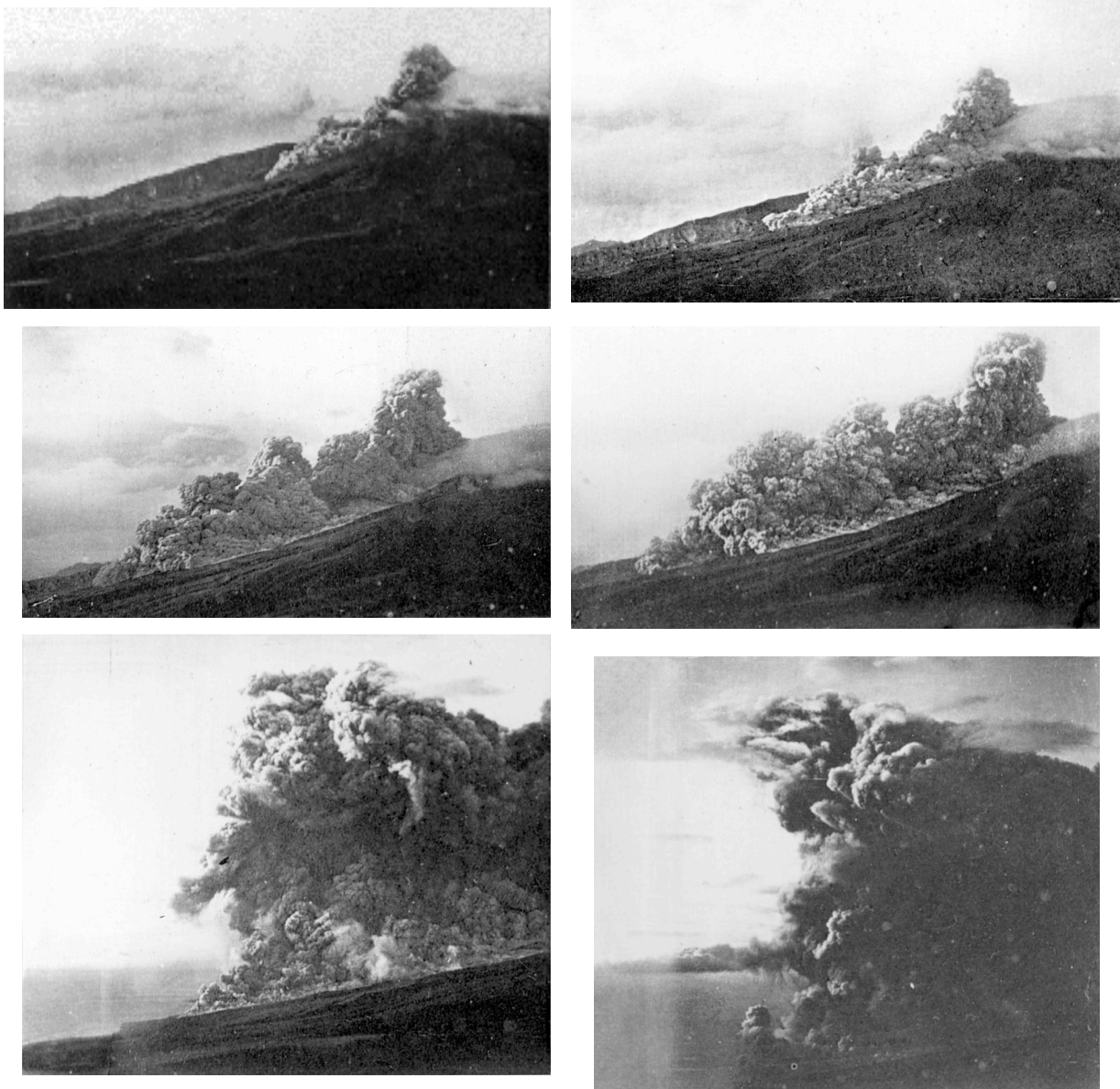


***Diagram of a typical pyroclastic flow progression, showing the separation into underflow and surge [Fisher 1982, p. 366].***

"glowing cloud" and "ground surge", are sometimes used to describe pyroclastic surge. The French term "nuée ardente" is often used to describe a common phenomenon where an avalanche of coarse material, a pyroclastic flow, is accompanied by an overriding ash cloud of fine material, a pyroclastic surge. The diagram below shows how the ash cloud (surge) layer of a nuée ardente separates from the ash-and-block (flow) layer. The surge layer may separate from the flow layer climbing hills and traveling greater distances [Fisher 1995, p. 262. fig. 18].

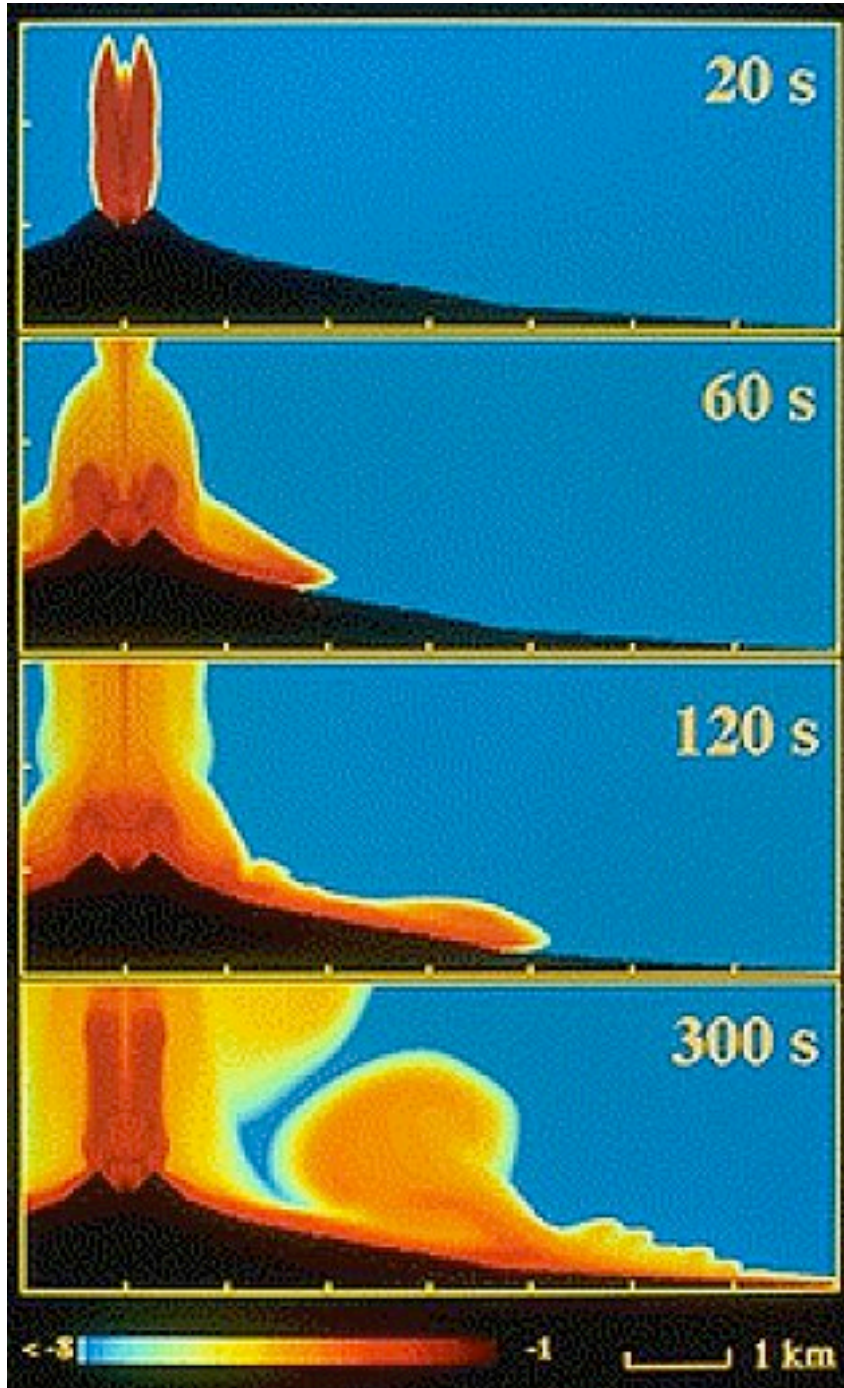
The following image sequence shows an example of a nuée ardente, which occurred at Mt. Pelée on 25 January 1903 [LaCroix 1904, pl. XII]:

***A series of images showing the progression of pyroclastic flow. Mt. Pelée, 25 January 1903 [LaCroix 1904, pl. XII].***





Pyroclastic flow can result from a variety of eruptive mechanisms. In the image series shown above, the flow essentially spilled over the rim of the volcanic vent and poured down the side of the mountain. The 79 A.D. pyroclastic flows at Vesuvius were the result of a "column collapse" mechanism, where material is first ejected high into the atmosphere, and then falls to earth at high velocity. The image below shows the results of a numeric simulation of column collapse at Vesuvius [Dobran 1996].



*Digital simulation of pyroclastic flow resulting from the collapse of the eruptive column at Vesuvius. The shading indicates temperature and pyroclast concentration, with darker shades indicating high and lighter indicating low. The color animation of the eruption sequence. Is on the Internet at:*

<http://urban.arch.virginia.edu/struct/pompeii/images/video/dobran-simulation.mpeg>

Pyroclastic surge and flow were both significant factors in the Peléan phase that began on the morning of 25 August. The deposits reveal that the city was hit first by a pyroclastic surge, leaving a deposit of 10 to 20 cm, closely followed by a pyroclastic flow that left a deposit varying in thickness from 200 cm at the north wall of the city to 50 cm in the Necropolis to the south [Sigurdsson 1982]. Shortly thereafter, there was a second pyroclastic surge leaving a deposit of 10 to 20 cm, rich in fragments of limestone and dense volcanic rocks. The eruptive activity concluded with a 70 cm of air-fall ash and *accretionary lapilli*, small pellets of cemented ash formed by the interaction of hot ash with water in the air [MacDonald 1972, p. 133]; like the initial Plinian phase, this final phase of air-fall material posed little threat to the masonry walls.

There is no doubt that the pyroclastic surge and flow events during the Peléan phase inflicted significant structural damage; the presence of bricks and roof tiles in the surge deposits attest to this damage [Sigurdsson 1982, p. 50]. However, they were not the only source of damage, there was significant seismic activity on the morning of 25 August, during the eruption, and there was the previous destructive earthquake of 62 A.D.

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In the 19<sup>th</sup> century there was intense interest in the 79 AD eruption of Vesuvius and the burial of Pompeii and other cities around the bay of Naples. In the following few pages, there is information on the three popular culture events drove this interest:

1. The publication in 1834 of Edward Bulwer Lytton's *The last days of Pompeii*, which was given a big sales boost by the almost simultaneous and biggest modern eruption of Vesuvius. The book was a best seller in Europe and the US.
2. The publication in 1869 of Mark Train's immensely popular irreverent travelogue *Innocents Abroad*, which contained a long section on Vesuvius and Pompeii.
3. The composition and publication of the hit song *Funiculi', Funicula'!*, with double-meaning words in Neapolitan slang. The song commemorated the opening of the cable tram that took tourists to the top of Vesuvius,



← **Edward  
Bulwer Lytton**





[Bulwer and Vesuvius: The Topicality of The Last Days of Pompeii](#) (in Notes)

James C. Simmons

*Nineteenth-Century Fiction*, Vol. 24, No. 1. (Jun., 1969), pp. 103-105.

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## Notes

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BULWER AND VESUVIUS: THE TOPICALITY OF  
*The Last Days of Pompeii*

CRITICS OF EARLY VICTORIAN FICTION have long been aware of the phenomenal sales enjoyed by Edward Bulwer-Lytton's *The Last Days of Pompeii* when it appeared anonymously in the early autumn of 1834. In his fine and thorough study of the Bentley publishing firm, Royal A. Gettmann has noted that this novel was "one of the chief sources of the Bentley's early prosperity,"<sup>1</sup> and Michael Sadleir has observed that the book enjoyed "the most spectacular success of any novel since *Waverley*."<sup>2</sup> However, critical attempts to arrive at a satisfactory explanation for the extraordinary reception of Bulwer's historical romance have generally been wide of the mark. Curtis Dahl perhaps comes closest, relating the novel, as he does, to that unique and curious cultural phenomenon of the nineteenth century, the "school of catastrophe," which took as the subject for much of its literature and art the violent destruction of Pompeii.<sup>3</sup>

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<sup>1</sup> *A Victorian Publisher: A Study of the Bentley Papers* (Cambridge, Eng., 1960), p. 160.

<sup>2</sup> *Bulwer: A Panorama, Edward and Rosina, 1803-1836* (London, 1931), p. 366.

<sup>3</sup> "Bulwer-Lytton and the School of Catastrophe," *Philological Quarterly*, XXXII (Oct. 1953), 428-442.

But this is only a partial explanation. The full answer lies elsewhere, in the faded files of English newspapers for the week of Sept. 22 to 29. For Bulwer's novel by sheer chance received a prepublication boost that no human press agent could have equalled. Its appearance in the bookstores coincided with the most destructive eruptions of Vesuvius in modern centuries.

After a decade of disturbances, the volcano erupted on August 27, 1834, with a fury which surpassed, in the words of one magazine, "everything which history has transmitted to us."<sup>4</sup> For three days the countryside around was rocked by earthquakes and devastated by heavy rock and ash rains. Lava flows broke forth from the sides of the mountain, rushing down the slopes, burying everything in their paths. To judge from the numerous eyewitness accounts, the destruction indeed must have been fearful. Charles Daubeny, the Victorian geologist and expert on volcanic activity, arrived on the scene shortly after the eruptions began and observed one lava flow he estimated at one-half mile wide and fifteen to eighteen feet thick engulf a village of 180 houses and 500 acres of farmland.<sup>5</sup> Captain Basil Hall, visiting near Naples at the time, made several trips up the slopes of the volcano and returned with appalling descriptions of wasted villages and crops, desolate landscapes, clouds of putrid gases, and explosions which hurled rock boulders 2300 feet into the air.<sup>6</sup> The partially excavated city of Pompeii was once again threatened, and for a time it was feared that the nearby city of Naples would be buried under ash and cinders. By the 29th of August, after three days of constant disturbance, Vesuvius settled once more into some semblance of tranquillity, but not before thousands of peasants had been forced to flee their homes, 1500 houses, palaces, and other buildings had been destroyed, and 2500 acres of farmland laid to waste.

<sup>4</sup> *Gentleman's Magazine*, II (2nd series: Oct. 1834), 420.

<sup>5</sup> "An Account of the Eruption of Vesuvius in the Month of August, 1834," a paper read before the Royal Society, March 19, 1835; reprinted in Daubeny, *Miscellanies* (Oxford and London, 1867), I, part II, pp. 3-13.

<sup>6</sup> *Patchwork* (Philadelphia, 1841), II, 133-143.



Details of the disaster first appeared in the London papers and magazines on the 22nd of September. Throughout the last week of September, as additional details of the eruptions arrived from overseas, the news of Vesuvius received extensive coverage on the front pages of the London papers. The *Examiner* called it the worst disaster in “the whole history of that Majestic Terror,” and treated its readers to detailed and graphic descriptions of its horrors.<sup>7</sup> The *Times*’ correspondent at the scene reported that “four villages, some detached houses, country villas, vines, beautiful groves, and gardens, which a few instants before presented a magnificent spectacle, now resembled a sea of fire.”<sup>8</sup> Allusions to the fate of the ancient city of Pompeii were common in the dispatches.

And so, the violence of Vesuvius and the tragedy of Pompeii were brought dramatically before the public at the exact time Bulwer’s *The Last Days of Pompeii* was released by the publishers on September 29, 1834, one month following the eruption and only one week after the news reached England. The novel thus possessed a dramatic topicality for the readers of the day, and the reviewers of the book bear witness to the degree that people felt the novel embodied an accurate description of the earlier eruption and its relevance to the contemporary situation. “At what a moment . . . has it appeared!” exclaimed the *Athenaeum* in an enthusiastic review which included a lengthy account of the current disaster.<sup>9</sup> “Upon the whole,” wrote the author in the notes he affixed to the rear of his story, “I believe my description of that awful event is very little assisted by invention, and will be found not the less accurate for its appearance in a Romance.”<sup>10</sup> No doubt, many of Bulwer’s English readers, having first devoured the accounts in the papers, would have agreed.

JAMES C. SIMMONS

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<sup>7</sup> Sept. 28, 1834, p. 617.

<sup>8</sup> Sept. 22, 1834, p. 3.

<sup>9</sup> Sept. 27, 1834, p. 708.

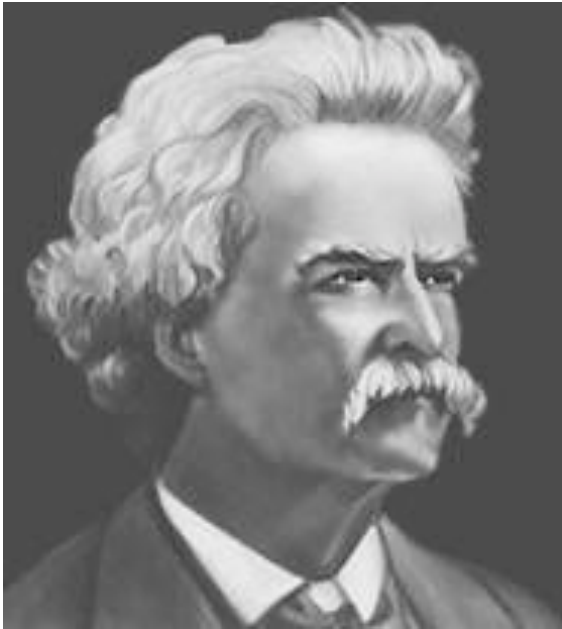
<sup>10</sup> *The Last Days of Pompeii*, in *The Collected Works of Edward Bulwer-Lytton* (Knebworth ed.; Boston, 1891), II, 234.



From <http://faculty.ed.umuc.edu/~jmatthew/naples/MarkTwain.html>

## **An excerpt from *The Innocents Abroad* by Mark Twain (1869)**

### **ASCENT OF VESUVIUS**



**I shall remember our trip to Vesuvius for many a day - partly because of its sight-seeing experiences, but chiefly on account of the fatigue of the journey. Two or three of us had been resting ourselves among the tranquil and beautiful scenery of the island of Ischia, eighteen miles out in the harbor, for two days; we called it "resting," but I do not remember now what the resting consisted of, for when we got back to Naples we had not slept for forty-eight hours. We were just about to go to bed early in the evening, and catch up on some**

**of the sleep we had lost, when we heard of this Vesuvius expedition. There were to be eight of us in the party, and we were to leave Naples at mid-night.**

**We laid in some provisions for the trip, engaged carriages to take us to Annunciation, and then moved about the city, to keep awake, till twelve. We got away punctually, and in the course of an hour and a half arrived at the town of Annunciation. Annunciation is the very last place under the sun. In other towns in Italy, the people lie around quietly and wait for you to ask them a question or do some overt act that can be charged for - but in Annunciation they have lost even that fragment of delicacy; they seize a lady's shawl from a chair and hand it to her and charge a penny; they open a carriage door, and charge for it -- shut it when you get out, and charge for it; they help you take off a duster -- two cents; brush your clothes and make them worse than they were before -- two cents; smile upon you -two cents; bow, with a lickspittle smirk, hat in hand -- two cents; they volunteer all information, such as that the mules will arrive presently -- two cents -- warm day, sir -- two cents -- take you four hours to make the ascent --**

two cents. And so they go. They crowd you -- infest you -- swarm about you, and sweat and smell offensively, and look sneaking and mean, and obsequious. There is no office too degrading for them to perform, for money. I have had no opportunity to find out anything about the upper classes by my own observation, but from what I hear said about them I judge that what they lack in one or two of the bad traits the canaille have, they make up in one or two others that are worse. How the people beg! -- many of them very well dressed, too.

I said I knew nothing against the upper classes by personal observation. I must recall it! I had forgotten. What I saw their bravest and their fairest do last night, the lowest multitude that could be scraped up out of the purlieus of Christendom would blush to do, I think. They assembled by hundreds, and even thousands, in the great Theater of San Carlo, to do -- what? Why, simply, to make fun of an old woman -- to deride, to hiss, to jeer at an actress they once worshipped; but whose beauty is faded now and whose voice has lost its former richness. Everybody spoke of the rare sport there was to be. They said the theater would be crammed, because Frezzolini was going to sing. It was said she could not sing well, now, but then the people liked to see her, anyhow. And we went. And every time the woman sang they hissed and laughed -- the whole magnificent house -- and as soon as she left the stage they called her on again with applause. Once or twice she was encored five and six times in succession, and received with hisses and when she appeared, and discharged with hisses and laughter when she had finished -- then instantly encored and insulted again! And how the high-born knaves enjoyed it! White-kidded gentlemen and ladies laughed till the tears came, and clapped their hands in very ecstasy when that unhappy old woman would come meekly out for the sixth time, with uncomplaining patience, to meet a storm of hisses! It was the cruelest exhibition -- the most wanton, the most unfeeling. The singer would have conquered an audience of American rowdies by her brave, unflinching tranquility (for she answered encore after encore, and smiled and bowed pleasantly, and sang the best she possibly could, and went bowing off, through all the jeers and hisses, without ever losing countenance or temper); and surely in any other land than Italy her sex and her helplessness must have been an ample protection to her -- she could have needed no other. Think what a multitude of small souls were crowded into that theater last night. If the manager could have filled his theater with Neapolitan souls alone, without the bodies, he could not have cleared less than ninety millions of dollars. What



traits of character must a man have to enable him to help three thousand miscreants to hiss, and jeer, and laugh at one friendless old woman, and shamefully 'humiliate her? He must have all the vile, mean traits there are. My observation persuades me (I do not like to venture beyond my own personal observation) that the upper classes of Naples possess those traits of character. Otherwise they may be very good people; I cannot say.

In this city of Naples, they believe in and support one of the wretchedest of all the religious impostures one can find in Italy-- the miraculous liquefaction of the blood of St. Januarius. Twice a year the priests assemble all the people at the Cathedral, and get out this vial of clotted blood and let them see it slowly dissolve and become liquid -- and every day for eight days this dismal farce is repeated, while the priests go among the crowd and collect money for the exhibition. The first day, the blood liquefies in forty-seven minutes -- the church is crammed, then, and time must be allowed the collectors to get around: after that it liquefies a little quicker and a little quicker, every day, as the houses grow smaller, till on the eighth day, with only a few dozen present to see the miracle, it liquefies in four minutes. And here, also, they used to have a grand procession, of priests, citizens, soldiers, sailors, and the high dignitaries of the City Government, once a year, to shave the head of a made up Madonna -- a stuffed and painted image, like a milliner's dummy -- whose hair miraculously grew and restored itself every twelve months. They still kept up this shaving procession as late as four or five years ago. It was a source of great profit to the church that possessed the remarkable effigy, and the ceremony of the public barbering of her was always carried out with the greatest possible *éclat* and display -- the more the better, because the more excitement there was about it the larger the crowds it drew and the heavier the revenues it produced -- but at last a day came when the Pope and his servants were unpopular in Naples, and the City Government stopped the Madonna's annual show.

There we have two specimens of these Neapolitans -- two of the silliest possible frauds, which half the population religiously and faithfully believed, and the other half either believed also or else said nothing about, and thus lent themselves to the support of the imposture. I am very well satisfied to think the whole population believed in those poor, cheap, miracles -- a people who want two cents every time they bow to you, and who abuse a woman, are capable of it, I think.

These Neapolitans always ask four times as much money as they intend to take, but if you give them what they first demand, they feel ashamed of themselves for aiming so low, and immediately ask more. When money is to be paid and received, there is always some vehement jawing and gesticulating about it. One cannot buy and pay for two cents' worth of clams without trouble and a quarrel. One "course," in a two-horse carriage, costs a franc -- that is law -- but the hackman always demands more, on some pretense or other, and if he gets it he makes a new demand. It is said that a stranger took a one-horse carriage for a course -- tariff, half a franc. He gave the man five francs, by the way of experiment. He demanded more, received another franc. Again he demanded more, and got a franc --demanded more, and it was refused. He grew vehement - was again refused, and became noisy. The stranger said, "Well, give me the seven francs again, and I will see what I can do" -- and when he got them, he handed the hackman half a franc, and he immediately asked for two cents to buy a drink with. It may be thought that I am prejudiced. Perhaps I am. I would be ashamed of myself if I were not.

Well, as I was saying, we got our mules and horses, after an hour and a half of bargaining with the population of Annunciation, and started sleepily up the mountain, with a vagrant at each mule's tail who pretended to be driving the brute along, but was really holding on and getting himself dragged up instead. I made slow headway at first, but I began to get dissatisfied at the idea of paying my minion five francs to hold my mule back by the tail and keep him from going up the hill, and so I discharged him. I got along faster then. We had one magnificent picture of Naples from a high point on the mountain side. We saw nothing but the gas lamps, of course - two-thirds of a circle, skirting the great Bay - a necklace of diamonds glinting up through the darkness from the remote distance - less brilliant than the stars overhead, but more softly, richly beautiful -- and over all the great city the lights crossed and recrossed each other in many and many a sparkling line and curve. And back of the town, far around and abroad over the miles of level campagna, were scattered rows, and circles, and clusters of lights, all glowing like so many gems, and marking where a score of villages were sleeping. About this time, the fellow who was hanging on to the tail of the horse in front of me and practicing all sorts of unnecessary cruelty upon the animal, got kicked some fourteen rods, and this incident, together with the fairy

spectacle of the lights far in the distance, made me serenely happy, and I was glad I started to Vesuvius.

This subject will be excellent matter for a chapter, and to-morrow or next day I will write it.

### **CHAPTER III ASCENT OF VESUVIUS -- CONTINUED**

“See Naples and die.” Well, I do not know that one would necessarily die after merely seeing it, but to attempt to live there might turn out a little differently. To see Naples as we saw it in the early dawn from far up on the side of Vesuvius, is to see a picture of wonderful beauty. At that distance its dingy buildings looked white - and so, rank on rank of balconies, windows and roofs, they piled themselves up from the blue ocean till the colossal castle of St. Elmo topped the grand white pyramid and gave the picture symmetry, emphasis, and completeness. And when its lilies turned to roses - when it blushed under the sun’s first kiss -- It was beautiful beyond all description. One might well say, then, “See Naples and die.” The frame of the picture was charming, itself. In front, the smooth sea -- a vast mosaic of many colors; the lofty islands swimming in a dreamy haze in the distance; at our end of the city the stately double peak of Vesuvius, and its strong black ribs and seams of lava stretching down to the limitless level campagna -- a green carpet that enchants the eye and leads it on and on, past clusters of trees and isolated houses, and snowy villages, until it shreds out in a fringe of mist and general vagueness far away. It is from the Hermitage, there on the side of Vesuvius, that one should “see Naples and die.”

But do not go within the walls and look at it in detail. That takes away some of the romance of the thing. The people are filthy in their habits, and this makes filthy streets and breeds disagreeable sights and smells. There never was a community so prejudiced against the cholera as these Neapolitans are. But they have good reason to be. The cholera generally vanquishes a Neapolitan when it seizes him, because, you understand before the doctor can dig through the dirt and get at the disease the man dies. The upper classes take a sea-bath every day, and are pretty decent.

The streets are generally about wide enough for one wagon and how they do swarm with people! It is Broadway repeated in every street, in every court, in every alley! Such masses such throngs, such multitudes of hurrying, bustling, struggling humanity! We never saw the like of it, hardly even in New York, I think. There are seldom any sidewalks, and when there are, they are not often wide enough to pass a man on without caroming on him. So everybody walks in the street - and where the street is wide enough, carriages are forever dashing along Why a thousand people are not run over and crippled every day is a mystery that no man can solve.

But if there is an eighth wonder in the world, it must be the dwelling-houses of Naples. I honestly believe a good majority of them are a hundred feet high! And the solid brick walls are seven feet through. You go up nine flights of stairs before you get to the "first" floor. No, not nine, but there or thereabouts There is a little bird-cage of an iron railing in front of every window clear away up, up, up, among the eternal clouds, where the roof is, and there is always somebody looking out of every window -- people of ordinary size looking out from the first floor, people a shade smaller from the second, people that look a little smaller yet from the third -- and from thence upward they grow smaller and smaller by a regularly graduated diminution, till the folks in the topmost windows seem more like birds in the uncommonly tall martin-box than anything else. The perspective of one of these narrow cracks of streets, with its rows of tall houses stretching away till they come together in the distance like railway tracks; its clothes-lines crossing over at all altitudes and waving their bannered raggedness over the swarms of people below; and the white-dressed women perched in balcony railings all the way from the pavement up to the heavens - a perspective like that is really worth going into Neapolitan details to see.

Naples, with its immediate suburbs, contains six hundred and twenty-five thousand inhabitants, but I am satisfied it covers no more ground than an American city of one hundred and fifty thousand. It reaches up into the air infinitely higher than three American cities, though, and there is where the secret of it lies. I will observe here, in passing, that the contrasts between opulence and poverty, and magnificence and misery, are more frequent and more striking in Naples than in Paris even. One must go to the Bois de Boulogne to see fashionable dressing, splendid equipages, and stunning liveries, and to the Faubourg St. An-toine to see vice, misery, hunger, rags, dirt -- but in

the thoroughfares of Naples these things are all mixed together. Naked boys of nine years and the fancy-dressed children of luxury; shreds and tatters, and brilliant uniforms; jackass carts and state carriages; beggars, princes, and bishops, jostle each other in every street.

At six o'clock every evening, all Naples turns out to drive on the Riviera di Chiaja (whatever that may mean); and for two hours one may stand there and see the motliest and the worst-mixed procession go by that ever eyes beheld. Princes (there are more princes than policemen in Naples - the city is infested with them) - princes who live up seven flights of stairs and don't own any principalities, will keep a carriage and go hungry; and clerks, mechanics, milliners, and strumpets will go without their dinners and squander the money on a hack-ride in the Chiaja; the rag-tag and rubbish of the city stack themselves up, to the number of twenty or thirty, on a rickety little go-cart hauled by a donkey not much bigger than a cat, and they drive in the Chiaja; dukes and bankers, in sumptuous carriages and with gorgeous drivers and footmen, turn out, also, and so the furious procession goes. For two hours rank and wealth, and obscurity and poverty, clatter along side by side in the wild procession, and then go home serene, happy, covered with glory!

I was looking at a magnificent marble staircase in the King's palace, the other day, which, it was said, cost five million francs, and I suppose it did cost half a million, may be. I felt as if it must be a fine thing to live in a country where there was such comfort and such luxury as this. And then I stepped out musing, and almost walked over a vagabond who was eating his dinner on the curbstone -- a piece of bread and a bunch of grapes. When I found that this mustang was clerking in a fruit establishment (he had the establishment along with him in a basket), at two cents a day, and that he had no palace at home where he lived, I lost some of my enthusiasm concerning the happiness of living in Italy.

This naturally suggests to me a thought about wages there. Lieutenants in the army get about a dollar a day, and common soldiers a couple of cents. I only know one clerk -- he gets four dollars a month. Printers get six dollars and a half a month, but I have heard of a foreman who gets thirteen. To be growing suddenly and violently rich, as this man is, naturally makes him a bloated aristocrat. The airs he puts on are insufferable. And, speaking of wages, reminds

me of prices of merchandise. In Paris you pay twelve dollars a dozen for Jouvin's best kid gloves; gloves of about as good quality sell here at three or dollars a dozen. You pay five and six dollars apiece for fine four linen shirts in Paris; here and in Leghorn you pay two and a half. In Marseilles you pay forty dollars for a first-class dress coat made by a good tailor, but in Leghorn you can get a full dress suit for the same money. Here you get handsome business suits at from ten to twenty dollars, and in Leghorn you can get an overcoat for fifteen dollars that would cost you seventy in New York. Fine kid boots are worth eight dollars in Marseilles and four dollars here. Lyons velvets rank higher in America than those of Genoa. Yet the bulk of Lyons velvets you buy in the States are made in Genoa and imported into Lyons, where they receive the Lyons stamp and are then exported to America. You can buy enough velvet in Genoa for twenty-five dollars to make a five hundred dollar cloak in New York -- so the ladies tell me. Of course, these things bring me back, by a natural and easy transition, to the

And thus the wonderful Blue Grotto is suggested to me. It is situated on the island of Capri, twenty-two miles from Naples We chartered a little steamer and went out there. Of course the police boarded us and put us through a health examination, and inquired into our politics, before they would let us land. The airs these little insect governments put on are in the last degree ridiculous. They even put a policeman on board of our boat to keep an eye on us as long as we were in the Capri dominions. They thought we wanted to steal the grotto, I suppose. It was worth stealing. The entrance to the cave is four feet high and four feet wide, and is in the face of a lofty perpendicular cliff --the sea wall. You enter in small boats -- and a tight squeeze it is too. You cannot go in at all when the tide is up. Once within, you find yourself in an arched cavern about one hundred and sixty feet long, one hundred and twenty wide, and about seventy high. How deep it is no man knows. It goes down to the bottom of the ocean. The waters of this placid subterranean lake are the brightest, loveliest blue that can be imagined. They are as transparent as plate glass, and their coloring would shame the richest sky that ever bent over Italy, No tint could be more ravishing, no luster more superb. Throw a stone into the water, and the myriad of tiny bubbles that are created flash out a brilliant glare like blue theatrical fires. Dip an oar, and its blade turns to splendid frosted silver, tinted with blue. Let a man jump in, and instantly he is cased in an armor more gorgeous than ever kingly Crusader wore.



Then we went to Ischia, but I had already been to that island and tired myself to death “resting” a couple of days and studying human villainy, with the landlord of the Grande Sentinelle for a model. So we went to Procida, and from thence to Pozzuoli, where St. Paul landed after he sailed from Samos. I landed at precisely the same spot where St. Paul landed, and so did Dan and the others. It was a remarkable coincidence. St. Paul preached to these people seven days before he started to Rome.

Nero’s Baths, the ruins of Baiae, the Temple of Serapis; Cumae, where the Cumaean Sibyl interpreted the oracles, the Lake Agnano, with its ancient submerged city still visible far down in the depths - these and a hundred other points of interest we examined with critical imbecility, but the Grotto of the Dog claimed our chief attention, because we had heard and read so much about it. Everybody has written about the Grotto del Cane and its poisonous vapors, from Pliny down to Smith, and every tourist has held a dog over its floor by the legs to test the capabilities of the place. The dog dies in a minute and a half --a chicken instantly. As a general thing, strangers who crawl in there to sleep do not get up until they are called. And then they don’t, either. The stranger that ventures to sleep there takes a permanent contract. I longed to see this grotto. I resolved to take a dog and hold him myself; suffocate him a little, and time him; suffocate him some more, and then finish him. We reached the grotto about three in the afternoon, and proceeded at once to make the experiments. But now, an important difficulty presented itself. We had no dog.

At the Hermitage we were about fifteen or eighteen hundred feet above the sea, and thus far a portion of the ascent had been pretty abrupt. For the next two miles the road was a mixture --sometimes the ascent was abrupt and sometimes it was not; but one characteristic it possessed all the time, without failure -- without modification -- it was all uncompromisingly and unspeakably infamous. It was a rough, narrow trail, and led over an old lava-flow -- a black ocean which was tumbled into a thousand fantastic shapes -- and barrenness -- a wild chaos of ruin, desolation, a wilderness of billowy upheavals, of furious whirlpools, of miniature mountains rent asunder -- of gnarled and knotted, wrinkled and twisted masses of blackness that mimicked branching roots, great vines, trunks of trees, all interlaced and

mingled together; and all these weird shapes, all this turbulent panorama, all this stormy, far-stretching waste of blackness, with its thrilling suggestiveness of life, of action of boiling, surging, furious motion, was petrified! -- all stricken dead and cold in the instant of its maddest rioting! -- fettered, paralyzed, and left to glower at heaven in impotent rage forevermore!

Finally we stood in a level, narrow valley (a valley that had been created by the terrific march of some old-time eruption) and on either hand towered the two steep peaks of Vesuvius. The one we had to climb -- the one that contains the active volcano -- seemed about eight hundred or one thousand feet high and looked almost too straight-up-and-down for any man to climb, and certainly no mule could climb it with a man on his back. Four of these native pirates will carry you to the top in a sedan chair, if you wish it, but suppose they were to slip and let you fall -- is it likely that you would ever stop rolling? Not this side of eternity, perhaps. We left the mules, sharpened our finger nails, and began the ascent I have been writing about so long at twenty minutes to six in the morning. The path led straight up a rugged sweep of loose chunks of pumice-stone, and for about every two steps forward we took, we slid back one. It was so excessively steep that we had to stop, every fifty or sixty steps, and rest a moment. To see our comrades, we had to look very nearly straight up at those above us, and very nearly straight down at those below. We stood on the summit at last -- it had taken an hour and fifteen minutes to make the trip.

What we saw there was simply a circular crater -- a circular ditch, if you please -- about two hundred feet deep, and four or five hundred feet wide, whose inner wall was about half a mile in circumference. In the center of the great circus-ring thus formed was a torn and ragged upheaval a hundred feet high, all snowed over with a sulphur crust of many and many brilliant and beautiful color, and the ditch inclosed this like the moat of a castle or surrounded it as a little river does a little island, if the simile is better. The sulphur coating of that island was gaudy in the extreme -- all mingled together in the richest confusion were red, blue, brown, black, yellow, white -- I do not know that there was a color, or shade of a color, or combination of colors, unrepresented -- and when the sun burst through the morning mists and fired this tinted magnificence, it topped imperial Vesuvius like a jeweled crown!

The crater itself -- the ditch -- was not so variegated in coloring, but yet, in its softness, richness, and unpretentious elegance, it was more charming, more fascinating to the eye. There was nothing "loud" about its well-bred and well-dressed look. Beautiful? One could stand and look down upon it for a week without getting tired of it. It had the semblance of a pleasant meadow, whose slender grasses and whose velvety mosses were frosted with a shining dust, and tinted with palest green that deepened gradually to the darkest hue of the orange leaf, and deepened yet again into gravest brown, then faded into orange, then into brightest gold, and culminated in the delicate pink of a new-blown rose. Where portions of the meadow had sunk and where other portions had been broken up like an ice-floe, the cavernous openings of the one, and the ragged upturned edges exposed by the other, were hung with a lacework of soft-tinted crystals of sulphur that changed their deformities into quaint shapes and figures that were full of grace and beauty.

The walls of the ditch were brilliant with yellow banks of sulphur and with lava and pumice-stone of many colors. No fire was visible anywhere, but gusts of sulphurous steam issued silently and invisibly from a thousand little cracks and fissures in the crater, and were wafted to our noses with every breeze. But so long as we kept our nostrils buried in our handkerchiefs, there was small danger of suffocation.

Some of the boys thrust long slips of paper down into holes and set them on fire, and so, achieved the glory of lighting their cigars by the flames of Vesuvius, and others cooked eggs over fissures in the rocks and were happy.

The view from the summit would have been superb but for the fact that the sun could only pierce the mists at long intervals. Thus the glimpses we had of the grand panorama below were only fitful and unsatisfactory.

## THE DESCENT

The descent of the mountain was a labor of only four minutes. Instead of stalking down the rugged paths we ascended, we chose one which was bedded knee-deep in loose ashes, and plowed our way with prodigious strides that would almost have shamed the performance of him of the seven-league boots. The Vesuvius of to-

day is a very poor affair compared to the mighty volcano of Kilauea, in the Sandwich Islands, but I am glad I visited it. It was well worth it.

It is said that during one of the grand eruptions of Vesuvius it discharged massy rocks weighing many tons a thousand feet into the air, its vast jets of smoke and steam ascended thirty miles toward the firmament, and clouds of its ashes were wafted abroad and fell upon the decks of ships seven hundred and fifty miles at sea! I will take the ashes at a moderate discount, if any one will take the thirty miles of smoke, but I do not feel able to take a commanding interest in the whole story by myself.

#### CHAPTER IV THE BURIED CITY OF POMPEII.

They pronounce it Pompeii. I always had an idea that you went down into Pompeii with torches, by the way of damp, dark stairways, just as you do in silver mines, and traversed gloomy tunnels with lava overhead and something on either hand like dilapidated prisons gouged out of the solid earth, that faintly resembled houses. But you do nothing of the kind. Fully one half of the buried city, perhaps, is completely exhumed and thrown open freely to the light of day; and there stand the long rows of solidly built brick houses (roofless) just as they stood eighteen hundred years ago, hot with the flaming sun; and there lie their floors, clean swept, and not a bright fragment tarnished or wanting of the labored mosaics that pictured them with the beasts and birds and flowers which we copy in perishable carpets to-day; and there are the Venus's and Abacuses and Adonis's, making love and getting drunk in many hued frescoes on the walls of saloon and bedchamber; and there are the narrow streets and narrower sidewalks, paved with flags of good hard lava, the one deeply rutted with the chariot wheels, and the other with the passing feet of the Pompeii's of by-gone centuries; and there are the bookshops, the temples, the halls of justice, the baths, the theaters -- all clean scraped and neat, and suggesting nothing of the nature of a silver mine away down in the bowels of the earth. The broken pillars lying about, the odorless doorways and the crumbled tops of the wilderness of walls, were wonderfully suggestive of the "burnt district" in one of our cities, and if there had been any charred timbers, shattered windows, heaps of debris, and general blackness and smokiness about the place, the resemblance would have been

perfect. But no -- the sun shines as brightly down on old Pompeii today as it did when Christ was born in Bethlehem, and its streets are cleaner a hundred times than ever Pompeii saw them in her prime. I know whereof I speak -- for in the great, chief thoroughfares (Merchant Street and the Street of Fortune) have I not seen with my own eyes how for two hundred years at least the pavements were not repaired! - how ruts five and even ten inches deep were worn into the thick flagstones by the chariot wheels of generations of swindled taxpayers? And do I not know by these signs that street commissioners of Pompeii never attended to their business, and that if they never mended the pavements they never cleaned them? And, besides, is it not the inborn nature of street commissioners to avoid their duty whenever they get a chance? I wish I knew the name of the last one that held office in Pompeii so that I could give him a blast. I speak with feeling on this subject, because I caught my foot in one of those ruts, and the sadness that came over me when I saw the first poor skeleton, with ashes and lava sticking to it, was tempered by the reflection that may be that party was the street commissioner.

No -- Pompeii is no longer a buried city. It is a city of hundreds and hundreds of roofless houses, and a tangled maze of streets where one could easily get lost, without a guide, and have to sleep in some ghostly palace that had known no living tenant since that awful November night of eighteen centuries ago.

We passed through the gate which faces the Mediterranean (called the "Marine Gate"), and by the rusty, broken image of Minorca, still keeping tireless watch and ward over the possessions it was powerless to save, and went up a long street and stood in the broad court of the Forum of Justice. The floor was level and clean, and up and down either side was a noble colonnade of broken pillars, with their beautiful Ionic and Corinthian columns scattered about them. At the upper end were the vacant seats of the judges, and behind them we descended into a dungeon where the ashes and cinders had found two prisoners chained on that memorable November night, and tortured them to death. How they must have tugged at the pitiless fetters as the fierce fires surged around them!

Then we lounged through many and many a sumptuous private mansion which we could not have entered without a formal invitation in incomprehensible Latin, in the olden time, when the owners lived there -- and we probably wouldn't have got it. These people built their

houses a good deal alike. The floors were laid in fanciful figures wrought in mosaics of many colored marbles. At the threshold your eyes fall upon a Latin sentence of welcome, sometimes, or a picture of a dog, with the legend, "Beware of the Dog," and sometimes a picture of a bear or a faun with no inscription at all. Then you enter a sort of vestibule, where they used to keep the hayrack, I suppose; next a room with a large marble basin in the midst and the pipes of a fountain; on either side are bedrooms; beyond the fountain is a reception room, then a little garden, dining room, and so forth and so on. The floors were all mosaic, the walls were stocked, or frescoed, or ornamented with bas-reliefs, and here and there were statues, large and small, and little fish pools, and cascades of sparkling water that sprang from secret places in the colonnade of handsome pillars that surrounded the court, and kept the flower beds fresh and the air cool. Those Pompeii's were very luxurious in their tastes and habits.

The most exquisite bronzes we have seen in Europe came from the exhumed cities of Herculaneum and Pompeii, and also the finest cameos and the most delicate engravings on precious stones; their pictures, the leader of the orchestra beating time, and the "versatile" sounds (who had "just returned from a most successful tour in the provinces to play his last and farewell engagement of positively six nights only, in Pompeii, previous to his departure for Herculaneum") charging around the stage and piling the agony mountains high -- but I could not do it with such a "house" as that; those empty benches tied my fancy down to dull reality. I said, these people that ought to be here have been dead, and still, and moldering to dust for ages and ages, and will never care for the trifles and follies of life any more forever -- "Owing to circumstances, etc., etc., there will not be any performance to-night." Close down the curtain. Put out the lights.

And so I turned away and went through shop after shop and store after store, far down the long street of the merchants, and called for the wares of Rome and the East, but the tradesmen were gone, the marts were silent, and nothing was left but the broken jars all set in cement of cinders and ashes; the wine and the oil that once had filled them were gone with their owners. In a bookshop was a mill for grinding the grain, and the furnaces for baking the bread; and they say that here, in the same furnaces, the exhumed of Pompeii found nice, well baked loaves which the baker had not found time to remove from the ovens the last time he left his shop, because circumstances compelled him to leave in such a hurry.



In one house (the only building in Pompeii which no woman is now allowed to enter) were the small rooms and short beds of solid masonry, just as they were in the old times, and on the walls were pictures which looked almost as fresh as if they were painted yesterday, but which no pen could have the hardihood to describe; and here and there were Latin inscriptions -- obscene scintillation's of wit, scratched by hands that possibly were uplifted to Heaven for succor in the midst of a driving storm of fire before the night was done.

In one of the principal streets was a ponderous stone tank, and a waterspout that supplied it, and where the tired, heated toilers from the Campagna used to rest their right hands when they bent over to put their lips to the spout, the thick stone was worn down to a broad groove an inch or two deep. Think of the countless thousands of hands that had pressed that spot in the ages that are gone, to so reduce a stone that is as hard as iron!

They had a great public bulletin board in Pompeii -- a place where announcements for gladiatorial combats, elections, and such things, were posted -- not on perishable paper, but carved in enduring stone. One lady, who, I take it, was rich and well brought up, advertised a dwelling or so to rent, with baths and all the modern improvements, and several hundred shops, stipulating that the dwellings should not be put to immoral purposes. You can find out who lived in many a house in Pompeii by the carved stone droplets affixed to them: and in the same way you can tell who they were that occupy the tombs. Everywhere around are things that reveal to you something of the customs and history of this forgotten people. But what would a volcano leave of an American city, if it once rained its cinders on it? Hardly a sign or a symbol to tell its story.

In one of these long Pompeii halls the skeleton of a man was found, with ten pieces of gold in one hand and a large key in the other. He had seized his money and started toward the door, but the fiery tempest caught him at the very threshold, and he sank down and died. One more minute of precious time would have saved him. I saw the skeletons of a man, a woman, and two young girls. The woman had her hands spread wide apart, as if in mortal terror, and I imagined I could still trace upon her shapeless face something of the expression of wild despair that distorted it when the heavens rained

fire in these streets, so many ages ago. The girls and the man lay with their faces upon their arms, as if they had tried to shield them from the enveloping cinders. In one apartment eighteen skeletons were found, all in sitting postures, and blackened places on the walls still mark their shapes and show their attitudes, like shadows. One of them, a woman, still wore upon her skeleton throat a necklace, with her name engraved upon it - JULIE DI DIOMEDE.

But perhaps the most poetical thing Pompeii has yielded to modern research, was that grand figure of a Roman soldier, clad in complete armor; who, true to his duty, true to his proud name of a soldier of Rome, and full of the stern courage which had given to that name its glory, stood to his post by the city gate, erect and unflinching, till the hell that raged around him burned out the dauntless spirit it could not conquer. We never read of Pompeii but we think of that soldier; we cannot write of Pompeii without the natural impulse to grant to him the mention he so well deserves. Let us remember that he was a soldier -- not a policeman -- and so, praise him. Being a soldier, he stayed, -- because the warrior instinct forbade him to fly. Had he been a policeman he would have stayed, also --because he would have been asleep.

There are not half a dozen flights of stairs in Pompeii, and no other evidences that the houses were more than one story high. The people did not live in the clouds, as do the Venetian, the Genovese and Neapolitans of to-day.

We came out from under the solemn mysteries of this city of the Venerable Past -- this city which perished, with all its old ways and its quaint old fashions about it, remote centuries ago, when the Disciples were preaching the new religion, which is as old as the hills to us now -- and went dreaming among the trees that grow over acres and acres of its still buried streets and squares, till a shrill whistle and the cry of "All aboard - last train for Naples!" woke me up and reminded me that I belonged in the nineteenth century, and was not a dusty mummy, caked with ashes and cinders, eighteen hundred years old. The transition was startling. The idea of a railroad train actually running to old dead Pompeii, and whistling irreverently, and calling for passengers in the most bustling and business-like way, was as strange a thing as one could imagine, and as unpolitical and disagreeable as it was strange.

**Compare the cheerful life and the sunshine of this day with the horrors the younger Pliny saw here, the 9th of November, A.D. 79, when he was so bravely striving to remove his mother out of reach of harm, while she begged him, with all a mothers unselfishness, to leave her to perish and save himself.**

**“By this time the murky darkness had so increased that one might have believed himself abroad in a black and monacles night, or in a chamber where all the lights had been extinguished. On every hand was heard the complaints of women, the wailing of children, and the cries of men. One called his father, another his son, and another his wife, and only by their voices could they know each other. Many in their despair begged that death would come and end their distress.**

**“Some implored the gods to succor them, and some believed that the night was the last, the eternal night which should engulf the universe!**

**“Even so it seemed to me - and I consoled myself for the coming death with the reflection: BEHOLD! THE WORLD IS PASSING AWAY!”**

**.....**

**After browsing among the stately ruins of Rome, of Bay, of Pompeii, and after glancing down the long marble ranks of battered and nameless imperial heads that stretch down the corridors of the Vatican, one thing strikes me with a force it never had before: the insubstantial, unlashng character of fame. Men lived long lives, in the olden time, and struggled feverishly through them, toiling like slaves, in oratory, in general ship, or in literature, and then laid them down and died, happy in the possession of an enduring history and a deathless name. Well, twenty little centuries flutter away, and what is left of these things? A crazy inscription on a block of stone, which snuff antiquaries bother over and tangle up and make nothing out of but a bare name (which they spell wrong) - no history, no tradition, no poetry - nothing that can give it even a passing interest. What may be left to General Grant's great name forty centuries hence? This - in the Encyclopedia for A.D. 5868, possibly.**

**“URIC S. (or Z.) GRANT -- popular poet of ancient times in the Aztec provinces of the United States of British America. Some authors say flourished about A.D. 742; but the learned Shah Food states that he was a contemporary of Scharkspyre, the English poet, and flourished**

about A.D. 1328, some three centuries after the Trojan war instead of before it. He wrote 'Rock me to Sleep, Mother.' ”

These thoughts sadden me. I will to bed.

(End of *Innocents Abroad* excerpt.)

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**The Vesuvio car of the Vesuvius funicular**

The cablecar line inspired the Neapolitan folksong *Funiculi Funicula*

# Funiculi ' funicula '

(music of Luigi Denza,  
text of Peppino Turco, 1880)



Original text - Neapolitan dialect

1.

*Aieressera, oi' ne', me ne sagliette,  
tu saie addo'?*

*Addo' 'stu core 'ngrato cchiu' dispietto farme nun po'!*

*Addo' lo fuoco coce, ma si fuie  
te lassa sta!*

*E nun te corre appriesso, nun te struie, 'ncielo a guarda'!...*

*Jammo 'ncoppa, jammo ja',  
funiculi', funicula'!*

2.

*Ne'... jammo da la terra a la montagna! no passo nc'e'!*

*Se vede Francia, Proceta e la Spagna...*

*Io veco a tte!*

*Tirato co la fune, ditto 'nfatto,  
'ncielo se va..*

*Se va comm' 'a lu viento a l'intrasatto, gue', saglie sa'!*

*Jammo 'ncoppa, jammo ja',  
funiculi', funicula'!*

3.

*Se n' 'e' sagliuta, oi' ne', se n' 'e' sagliuta la capa già!*

*E' gghiuta, po' e' turnata, po' e' venuta...  
sta sempe cca'!*

*La capa vota, vota, attuorno, attuorno,  
attuorno a tte!*

*Sto core canta sempe*

*nu taluorno*

*Sposammo, oi' ne'!*

*Jammo 'ncoppa, jammo ja',  
funiculi', funicula'!*

**English translation**

**1.**

**Do you know where I got on, yesterday evening, baby?  
Where this ungrateful heart can't be spiteful to me more!  
Where the fire burns, but if you  
run away it let you go!  
And it doesn't run after you,  
doesn't tire you, looking at sky!...  
Let's go on, let's go, let's go,  
funiculi', funicula'!**

**2.**

**We go from the ground to the  
mountain, baby! Without walking!  
You can see France, Procida and  
Spain...  
I see you!  
Pulled by a rope, no sooner said  
than done, we go to the skies..  
We go like the wind all of a sudden, go up, go up!  
Let's go on, let's go, let's go,  
funiculi', funicula'!**

**3.**

**The head has already got on,  
baby, got on!  
It has gone, then returned, then  
come...  
It is still here!  
The head turns, turns, around,  
around,  
around you!  
This heart always sings one of these days Get married to me, baby!  
Let's go on, let's go, let's go,  
funiculi', funicula'!**

**The song was written by journalist Peppino Turco and was set by Luigi Denza in 1880. They drew the inspiration from the inauguration of the first funicular of Mt.Vesuvius. They composed this music in few hours, and in spite of that the song met with success. The famous melody was sang the first time in the public rooms of the Quisisana Hotel in Castellammare di Stabia. Turco and Denza presented it to the Piedigrotta's day in the same year. The success roused contributed to diffuse Neapolitan song in the world and to recall a lot of tourists.**

**The Church, of course, condemned the song on the grounds of "suggestiveness" -- especially the third stanza, which uses a lot double meaning Neapolitan slang. The first and second stanzas are not much better. The Quisisana Hotel in Casellammare di Stabia was, in those days, a notorious "get-away" that rented rooms by the hour. It is now apparently "respectable" and one of a number of Qisisana Hotels in the Campania. (As respectable as hotels in Italy get, that is.)**



# **The Victims of Vesuvius: A Window on Equinimity in the Roman World**

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**April 1, 1998**

*(complete text of Professor Craig's comments)*

**When Mt. Vesuvius erupted on the 24th of August in 79 CE, it buried the Roman cities on its flanks, a tragedy that preserved for modern students of antiquity an invaluable wealth of information about the Roman world. The most famous of these cities is of course Pompeii.. But the most exciting of these sites for our understanding of the Roman world, at least over the last two decades, has been the more modest community of Herculaneum. For here, in 1981, emerged a find that would provide information about the very appearance, stature, and physical dimensions of the people who lived there.**

**In the boathouses at what had been the beach at Herculaneum, in the years 1981-1987, more than 190 skeletons of Vesuvius' victims were found. Since the Romans regularly cremated their dead, this trove of skeletons, coming from both sexes, and spanning the spectrum of age and socio-economic class, may yet open a whole new chapter in classical studies. And in centaurian studies as well. For in boathouse D at Herculaneum was found a skeleton that any dispassionate physical anthropologist would recognize instantly as that of an adult male centaur.**

**I say this to you with a grim confidence that many of you are now hearing about this discovery for the first time. This is understandable. For the centaur of Herculaneum has been kept in the shadows, a victim of two powerful and irrational forces, professional jealousy and bureaucratic in-fighting. Today, I want to acquaint you with the evidence, briefly explain how these factors have worked to suppress it, and end with a positive conclusion about what this evidence can teach us about the centaurian presence in Roman culture.**

## **1. THE EVIDENCE**

**The eruption of 79 is well understood through Pliny's eyewitness account and the comparative data from Montserrat. There was no lava flow, but a series of "glowing avalanches" that descended the volcano's flanks. These avalanches consisted of a surge of hot heavier-than-air gasses and dust that killed those sheltering in the boathouses, and a later flow of pyroclastic material that buried the old beach under 17 meters of fill that hardened like rock, effectively sealing the area and making tampering impossible before the excavations of 1981. Just within the entrance to boathouse D\*\*, there were apparently the remains of a human together with a horse. There was a human skull but no equine skull. Nor were any remains found of the human's pelvic bones. Further, as the work**

proceeded to remove the hardened volcanic flow, it became clear that there were 4 femurs, all equine.

Although these finds have not yet been published, they have been recently interpreted in a series of conference papers by professor Joseph Wiener, Jr., just named Ronald McDonald Chair of the History of Business at the Warton Business School. Wiener argues on the basis of the equine remains and the arches of these structures that Herculaneum housed the first fast food restaurant. I find this thesis unconvincing, for reasons that I will be happy to describe in detail in the question and answer period. A more sober, and in fact inescapable conclusion is that more than a thousand years after the burials at Volos, another centaur had deposited himself in the archaeological record.

## 2. HOW THE STORY HAS BEEN SUPPRESSED

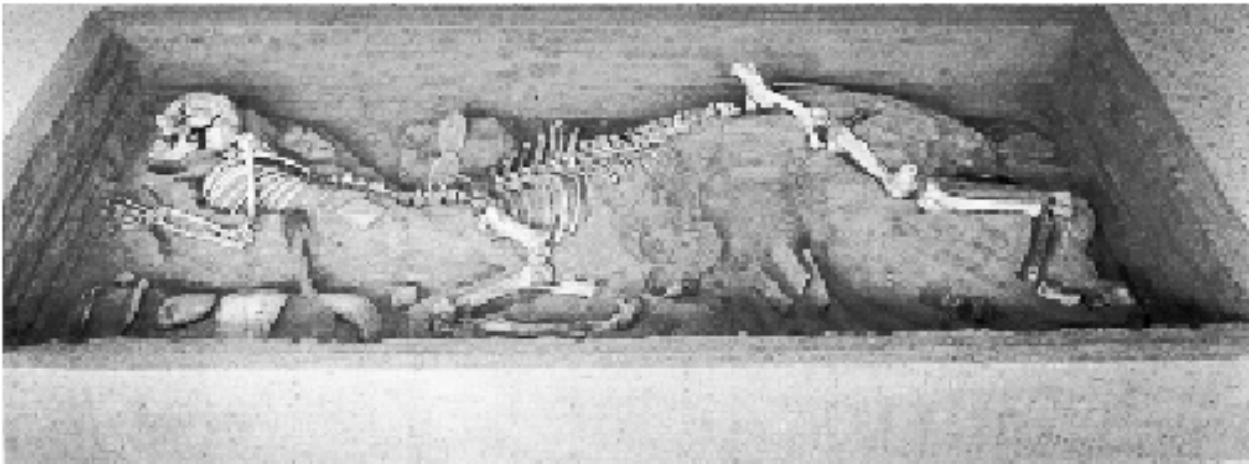
The noted American physical anthropologist Iris Trout was invited to work on the skeletal remains by Giovanone Lostronzo, then director of the Pompeii soprintendenza, which controls Herculaneum. Dr. Trout graciously provided me with information for this paper, including the slide from boathouse D. Her principal funding came from the National Geographic Society, so yielding a sumptuously illustrated cover story in *National Geographic* in May of 1984.\*\* This article contained no treatment of the finds in boathouse D, which Trout had only studied in a preliminary way and hope to treat in a later publication. But the National Geographic article touched off a firestorm of controversy in the *Soprintendenza*, largely because of artistic differences about the lighting in the photographs. Non-Italians were forbidden further access to the remains, which were to be published by Italian scholars.

This act of scholarly pettiness was followed by one of wanton administrative caprice. The Italian government's attempts at fiscal restraint to conform to the European Economic Community guidelines led to deep cuts in the *Soprintendenza*, as throughout the government. In the face of these deep cuts, there was devised a program known as *gli scavi eccellenti*, or Excavations of Excellence (more literally "Trenches of Excellence."). These trenches, including Pompeii, were protected from budget cuts. Incredibly, Herculaneum was not designated as a trench of excellence, and felt the full force of the budget ax; there was no money to finish the work.

## 3. CONCLUSION

So we have a centaur find, which I myself have seen in situ, but which has yet to be properly published and seriously considered in the academic community. The significance of this find both for our understanding of Roman and of centaurian culture is enormous. Centaurs are often stereotyped as hard-fighting, hard-drinking pan-sexual Yahoos, a kind of quadruped prototype for a chapter of Hells Angels, or a social club in Tuscaloosa. Thus on the Parthenon\*\*, the metopes of the Doric frieze on the south face depict a battle of humans and Centaurs as a metaphor for the triumph of Athenian culture over savagery.

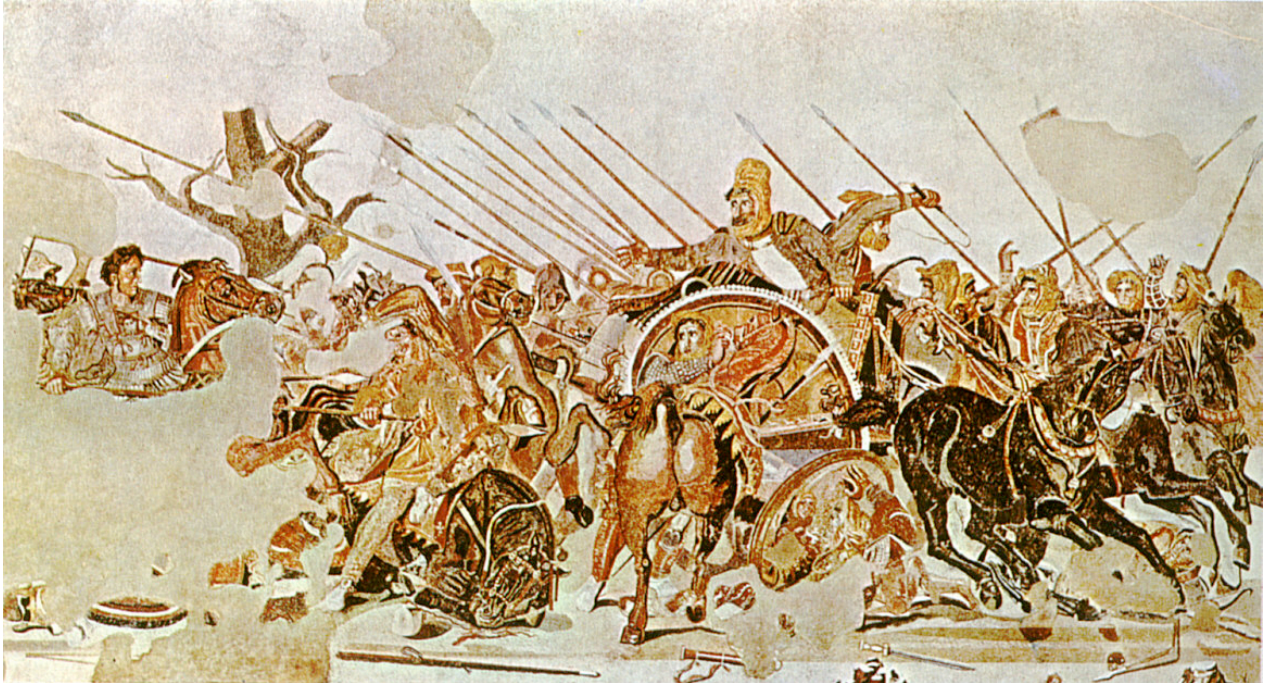
The one exception to this intense negative stereotype, which is applied to every centaurian group from ancient Volos to later Roman Tunisia, is Cheiron, the tutor of Achilles\*\*. This centaur is gentle, bookish, a kind of quadruped prototype for a professor in the humanities. This Cheiron type, which is taken as the exception, finds its most famous artistic representation in a Roman Wall Painting now in the *Museo Nazionale di Napoli*. It is too seldom remarked that that painting was torn by the Bourbon excavators from the wall of the Basilica, the most prominent public building, in Herculaneum. So public a celebration of the centaur's educational role, found in a small town that has now provided us with our earliest centaurian skeleton of the classical period, is extremely suggestive. Before the centaur of Herculaneum came to light, one might have thought this painting a simple treatment of a mythological theme. Now, having established the centaurian presence in the town, we may more naturally see it as a public endorsement of the public role of the centaurs with whom the artists and their patrons walked the streets of Herculaneum. While the wild stereotype of the centaur would do for racy mythology texts and off-color mosaics, the centaur on the street whom one might meet in a small Italian town of the first century CE was a much less exotic, and a much more productive and respected member of the Roman community.



*More on centaur science is on the internet at*  
<http://notes.utk.edu/bio/unistudy.nsf/0/4587dc2a1910ed1a8525659e007e7378>

Unit 3

# ***The Alexander Mosaic, House of the Faun, Pompeii***



***Mosaic from the Museo Nazionale, Naples, Italy. Dated from the late 2nd century. B.C., copy of a painting dated to c. 300 B.C.***

***Traditionally this scene represents the turning point at Issus when Darius fled the battle; but Philoxenus, the artist from whose painting the mosaic was copied, may have incorporated elements from other battles. Alexander's personal moment of peril seems borrowed from the Granicus, and the confrontation also has echoes of Gaugamela.***

**The Mosaic was found in the fall of 1831 and moved to the National Archeological Museum in Naples in 1843. The part that is preserved is 19 by 10.3 feet.**

**This mosaic depicts a battle between Alexander the Great and the Persian king Darius, probably the Battle of the Issus River in November of 333 B.C. It is in opus vermiculatum, with over one and a half million tesserae, none larger than 4 mm., in four colors: white, yellow, red, and black. The minuteness of the tesserae enables incredibly fine detail and painterly effects, including remarkable portraits of Alexander and Darius.**

**The border of this huge mosaic consists of large stones in a dentate pattern. In the corners are rosettes. Within the border along the bottom of the picture is a blank brown stripe, which some consider to be part of the picture, balancing the white expanse of sky at the top, while others argue that it is simply part of the frame.**

**The composition of the mosaic is dominated by the two protagonists: On the left, Alexander, with his head uncovered, rushes forward on his horse Bucephalus. He holds a spear with which he has skewered a Persian soldier, who has rushed to the defence of Darius. With Alexander appear his helmeted Macedonian soldiers, although little remains of them due to damage of the left side of the mosaic. On the right Darius, wearing a Persian cap, stretches out his hand to his wounded defender, while his charioteer whips the horses to flee toward the right. Around him are his Persian soldiers who mill in confusion in the background, their faces filled with fear and determination. One Persian, however, to the right of the dying defender of Darius, is intent upon Alexander, and holds his sword in his hand, ready to attack.**

**There are many details which emphasize the terror and confusion of the battle. The horse of the Persian defender of Darius collapses beneath him while he writhes in agony on Alexander's spear. Below Darius in his chariot, a Persian soldier, staring in horror at this scene, attempts to hold a rearing horse. The hindquarters of this horse project into the middle ground of the picture, giving it a sense of depth. To the right, a soldier is being crushed under the wheels of Darius' chariot. His face is reflected in the shield which he holds. Further to the right appear the terrified horses of the chariot team, trampling upon another unfortunate Persian.**

**The composition of the mosaic is dominated by diagonals. The center is dominated by the intersecting diagonals of the Persian speared by Alexander and the Persian restraining the rearing horse. Two other sets of intersecting diagonals are provided by the figures of Darius and his charioteer and by Alexander and the wounded Persian. The lances in the background of the picture also carry on the diagonal motif.**

**The setting of the battle is very stylized. In the background appears a tree with bare twisted limbs whose diagonals continue the unifying compositional motif of the mosaic. The tree also serves as a formal vertical counterweight to the Persian king and his charioteer, who rise above the battle fray. In the foreground are discarded weapons and rocks, which serve to define the space between the viewer and the battle scene.**

**The Alexander mosaic is thought to be based on a painting which Philoxenus of Eretria created for King Cassander of Macedonia. The painting is described by Pliny the Elder as representing "the battle of Alexander with Darius." Certain inconsistencies in the mosaic point to its derivation from another source. In the center of the composition appears a helmeted head to the right of the rearing horse. Two lance shafts come from the left and abruptly stop behind this head. To the right of the same head appears a head of a horse and beneath this are the hindquarters of another horse, neither of which is logically completed. Among the four horses of Darius' chariot there are parts of a white horse which do not fit together anatomically. Above these horses is a Persian soldier who appears to have two right hands, one on his head and the other raised in the air. These details provide evidence that the mosaicist misunderstood details of the original.**

**Nevertheless, the overall effect of the mosaic is masterful. The expert blending of the colors of the tesserae and the careful control of the overall composition create a scene which comes to life with all the horror and confusion of battle. The Alexander mosaic is a truly great work, unmatched in the history of Roman art.**

**(The mosaic is in the Naples National Archeological Museum. A replica has been installed in the House of the Faun in Pompeii. SEE FOLLOWING.)**



From Archeology Magazine Volume 59 Number 1, January/February 2006:  
<http://www.archaeology.org/0601/abstracts/mosaic.html>

## Alexander, Piece by Piece

By Marco Merola



***A panel with the face of one of the horses, some of the most complicated and time-consuming parts of the Alexander mosaic to re-create (Photo - - Pasquale Sorrentino)***

*In 2003, a team of artists from the International Center for the Study and Teaching of Mosaic (CISIM) in Ravenna, Italy, made an ambitious proposal to the archaeological superintendent of Pompeii: create an exact copy of the Alexander Mosaic*

*and install it in its original home. More than two years, 16,000 hours of work, and \$216,000 later, the most famous mosaic to survive from the ancient Roman world once again adorns Pompeii's House of the Faun.*

**One of the iconic images of the great Macedonian leader, the mosaic depicts a confrontation between Alexander and the Persian king Darius in the fourth century B.C. Since 1843, the mosaic has hung on the wall of the National Archaeological Museum in Naples, safe from the feet of Pompeii's two million plus yearly visitors, as well as from the rain and sun that have**

**damaged the whole site. So why bring Alexander back to Pompeii? The House of the Faun was once Pompeii's biggest and most impressive urban villa, filled with simple but elegant decorations designed to demonstrate the vast wealth of the house's owners. But today, although the sheer size of the house is still clear, the brightly colored paintings and mosaics, the gleaming marble and bronze statues, the fountains, and the hustle and bustle of a palatial villa are gone. Superintendent Pietro Giovanni Guzzo wants to change that. "I want visitors to have the impression that they are entering the same luxurious house in which the ancient Pompeian owners lived before it was destroyed by the eruption of Mount Vesuvius in A.D. 79."**

## Lararium



### The Lararium of Pompeian Homes



The lararium was often located in the atrium of the Pompeian home (Grant 114).

"The lararium, the shrine of the household gods, takes its name from the lares to whose vigilance was entrusted the protection of the household. They received regular offerings and were specially celebrated each month... usually with a wreath and portion of meal, but on important occasions with the sacrifice of a lamb" (Desceudres 90)

"The ceremonies in honour of the lar familiaris were conducted by the head of family (the paterfamilias), and were in essence a smaller-scale version of the public sacrifices

and prayers made to the great gods" (Desceudres 90).

"They are visually represented in pairs as youths in a dance step with their country-style short-sleeved tunics swishing out around them, a rhyton (a drinking horn in the shape of an animals head) held high in one hand and a dish (patra) extended in the other" (Desceudres 90).

"There are three main types of lararia: the simplest is merely a niche in the wall to provide a resting place for statuettes and figurines; the background is sometimes painted. In richer houses the niche is replaced by a aedicula, a three-dimensional miniature temple set on a podium, its sides lined with marble plaques or covered with painted stucco, imitating marble... The third type of lararium was painted on the wall to give the illusion of an aedicula, and the figures of the domestic gods were also painted" (Desceudres 91-92)

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A Lar was usually depicted as youth in a short tunic, often holding an uplifted drinking horn (*rhyton*). From the time of Cicero, Lares generally appeared in pairs, as in the painting above in which they flank the central figure who probably represents the Genius, or protecting spirit of the shop's owner. The two figures

at each end are deities appropriate for a drink shop - Mercury, the god of commerce, and Bacchus, the god of wine.

Serpents, like those beneath the figures, frequently figure into *lararia*, although their significance and symbolic associations are still debated.

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## ***Naples museum exposes public to ancient erotica***

<http://archives.cnn.com/2000/STYLE/arts/08/01/erotic.art/>



***Archaeologists say erotic art was commonplace during ancient Roman times -- in bedrooms, gardens and dining rooms***

August 1, 2000

From Gayle Young, CNN Correspondent

**NAPLES, Italy (CNN)** -- It was hidden in storerooms for years, deemed far too risqué for public display. Now a collection of ancient erotic art is out in the open at Naples' National Museum of Archaeology -- proof that times have changed and that people aren't as easily shocked.

**Even though some of the pieces are 2,000 years old, they are remarkably graphic. And that's not deterring museumgoers. "Thousands of people have come since we opened this exhibit in April," museum guide Arianna Vernillo said. "People are really interested."**

**The erotic art was discovered in the ancient Roman city of Pompeii, which was entombed by volcanic ash when Mount Vesuvius erupted in 79 A.D. and was excavated in the 1700s. Much of the collection was assembled by a Catholic cardinal in the 18th century, but it was for his private viewing pleasure, not for public display. You might figure these works would have been for private perusal during ancient Roman times as well. You'd be wrong. Archaeologists say erotica was ubiquitous back then: in bedrooms, gardens and -- most popular of all -- the dining room.**

**A large erection, for example, was considered a sign of prosperity. The image decorated serving trays, made a conveniently sized lamp, even graced front doors. Popular frescoes, meanwhile, showed a pantheon of possible sexual positions. Historians say many of these works were meant to generate laughs, not lust. And they still get a rise out of people today.**



<http://news.bbc.co.uk/1/hi/entertainment/arts/1657457.stm>

Thursday, 15 November, 2001, 14:01 GMT

## **Erotic frescoes on display at Pompeii**



### ***Frescoes adorn many parts of the ancient city***

**A series of erotic frescoes buried under volcanic ash 2,000 years ago have been unveiled at the ancient Roman city of Pompeii.**

**The display of paintings and a restored public bath were inaugurated on Wednesday, and will open to the public in December.**

**The seven frescoes depict lively sexual activity involving numerous partners and perhaps the only female homosexual scene on display in Pompeii.**

**These scenes of explicit sex are expected to resurrect last year's debate over "scandalous" Roman art when curators unveiled a collection in Naples of ancient artifacts that outraged the Catholic Church.**

**The frescoes and the bath were buried along with the entire city of Pompeii by the eruption of Mount Vesuvius in 79 AD.**

**The famous city near Naples has been painstakingly uncovered over the last 200 years, giving a unique glimpse into Roman life.**

**The bath has been undergoing restoration since the 1950s when it was discovered.**

**Tourist brochures will refer to the bath as the Red Light Spa, although they say it was most likely not formally a house of prostitution.**

**"There is no element that would make one think the upper floor of the Subterranean Spa was a brothel.**

**Furthermore, the archaeologists who led the dig have excluded that idea," said Antonio Varon of the Pompeii archaeological heritage department.**

**'Corrupt morals'**

**Less than 100 steps from the entrance of the ancient town, the bath is expected to be a popular tourist destination.**

**In last year's controversial Naples exhibition, more than 300 artifacts that had been kept under lock and key for 200 years, unearthed from Pompeii, Herculaneum and other ancient Roman towns, outraged the Roman Catholic Church.**

**The highlight of the exhibition at the National Archeological Museum in Naples was a marble statue of the mythological figure of Pan - the god of shepherds and nature - cavorting sexually with a goat.**

**A local priest condemned it as a temptation that could "corrupt the morals of the chastest".**

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# **Erotic Art Of Pompei**

**The city of Pompeii, along with Herculaneum and many smaller places around the Bay of Naples, were Roman municipalities destroyed during an eruption of the volcano Mount Vesuvius in AD 79. The eruption was described by Pliny the Younger, whose uncle Pliny the Elder died after making several trips across the bay with a flotilla of pleasure craft and fishing boats to save some of those trapped in seaside towns.**

**Ancient Pompeii was full of erotic or pornographic frescoes, symbols, inscriptions, and even household items. The ancient Roman culture of the time was much more sexually permissive than most present-day cultures and apparently had no concept of obscenity or that such art should be hidden from minors.**

**When the serious excavation of Pompeii began in the 18th century, a clash of the cultures was the result. A fresco on a wall that showed the ancient god of sex and fertility, Priapus with his extremely enlarged penis, was covered with plaster and only rediscovered because of rainfall in 1998.**

In 1819, when king Francis I of Naples visited the exhibition at the National Museum with his wife and daughter, he was so embarrassed by the erotic artwork that he decided to have it locked away in a secret cabinet, accessible only to "people of mature age and respected morals." Re-opened, closed, re-opened again and then closed again for nearly 100 years, it was made briefly accessible again at the end of the 1960s (the time of the sexual revolution) and has finally been re-opened in the year 2000. Minors are not allowed entry to the once secret cabinet without a guardian or a written permission.

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## ***Ancient Graffiti on the walls of Pompeii***



***Political Graffito -- Pompeii***

### ***(Texts in Vulgar Latin)***

\* **Suspirium puellarum Celadus thraex.**

Celadus the Thracian makes the girls moan!

(C.I.L. IV, 4397; in the barracks of the gladiators)

\* **Puteolanis felicia, omnibus Nucerinis felicia et uncum Pompeianis Petecusanis.**

Happiness to the people of Pozzuoli! Happiness to all from Nuceria!

And the meathook for the Pompeians and those of Pithecusa!

\* **Luci Istacidi, at quem non ceno, barbarus ille mihi est.**

Someone at whose table I do not dine, Lucius Istacidius, is barbaric to me.

\* **Arphocras hic cum Drauca bene futuit denario.**

Here Harpocras has had a good denarius fuck with Drauca.

*(C.I.L. IV, 2193; in the brothel)*

\* **Lucius pinxit.**

Lucius painted this.

\* **Virgula Tertio suo: indecens es.**

Virgula to her Tertius: you are one horny lad!

\* **Lucrum gaudium.**

Profit is happiness!

\* **Miximus in lecto. Fateor, peccavimus, hospes. Si dices: Quare? Nulla fuit matella.**

We have pissed in our beds. Host, I admit that we shouldn't have done this. If you ask: Why? There was no chamberpot.

\* **Oppi, emboliari, fur, furuncule.**

Oppius, clown, thief, petty crook!

\* **Marci luni insula sum.**

I am the flat of Marcus Iunius.

\* **Cacator cave malum, aut si contempseris, habeas Iovem iratum.**

Watch it, you that shits in this place! May you have Jove's anger if you ignore this.

\* **Pituita me tenet.**

I've caught a cold.

\* **Myrtis bene felas.**

Myrtis, you do great blow jobs.

\* **Pecunia non olet.**

Money doesn't stink

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# ***Wall Paintings and Graffiti: Revealing the Subtleties of A Lost World***



← ***A decorated  
Pompeian Villa***

**Interest in Roman culture and Roman authors emerged with the flowering of the Renaissance in Europe. Rome has kept a hold on the imagination of Westerners for centuries and continues, as evidenced by the creation of this site, to fascinate. Although**

**Rome has been closely studied for so long, much of what has been focused on is that of the majestic. The modern conception of 'Rome' is linked to images of impressive marble facades, temples, forums and amphitheaters.**

**Rome was in fact a far more colorful place than it's stony ruins would suggest. The white marble which has become ingrained in the modern perception of Rome is a good representation of what posterity does to a culture: stripping it of color and subtleties and leaving the marble pillars. Pompeii enables us to see the intricacies of Roman culture that, to a large extent, would otherwise have been lost. In Pompeii often florid frescoes covered the walls and mosaics the floors of many of the buildings.**

**To modern viewer, these grand marble structures of the past symbolize a great imperialistic power that conquered most of the Mediterranean and created legendary men like Julius Caesar, Cicero and Pompey. Virgil is taught in both History and English classes in American high schools and Cicero, Pliny and various other Roman authors are some of the primary sources for the Roman period. Although Martial, Juvenal and Catullus addressed more common issues than other Ancient Roman authors, they were of wealthy backgrounds. The voices of the heart of Rome, the mob, were largely lost in the mists of time and are uniquely unveiled on the walls of Pompeii.**



Public art and graffiti give insights into subtleties like how the classes related, what people wore, what they ate and most especially who they slept with. Attitudes towards sexuality affect how a culture approaches gender, power and daily relations. Sexuality, for example, permeates our everyday life, on television, on the internet and in politics. For example homosexuality is the source of much discomfort and in recent elections multiple states banned gay marriage. There are websites dedicated to gay rights and sections of cities where homosexuals live and maintain their own culture. Another instance where sexual relations permeate everyday life, is in attitudes towards male virility. Modern medicines like Viagra are marketed with slogans like, 'get back to mischief' and men are praised for the number of women they can sleep with and for how long they last. Although these attitudes towards sexuality permeate daily life, there is still a level of discomfort with the act of sex and total nudity (sale of magazines with nudity is prohibited to minors). While sex and sexuality offend the modern sensibility Romans appeared to be far more comfortable with them, so much so that their public art includes many images of sexual acts and nude figures.

## Frescoes Mosaics and Public Art

Art was very important to Pompeians. They covered their walls and their floors with colorful designs and vivid images of everything from the extraordinary to the mundane. As Amery puts it in *The Lost World of Pompeii*, 'Pompeian artists also recorded simple everyday behavior, stylized it and related it artistically to Attic pottery designs and myths: girls combing their hair, emancipated slaves at the baths, surgery, saving lives, couples making love -- and everywhere there is food, drink and flowers.' (Amery 144) The wide use of artistic representation provides a wealth of information about aspects of Roman life that would otherwise be largely unknown or at least far less fleshed out by the writings that survive. This artwork

give insights into the intricacies of daily life and insight into the subtleties of sexuality.



### Insights into Daily Life

← *Terentius Nero and his wife*

Pompeii visually documents everyday activities in the Roman world. Looking at the mosaics that have survived, one can get a sense of what Pompeians valued.

Marriage



**'It was the baker Terentius Neo, and not Paquius Proculus as had been believed for a long time as a result of mistaking an electoral poster on the outer wall of the house with the name of the owner, which was subsequently found as graffiti inside, and who had himself portrayed with his wife in solemn attire and with the refined air of a couple of intellectuals. He is holding a papyrus scroll against his chin, while she has her stylus and diptych open, as if in the act of finishing off a poem. But these features conceal humble origins: the white toga and barbule are unable to hide the typically Samnite features of the man - high cheekbones, full lips, large dark eyes, and swarthy complexion. Furthermore, the woman's curly hair, earrings and expensive red cloak are unable to conceal her embarrassment at having to pose for such a long time surrounded by such unfamiliar objects.'**

### **Women and Jewelry**

**Not all images showed women who were naked or in sexual contexts. Some, like the two below, depict everyday women in everyday pursuits. The image on the left is often called 'Sappho' because of her demeanor of a poet with her *stylus* pressed against her mouth as she is lost in thought. Her hairstyle and jewelry are intricate and expensive.**



### **Food**

**Pompeii began as a fishing town and, as the mosaic below displays, continued to have a seafood diet. The 'Fruiti di Mare' or literally Fruit of the Sea mosaic includes the wide variety of local fish. So, did every Pompeian cook for themselves at night? Physical evidence and mosaics like the one indicate that there were vendors who sold various types of pre-prepared foods to customers.**



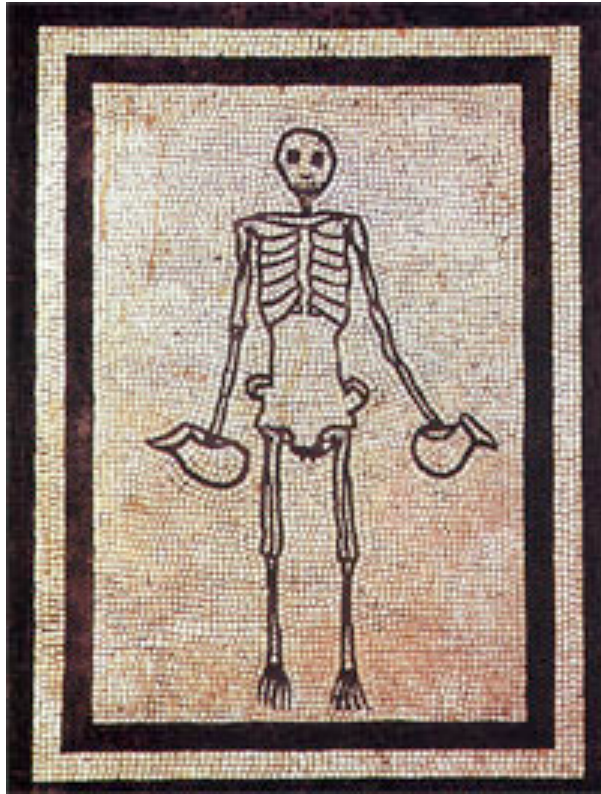
← *Bakery of Sotericus*

### Pets/Animals

The image is a nice and fun commonality between our culture and that of the Pompeians. While we put up placards on our fences saying 'Beware of Dog,' the Pompeians, or at least this particular Pompeian had it inlaid on his front porch. ('Cave Canem' translates Beware of Dog)







### Death

Pompeians alluded to death and mortality often in their artwork. There are many images of skeletons throughout the city. This morbidity starkly contrasts the lively abandon displayed in erotic motifs. It is almost as if the Pompeians were aware of the inevitability of their demise and were enjoying their last days in merriment and with good food.



**Warning!! The following few pages are just full of ancient Pompeian dirty pictures. If you don't want to view them, skip the next four pages.**

## **Insights into Sexuality**

Frescoes, mosaics and many other art forms were often filled with images of sexuality. The comfort with the human form and with the act of sex reveals a mindset greatly different than the modern frame of mind which considers too much nudity licentious and distasteful. According to Antonio Varone in *Eroticism in Pompeii* 'Sex was considered neither sinful or shameful and could be freely displayed or discussed.' (Varone 38) On this note it is important to remember that Roman's would not see some of these images as sexual or suggestive, but rather as humorous or religious.

As Varone poetically puts it, 'People of the Roman world did not need to mince words or to don mental veils to cover the nudity of their humanity. The Romans practiced, without ever recognizing them as such, what we consider perversions, and did so with insistence and apparent innocence. Even the notion of the obscene as we use the term today did not exist, on the same level as morbidity, in actions that present-day sensibility would consider decidedly dirty. Consequently, many of the 'situations' that we generally and immediately sense as strongly erotic were to the Romans utterly without that very particular emotional charge engendered by the blending of intense desire, seductive offer and a sense of the forbidden in the same situation.' (Varone 9)



Depictions of phalli can be found throughout Pompeii in a multitude of forms: on street corners, shop signs, bronze fittings, in paintings and even on everyday objects which had no erotic meaning. (Varone 15) Priapus, as seen in the image below, was a god who was over-endowed by definition. (Varone 15) His image was often put in gardens as a symbol of the fertility of nature to protect the gardens fruits and ward off thieves to whom he would inflict 'the homosexual punishment' when caught.(Varone 16) The phallus was seen as magical and was used to ward off the evil eye. Varone says of the Romans attitudes towards phalli, 'They were not imbued with any obscene meaning or licentiousness, since they could

be calmly displayed inside the home, in front of children, guests and conscientious mothers.' (Varone 17)







← *Priapus weighing his Penis (House of the Vettii)*

'Since the Romans often associated going to the baths with the idea of sex, for the physical and psychic benefits it brought and as a purely enjoyable interlude, we should certainly not be surprised, as we gather from some ancient authors (Martial, Ovid and Cicero) if the baths also became a place of enticement or, to put it bluntly, of prostitution.' (Varone 38) although the baths were associated with sex, the risqué scenes displayed below were probably viewed as ironic cartoons, more likely to provoke laughter than lust.



**Sex and sexual artwork was not associated merely with secular life. Religion was also depicted with sensual and sexual imagery**



*Villa Venus Marinus*



**Satyr and A Nymph →**  
*(from the cubiculum of the House of the Faun)*

← *House of the Dionysic Mysteries*





**Sex was not only on their walls but on their mirrors, cups, perfume bottles and various other objects of daily life.**

**This chalice is an example of one of the various other types of mediums which captured sexual acts: on one side a man is having sex with another man and on the other side with a boy or girl (it is hard to tell which sex the partner is).**



# Graffiti

The exceptional nature of the destruction of Pompeii facilitated the preservation of graffiti that gives a unique insight into the attitudes, views and mentalities of the common man. Graffiti was scrawled on street corners, carved in stone and plastered on walls; there was not a significant area or edifice in the city without graffiti. These wall inscriptions are written in a spontaneous popular style that differs from the typical Ciceronian Latin that we are taught at school. (Varone 9) The spontaneity of this graffiti gives the onlooker a peek into the life of an average man or woman over a thousand years ago and confides his or her desires, interests, sex life and various aspects of his/her daily life. Having the ability to see the words of a common individual who would otherwise be totally forgotten is one of the appeals of Pompeii.

## Insights into daily life

The graffiti of Pompeii covers a wide variety of subjects about daily life such as politics, food, health, friendship and many others. I have chosen a few examples of graffiti that are particularly insightful. Most other literary evidence that remains of Rome are the works of the great others who spent their lives in Rome hobnobbing with aristocrats and emperors. Pompeii gives a peek into a suburban city on the outskirts of Rome and how its middle class occupants felt about the world, the empire they served.



### Politics

There is a fair amount of evidence that lays out a clear picture of what politics was like in Rome and on the highest level in the provinces, but how did politics work within Italian cities? Political propaganda and placards can be found all over Pompeii's forum and over 3,000 have been recorded, one half of which were referring to the last election. (Amery 58)

← *Fragment of a Roman wall painting containing an electoral inscription from the officina of Verecundus. Depicts Mercury with caduceus and petasus emerging from a little Etruscan-Italic temple. He holds a purse of money in his right hand. Covering the wall are several inscriptions, including one which reads: "Holconium Priscum / Ilvir(um) l(ure) d(icundo) d(dignum) r(ei) p(ublicae) o(ro) v(os) f(aciatis)" or "I ask you to elect Holconius Priscus as duovir. He is worthy of holding office." Note that the letters of the inscription are well formed and "professional" -- this was clearly not just the scrawl of a passing political partisan.*

*the scrawl of a passing political partisan.*



A translated example of a typical campaign slogan can be seen below and beneath it a political inscription that gives insights into women's role in politics. According to the latter inscription the politician's grand mother helped with his campaign. How she helped is unclear, but this does give a sense of the activities of the common woman.

*'Vesonius Primus urges the election of Gnaeus Henus as aedile, a man worthy of public office.'* (Amery 58)

*'Vote for Lucius Popidius Salanus; his grand mother worked hard for his last election and is pleased with the results.'* (Amery 60)

### Irony

Many of the wall inscriptions indicate that Romans had a good sense of humor and enjoyed an ironic turn of phrase. One such graffiti seems to be the response of one man to the complaints of another. The first man states:

**'Chius, I hope your piles are chafed once more, That they may burn worse than they've burnt before.'** (Amery 60)

The other man gives the cleverly acerbic response:

*'I wonder, wall, that you do not smash, who have to bear the weight of all this trash.'* (Amery 61)

### Rivalry

Pompeii had a rivalry with its neighbor Nuceria that was so violent it reached Rome in 59 AD when a riot broke out in which thousands were injured. The riot was so severe that it was mentioned by Tacitus, who says that the emperor Nero ordered an investigation of the riots. The conclusion of the investigation was that Pompeii should be banned from holding gatherings of the sort for 10 years. Graffiti supports the account of Tacitus. An example of such graffiti is seen below.

*'Happiness to the people of Pozzuli! Prosperity to all from Nuceria! The meat hook for the Pompeians and those of Pithecusa!'*(Amery 85)

### Food and Class Relations

The graffiti that survive allude to the common practice of lower classes to depend on the richer for a good meal.

*'O Lucius Istacidius, rude fellow that he is, who doesn't invite me to dinner.'* (Varone 42)



*'Health to whoever invites me to lunch.'* (Varone 42)

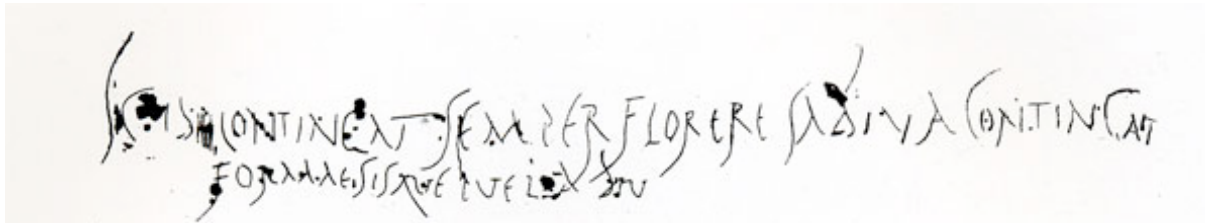
**And, of course, love – with imagery strikingly similar to our own**

Psice (Psyche – woman's name) in a heart →

**Beware!! Following pages have more of that Pompeian sex stuff.**

## Insights into sexuality

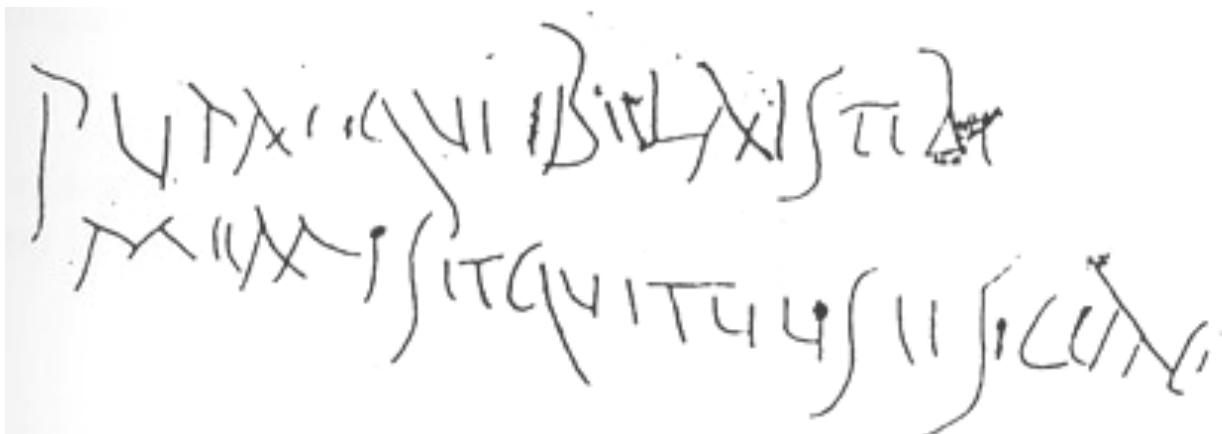
Note that the graffiti on this page are definitely not written by a "professional" hand -- just dashed off quickly in the least elegant form of Latin script. Afterward,



the scribner probably also dashed off.

**Sic {t}ib{i} contingat semper florere, Sabina; contingant formae sisque puella diu**

"So may you forever flower, Sabina; may you acquire beauty and keep your girlish figure for a long time"



**Pupa quae bela es, tibi me misit qui tuus est. Vale**

"Doll, you're beautiful! I've been sent to you by one who is yours, Bye!"





VIIAII RIA  
MAXIMO  
MINTA  
IXMVCCAVIT  
PIRVINDIMIA  
TOTA  
HTR II IN  
IVT RV INTRII  
AY: F: M: I  
S  
5

***Verenia Maximo mentla exmuccavit per vindemiam  
tota et relinque tutrumque ventre inane et os plenu***

**"Veneria has sucked the cock of Maximus  
throughout the vintage, leaving both her holes  
empty and only her mouth full." (Varone 78-9)**

# ***Private and Public***

Architecture in Pompeii

***Upper-middle-class housing***



**Pompeii Firehouse**





# Private Architecture

The houses and homes of Pompeii reveal a great deal about the people of the city, their activities and their interests. Houses run the full gamut from tiny little homes attached to stores and businesses to sprawling villas attached to large estates. Andrew Wallace-Hadrill, a scholar of Pompeii, has developed a system for classifying houses based on size, function, architectural features and decoration. According to Wallace-Hadrill, all houses at Pompeii fall roughly into four major categories.

**Type I** – Comprised of just one or two rooms, these structures were used as shops and workshops as well as living spaces. Some were left unoccupied at night, but many business owners lived in a few rooms located behind or above the public rooms. Some decoration occurs in houses of this type, though most are relatively plain.



**Type II** – These larger workshops and residences range in size from two to seven rooms on the ground floor. Most lack an regular plan, and only a few feature an atrium and an impluvium. Many of these houses, though modest in size, display lavish decoration including frescoed walls and mosaics.

**Type III** – Usually following a roughly symmetrical plan, Type III houses have an average of eight rooms, maximum thirteen. They are typically a combination of public and private spaces, with workshops or other shops built into the interior or the façade of the house. General features of houses of this type include atria and

colonnaded gardens. A Type III house would have been considered the average Pompeian residence.

**Type IV – The largest of the houses, Type IV houses were often designed for entertaining and featured quarters for large numbers of house slaves. Nearly all have at least one, and sometimes two atria. A select few have large ornamental gardens in the inner courtyards. The interiors were richly decorated, but as with even the poorest of houses, the exteriors remained relatively austere. Some believe that houses of this size were once several smaller residences that were remodeled to make one building complex, citing the multiple entrances as evidence.**



The houses of Pompeii offer an intimate look into the lives of the people who once lived in them. The homes were designed to be retreats from the busy lives that many Pompeians lived, set apart from the world and the public sphere.





# Public Architecture

For a relatively small, non-prominent town, Pompeii had a wealth of public architecture, from governmental buildings to temples to commercial buildings. The architecture of this public sphere followed the same categories as life to a large degree, political, religious, commercial and recreational. The town had grown and developed from a small agricultural community into a sizable town, passing through many phases of growth and architecture. The Pompeii that was destroyed by the eruption of AD 79 and discovered by archaeologists centuries later had been almost entirely rebuilt after the devastating earthquake of AD 62. Most major buildings were redesigned during this period, only to be buried again.



The *Forum* was the

geographical, political, and commercial center of the city. Political organizations, religious festivals, civic and legal administrative bodies, entertainment and markets were either located in the Forum or adjacent to it. On three sides two-storey Doric buildings marked the boundaries of the Forum, and on the fourth side stood the Temple of Jupiter. The Forum was a place for the citizens to gather and cast their votes in the city government. The offices of the government were located in the buildings located around the Forum itself.

The *Basilica* was the center of commercial transactions and administration of justice in Pompeii and occupied the southwest corner of the Forum. It



was also one of the oldest and most impressive structures in Pompeii. The two-storey building features fluted Ionic columns supporting the roof and 24 decorated painted panels interspersing the pilasters.

The *Comitium* served as the location for court proceedings and town meetings, complete with an open-air court room according to tradition. It was located in the southeast region of the Forum. Next to the Comitium was the Curia chamber, the meeting place of the magistrates. The building was lavishly decorated featuring marble floors. The *Tabularium*, the center of record-keeping at Pompeii, was housed next door.

The strong link between government and religion in the ancient world is evidenced by the large number of religious buildings located in and near the Forum. Several temples found their homes in this region of the city. Multiple temples of the imperial cult could be found in the Forum, including the *Temple of Vespasian*, the *Temple of Fortuna Augusta* and several other small shrines.

*Temple of Apollo* was the greatest of the temples the traditional gods. Located prominently on the western side of the Forum, the parts of the temple date back to the 6th century BC. The temple was rebuilt several times and in its final stages greatly resembled the traditional Greek temple. The cult of Apollo was most important during the reign of Augustus. The building itself sits in the middle of a colonnaded courtyard and is guarded by a statue of Apollo himself.

The *Triangular Forum* was one of the oldest parts of the city. It included a Doric temple thought to have been dedicated to Heracles and Athena. Eventually the area was converted to a park in the time before AD 79.



Jupiter was king of the gods, and Jupiter's temple held the position of honor in the Forum occupying the north end. Also known as the *Capitolium*, *Temple of Jupiter* was remodeled into a grand and imposing structure with Vesuvius in the background adding to its majestic appearance. The Roman triad, Jupiter, Juno and Minerva,

were all worshipped in the temple. After suffering damage during the earthquake of 62, the temple was largely abandoned as rebuilding was postponed.





The Temple of Isis is a symbol of the growing popularity of mystery cults in the Roman Empire at the time of Pompeii's destruction. The temple was located in the Theatre District and hidden from view to maintain the mystery of its traditions. The building contained a subterranean reservoir to hold water of the Nile River.



The *Macellum* was the main market building in the Forum. Foodstuffs of every type could be found in this market, from meat and fish to wine to bread. The various stalls around

the open courtyard were each marked off for a particular good. Many other stores were located throughout the city selling grain, bread and other foods.





The *Eumachia* was the only building in Pompeii known to have been built under the patronage of a woman. Eumachia was the most prominent woman in the city

and dedicated her shrine to Augustan Concord and Piety.



The construction of the *Large Theatre* moved gladiatorial matches, spectacles and plays from the Forum. The theatre was later enlarged to seat 5,000 people.

**The original 3rd to 2nd century BC building was refined and redecorated in the 1st century BC.**





*The Odeon was a roofed structure adjoining the large theatre.*



**The Odeon was a smaller theatre, seating only 1,500. Largely paid for by two colonial\***

**philanthropists, the Odeon served as the first meeting place for the new colonial class. It was mostly used for lectures, poetry readings, concerts and dramas.**

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Not only was the *Amphitheatre* the largest construction in Pompeii, but it was also the greatest contribution of the colonial\* period. It is the oldest known surviving structure of its kind built solely for gladiatorial combat.\*\* The 35 rows of seating could hold some 20,000 people.



\* Colonial means Roman as opposed to pre-existing Pompeian population. Pompeii became a “colony” after Rome conquered the city.

\*\*There were previous temporary wooden amphitheatres in Rome, but this is the earliest known stone Amphitheatre, predating the Roman Flavian Amphitheatre (Colosseum) by at least 25 years.



Not exactly a building, the rectangular *Palaestra* was the athletic field located near the amphitheatre. The large enclosed area was lined with trees and even included a large swimming pool. The complex was decorated with dozens of statues of nude males. The activities of the Palaestra were often of a military nature and served as a place of preparation for the young soldiers of the city.



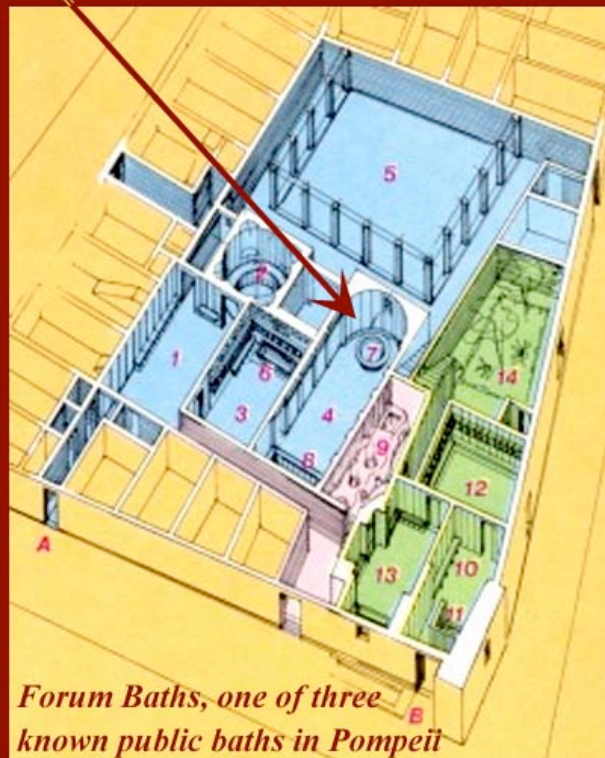




*Caldarium (Sauna)*

## POMPEII BATHS

- A men's entrance.*
- B women's entrance.*
- 1 men's apodyterium, or dressing room.*
- 2 frigidarium, or cold bath.*
- 3 tepidarium, or warm bath.*
- 4 calidarium, or hot bath.*
- 5 palaestra, or gymnasium.*
- 6 bronze brazier and seats.*
- 7 basin for ablutions.*
- 8 bathtub.*
- 9 furnaces for air and water at different temperatures, serving the facilities for both men and women.*
- 10 women's dressing room.*
- 11 tub for cold bath.*
- 12 tepidarium.*
- 13 calidarium.*
- 14 open-air courtyard.*

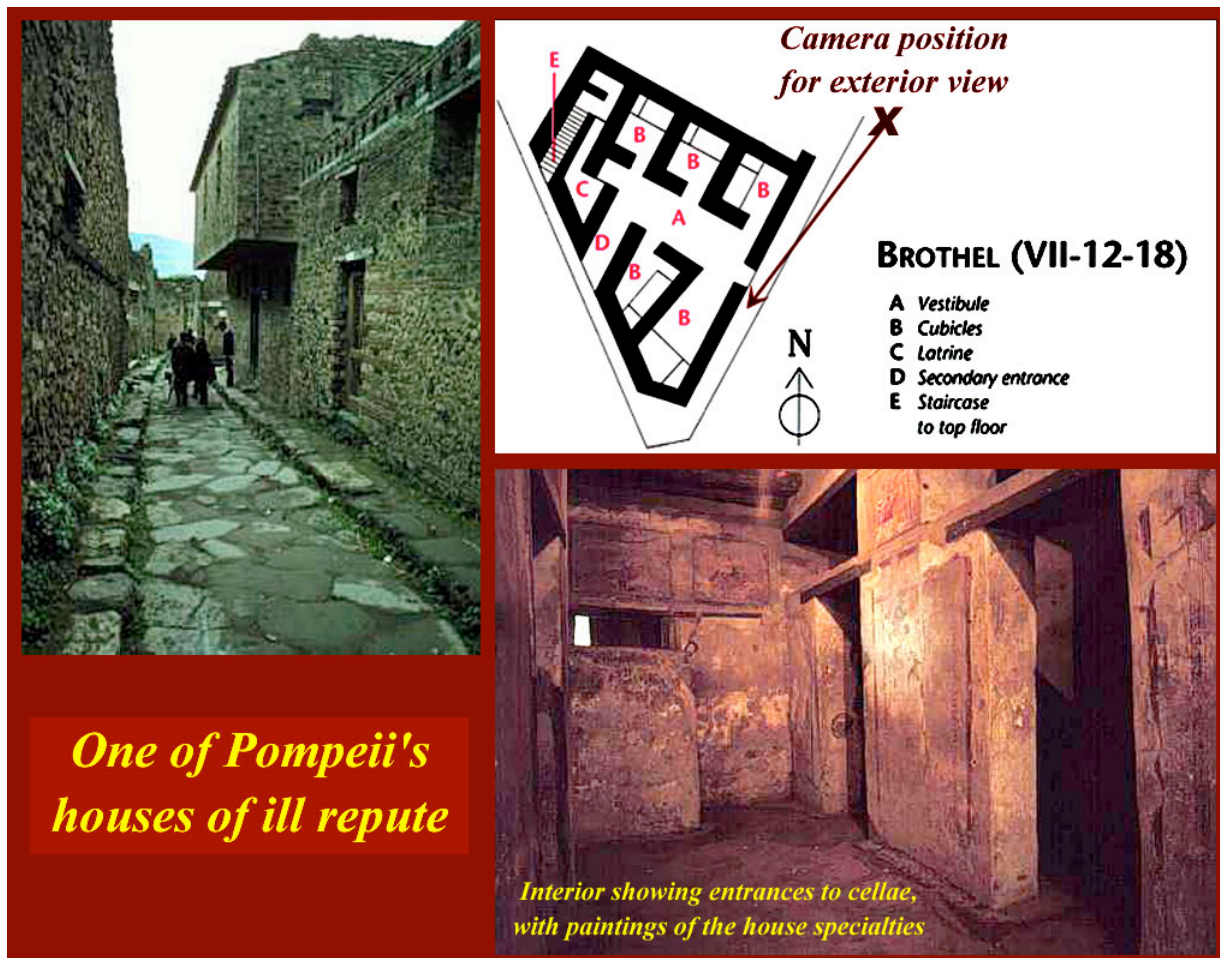


*Forum Baths, one of three known public baths in Pompeii*

**Bath Houses** were a common Roman tradition, and so far five have been excavated in Pompeii, the Stabian Baths, the Forum Baths, the Central Baths, the Amphitheatre Baths and the Suburban Baths. Bath houses were extremely popular and a rather large proportion of the business carried on in the city was done in the baths. In fact, they were so important that they were the first structures to be rebuilt after the earthquake in AD 62. The building was divided

according to sex with an area for the men and an entirely separate area for the women. Each bath area included three pools, the tepidarium, the caldarium and the frigidarium, ranging in temperature from warm to hot to cold. Some baths even featured sauna facilities.

*Brothels* were also quite popular in Pompeii, Some researchers say that 25 have been found to date. A brothel usually contained several small rooms compete with straw mattresses and mood-inspiring decor. This one is the one that is most likely to be a real whore house, while the others are probably appendages to bars, baths, etc.







## ***Domestic Painting – the Four Pompeiian Styles***



## Roman Painting – In Short

Four "Pompeian" styles of painted wall decoration, which appear throughout Italy and the Roman world, were identified by A. Mau (Pompeii, Its Life and Art, tr. F. W. Kelsey, London, 1899) in the late nineteenth century. They can be a useful guide to the development of Roman wall painting, provided that one is not too obsessive about them. There is substantial overlap among Mau's styles, and one frequently finds transitional works which combine elements of a preceding style with elements of its successor.

Classification by Style properly refers to the decorated wall as a whole. When considering paintings in isolation, as often in museums, the ability to assign a specific Style to a painting depends on three factors: the design of the painting, the date of the painting, and the type of decoration (especially important in distinguishing III/IV Style) which originally surrounded the painting. Examples in museums have unfortunately been removed from their original context. A notable exception is the II Style reconstructed cubiculum of P. Fannius Sinistor, from Boscoreale, now in the Metropolitan Museum of New York. Many original works, or their reproductions, can also be seen in situ at Pompeii and Herculaneum.

Style I ("incrustation") originated in the early 2d century BC. It is an imitation of marble veneering, in which the painted decoration resembles slabs of colored marble.

Style II ("architectonic") began in the early 1st century BC. This style opened up the wall by providing an illusion of windows and porticos which looked outward onto imaginary scenes, usually framed by painted columns and architraves. Painted architecture in this style tended towards the heavy and substantial, with multi-point perspective sometimes giving an Escher-like effect. Examples in Style II include the "Odyssey" paintings from a Roman house on the Esquiline (now in the Vatican), Livia's Villa at Prima Porta (paintings in the Museo Nazionale Romano), the Villa at Boscoreale, and the Villa of the Mysteries frieze at Pompeii.

Style III ("ornamental") dates from the Augustan period at the end of the first century BC. Abandoning Style II realistic architecture and open vistas, Style III closed up the walls to create a "picture gallery" effect. Typically a large central picture would be flanked by a smaller picture on each side. Architecture becomes attenuated and insubstantial, and elongated candelabrae often replace the earlier painted columns.

Style IV appears in Pompeii following the earthquake of 62 AD, and continues in the Roman world well into the second century AD. Style IV is heterogeneous, and incorporates elements from all of the earlier styles. Architecture becomes more realistic, and the wall tends to open up again, but not so far as in Style II. Developing from Style III, paintings are given an illusion of portability by being set into trompe-l'oeil aediculae, screens, and tapestries. Further developments include the imitation of stage backgrounds, and an "intricate" style consisting of arabesques on white ground, as in the Domus Aurea of Nero in Rome.



## ***Roman Domestic Painting – Four Pompeian Styles***

The history of Roman painting is essentially a history of wall paintings on plaster. Although ancient literary references inform us of Roman paintings on wood, ivory, and other materials, works that have survived are in the durable medium of fresco that was used to adorn the interiors of private homes in Roman cities and in the countryside. According to Pliny, it was Studius "who first instituted that most delightful technique of painting walls with representations of villas, porticos and landscape gardens, woods, groves, hills, pools, channels, rivers, and coastlines." Despite the lack of physical evidence, we can assume that many portable paintings depicted subjects similar to those found on the painted walls in Roman villas. It is also reasonable to suppose that Roman panel paintings, which included both original creations and adaptations of renowned Hellenistic works, were the prototypes for the myths depicted in fresco. Roman artists specializing in fresco most likely traveled with copybooks that reproduced popular paintings, as well as decorative patterns.

The majority of Roman frescoes were found in Campania, in the region around the Bay of Naples. It is here that Mount Vesuvius erupted on August 24, 79 A.D., burying much of the countryside, the cities of Pompeii and Herculaneum, and nearby private residences. As so often happens in archaeology, a disaster served to freeze a moment in the past, allowing excavators to delve into the life of this region's ancient inhabitants. Frescoes from the villas at Boscoreale and Boscotrecase provide an unparalleled record of the life of wealthy Romans during this period.

Art historians and archaeologists describe the development of Roman painting in four styles.



← ***First Style, House of Sallust, with***

***reconstruction (upper right)***



The “First style (ca. 200–60 B.C.) was largely an exploration of simulating marble of various colors and types on painted plaster. Artists of the Late Republican period (second to first century B.C.) drew upon examples of early Hellenistic (late fourth to third century B.C.) painting and architecture in order to simulate



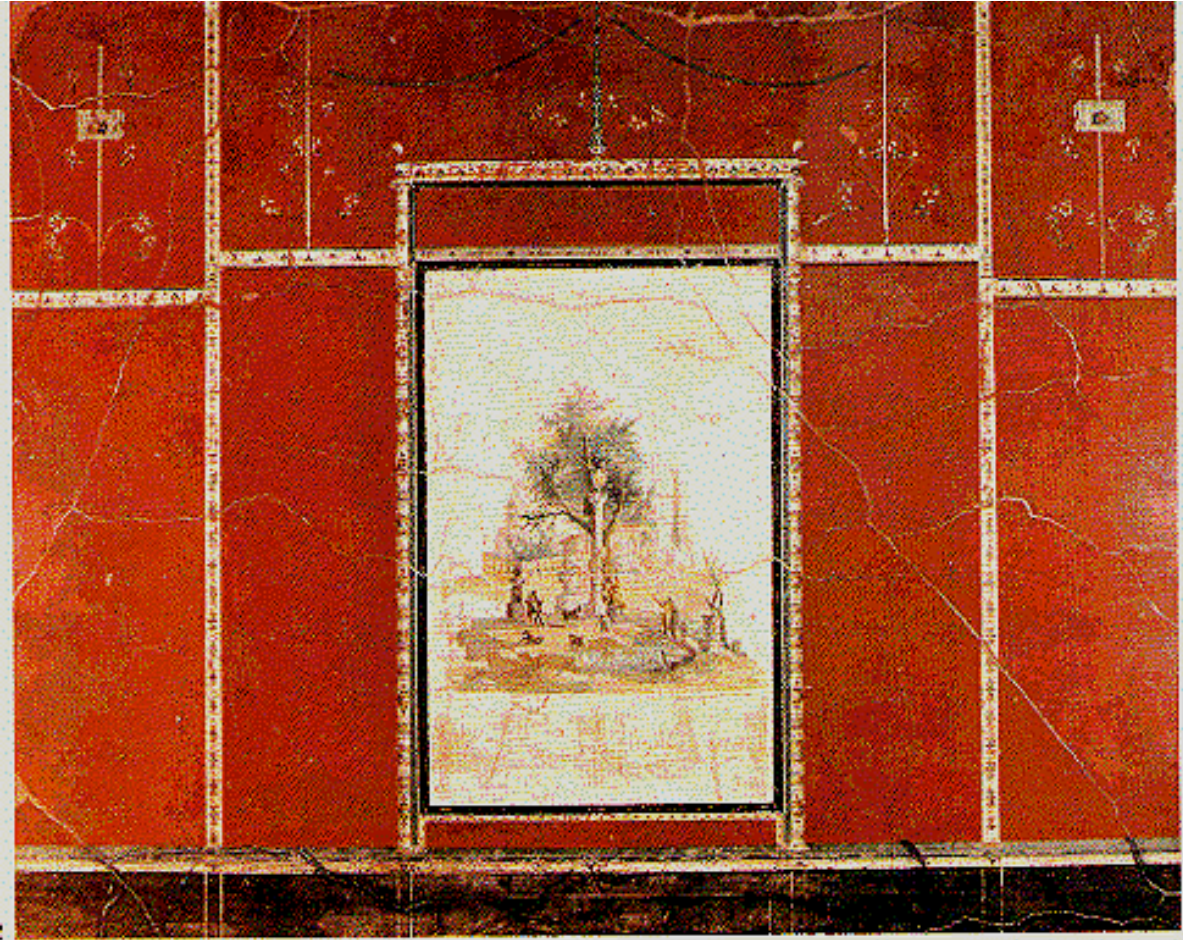
Wall Painting from bedroom at Boscoreale (Ramage78)

masonry. Typically, the wall was divided into three horizontal, painted zones crowned with a stucco cornice of dentils based upon the Doric architectural order. The decline of the First Style coincided with the Roman colonization of Pompeii in 80 B.C., which transformed what had essentially been an Italic town with Greek influences into a Roman city. Going beyond the simple representation of costlier building materials, artists began to borrow from the figural repertoire of Hellenistic wall painting, depicting gods, mortals, and heroes in various contexts.

The Second Style (03.14.13a-g) in Roman wall painting emerged in the early first century B.C., during which time fresco artists imitated architectural forms purely by pictorial means. In place of stucco architectural

details, they used flat plaster on which projection and recession were suggested entirely by shading and perspective; as the style progressed, forms grew more complex. The Villa P. Fannius Synistor at Boscoreale is an exceptional example of the fully mature Second Style (03.14.4). Throughout the villa there are visual ambiguities to tease the eye, painted masonry, pillars, and columns that cast shadows into the viewer's space, and more conventional trompe l'oeil devices. Objects of daily life are depicted in such a way as to seem real, with metal and glass vases on shelves, and tables appearing to project out from the wall. At Boscoreale, the walls dissolve into elaborate displays of illusionist architecture and realms of fantasy. Some of the frescoes provide copies of lost, but presumably once famous, Hellenistic paintings. In the villa's triclinium, painted columns frame a series of figurative paintings (03.14.5; 03.14.6; 03.14.7) presented as if seen through a window in the wall or as if lodged in the architecture. The intention of the owner was to create a kind of picture gallery, with the choice of subjects most likely based on the quality and renown of the original paintings.





***Third style – naturalistic “paintings” bordered by monochrome panels with “grotesque” decorations***

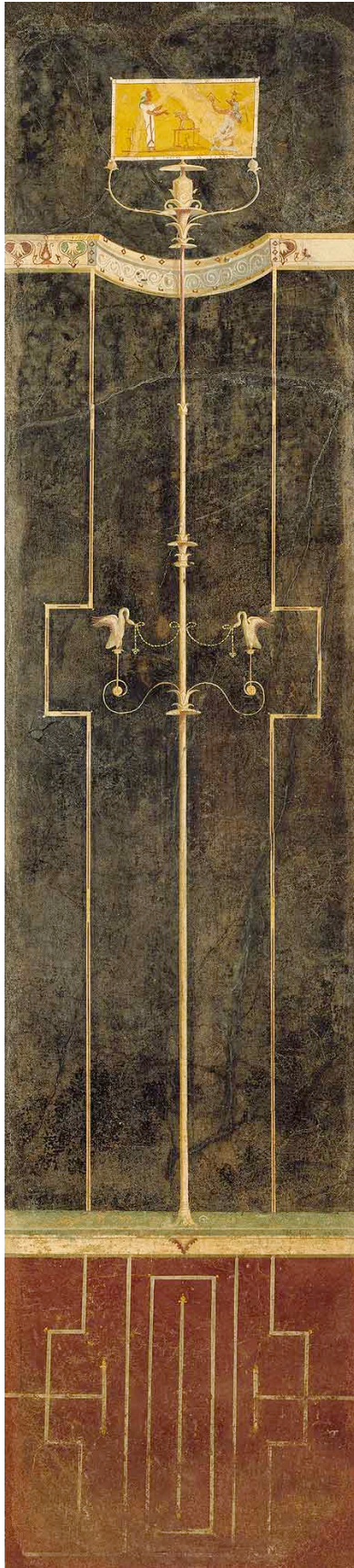
Under Emperor Augustus (r. 27 B.C.–14 A.D.) in the second half of the first century B.C., there was a new impulse to innovate, rather than re-create, in architecture, sculpture, and painting. The Third Style (ca. 20 B.C.– 20 A.D.), which coincided with Augustus' reign, rejected illusion in favor of surface ornamentation. Wall paintings from this period typically comprise a single monochrome background—such as red, black, or white—with elaborate architectural and vegetal details. Small figural and landscape scenes appear in the center of the wall as a part of, not the dominant element in, the overall decorative scheme. The finest known

achievements of the early Third Style are the frescoes from the Imperial villa at Boscotrecase where attenuated candelabra and columns support exquisitely rendered vignettes. The early Third Style, which was in effect the court style of Emperor Augustus and his friend Agrippa, eventually gave way to a rekindled interest in elaboration for its own sake (left).



Detail of the Red Room's North Wall  
(von Blackenhagen pl.25.2)





Characterized as a baroque reaction to the Third Style's mannerism, the Fourth Style in Roman wall painting (ca. 20–79) is generally less disciplined than its predecessor. It revives large-scale narrative painting and panoramic vistas, while retaining the architectural details of the Third Style. In the Julio-Claudian phase (ca. 20–54), a textilelike quality dominates and tendrils seem to connect all the elements on the wall. The colors warm up once again, and they are used to advantage in the depiction of scenes drawn from mythology.

*Fourth Style, early phase (below) and later phase (left)*



Some of the best evidence for the techniques of Roman wall painting is in Pliny's *Natural History* and in Vitruvius' manual *De Architectura*. Vitruvius describes the elaborate methods employed by wall painters, including the insertion of sheets of lead in the wall to prevent the capillary action of moisture from attacking the fresco, the preparation of as many as seven layers of plaster on the wall, and the use of marble powder in the top layers to produce a mirrorlike sheen on the surface. Preliminary drawings or light incisions on the prepared surface guided the artists in decorating the walls a fresco (on fresh plaster) with bold primary



colors. Softer, pastel colors were often added a secco (on dry plaster) in a subsequent phase. Vitruvius also informs us about the pigments used by the Roman artist. Black was drawn from the carbon created by burning brushwood or pine chips. Ocher was extracted from mines and served for yellow. Red was derived either from cinnabar, red ocher, or from heating white lead. Blue was made from mixing sand and copper, and then baking the mixture. The deepest shade of purple was by far the most precious color, as it was usually obtained from sea whelks.



*A Third and Fourth Style Composite in Pompeii – wider sections are third style and narrow sections are fourth style*



Unit 4

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by Lisetta Giacomelli 1, Annamaria Perrotta 2 , Roberto Scandone 3 , Claudio Scarpati 2

## ***The eruption of Vesuvius of 79 AD and its impact on human environment in Pompeii***

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**The eruption of Vesuvius of 79 AD caused extensive destructions all over the Campanian area, engulfing the cities of Pompei, Herculaneum, Oplonti and Stabiae. The eruption followed a long quiescence period and the inhabitants of the area were surprised by the volcanic events. The first part of the eruption was characterized by a widespread dispersal of pumices from a high eruptive column. The second part of the eruption, characterized by pyroclastic flows emplacement, caused the major damages with extensive life losses in most of the towns surrounding the volcano. In Pompei, the major casualties during the first phase resulted from roof collapses. During the second phase, people were killed either by physical trauma due to the kinetic energy of the flow or by suffocation because of the ash-rich atmosphere.**

**The sequence of events during the 79 AD eruption of Vesuvius**

**Vesuvius is one of the most studied volcanoes in the world, because of its long time interval with historic eruptions (2000 years), its easy accessibility, and the first well-documented historic explosive eruption: that of 79 AD. The eruption destroyed Pompeii, Herculaneum, Oplonti and Stabiae and caused the death of Pliny the Elder among many other people.**

**Before the eruption, earthquakes occurred for some time, but were disregarded by local inhabitants because of their familiarity with the phenomenon. As the younger Pliny testified “for several days before (the eruption) the earth had been shaken, but this fact did not cause fear because this was a feature commonly observed in Campania”. The effects of these earthquakes are still visible in**

several buildings in Pompeii, and Villa Regina, where hastened repair works were underway in the days immediately preceding the eruption.

The main phases of the eruption have been described by Pliny the Younger who observed the eruption from a distance of more than 25 km, basing also on contemporary testimonies and closer view accounts, especially for what regards the death of the uncle, Pliny the Elder, gone to the rescue of the inhabitants of the area.

The beginning of the eruption is uncertain: the two Plinys observed the cloud at the seventh hour of the day (1 PM). We must presume that the eruption began sometime earlier to allow the arrival, at about the same hour, of a messenger sent from the Vesuvian area.

The eruptive cloud was directly observed from Misenum at a distance of 21 km, so that they could fully appreciate its total extent and behavior. ("It resembled a pine [Mediterranean pine] more than any other tree. Like a very high tree, the cloud went high and expanded in different branches. I believe, because it was first driven by a sudden gust of air then, with its diminution or because of the weight, the cloud expanded laterally, sometimes white, sometimes dark and stained by the sustained sand and ash").

During the night of the first day of the eruption, and for most of the morning of the next day, the houses of Misenum were shaken by earthquakes that caused much panic.

In the morning of the second day of eruption, Pliny the Younger observed the development of pyroclastic flows descending down the flanks of Vesuvius and flowing on the sea. " From the other side, black and horrible clouds, broken by sinuous shapes of flaming winds, were opening with long tongues of fire ... After a little while descended onto the land, opened the sea, covered Capri and prevented the sight of Misenum ..."

The sequence of events described by the Younger Pliny fits well the geologic record of the eruption (Lirer et al., 1973; Sigurdsson et al., 1985).

We can summarize the temporal evolution of the eruption into major phases which are typical of most large scale explosive eruptions.

- 1 The first phase, after minor phreatic explosions, is characterized by the development of an high, sustained column where the erupted mixture of juvenile gases and pyroclasts, mixing turbulently with atmospheric air, rises convectively into the stratosphere reaching an estimated maximum height of 32 km.

- 2 The second phase is characterized by the collapse of the eruptive column with the emplacement of pyroclastic flows and surges which destroyed every settlement within a radius of 10–15 km from the volcano.

**3 Collapse of the magma chamber, ingression of water into the feeding system, magma water interaction and final phreato-magmatic activity.**

**4 Post eruption remobilization of ashes and pumice by rain water during the following years.**

The four phases are identified by their typical deposits (Figure 1).

- The first phase produced a fall deposits consisting of a lower part of well-sorted white pumice and an upper part of gray pumice dispersed to the southeast of the volcano and traced on land to a distance of more than 70 km (Lirer et al., 1973).
- The deposits of the second phase consist of surge deposits made of layers of thin, poorly-sorted ash with cross bedding, and dune structures alternated with pyroclastic flow deposits made by thick and massive layers partly indurated and poorly sorted (Sigurdsson et al., 1985).
- Silty sands beds with abundant accretionary lapilli form the deposit of the third phase. In proximal areas a debris flow deposit consisting of angular lava and carbonate blocks supported by an ash matrix with minor pumices is correlated with this phase (Sigurdsson et al., 1985, Sheridan et al., 1981).
- The deposits of the fourth phase are a succession of lahars made up of a conglomerate composed of coarse pebbles with a matrix composed of small pebbles and coarse sand (Lirer et al., 2001).

Carey and Sigurdsson (1987) estimated the height of the eruption column during the development of the Plinian phase basing on the isopleth distribution of maximum diameters of pumice and lithic fragments. They estimated that the eruption column rose from an height of 14 km to 26 km during the emission of white pumice and then to 32 km during the emission of grey pumice immediately before the deposition of pyroclastic flows. The estimates of the column heights permitted the evaluation of the corresponding magma discharge rates.

Scandone and Giacomelli (2001) used the estimates of Carey and Sigurdsson (1987) to evaluate the temporal evolution of the eruption fed by a 7–12 km deep magma chamber. The progressive removal of magma in the course of the eruption caused a slow boiling of magma within the chamber because of decompression. This in turn produced a faster and faster emission rate until the final collapse of the wall surrounding the reservoir. Scandone and Giacomelli (2001) evaluate the duration of the first phase at approximately 22 hours (several hours longer than previously estimated basing on average effusion rates). During this phase there was a steady increase in magma discharge rate. The second and most destructive phase with the massive emplacement of the major pyroclastic flows and surges lasted only about 5–6 hours.

# **State of the buildings and distribution of victims inside the city of Pompeii**

The city of Pompeii was destroyed and many of its inhabitants were killed during the 79 AD eruption. Several authors have reconstructed the succession of products emplaced during the eruption (e.g. Lirer et al., 1973; Sigurdsson et al., 1985; Carey and Sigurdsson, 1987) but the stratigraphic framework used here largely follows that of Luongo et al. (2002a, 2002b) which specifically studied the impact of this eruption on Pompeii. In the following paragraphs we summarise the damage suffered by population and buildings during the two main phases of the eruption and report the stratigraphic height at which were recovered human bodies and crumbled walls. The main sedimentological characteristics of the 79 AD deposit are reported in Figure 2. On the basis of these characteristics the deposit has been sub-divided in 8 units named A to H from base upwards; a soil at the top of the sequence (unit I) is also reported.

The state of the buildings all over the city is summarised in the following observations:

- a) the amount of destruction is not the same throughout the city some buildings were more affected than others;
- b) the northern (relatively proximal) and southern (relatively distal) sectors in the city were generally affected in the same way;
- c) the ground floor is partly intact in most of the buildings, whereas the upper floor is almost completely demolished;
- d) the E-W oriented walls are by far more damaged than those striking N-S;
- e) in many cases, the northern vent-facing part of the buildings was more damaged than the southern one;
- f) most of the destruction is stratigraphically related to unit E.

As shown in the Table 1, 394 corpses were found in the pumice fall deposit and 650 in the pyroclastic density currents (PDCs) deposit. So a total of 1044 victims were recovered inside 2/3 of the city of Pompeii (the excavated part). Other 100 victims are estimated on the basis of many groups of scattered bones. Finally, considering the regions partially excavated (I, III, IV, V, IX) an estimate of 464 corpses still buried is obtained. Furthermore, it is meaningful to document the amount of victims with respect to their location (e.g. inside or outside the buildings). Most of the corpses within the pumice fall deposit were found inside buildings (80% as shown in Table 1) whereas, of the 650 corpses recovered in the PDCs deposit 334 were found inside buildings and 316 outdoor (Table 1). Luongo et al. (2002b), on the basis of recent excavation, state that all human casts in the PDCs deposit lie over the well-recognisable lithic-rich unit D, enclosed within the



unit E (Figure 2 ). These corpses are mostly intact and only few corpses are partially or fully dismembered. In the still preserved outcrops of Pompeii and in the photographs of the Pompeii Archive most of the casts lay prone in the attempt to shelter their face; it is noteworthy that in some places (e.g. garden of fugitives, Regio I, Insula 21; Stabian house, Regio I Insula 22) human casts show the head and the bust supported by arms, with this raised part of the body at higher stratigraphic level within E1.

## The effects of the 79 AD eruption on Pompeii

The process of Pompeii's destruction and burial started with the accumulation of a thick pumice lapilli deposit (layers A and B in Figure 1) resulting from the column fallout. The rate of deposition in the city ranged from 15 cm per hour in open areas to 25/30 cm per hour in places accumulating additional pyroclasts rolling from the steeper roofs. Within six hours from the beginning of the eruption the roofs and part of the walls of the buildings had collapsed under the pumice load. By the morning of 25 August most structures were seriously damaged; the pumice fall deposit, generally 3 m thick, totally buried the lower part of the buildings. The percentage of vic-tims (38%) found in this deposit at Pompeii is anomalously high with respect to a mean of 4% of deaths caused by tephra fallout in the last four centuries during explosive eruptions (Blong, 1984; Tanguy et al., 1999). This high percentage of deaths is possibly due to the attempt of some people to take shelter into buildings where roofs and walls collapsed under the load of the pyroclastic material. The small percentage of people found dead outdoor within the pumice fall deposit was probably killed by the crumbling roof tiles or by the largest lithic fragments following ballistic paths.

The first PDC flowed through the city depositing the basal ash layer C and causing irrelevant damages. Based on the evidence that all of the human remains lie above this deposit, it can be deduced that people were not killed by the earlier PDC (units S4 and S5 of Sigurdsson et al., 1985). The inhabitants survived also to the successive fallout phase that emplaced the lithic-rich layer D and some were able to walk outdoor during the emplacement of the basal part of the unit E. In fact, we found the victims several centimetres above the base of this unit. Possibly, the parental pyroclastic current ran over the city with a low-temperature, dilute frontal part settling progressively few centimetres of ash. The rear part of the current had a non-uniform behaviour in terms of concentration, possibly due to the canalization of the basal part of the current along the longitudinal walls of the buildings. Inside these areas the current showed a greater destructive power, flattening most of the (especially transversal) walls, standing out of the pumice fallout deposit, in its north-south path. In the areas outside the channels the current had essentially a depositional behaviour engulfing the city and suffocating the inhabitants. These opposed behaviour of the PDC in very close areas testify to the different kinetic conditions undergone by the Pompeii inhabitants and hence the different physical integrity of their corpses. Observations on objects, cloths, frescoes and skeletons rule out the

possibility that burn injuries contributed to kill Pompeii inhabitants, as recently proposed for Herculaneum inhabitants (Capasso et al., 2000; Mastrolorenzo et al., 2001). Furthermore, the proposed non-uniform behaviour of PDCs, due to the interaction with the urban structures, justifies the described different state of destruction of the buildings throughout the city.

A final phreatomagmatic phase, punctuated by two minor lithic fall episodes, emplaced the upper part of the succession (F to H units). Field features, such as the presence of accretionary lapilli in the upper part of the ash and pumice deposit and the lack of high temperature evidences in the buildings, support the idea of low emplacement temperature for the pyroclastic currents during the final phase of the eruption.

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## *The eruption of Vesuvius*

A Plinian timetable of 24/25 August AD 79

At the time of the eruption, three significant individuals were staying at Misenum, across the Bay of Naples from Vesuvius. Pliny the Elder, writer on natural history and commander of the Roman fleet, was being visited by his sister and her son, later known as Pliny the Younger.

Although he was only 18 years old when the disaster struck, what he experienced then made a deep impression on Pliny the Younger. Many years later, when he was asked by the Roman historian Tacitus to provide an eye-witness description of the calamity for his *Historiae*, Pliny produced a vivid, hour-by-hour account that has provided valuable clues for present-day volcanologists. They have been able to marry these with the latest research to come up with a new scientific account of the deaths of the thousands who were living in the shadow of Vesuvius on that fateful day - including Pliny the Elder.

<u>Time</u>	<u>Pliny the Younger's account</u>
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1pm

'About one in the afternoon, my mother desired him [Pliny the Elder, the writer's uncle] to observe a cloud of very unusual size and appearance... [It resembled] a pine tree, for it shot up a great height in the form of a trunk, which extended itself at the top into several branches... I imagine, a momentary gust of air blew it aloft, and then failing, forsook it; thus causing the cloud to expand laterally as it dissolved, or possibly the downward pressure of its own weight produced this effect. It was at one moment white, at another dark and spotted, as if it had carried up earth or cinders.'

2-3pm

Pliny the Elder sails to get a better view of the disaster and to rescue a friend whose villa is at the foot of Vesuvius (Pliny the Younger decides to remain at Misenum, reading Livy's *History of Rome*). 'Hastening to the place from whence others were flying, he steered his direct course to the point of danger... And now cinders, which grew thicker and hotter the nearer he approached, fell into the ships, then pumice-stones too, with stones blackened, scorched and cracked by fire, then the sea ebbed suddenly under them, while the shore was blocked up by landslips from the mountains... He said to the captain... "Fortune befriends the brave: carry me to Pomponianus." Pomponianus was then at Stabiae, distant by half the width of the bay [of Naples]...'

6pm

Arriving at the house of his friend, Pliny the Elder goes to sleep while the downpour continues. On waking: 'They consulted together as to whether they should hold out in the house, or wander about in the open. For the house now tottered under repeated and violent concussions, and seemed to rock to and fro as if torn from its foundations. In the open air, on the other hand, they dreaded the falling pumice-stones, light and porous though they were; yet this, by comparison, seemed the lesser danger of the two; a conclusion which my uncle arrived at by balancing reasons, and the others by balancing fears. They tied pillows upon their heads with napkins; and this was their whole defense against the showers that fell round them...'

6pm-12am

'It was now day everywhere else, but there a deeper darkness prevailed than in the most obscure night... They thought proper to go down upon the shore to observe from close at hand if they could possibly put out to sea, but they found the waves still ran extremely high and contrary. There my uncle, having thrown himself down upon a disused sail, repeatedly called for, and drank, a draught of cold water.'

1am

Pliny the Younger and his mother have stayed in Misenum, across the Bay of Naples. 'That night they [the earthquakes] became so violent that one might think that the world was not being merely shaken but turned topsy-turvy. My mother flew to my chamber... We sat down in the forecourt of the house...'

6.00am

'It was now six o'clock in the morning, the light still ambiguous and faint. The buildings around us [Pliny the Younger and his mother] already tottered, and though we stood upon open ground... there was certain and formidable danger from their collapsing. It was not till then we resolved to quit the town...'

**8.30am**

**Pliny the Elder remains on the shore with his companions. 'Flames, and a strong smell of sulfur, which was the forerunner of them, dispersed the rest of the company to flight; him [Pliny] they only aroused. He raised himself up with the assistance of two of his slaves, but instantly fell; some unusually gross vapor, as I conjecture, having obstructed his breathing and blocked his windpipe... When day dawned again [three days later]... his body was found entire and uninjured, and still fully clothed as in life; its posture was that of a sleeping, rather than a dead man.' Meanwhile, back at Misenum: '... A black and dreadful cloud bursting out in gusts of igneous serpentine vapor now and again yawned open to reveal long fantastic flames, resembling flashes of lightning but much larger... Soon afterwards the cloud... began to descend upon the earth, and cover the sea... Ashes now fall upon us, though as yet in no great quantity. I looked behind me; gross darkness pressed upon our rear, and came rolling over the land after us like a torrent... We had scarce sat down, when darkness overspread us, not like that of a moonless or cloudy night, but of a room when it is shut up, and the lamp put out. You could hear the shrieks of women, the crying of children, and the shouts of men...'**

**1pm**

**'At last this dreadful darkness was attenuated by degrees to a kind of cloud or smoke, and passed away; presently the real day returned, and even the sun appeared, though lurid as when an eclipse is in progress. Every object that presented itself to our yet affrighted gaze was changed, covered over with a drift of ashes, as with snow...'**



From: <http://metamedia.stanford.edu/traumwerk/index.php/Pompeii>

# Pompeii



Pompeii was a wealthy Roman city that had been founded by Oscans as a fishing town centuries before the city's destruction and probably around the time of Rome's s first settlement. The city had a rich history and at the time of the eruption was a middle class commercial city. Although the city had suffered a major earthquake in the twenty years preceding the eruption, the city had already rebuilt or repaired many of its public buildings like the baths and the amphitheater. Pompeii was rediscovered in the 17th century and 'Excavations' began in the early 18th century, continuing to this day. As an archaeological site Pompeii provides a wealth of information about Roman culture and the ancient World. The unique nature its demise fascinates the

of imagination and the city has been used by authors to evoke the tragic and mysterious. When the city was buried it was preserved in that snapshot in time and therefore reveals things about everyday life that otherwise would have been lost and forgotten. The site reveals how and to what degree religions were practiced, what foods were eaten and other aspects of ordinary life. The public visuals of art and graffiti also reveal subtleties about Roman culture not always seen in the typical grand monuments that are excavated.



## ***Brief History***

As Paul Zanker says in his book, *Pompeii: Public and Private Life*,

***"Unlike most of the excavated Roman sites in North Africa and Asia Minor, Pompeii is particularly interesting because it spans the two***

***periods that probably saw the most profound and sweeping changes in urban structures: the last years of the Republic, when cities were growing more uniform, and the early years of the Empire, when the establishment of the monarchy embedded new values in the townscape." (4-5)***

This account of the history of Pompeii will focus on three time periods: the period of time before the Social War, when Pompeian citizens did not yet have Roman citizenship, the period of time directly following the War, when Pompeii was a Roman colony, and the Age of Augustus, when the city underwent significant religious and cultural renewal. Focusing on the Forum and the way that it changed in these three time periods, one can see how Pompeii transformed as a city in response to the different political atmospheres that it experienced.

Archaeologists have determined the approximate date at which changes to the Forum occurred based on the type of stone that was used in the construction of various parts of the Forum. During the earliest period, the primary building materials were limestone and tufa. During the colonial era, brick and cement-faced brick were used extensively, while in the early years of the empire, a white limestone that gave the illusion of marble was predominant (Grant 67).

## **Pre-Colonial Era**

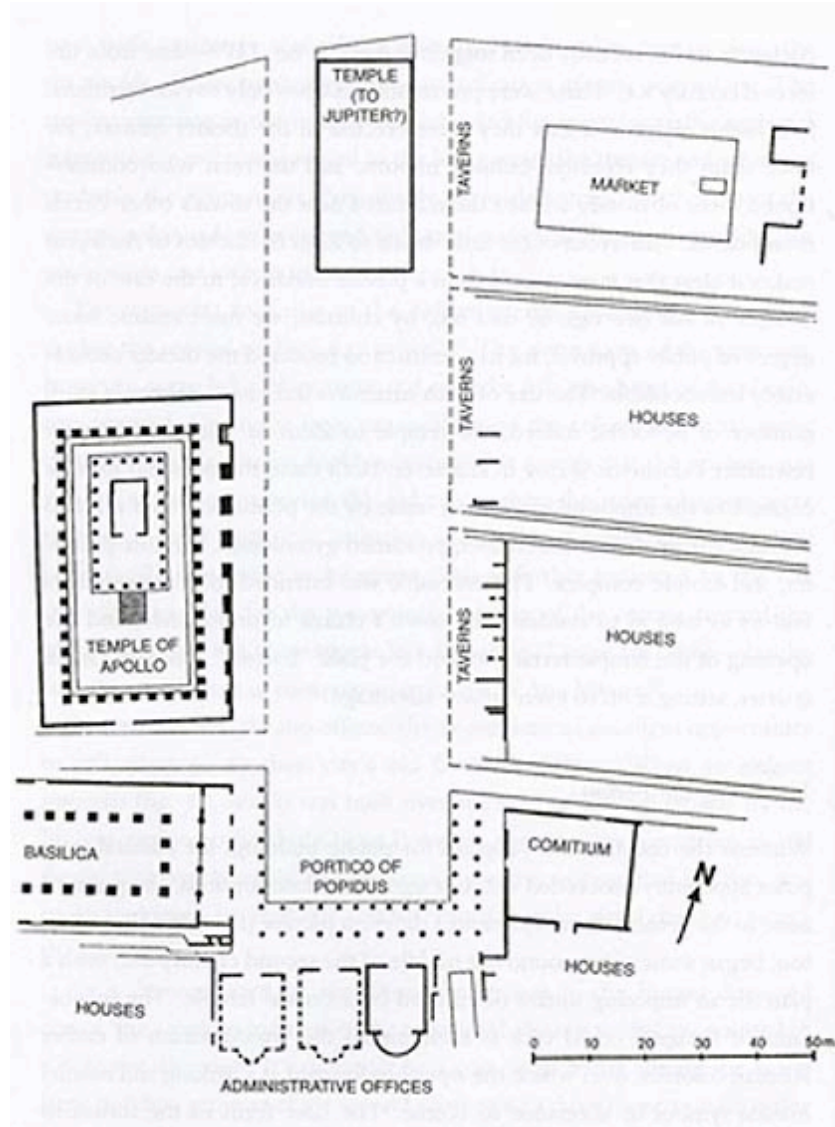
The precise year that Pompeii was originally settled is unknown. However, what is known is that the first inhabitants of the city, a native Italian group called the Oscans, established Pompeii as a small fishing and agricultural village sometime around the eighth century B.C. (Grant 15). Though the inhabitants of Pompeii continued to speak the Oscan language until the Social War of 90 B.C., few traces remain of this group of people, and so very little is known about them and their lives in Pompeii (Brion 13).

By the seventh century B.C., the Greeks had spread into the Bay of Naples. By 650 B.C., they had established the city of Naples, originally called Neapolis or "New City", as the center of trade in the area (Time-Life Books 12). Presumably because of its convenient location, at the mouth of the Sarno river and on a volcanic ridge that gave the city a defensive advantage against attack, the Greeks established a trading post at Pompeii. The Greeks established the Triangular Forum at Pompeii. This area contained a Doric temple believed to be devoted to Heracles, who was popular with merchants because of his long journeys (Grant 15). Over time, Greek culture came to supplant that of the Oscans. Many of the oldest buildings in the city, such as the House of the Faun, which contains a famous mosaic of Alexander the Great, and the original theater, which was built in the Greek style, display these Hellenistic influences on the city (Zanker 42-44).

Soon, however, conflicts arose for control over the Campanian region. The Etruscans, an economically and militarily powerful group of loosely organized

city-states from the north-west of Rome, attempted to take over the region. It is unclear how successful the Etruscans were in their search for power, but if they did at some point dominate the area, the Greeks drove them out in the year 474 B.C. with a decisive naval battle (Grant 20). Before long, the Samnites, a collection of warlike peoples from the hilly region north of Campania, invaded the region, because of its fertile land and active trade relations. Because mainland Greece was involved in the Peloponnesian War at this time, the Samnites conquered the area with relative ease (Grant 20).

In the Samnite Wars, which took place between 343 and 290 B.C., the Romans replaced the Samnites as the dominant power in the area. They gave Pompeii the status of ally, or *socius*, which meant that Pompeians were able to keep their traditional institutions and culture but had to acknowledge that they were under Roman dominion without receiving Roman citizenship (Brion 16).



← Here is a diagram of how the Forum may have looked during this time period, taken from Paul Zanker's *Pompeii: Public and Private Life*:

Judging from the remains at other Samnite towns, Pompeii may have had an irregularly shaped forum west of the Greek Triangular Forum for quite some time before the Samnite Wars. Regardless, it was not until the middle of the second century B.C. that the Forum was made rectangular and surrounded by a two-storey colonnade (Grant 67). However, relatively little effort was put toward creating an impressive city center during this time period. The Forum at this point consisted of three administrative offices on

the southern end, the *comitium*, or assembly area, the basilica, the marketplace, and the temples to Apollo and Jupiter (See *Olympian Gods*). Because the façades of the administrative offices are not well aligned, archaeologists have concluded

that they were not built at the same time, but instead one after another (Zanker 55). Archaeologists believe that one of these offices was used by the *duoviri*, a pair of chief officials responsible for judicial matters in the city, that another was used by the *aediles*, another pair of officials who were in charge of municipal functions such as roads and sanitation, and that the third office was used as a meeting place for the town council (Grant 69). The Basilica, believed to have been constructed around 130 B.C., lies on the south-western end of the Forum and was the most elaborate structure in the Forum at the time. It is believed to have served as a commercial center, auction house, and law court. Its location on a street that led directly out to the river port was arguably to facilitate trade with inland cities. The other sides of the Forum seem not to have featured public buildings, but instead a row of houses or taverns, giving the Forum a somewhat awkward and disjointed appearance (Zanker 55-57)

Scholars have interpreted the state of the Forum during this era as representative of the mixed feelings that the citizens of Pompeii had about accepting Roman dominion. On the one hand, the regularization of the Forum and the construction of the administrative buildings has been seen as a sort of "self-Romanization" of people who expected to receive Roman citizenship in the near future. However, its somewhat uncoordinated construction has been seen as a sign that the individuals in charge were not without reservations about changing the face of their city (Zanker 59).

## Colonial era

In the year 90 B.C., a rebellion against Rome, called the Social War, broke out. Due to early successes of the rebels, Pompeii joined their cause, only to be attacked by and to fall to Roman forces under Lucius Cornelius Sulla in 89 B.C. Damage caused by this attack can still be seen on the northern wall of the city (Zanker 61). Following the Social War, the citizens of Pompeii received Roman citizenship, but in order to prevent another uprising, Rome established colonies of army veterans in the cities that had participated in the rebellion. Pompeii was renamed *Colonia Cornelia Veneria Pompeianorum* in honor of Venus, the town's new patron goddess, and the responsibility for establishing a colony in the city was given to Publius Sulla, the nephew of the general (Brion 16-17).

The arrival of an estimated two thousand veterans and their families created a whole new atmosphere in Pompeii. While many of the veterans settled in villas outside of the Herculaneum gate, others received property inside the city that had been seized from citizens who had sided with the rebels during the Social War. It was during this time, too, that Latin replaced Oscan as the official language of Pompeii. The new public buildings created during this time, including the amphitheater, the Temple to Venus, and the Forum baths, had the dual purpose of catering to the veterans' needs and emphasizing Pompeii's new status as a Roman colony (Zanker 64-65). The colonists also began the custom of building large Tombs along the roads outside of the city, in imitation of those at Rome (Zanker 76).

The Forum underwent very little change during this time period. However, small changes served to emphasize the new cultural climate. The Forum seems to have become more important in public life; the veterans completed the construction of the comitium, and placed statues honoring civic leaders in front of the administrative buildings on the south end of the Forum. Also, the Temple to Jupiter was pulled down and rebuilt as a *capitolum* to celebrate the city's status as a colony (Zanker 63-64).

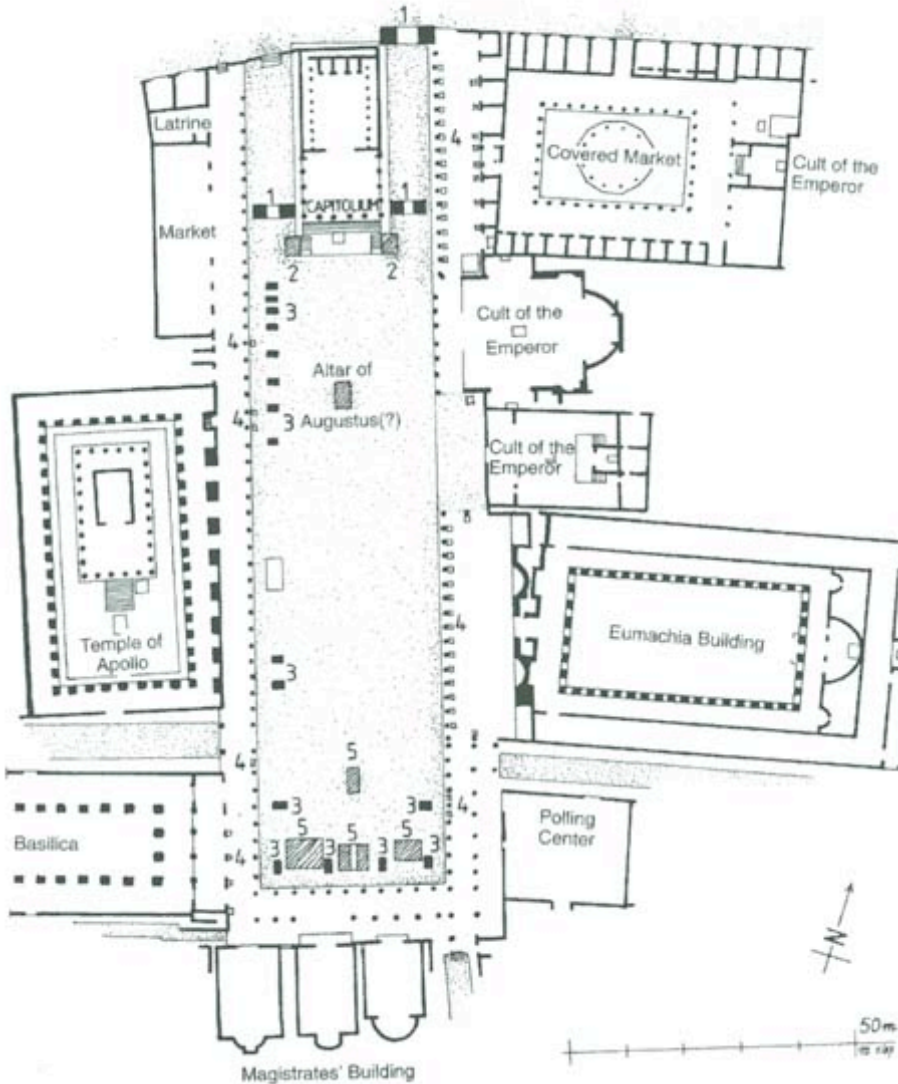
## Age of Augustus

In the year 23 B.C., Augustus Caesar established a monarchy in Rome and became the first Roman Emperor. The Roman Republic had been caught up in nearly a century of civil wars that had left Rome in a state of political chaos. During his reign as Emperor, Augustus returned peace and prosperity to Rome by encouraging religious and cultural renewal among Roman citizens. Like the influential families throughout the rest of the empire, many of the elite in Pompeii supported Augustan ideologies (Zanker 78).

As the city's cultural center, the Forum in Pompeii underwent vast improvements in the Augustan era. Renewed attention was given to the Olympian Gods, as Augustus hoped that a return to the traditional religion of Rome would lead to a new sense of virtue and morality throughout the Empire. Pompeii's town council made plans to rebuild the Temple to Venus and to construct a new wall and sundial for the Temple to Apollo (Zanker 78-79).

Many of the new buildings that were added to the Forum at this time were meant to honor the new emperor. The taverns and shops that had previously been located on the eastern side of the Forum were torn down and replaced by the Sanctuary of the Lares, the Temple of Vespasian, and the Eumachia Building (See The Imperial Cult). These buildings were funded by individual donors, who wanted to simultaneously promote themselves, improve their city, and show their loyalty toward the imperial family (Zanker 101). A perfect example of these three aims can be seen in the Eumachia building. A niche in the building features an honorific statue of the priestess Eumachia, while her dedication of the building to Concordia Augusta and Pietas emphasized links to the empire. The building also served a practical purpose as the city's wool market. Through such benefactors, who funded not only the new buildings in the Forum but also other public amenities such as a new theater, an aqueduct, the renovation of the public baths, and a large palaestra used as an athletic field near the amphitheater, the very cultural identity of Pompeii was transformed. Through these new structures, Pompeii gained a new, symbolic cultural connection with Rome (Zanker 101-121).



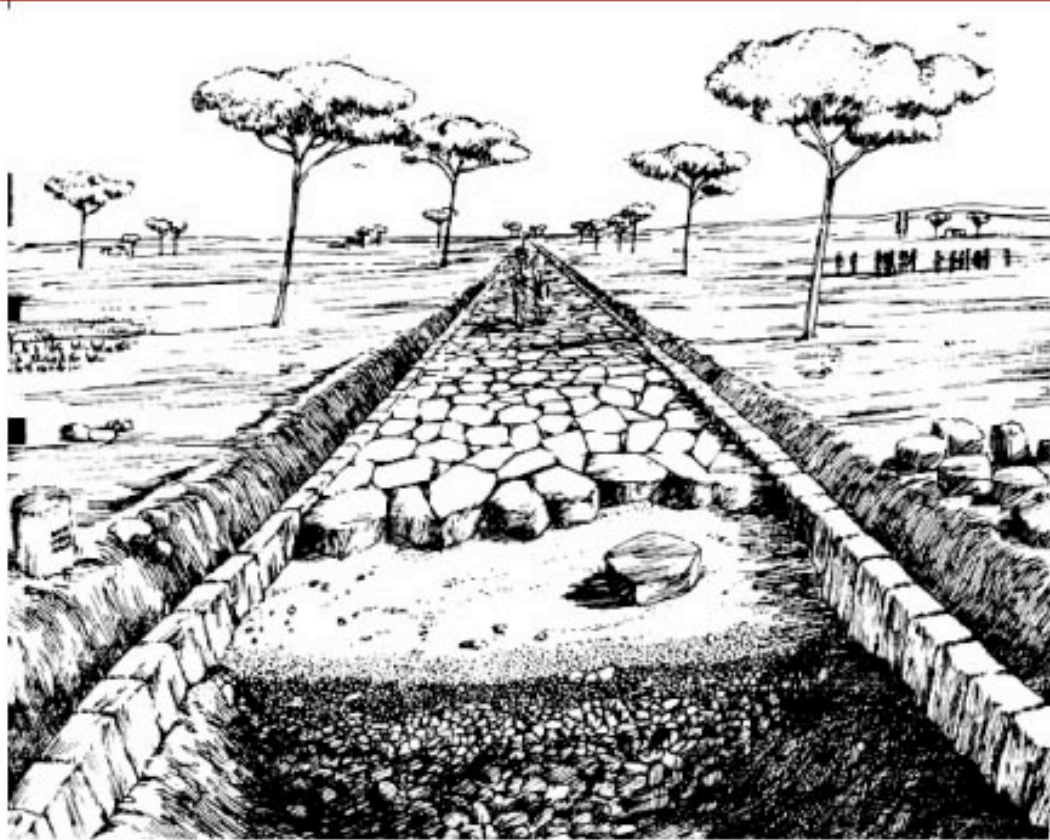


← Here is a diagram of how the Forum would have looked during the Age of Augustus, taken from Paul Zanker's *Pompeii: Public and Private Life*:

In addition to these new buildings, several honorific monuments were added to the Forum. Augustus had decreed that public places in the Roman Empire should display statues of himself as well as of important previous Roman rulers and generals in order to provide inspiration and models of Roman greatness to all Roman citizens

(Time-Life Books 55). In Pompeii, at least forty statues were installed around the Forum. The old statues of civic leaders from the Colonial Era were relocated away from the south end of the Forum, through which many people would have passed on their way from the Via dell'Abbondanza and the Marine Gate, and replaced by an arch and two large monuments to the imperial family. On the north end of the Forum, large arches were built on each side of the *capitolum*, and equestrian statues believed to honor the imperial family were placed by the steps of the temple (Zanker 102-103).

# Road Ruts!



**Roman Roads**





What about those road ruts? Many human guides and many guidebooks will tell you that they were worn into the stones by Roman war chariots. There has also been a long-standing urban legend supposedly linking the standard gauge of railroad tracks to Roman road ruts and the width of the backsides of Roman war-chariot horse teams. More than 2000 Internet sites carry the legend, but it's all bunkum, as both the archeological and railroad communities know. The professionals also know that, while wear may have deepened and broadened some ruts slightly, they were invariably carved into the roads intentionally and by hand to keep traffic going the way it was planned to go. Ruts were carved into narrow sections or through gates like those in the Forum Transitorium or between the famous stepping stones in Pompeii to prevent side-slipping and to keep the wagons "on track". In tight corners, for example at the corner of the Temple of Julius Caesar, carved ruts were curved to nudge the front wheels of four-wheeled carts around: articulated front axles wouldn't be invented until several hundred years after the fall of the Empire. (The lack of articulated front axles was also the real reason that Roman surveyors aimed for strictly straight roads.)



***"Switch" ruts cut into the road through the Forum Transitorium in Rome. This narrow forum, also known as the Forum of Nerva, got its "transitorium" name from the road that ran through it to provide "transit" for goods coming into the main Republican Forum.***

The ruts were sometimes used like railroad switches. A wagon would be brought near a set of forked ruts, and a stone would be placed at the fork to block the rut that the drover did not want to follow. The oxen would then be urged forward and the emplaced stone would bump the wheels into the preferred track. A set of such "switch" ruts, which gave the drover the choice of three different onward tracks is still visible in the Forum Transitorium in Rome.

Roman roads in the countryside were "high crowned" for drainage, much higher in the middle than at the curbed edges, and ruts were carved into them to keep heavy wagons from sliding toward the edges and tearing up the curb stones when passing in opposite directions. The distance between ruts was essentially irrelevant since the drover would only have to find a rut with wheels on one side to keep his wagon on track.

And furthermore: Chariots were never allowed inside Roman cities, so they couldn't have cut those ruts between the stepping-stones at Pompeii. Religious laws forbade the entry of any weaponry of war, including chariots, inside the "sacred boundary" (the Pomerium) of any Roman city.

Chariots also were not used on the Roman roads that spanned the empire. They were strictly for off-road use and only in battlefields that had been determined to be soft and rather smooth. Otherwise they would be rattled apart – no springs and no flexibility. No commander would allow his chariots to be damaged by allowing them to be driven on stone Roman roads. They would be disassembled and carried on ox carts to the battle area and then would be reassembled in the field. (Tanks are treated the same way today – trucked to the battle area and kept off the roads as much as possible so they won't throw their tracks.) The stone roads would have been just as hard on the animals that pulled the chariots. I used the word "animals" advisedly, because horses were almost never used for war chariots – donkeys and mules were the animals of choice.

Real war chariots, by the way, stopped being used by the Roman army long before those rutted urban streets were even built. The only chariot on a battlefield would be the General's transportation, and he would never have driven it into battle – good generals directed battles from nearby hilltops while Centurions and non-coms led the troops into battle on foot or on horseback.

The only chariot in a city would be the one used by a victorious General during his ceremonial triumphal march into Rome (or some smaller victory celebration in his home town or the conquered town – and only that one chariot would be used. The ones used in Rome were bulky and highly decorated, and, if we can believe contemporary

**pictures, they often might really be four-wheeled carts. Whatever its form, a triumphal chariot was almost always a single-use artifact that went into a temple or a private museum after the triumph. Old style two-wheeled chariots were pretty much reserved for statuary.**

**Racing chariots were also not allowed into the city (nor for that matter were horses in general – except for Triumphs or religious observances.) In any event, racing chariots were flimsy wickerwork affairs that only weighed a few pounds, so they certainly wouldn't have cut ruts into heavy basalt Roman pavers.**

**So the famous Pompeii ruts were really there just to keep ox-carts from throwing wheels as they went between the stepping stones of for getting wagons around corners – or sometimes both, as in the picture below.**



**The Romans learned about carving ruts into roads from the Greeks. See <http://en.wikipedia.org/wiki/Diolkos> for the Diolkos Trackway, which was used to portage ships across the Isthmus of Corinth from ca. 700 BC until it appears to have been abandoned when Nero tried**



**to dig a trans-isthmus canal in 67 AD. It is estimated that a ship could be pulled across the 6 km. length in about three hours.**

## **Stone-age Pompeii uncovered (news item: 18 Apr 2005)**

Swedish archeologists have found previously unknown prehistoric settlements under ancient Pompeii.

The Swedish Pompeii Project, tied to Stockholm University and the Swedish Institute in Rome, has worked for five seasons in a section of Pompeii to study and document the relics of the ancient city. When a well was emptied of its contents of pumice stone from the eruption of Vesuvius in A.D. 79, a spectacular discovery was made: about two meters below the ancient floor level the wall of the well revealed a prehistoric layer. The lowest and oldest layer has been carbon-dated to about 3500 BC - the Stone Age. It is covered by a layer of ash, which probably testifies to an earlier volcanic eruption. On top of this there are remains from the Bronze Age. The rich earth is full of pottery shards. In other words, this is a settlement layer. A Stone Age settlement was thus buried by a volcanic eruption from Vesuvius, just as was ancient Pompeii. The place was resettled during the Bronze Age.

"The plan is now to continue the study to find out how extensive the prehistoric settlement was," says Professor Anne-Marie Leander Touati, who is leading the project. The work requires drastic measures, since the ancient street pavement must be removed to make it possible to excavate a wider area than the narrow space around the well allows.

"The archeological authorities in Pompeii are excited about the find and have great expectations for the continuing field work," says Anne-Marie Leander Touati.

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# ***The Economics of Pompeii***



At the time of the eruption, Pompeii was essentially a middle-class commercial city. In contrast with Herculaneum, which had a distinct upper class quarter featuring elegant mansions, portions of many of Pompeii's large homes had been let out as stores, workshops, and taverns. Marcel Brion describes this phenomenon in his book, *Pompeii and Herculaneum: The Glory and the Grief*

"(The) surprising fact which strikes today's visitor is the contrast between the aristocratic elegance of certain dwellings and the vulgarity of the trades or businesses established in them. This social phenomenon

arose from the increasing wealth of the business class as a result of the thriving trade, operating through the medium of the port of Pompeii, between northern Italy, Greece, and the countries of the East. The Sarno was at this time a navigable river up which ships of respectable tonnage could proceed quite far, and its large estuary contained the harbor installations. This commercial prosperity had raised men of the lower-middle class, often freedmen who through their ability and intelligence had made fortunes, to administrative position and the status of eminent citizens...Simultaneous with the rise of these new-rich proletarians, was the decline of the aristocracy, which did not enter into trade or business. Thus there came about, at the moment when these freedmen were greatly expanding their trading activities, an exodus of the upper class, who left a city which had become noisy, vulgar and over-run by *nouveaux-riches*, and retired to the country, where they devoted themselves to the cultivation of their lands."

Agriculture, production, and trade, then, were very important to the livelihood of many of the inhabitants of Pompeii. However, more than this, an investigation of the economic circumstances of the city touches upon its identity in the context of its social world as well as its relationships with other places. The first two sections below describe how goods were produced in and around Pompeii, while the last goes on to illustrate how those goods were then distributed and exchanged, both within the city and on a larger scale.



## Agriculture

← *Pompeii was noted for its wine grapes. The well drained and rich volcanic soils of the slopes of Somma/Vesuvius produced grapes for two of the three wines that the ancient Romans considered the most desirable – “Pomeiiianus” and “Vesuvianus” (most favored of the three was “Falerianus” which was made from grapes grown in volcanic soils in the southern Campania, just north of the Campi*

*Phlegraei above the Bay of Naples.*

The mild climate and volcanic soil of the region around Pompeii made it an excellent area for agricultural production, capable of yielding three crops a year. Archaeologists have reconstructed the types of foods that Pompeians grew from carbonized pollen grains, seeds, and roots that have been found around the city (Time-Life Books 106). Much of the area around the city was filled with farms that grew grapes, apples, pears, quinces, figs, almonds, melons, cherries, hemp, grain, and cabbage, as well as the olives and grapes necessary for the Pompeian wine and olive-oil trades (See Trade and Commerce) (Laurence). There were three basic types of locations in the area in which agricultural production occurred. The first was the luxury villas around the Bay of Naples, many of which contained agricultural plots. The second was a category of estates that were primarily farms

rather than luxurious homes. However, the owners of this category of property, like the owners of the luxury villas, were well-off and did not live there year round. Instead, they had an agent who lived on the property permanently and looked after the farm while the owner was away. The final type was the farm-house, in which a farmer lived and worked the farm the entire year (Grant 191).

There is also evidence that agricultural production went on inside the city itself. Just north of the amphitheatre is a large vineyard, identified based on ancient roots and by holes dug in the ground meant to retain water, very similar to those made by modern Italian farmers in the area (Grant 192). There are a number of other agricultural plots in the city, and estimates suggest that they account for approximately ten percent of the total urban area. Most are concentrated in the south-eastern part of the city, but there are small productive gardens even in densely populated areas. None of these gardens would have produced a large amount of crop, and so archaeologists have concluded that the produce from these plots was for local consumption only. The presence of these agricultural plots within the city walls suggests that the divisions between the city of Pompeii and the rural area around it was not extremely pronounced (Laurence).

## Workshop Production

The economy of Pompeii was largely based on small-scale production through workshops that specialized in a single product. Archaeologists have identified these workshops by the presence of specialized equipment that does not appear in domestic settings. Two of the most important guilds of tradespeople were the bakers and the fullers.



Archaeologists have identified bakeries based on the presence of mills and large ovens. The local volcanic rock apparently made quite high quality millstones, and in addition to supplying the bakeries of Pompeii, millstones were produced for export to other regions (Tanzer 19). The highest concentration of bakeries in the city were located east of the Forum near or on the Via degli Augustali. However, most of these bakeries did not have

mills and thus did not grind their own flour. Bakeries containing mills are much more concentrated toward the north of the city, where it would have been easier to bring in grain from rural farms than at the more central location east of the Forum





The type of bread made in Pompeii has been determined from wall paintings and even from carbonized remains discovered still in the ovens where they had been left on the day of the eruption. Images of the bread also appear in wall paintings that portray peddlers selling various types of food. The typical loaf seems to have been round and flat. It was scored into eight to ten wedges, and the name of the baker was stamped into each loaf (Tanzer 23-26).



**Charred bread discovered in an oven in Pompeii**

**Romans imported their wheat from throughout the Empire. They liked white bread. Pliny wrote in 70 AD: 'The wheat of Cyprus is swarthy and produces a dark bread, for which reason it is usually mixed with the white wheat of Alexandria'. Pliny disagreed with Plato who had written in 400 BC that the ideal state where men would like to an old age was that in which whole grain bread was made from local wheat. All Greeks did not agree with Plato. Socrates considered whole grain bread to be pig food. Pliny also wrote of the different types of bread which the Romans enjoyed over the centuries: I can't find thorough descriptions so add my own 'guesses' as to what these are:**

- \* a bread to eat primarily with oysters - perhaps some sort of cracker**
- \* cakebread - similar to a coffee cake speusticus**
- \* hurry bread - most likely an unleavened bread oven bread – not really what we consider an Italian or French bread**
- \* tin bread - bread cooked over an open fire in a 'tin' can. Today we use cake mix and 'bake' it in a #10 can over an open fire when camping**
- \* Parthian bread - a flat bread**
- \* rich breads - made with milk, eggs and butter bread made of rye, acorns or millet**
- \* crusty bread - baked in a brick oven hearth**
- \* baked bread - baked on the hot stones of the hearth bread baked with cheese**

**Other breads described by various authors are:**

- \* panis sordidus (soft bread) - made of coarse grain and the cheapest bread**
- \* panis secundus - a bread of somewhat better quality**
- \* siligineus - very white, very expensive**
- \* sweet bread**



- \* *pician bread was similar to a biscuit*
- \* *libae were smaller rolls*

***From excavations at Pompeii and Herculaneum there is evidence of at least ten kinds of Roman bread. Even dog biscuits were made. Standard loaves were flat, about 2 inches thick and the backs marked with 6 or more notches to ease breaking the bread.***

Textile workshops were also concentrated around the region east of the Forum. Many of them were located on important through-routes of the city. Several different types of textile workshops have been identified within Pompeii. The locations where fabric was produced and dyed, called *officinae lanificariae* and *officinae tinctoriae* respectively, are characterized by the presence of specialized vats and furnaces (Laurence).



The largest and most influential representatives of the textile trades, however, were not involved with the manufacture of fabrics. This group was the fullers, or *fullones*, and their workshops, which held vats and treading stools, were called *fullonicae*.

← *Fullers at work*

Fullers were responsible for cleaning

fabrics, both before and after they had been made into garments. Here is a description of the fullers' trade from Helen Tanzer's *The Common People of Pompeii*.

"The fullers received the cloth directly from the loom and proceeded to wash it by treading it in tubs with water and soda or other alkaline reagents. It was next treated with fullers' earth and then beaten with wooden mallets to make the texture closer, and washed again to clean and shrink it. They then brushed it with tools made for



brushing tools made for

the purpose, sometimes teazel burs, to raise the nap. The cloth was finally bleached with sulfur, and rubbed with some sort of dry, white earth. After pressing, it was ready to go out for use as garments." (8)

Fullers also received a lot of business cleaning the ubiquitous white toga of Roman citizens.

Evidence of the importance of the *fullones* is their use of the Eumachia building (See The Imperial Cult) as a market separate from the provision market or *macellum*, also located in the Forum, that the other tradespeople used (Tanzer 8).

Here is a diagram of the location of workshops in Pompeii taken from Ray Laurence's *Roman Pompeii: Space and Society*:



## Trade and Commerce

Goods of Pompeian origin have been found throughout the former Roman Empire, and products from many different regions have been discovered within the city itself. Archaeologists have attempted to use these finds in order to reconstruct the trade relations of Pompeii.

In particular, pottery has been used to trace the flow of goods out of Pompeii.

Due to the volcanic elements in the earth around Pompeii, pottery manufactured in or around the city is made out of a characteristic red clay. This allows pottery of Pompeian origin, called Pompeian Red Ware, to be identified relatively easily when found in other parts of the empire. This in turn makes it easier for archaeologists to tell where Pompeian exports ultimately ended up. Pottery itself was not a main exported good; instead, it was generally traded alongside other



more important products. Thus, Pompeian Red Ware can not be used to determine the scale of trade between Pompeii and the rest of the empire, only the regions where it did occur. Pompeian Red Ware has been found in Greece, north Africa, Italy, Germany, and Britain. This evidence has been used to argue that Pompeian products were traded over incredibly long distances. However, most scholars agree that Pompeian manufacturers were at best minimally involved with the export of their products (Laurence).

Because Workshop Production at Pompeii was on a small scale, archaeologists have concluded that Pompeii did not produce many goods for the express purpose of exporting them. That is, those goods that left Pompeii were not produced with a specific market outside the city in mind. Instead, producers in Pompeii traded their wares with individuals called *negotiatores*, in exchange for goods from other regions of the empire. These traders facilitated trade around the Mediterranean by transporting goods from one location to another for sale. Most likely, the *negotiatores* initially exchanged Pompeian products in the nearby trade center of Puteoli. From there, because of strong trade links between Puteoli and Rome, some Pompeian products made their way to the capital. Traders in both Puteoli and Rome were responsible for the distribution of Pompeian products on a wider scale across the empire (Laurence).

The most well known Pompeian exports were wine, olive-oil, and a fish sauce called *garum*. Many of the rich families in and around Pompeii made their money off of the wine and oil trades. Pompeii was associated with a specific variety of grape-vine, and the wine made from this species was generally held in high regard (Grant 194). There were also large olive groves outside of Pompeii, and because local volcanic rock made very good olive crushers, most farms had their own presses and vats for olive-oil production (Grant 196).



Pompeii was particularly famous for its *garum*. Following is a description of *garum* production, taken from Michael Grant's *Cities of Vesuvius: Pompeii and Herculaneum*

"The entrails of sprats or sardines - the parts that could not be used for salting - were mixed with finely

chopped portions of fish and with roe and eggs, and then pounded, crushed and stirred. The mixture was left in the sun or in a warm room and beaten into a homogeneous pulp until it fermented. When this *liquamen*, as it was called, had been much reduced over a period of six weeks by evaporation, it was placed in a basket with a perforated bottom through which the residue filtered slowly down into a receptacle. This end product, decanted into jars, was the famous *garum*; the dregs left over, also regarded as edible, were known as *altec*." (200)

*Garum* was produced in salting factories, called "*salsamentarii*", and sold by "*salsarii*". It was used to season meat, fowl, vegetables, fruit, and, of course,

even fish. *Garum* was available to all classes with expensive and inexpensive types and was very popular despite (or, maybe, because of its strong odor. The taste for it died out in Europe with the end of the Roman civilization -- except for natives in that tiny Roman outpost of Great Britain. Worcestershire sauce, of all things, is based on salted and fermented anchovies or sardines. (Worcestershire sauce has more fruit and spices than *garum* did, but *garum* was often used in combination with *caroenum*, which was wine or grape juice boiled down with spices. So Worcestershire sauce is really pretty much the same as this combination.) Fish sauces are used today like salt in western cooking or like/with soy sauce in Chinese cooking, and good-quality fish sauce imparts a distinct aroma and flavor all its own.



← The closest we come to Pompeian *garum* in the 21<sup>st</sup> century are the various south-Asian fish sauces.

(You can get them at the Grand Mart at

6255 Little River Turnpike, at the Vietnam Market at 6613 Wilson Blvd., or at other local oriental markets – check <http://localdc.com/ethnicmarkets.htm>.)

Because the *salsamentarii garum* vats would have smelled particularly unpleasant, scholars think that *garum* production did not take place within the city walls, but instead at Pompeii's port facility on the Sarno river (Tanzer 34).

Pompeii also imported many goods. An analysis of ceramic bowls found in the city showed large proportions of pottery from the local region of Campania, a slightly smaller amount from other regions in Italy, and smaller yet still significant proportions of bowls from the eastern Mediterranean and Southern Gaul. Pompeii had good river connections with the smaller towns of Campania and formed an important part of the economy that based itself on the luxury villas of the Bay of Naples (Laurence). Thus, it was relatively easy for Pompeians to obtain goods produced in the Campanian region. Because Pompeii was outside the customs limits of Puteoli, it had an advantage in terms of importing goods from the rest of the empire. Pompeians imported lamps from the northern parts of Italy, pottery from Gaul, and despite the local oil and wine industries, oil from southern Spain and wine from Spain, Sicily, and Crete (Grant 202).

Commerce within the city itself was mostly concentrated within the Forum and the area just around it, though there were shops extending a fair distance to the north-west of the Forum. The provision market of Pompeii was located in the



north-eastern corner of the Forum. A series of streets ran in from the Forum to each of the city gates, facilitating the transport of produce into the marketplace from the rural farms (Zanker 7).

← *Pompeii's macellum*

Following is a description of the provision market from

*Grant's Cities of Vesuvius: Pompeii and Herculaneum*

"The provision market, or *macellum*, was a large porticoed space containing shops, chapels, auction-rooms, a meeting place for the priests of Augustus' cult, a money-changers booth, and displays of fruits and vegetables. The models for this type of center were the *macella* at Rome, one named after Livia and the other built by Nero and depicted by him on a coin. In the middle of the Pompeian building was a small, twelve-sided, domed building with a water-tank, connected with the sewers. Inside the tank, fish-scales have been found. Here, then, was the fish-market" (199).

Pompeii had a market day every eight days (Tanzer 56).

Shops were located in most blocks, or *insulae* in Pompeii, though the main street of the city, the *Via dell' Abbondanza*, had a particularly high concentration of



them (Grant 193) – in fact it acquired its name from the “abundance” of shops and goods found by the archeologists.

← *Via dell'Abbondanza as it appears today and in a reconstruction drawing.*

**They were set into the street side of large houses. Occasionally the stores belonged to the owner of the house, in which case the house and shop were connected by a doorway. Quite often, however, an owner would rent out shop space to various merchants in order to add to his personal income. In those instances, the shop was not connected to the rest of the house. When this was the case, part of an upper story was often rented out with the shop for the merchant to live in, or sometimes there was enough space on the ground floor of for the merchant to have personal rooms at the back of the shop. The goods sold in these shops were sometimes made on the premises, and sometimes bought from other local merchants or foreign traders. The existence of shops set into the walls of large houses exemplifies the fact that space in Pompeii was often not clearly defined in terms of functional categories. Instead, residential and commercial areas existed together simultaneously at the same location (Laurence).**

**In addition to being sold in shops and in the provision market, both raw and prepared foods were sold in street stands at fixed locations and from portable trays carried by wandering vendors (Tanzer 28).**

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# ***Pompeii Discovery for Swedish Archeologists***

16th April 2005

**(AFP) Swedish archeologists have discovered a Stone Age settlement covered in ash under the ruins of the ancient city of Pompei, indicating that the volcano Vesuvius engulfed the area in lava more than 3,500 years before the famous 79 AD eruption.**

**The archeologists recently found burnt wood and grains of emmer wheat in the earth under Pompei, Anne-Marie Leander Touati, a professor of archeology at Stockholm University who led the team, told AFP. "Carbon dating shows that the finds are from prehistoric times, that is, from 3,500 years BC," Leander Touati said. It was until now believed that Pompei was first inhabited during the Bronze Age.**

**The group of archeologists - part of a larger international project - were mapping a Roman neighbourhood of Pompei when they made the discovery. "It was a real fluke," Leander Touati said, explaining that the group was emptying a well to determine its use when it made the find. "We realized that the well was a lot deeper than we thought, and we sent a guy down into the well. He moved some of the earth and suddenly he was in prehistoric times," she said.**

**The Stone Age remains were covered in a thick layer of ash. On top of that a layer of ceramic shards was found, which according to Leander Touati could be from the Bronze Age. Additional geological layers lay on top of that, and on top of it all were the ruins of Pompei. Pompei was covered in lava [not really –tkw] when Vesuvius erupted in 79 AD. The excellently preserved ruins have become one of the world's most visited archaeological sites.**

**Leander Touati said her group was now planning the next step. "We're going down there again," she said.**

# Thousands to Abandon Vesuvius 'Red Zone'

Rossella Lorenzi, Discovery News



**In Mount Vesuvius' Shadow – the effects of the 79AD Eruption. A new eruption could well have the same effects**

**Dec. 5, 2003 — Thousands of Italian families who live under the shadow of Mount Vesuvius will soon abandon their homes and relocate to safer areas, according to a law approved last week by Campania, the region which includes Naples.**

The measure, aimed at reducing the Vesuvius population, centers on a cash offer of \$35,000 for anyone willing to move outside the danger zone. The abandoned homes will be converted into small hotels and guest houses to accommodate tourists, whose movements would be easier to manage in case of danger. Of course, no more building will be allowed on the volcano's slopes.

**"Sixty years after the last eruption, we have made a very important choice for safety and prevention," said Marco Di Lello, city planning commissioner for the Region Campania.**

The only active volcano on the European mainland, Vesuvius is not an imminent threat. Yet geologists believe that it is only a matter of time before the volcano will repeat its most dramatic performance, which buried Pompeii and the nearby towns of Herculaneum and Stabiae in A.D. 79.

"Over the past 25,000 to 30,000 years, the volcano has displayed a wide variety of eruptive behaviors, from highly explosive and dangerous Plinian eruptions to more passive lava flows. It could exhibit any style of eruption during its next eruption," James Webster, curator of mineral deposits at the American Museum of Natural History in New York City, told Discovery News. Webster recently recreated the chemistry of Vesuvius' magma chambers in the lab.

Regional officials explained that by thinning out the number of people living in the danger zone, they would also reduce the time and the cost for what would be one of the biggest peace-time evacuations.

Squashed between the volcano and the sea, the danger zone is home to 600,000 people living in 18 towns within a 4-mile radius of Vesuvius.

About 2,700 families have already applied for the payment to move out of the "red zone." Local authorities hope that within ten years 150,000 people will be lured by the incentives.

The aim is to avoid the 1983 scenario, when a powerful earthquake near Naples raised fears of a devastating eruption: half a million panicked people tried to flee in their cars, blocking streets and emergency services.

Though local authorities maintain they can get everyone to safety within a week, some are critical of the plan. According to Flavio Dobran, a former professor of vulcanology at the universities of Rome and Pisa and the author of a project aimed at educating the public about risks and evacuation procedures, the pool of potential Vesuvius victims would affect a territory much larger than the red zone, with at least 3,000,000 people involved because of the panic.

"Paying people to move out of the danger zone doesn't really solve the problem," Dobran told Discovery News.

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# Satellites and sensors to halt crumbling of Italy's Pompeii

ROME - Reuters 5 April 2014



*Staff will be trained to use high-tech monitoring tools that should flag shifts in terrain in Pompeii so that they will be able to intervene to prevent collapses. AFP*

The ruins of ancient Pompeii will be monitored by satellites and sensors under an agreement with Italian defence and technology group Finmeccanica to try to stop the UNESCO world heritage site from crumbling. The state-controlled group will help train staff and donate its technology for free for three years in an investment worth up to 2 million euros (\$2.75 million), after which the equipment will be left to the restoration project.

Regular collapses of walls and houses in the treasured Roman town that was covered by ash in a volcanic eruption in 79 AD have caused an international outcry and increased pressure for an end to delays dogging a 105-million-euro restoration project part-funded by the [European Union](#) and launched last year.



Finmeccanica will train staff to use high-tech monitoring tools that should flag shifts in terrain in the 1,500 buildings of Pompeii, so that archaeologists can quickly intervene to prevent collapses. Soil movements, a major risk to the ruins especially during bad weather, will be monitored through high resolution images captured by the COSMO-SkyMed group of satellites, controlled by the Italian Space Agency, Finmeccanica said.

Technicians will build up a digital archive of the most important sites in Pompeii through hyperspectral imaging, which can capture the composition of different materials by measuring their electromagnetic radiation.

Site security will be able to access the information through a smartphone app, and vandalism or damage to the ruins will set off alarms.

**Private sponsors:** The partnership with Finmeccanica is the latest of several examples in which private companies have stepped in to fund restorations of Italy's fabled cultural heritage to make up for a dearth of public funds.

Luxury shoemaker Tod's is helping to restore the Colosseum, jeweller Bulgari the Spanish Steps, and fashion house Fendi the Trevi Fountain - all in Rome.

"I invite other private groups to come forward and not use the excuse that there are too many bureaucratic hurdles [to sponsorship]," Culture Minister Dario Franceschini said on Thursday. "We are here, there are no more alibis."

Italy's most popular tourist attraction after the Colosseum and Palatine Hill, which attracted 2.5 million visitors in 2013, Pompeii was preserved by the eruption of Vesuvius almost 2,000 years ago and was rediscovered in the 18th century, but has become a symbol of decades of mismanagement of Italy's heritage.

Three walls and an arch supporting a temple crumbled last month. Faulty restoration work, especially following the Second World War, combined with weather, pollution, weed growth and visiting crowds, caused the city to decay, Finmeccanica said.

So far, 40 million euros of the 105 million euros available for the Great Pompeii Project have been allocated.

The restoration hit delays amid disagreement over who should be named to lead the works, and on Thursday Franceschini said that the project's deputy director, Fabrizio Magani, would be replaced. He had been named to the post in December.

## Unit 5

# Herculaneum

by Iain Dickson, 'Melvadius Macrinus Cugerni'



With Vesuvius brooding on the horizon any visit to the Bay of Naples area should include a visit to

Herculaneum. It is unjustly less famous than its bigger brother Pompeii as the state of preservation of the buildings are generally much superior. It was lost to sight during the same series of eruptions that destroyed Pompeii but was possibly destroyed by a pyroclastic flow\* as much of the timber has survived in a charred condition giving a much better idea of what a Roman town may have looked like.

\* [A pyroclastic flow is described by the US Geological Survey as 'A ground-hugging avalanche of hot ash, pumice, rock fragments, and volcanic gas that rushes down the side of a volcano as fast as 100 km/hour or more. The temperature within a pyroclastic flow may be greater than 500° C, sufficient to burn and carbonize wood. Once deposited, the ash, pumice, and rock fragments may deform (flatten) and weld together because of the intense heat and the weight of the overlying material'.]

Herculaneum was originally discovered when a well was being dug in the early 18th Century at a depth of 50 – 60 feet below the modern surface. Initially a series of 'robber' shafts and tunnels were dug to strip the site of any saleable valuables. However, between 1749 to 1765 Herculaneum was explored on a more scientific basis for the Bourbon Kings of Naples and the Two Sicilies, initially under the supervision of Rocco Gioacchino Alcubierre and then his assistant Carlo Weber. A basic plan of the town was mapped out and much of the portable remains removed but eventually these tunnels collapsed and were closed down. The

modern towns of Resina and Portici grew up over the site and knowledge of where the entrances to the tunnels were was lost to the scientific community.

In the 20th Century, archaeological excavations re-commenced on a more modern and scientific basis fully uncovering a small section of the town but it was found that the earlier tunnelling had damaged the structure of much of the surviving buildings. The site is also suffering from exposure to the elements and the periodic earth tremors, so there is a constant battle to try and preserve the remains. Recent archaeological work at the site has rediscovered potentially one of the greatest treasure houses of contemporary Roman knowledge. The Villa of the Papyri was initially thought to contain unreadable charred scrolls, fused into solid lumps when it was originally excavated in the 18th Century. It was found that using various techniques some of the scrolls could be eased open and at least part of their contents read. A few were opened using an early mechanised method that allowed them to be slowly unrolled but it could take 4 years to do this and the scrolls were still extremely difficult to read when they were opened. Recent research using carefully measured chemical solutions is now enabling more of the 1800 to 2000 excavated scrolls to be opened into separate sheets but it is still a long process. Electronic equipment has recently been used enabling scholars to enhance the remaining script and more fully interpret some of the ancient texts contained on the scrolls. The scrolls opened and read to date appear to have mainly been various philosophical texts written in Greek rather than Latin but it is possible that more scrolls could be excavated in the future which will cover other aspects of Roman life. It has been speculated that there may be other Papyri with Latin texts in a lower unexplored section of the Villa. To my mind the fact that the villa was owned by a relative of Julius Caesar gives rise to several tantalising possibilities. It is entirely plausible that a more complete copy of Caesars 'Civil War', which is known to have missing or corrupted sections, or any number of texts that are known about from surviving fragments or other texts but have since been lost to history are just waiting to be rediscovered.

Herculaneum can be visited either by tour coaches, which spend a few hours there or else it can be reached by using the Circumvesuviana railway line to the 'Ercolano Scavi' station, from where it is about one mile straight down the hill to Herculaneum itself. One thing to note is that it may be best to buy a guidebook before you go into the excavations unless you wish to join a guided tour as when we last visited, a few years ago, there were no guide books available within the site itself. Although I believe that there is now a museum on the site so this information may be out of date.



←  
Herculaneum as seen from the approach road to the East of the excavations. The Decumanus Maximus can be seen running towards the hillside on the far side of the site. The theatre was partially excavated with tunnels by the

Bourbons but it lies slightly North of the line taken by the Decumanus Maximus (beneath the modern houses).

The main entrance to the site is in the NE corner and the entrance road crosses a bridge over part of the site, it then goes around the eastern and southern sides before entering by a bridge in the SW corner of the site. The area available to visit is a small section of the original town basically covering three roads (Cardo III to V) running from the ancient coastline inland to the North and two of the roads (Decumanus Maximus and Inferior) running in a East/West direction parallel to the old coast.

It is common for various sections of the site to be closed for repairs and my



photography is neither perfect nor definitive of all that Herculaneum contains but in the following section I will try to give a flavour of what a visit to it is like.

← Looking down on the Western side of the Palestra from the approach road.





← Looking down on Herculaneum from the East, with the 'House of the Gem' in the foreground. The orange

netting in the middle distance on the left of the picture is where a bridge crosses into the site from the site museum and the end of the access road. I believe that the area immediately beyond the bridge is where the Villa of the Papyri is in the process of being excavated, to the West of Herculaneum.



←

**The Sacred Area of Herculaneum seen from the south access road with the steps leading down to the old harbour and the arched storerooms where approximately 300 bodies of refugees from the eruption were found during the excavations of the harbour area. Fortunately or unfortunately this area remains closed to the general public but scientists have learnt a lot from these bodies. Most of the bodies found appear to be in general good health but several were suffering from advance stages of lead poisoning and amongst them there are apparently two armoured figures. There are hopes that research being carried out on these last two may help with future knowledge about how Roman arms and armour were worn and used in this period.**



**The Suburban Baths showing the view from the south. This building has in recent years apparently been used for the conservation of the various finds from the site so is normally not open to the public.**





**The final approach to the site is made over this bridge, although not generally recommended for an acrophobic, I've made the trip three times so far and never regretted it. It may now also be possible from this point to see the newly excavated areas to the West where I suspect that the Villa of the Papyri has been rediscovered.**

**← One of the 'tunnel' passages leading from the Southern end of each of the Cardo's down towards the Sacred Area and the old harbour. It is believed that no wagons could or were allowed into these areas so all traffic to and from the harbour was either on foot or possibly using mules to transport goods.**



← Wall mosaic from the 'House of Neptune and Amphitrite'. The left hand figure in this mosaic has sometimes also been described as Poseidon. There are several good wall mosaics in this building. This, of

course, is the most famous.



← Fresco depicting the myth of Hercules in the 'College of the Augustals', which was the cult dedicated to the Imperial Household.





A few of the statues and remains of marble furniture found in 'The House of the Deer'.





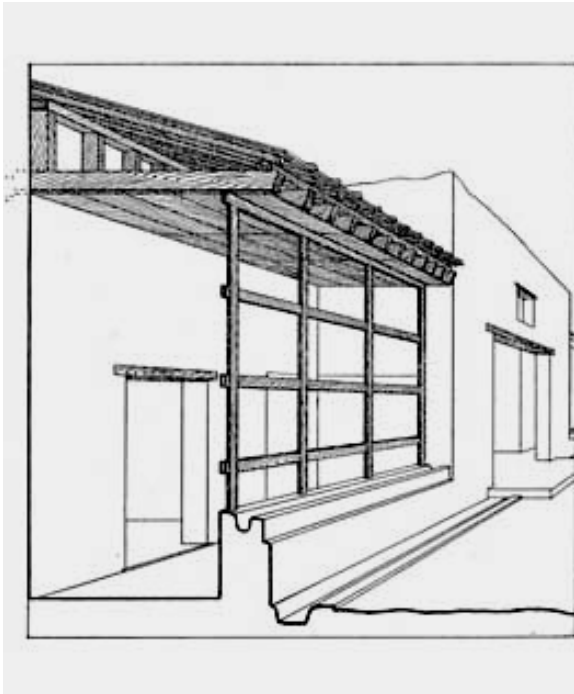
**Here some of the doors have partially survived on the northern side of the Decumanus Maximus. This was the main street of Herculaneum and in this section appears to have also fulfilled the function of a forum with wagons banned from entering it.**



← In some cases, like here in the 'House of the Mosaic Atrium' the carbonised timbers have been enclosed in sheets of rigid plastic to try and protect them.

The wooden framework to the right of the picture (mostly reconstructed) held panes of glass.





**Reconstruction of eastern verandah of the house of the mosaic atrium in Herculaneum (insula iv, n. 1-2).**

This habitation is one of the most important testimonies we possess of the structure of ceilings, roofing and verandas in ancient homes. The reconstruction shows a portion of the eastern ambulatory that looked out onto the house's elegant garden. The surviving beams and carbonized joists are the remains of a glass-enclosed, roofed veranda. The veranda is characterised by the presence of a peculiar wooden frame with rectangles sealed by glass panes. It is a *unicum* that confirms the widespread use of glass even in architecture the Vesuvian area during the I century A.D..



**House in Craticum' so called from its building style (*opus craticum*) where rubble walls and lime were supported by timber and covered with plaster. The timbers in this building appear to have been replaced almost entirely but the remains of carbonised roof timbers can be seen in the next building.**





In

several parts of the site differences in construction styles and quality can be seen, in part obvious from the height or completeness of the surviving structures. Other notable features include original iron grills in windows, the narrowness of the streets and indeed the sheer depth of the excavations.

Text and most pictures in this section are from <http://www.roman-empire.net/articles/article-011.html>

Book Review -- [http://www.washingtonpost.com/entertainment/books/from-pompeii-the-afterlife-of-a-roman-town-by-ingrid-d-rowland/2014/04/09/98a7cb62-ba97-11e3-9c3c-311301e2167d\\_story.html](http://www.washingtonpost.com/entertainment/books/from-pompeii-the-afterlife-of-a-roman-town-by-ingrid-d-rowland/2014/04/09/98a7cb62-ba97-11e3-9c3c-311301e2167d_story.html) -- April 10, 2014

Belknap/Harvard Univ. 340 pp. \$28.95 (from \$21.55 including shipping at Amazon.com)

## **‘From Pompeii: The Afterlife of a Roman Town,’ by Ingrid D. Rowland**



*Library of Congress/Library of Congress Prints and Photographs Division - Colorized photo of The Forum, Pompeii, Italy, ca. 1890- 1900 published by Detroit Publishing Company, 1905.*

*By Michael Dirda,*

On Aug. 24, A.D. 79, from his villa in Misenum, near Naples, the learned Pliny the Elder — whose “Natural History” is one of the great encyclopedic works of antiquity — noticed a cloud of unusual size and appearance. It appeared to be issuing from Mount Vesuvius. As his nephew Pliny the Younger later wrote to the historian Tacitus:

**“The pine tree, rather than any other, best describes its appearance and shape, for it rose high up into the sky on what one can describe as a very long trunk, and it then spread out into what looked like branches. . . . Its appearance varied between white on the one hand, and grimy and spotted on the other, according as it had thrust up earth or ashes. My uncle, most learned man that he was, realized that this was important, and should be investigated at closer quarters.”**

**In short order, the elder Pliny “ordered a fast-sailing ship to be made ready” and set off for closer observation at Stabiae, where he stopped to eat and even take a nap. By this time, Vesuvius was pouring out flames, while grit and pumice soon began to fill the courtyards of fashionable villas in Stabiae and the nearby towns of Herculaneum and Pompeii.**

**The napping Pliny was then awakened, for by now, continues his nephew, “the buildings were shaking with frequent large-scale tremors, as though dislodged from their foundations” and “seemed to shift now one way and now another, and then back again.” The inquisitive naturalist, finally aware of the danger, persuaded everyone in his party to make a dash for the sea, despite the rain of pumice and debris. “They used strips of cloth to fasten pillows on their heads as a protection against falling stones.” Alas, the scholarly but out-of-shape Pliny collapsed and died on the beach, probably overcome by the noxious gases and smoke.**

**Meanwhile, his nephew notes, panic was spreading back home in Misenum, as day turned to night: “You could hear women moaning, children howling, and men shouting; they were crying out, some seeking parents, others children, and others wives, or recognizing them by the sound of their voices. Some were lamenting their own misfortune; others that of their families. A few in their fear of death were praying for death. Many were raising their hands to implore the gods, but more took the view that no gods now existed anywhere, and that this was an eternal and final darkness hanging over the world.”**

**When true daylight finally reappeared, the exhausted survivors were “confronted with a scene of universal change, for everything was buried by deep ash, as though by snow.”**

**This is just part of the classic account of the eruption of Mount Vesuvius, which destroyed the cities of Pompeii and Herculaneum. While Ingrid D. Rowland briefly describes this earth-shattering event, her principal interest lies in what happened afterward. “[From Pompeii](#)” traces the Renaissance’s archaeological rediscovery of that ancient city and nearby Herculaneum, discusses their gradual emergence as tourist destinations in the 18th and 19th centuries, and proffers short accounts of some of the distinguished scholars, musicians, artists and moviemakers inspired by their visits to these haunted sites.**

Its historical breadth and richness notwithstanding, “From Pompeii” is a surprisingly intimate book. Rowland begins with her first encounter with Herculaneum as an 8-year-old with a Brownie Starmite camera. She refers occasionally to the philosopher-magus Giordano Bruno, whose biography she has written. A dust jacket note reminds us that she lives in Rome . “From Pompeii” is thus a personal, even idiosyncratic introduction to Pompeii in the mode of, say, the novelist E.M. Forster’s “Alexandria: A History and a Guide.” You never quite know what Rowland will talk about next.

Thus, her second chapter discusses Naples’s cult of San Gennaro, who is credited with protecting the city from a later eruption. The third chapter focuses on the 17th-century antiquary and Jesuit Athanasius Kircher, sometimes described as “the last man who knew everything.” Kircher’s masterwork, “Mundus subterraneus” — the “Subterranean World” — summed up three decades of geological research, with volcanoes featuring prominently. The image of Vesuvius that he produced in his text — based on his own drawings — became “the definitive cross-section of a volcanic cone for centuries to come.”

Rowland keeps up her wonderful digressiveness throughout. In her account of Leopold Mozart’s visit to Naples and environs, with his teenage son **Wolfgang** in tow, she pauses to spend a page on castrati and then several on the British ambassador and volcanologist Sir William Hamilton (whose life was fictionalized in Susan Sontag’s “The Volcano Lover”) and the learned Don Raimondo di Sangro, who — besides being a member of the baronial aristocracy — “conducted chemical experiments, invented powerful cannons, and collected curiosities.”

This aristocratic Freemason even wrote “an essay on *quipu*, the knotted belts that served the Incas as documents” and constructed “anatomical machines,” i.e., full-scale models of the male and female body that were so lifelike that for centuries it was rumored they were actually servants of Don Raimondo into whom he had injected some kind of alchemical preservative.

One of my favorite chapters focuses on Karl Bryullov’s gigantic history painting “**The Last Day of Pompeii**,” which made its young Russian creator famous and helped inspire Edward Bulwer-Lytton’s similarly titled novel, “The Last Days of Pompeii” (1834). Rowland duly summarizes its plot and that of “Pompeii,” **Robert Harris**’s 21st-century treatment of the same theme (though confessing that she couldn’t bear to read one gruesome scene of torture).

Like many of my generation, I know only the Classics Illustrated comic-book version of Bulwer-Lytton’s novel, which I discovered at age 10 or so: It climaxes, unforgettably, when a blind servant — who, unlike the sighted, can readily thread her way through the volcanic darkness — courageously saves her master and his beloved.



Still other sections in "From Pompeii" relate the reactions of Charles Dickens and Mark Twain to the ruins, the life of the philanthropist (and creator of New Pompeii) Bartolo Longo, the visits of the painter Renoir and the Japanese prince Hirohito, and even the use of Pompeii in Roberto Rossellini's film "Viaggio in Italia." This movie turns on a trip to the recovered city and a subsequent religious procession that together save the troubled marriage of an English couple played by George Sanders and Ingrid Bergman.

Mount Vesuvius last erupted in 1944, but scientists warn that its next explosion is likely to be particularly violent. Yet, long before that event, Rowland warns, Pompeii could "fall to pieces bit by bit, suffering gradual death by entropy and neglect." Because of excessive rains caused by climate change alone, Pompeii's buildings have been undermined to the point of collapse.

So, Rowland closes, perhaps inevitably, on a slightly somber note. But if you have any interest in Pompeii, or in entertaining scholarship, or in Italian culture, you'll want to set aside a few evenings for this deeply engaging work of popular history.

# Herculaneum

<http://www.britannica.com/eb/article?tocId=9040116>

Encyclopædia Britannica Article



← Ruins of the ancient city of Herculaneum, Italy, preserved by ash from the eruption of Mount Vesuvius in AD 79. In the 20th century protective roofing was added to several of the excavated structures. In the background are residences and walls of the modern town of Ercolano, partly demolished to make way for excavations.

© *Mathias Oppersdorff—Photo Researchers, Inc.*

Herculaneum was a city of 4,000–5,000 inhabitants in Campania, Italy. It lay 5 miles (8 km) southeast of Naples, at the western base of Mount Vesuvius, and was destroyed -- together with Pompeii, Torre Annunziata, and Stabiae -- by the Vesuvius eruption of AD 79. The town of Ercolano (pop. [1995 est.] 59,695) now lies over part

of the site. The excavations of Herculaneum and Pompeii in the mid-18th century precipitated the modern science of archaeology. Collectively, the ruins of Pompeii, Herculaneum, and Torre Annunziata were declared a UNESCO World Heritage site in 1997.



*Human remains found during excavations of Herculaneum, Italy.*

© *Gianni Tortoli—Photo Researchers, Inc.*

Ancient tradition connected Herculaneum with the name of the Greek hero Heracles, an indication that the city was of Greek origin. There is, however, historical evidence that toward the end of the

6th century BC a primitive nucleus of Oscan-speaking inhabitants came under Greek hegemony there and that in the 4th century BC Herculaneum came under the domination of the Samnites. The city became a Roman municipium in 89 BC, when, having participated in the Social War (“war of the allies” against Rome), it was defeated by Titus Didius, a legate of Lucius Cornelius Sulla. Herculaneum was severely shaken by an earthquake in AD 62, and the serious damage suffered by its public and private buildings had not yet been repaired when it was buried by the Vesuvius eruption of August 24–25, AD 79. Because few human remains were found during early excavations, it was assumed that, unlike the people of Pompeii, most of the inhabitants succeeded in escaping toward Naples, in the direction opposite to the fall of lapilli and ashes. In the 1980s, however, excavations at the ancient shoreline of the Bay of Naples (an area that is now inland) uncovered more than 120 human skeletons, suggesting that numerous additional inhabitants had also perished while attempting to escape. Nuées ardentes (a type of pyroclastic flow) were the most likely cause of death.

*Cross section of  
→  
some 18 metres  
(60 feet) of ash and  
pyroclastic  
materials that  
covered  
Herculaneum, Italy,  
when Mount  
Vesuvius erupted  
in AD 79.  
© Gianni Tortoli—  
Photo  
Researchers, Inc.*



The particular circumstances of the burial of Herculaneum, unlike those of Pompeii, led to the formation over the city of a compact mass of tufaceous material about 50 to 60 feet (15 to 18 metres) deep. Although this layer made excavation very difficult, it preserved Herculaneum and prevented tampering and looting. The special conditions of ground humidity made possible the conservation of wooden frameworks of houses, wooden furniture, the hull of a sizable boat, pieces of cloth, and food (carbonized loaves of bread left within ovens). Thus, Herculaneum offers a detailed impression of private life that is only with difficulty achieved in other centres of the ancient world. Excavation began in the 18th century, when all memory of the existence of Herculaneum had been lost for centuries and the only available reports of it were those that had come down through the authors of antiquity, without any information as to the exact position of the ancient city. Quite by accident, in 1709, during the digging of a well, a wall was discovered that was later found to be a part of the stage of the Herculaneum theatre. Tunnels were soon dug at the site by treasure hunters, and many of the theatre area's artifacts were removed. Regular excavations were started in 1738



under the patronage of the king of Naples, and from 1750 to 1764 the military engineer Karl Weber served as director of excavations. Under Weber, diagrams and plans of the ruins were produced, and numerous artifacts were uncovered and documented. Magnificent paintings and a group of portrait statues were excavated from a building thought to be the ancient basilica of Herculaneum, and a large number of bronze and marble works of art were recovered from a suburban villa, called the Villa of the Papyri because of its having contributed a whole library of ancient papyri in Greek. These papyri, on philosophical subjects of Epicurean inspiration, are preserved in the National Library of Naples.

*Triclinium with mosaic of  
→ Neptune and  
Amphitrite  
(1st century AD),  
Herculaneum, Italy.  
SCALA/Art Resource,  
New York*



The excavations were resumed in 1823 with the intention of discontinuing the previous tunneling and instead working from above ground, a method used with success at Pompeii; up to 1835 the work proved to be of value, bringing to light the first houses of Herculaneum, among which was the peristyle of the House of Argus. Abandoned and again resumed in 1869, after the unification of Italy, the excavations continued until 1875, when, because of the poor results obtained and the presence of the inhabited dwellings of Resina (now Ercolano), they were once more abandoned.



← *The Trellis House (left), Herculaneum*

After the efforts of the English archaeologist Charles Waldstein to internationalize the excavations at Herculaneum (1904) by collecting contributions for this purpose from various nations in Europe and America, the work was finally resumed in May 1927 with Italian state funds and with the object of conducting the excavations with the same continuity as those of Pompeii. The results of this work, interrupted only by World War II, made it possible to have a clear picture of the ancient city. The larger *decumanus* ("main road") forms one side of the quarter of the ancient forum with its public buildings. The *insulae* ("blocks") to the south of the



***decumanus*** are laid out in a strictly geometric pattern facing the ***cardines*** (“crossroads”). Many of the nobler houses afforded their patrons a view of the bay. Inside the residential quarter, houses of rich republican and patrician construction alternate with houses of the middle class (such as the Trellis House), also finely decorated, or with commercial houses and workshops.

The public monuments uncovered include the palaestra (sports ground), with a large portico surrounding a vast central piscina (swimming pool), and ***thermae*** (baths), one of which adjoins the former beachfront. This bath is in a remarkable state of preservation, having remained largely protected against the pyroclastic flows of the eruption.

Excavation continues, since the demolition of part of modern Ercolano, at the forum of the ancient city and at the ancient coastline.

## Villa of the Papyri

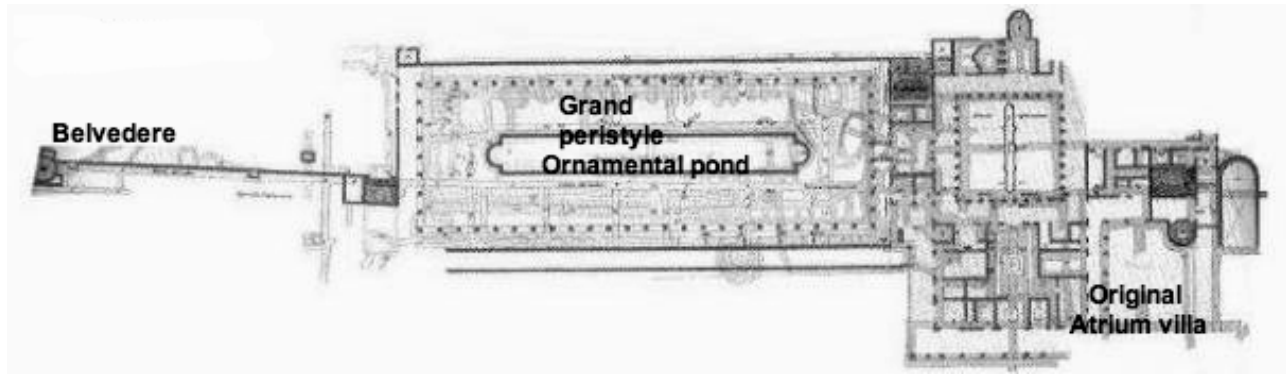
In late 1748 or early 1749 well diggers came across what turned out to be the belvedere of a sumptuous Roman villa. For six years the remains of the building were explored by tunnelling operations under the supervision of Karl Weber, a Swiss engineer acting on behalf of Cavaliere Alcubierre. He made detailed plans of the layout of the villa that were well ahead of their time, a copy of which are shown here.

The villa stretched for more than 250m along the shoreline. It would appear that it was originally built in the first century BC, as a formal atrium villa, and that it was subsequently extended to what we see today. (The J. Paul Getty Museum in Malibu, California, based on Weber's plans, gives a good good idea of what it would have looked like - see picture).

The tunnelling was not only arduous but also dangerous due to the build up of gases in the shafts. However, due to the excavators persistence over 90 statues were eventually uncovered before pressure from the residents of Resina forced Alcubierre to abandon the excavations in 1765.



Courtesy The J. Paul Getty Museum



On the western side of the building is a large peristyle over 90m long and 35m wide, with an ornamental pool running down the centre. The peristyle contained many fine statues in bronze and marble including the five 'Dancers of Herculaneum' which can be seen in the Museo Archeologico Nazionale in Naples. There were also many busts of Greek men of letters including philosophers and statesmen outside and inside the villa, lending credence to the belief that the owner was a reader and intellectual.

In 1752 an astonishing find was made when a tunnel was extended, opening up a room lined with shelves and crates stacked with scrolls. 'Scrolls' may be too fine a word, for what they found was a collection of blackened cylinders that at first were a mystery to the excavators. On examining some broken fragments, however, it was discovered that the cylinders were indeed scrolls containing Greek text written on scorched papyrus.

All attempts to read the papyri (altogether over 1800 scrolls were recovered) resulted in the destruction of the document, until Antonio Piaggio, a priest from the Vatican Library, created a mechanical 'unroller'. His process was extremely slow, but it did allow the documents to be read.

Most of the scrolls have turned out to be the work of Philodemus, an Epicurean philosopher of the first century BC.

*Piaggio's "unroller" →*

Work still continues on the scrolls using more modern techniques, but to date no classical masterpieces have



been recovered. Perhaps there is a second, Latin, library yet to be found.

From

<http://www.herculaneum.ox.ac.uk/herculaneumarchaeology/harchissue3.pdf>

## **THE VIRTUES OF VIRTUAL UNROLLING**

***BRENT SEALES discusses the technique of non-invasive scanning and its use as a tool for reading papyri without the need to unroll them. This new development has clear implications for the many unopened papyrus rolls recovered from Herculaneum in the eighteenth century.***

It is tantalizing to envision a technology capable of producing a readable image of a rolled-up text without the need to physically open it. Such a “virtual unrolling” would offer an obvious and substantial payoff, especially in the context of the Herculaneum scrolls. of the Herculaneum scrolls.

Assume for the moment that it is entirely possible to construct a very high-quality, comprehensive, penetrating scan of an object on the basis of which all subsequent analysis of an object can be performed. This could greatly simplify the complex interplay between conservation and scholarly analysis by almost completely decoupling the physical artifact from the interpretive process. It is not unlike emerging trends in medicine, where radiologists render accurate opinions about (completely digital) scans without ever seeing the about (completely digital) scans without ever seeing the patient, and where surgery is guided solely by images from cameras without the need for open access to the surgical field. In fact, remote surgeries using robotics have removed the physician from the patient to the point where certain procedures can be performed across continents.

My preliminary work has made me optimistic about solving the problem of virtual unrolling. The idea for a solution is based on obtaining a high-quality 3D data set from non-invasive, penetrating technology (e.g. CT scans) followed by careful analysis using specialized software tools. In fact a virtual unrolling system has three primary components. First, the scanning process must be non-invasive and must reveal the text. Second, since the text is written on surfaces that need to be flattened, there must be a set of software tools for digitally unwrapping them to produce readable images. Third, substantial computational requirements must be in place to support the collaborative, consistent manipulation of large amounts of data.

There are several non-invasive scanning technologies that can produce complete 3D views of the insides of objects. Computed Tomography (CT) scanning is based on X-rays that pass through a material. Magnetic Resonance Imaging (MRI) uses signals resulting from an induced magnetic field. Ultrasound can recover material structure using echoes that return from emitted sound waves. Clearly the imaging process to be used as the basis for virtual unrolling must produce a very high resolution, and must be able to distinguish clearly between the components of interest: ink and substrate material.

We have used a custom CT scanner to demonstrate preliminary results. Figure 1 shows a sample papyrus fragment that has been embedded in polyurethane. As a result it is completely inaccessible, making non-invasive scanning essential.

Figure 2 shows one of the papyrus samples being entombed in the resin. The CT scan produces a set of slices that penetrates the entire object, one of which is shown in Figure 3.

Figure 3 shows an edge-on view of the coiled papyrus. The scan was taken orthogonally to the axis of the roll, so that each slice appears as a spiral. The intensity variations along the cross-appears as a spiral. The intensity variations along the cross section result from ink on the papyrus.

Even though this scan contains a very clear signal (brighter intensities) where text is written on the papyrus, the slice-based representation makes it impossible to read. Software to locate the surface of the papyrus in all the slices makes possible a transformation of the data to a meaningful, readable representation. The result is a surface positioned readable representation in the CT data at exactly the right place to show the ink response.

Figure 4 shows the geometry of such a surface response without the texture that it will inherit from its position in the scan. Once this surface is correctly positioned, a simulation to unroll it (Figure 5) produces a flat 2D image of the text (Figure 6). The side-by-side comparison of Figure 6 to the photograph of the original papyrus in Figure 7 gives a taste of what virtual unrolling could provide in terms text quality. Results this good from a real scroll would be a breakthrough.

A working system to be applied to scrolls will need to improve some aspects of this prototype. It is crucial for the scan to reveal the ink and for the sampling rate of the scan to be very high. This resolution requirement implies the need for a high-performance computing and storage environment. A few back-of-the-envelope calculations illustrate the point. The scanner needs to be able to sample so that the writing in every layer can be resolved. The papyrus in the Herculaneum scrolls averages about 100-200 microns in thickness, meaning that a minimum sampling size of 50 microns is required to see something on every layer. This minimum sampling rate yields about two samples per layer of papyrus, or 20 samples per millimetre. It would take a slice resolution of 1600x1600 to scan a scroll with a diameter of 8cm. A complete (single-power) scan at this resolution could easily generate 15 gigabytes of data. Add to this the need for multi-power scanning in order to improve the procedure's ability to distinguish ink — the data sizes can really start to grow.

There have been a number of technical advances applied to the task of reading the scrolls from Herculaneum over the past two hundred years. Advances in optics (microscopes) and lighting produced a huge step forward, followed by the more recent confluence of multi-spectral imaging techniques and the digital image revolution. These remarkable imaging techniques and the superb resolution and availability of digital imaging software have already decoupled the process of analyzing primary materials from the need to have the primary source immediately available.



**I believe that a successful system for virtual unrolling could be the ultimate technological tool for the most belligerent (and unexamined) scrolls in the Herculaneum collection. As discussions continue about whether or not to continue excavations at Herculaneum, it is worth pointing out that virtual unrolling may allow an unprecedented capability to analyze any unopened scrolls that are found. This kind of analysis would require a much lower investment from conservators. Perhaps this and other technological innovations that ease the burden of handling and analyzing newly discovered scrolls can open the way for the discovery of what remains in Herculaneum.**

**From:**

**<http://www.humnet.ucla.edu/humnet/classics/Philodemus/Philhome.htm>**

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# **The Philodemus Project**

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**Mount Vesuvius as seen from the North side of the Bay of Naples. Herculaneum is at the foot of the mountain, toward the left. In the left middle-ground is the Castel dell'Ovo, constructed in 1154 on the island of Megaris, where the first Greek settlement at Naples, 'Parthenope', was founded; in Philodemus' day Lucullus had his villa on this island.**

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**When Mount Vesuvius erupted in 79 A.D., it buried two towns. One of these was Pompeii, now among the most familiar archaeological sites in the world. The other was Herculaneum, a seaside resort which was home to the villas of wealthy Romans who would come to the beautiful Bay of Naples to escape the heat and hubbub of the capital. Herculaneum has proved difficult to excavate, buried as it is beneath ca. 20 meters of concrete-like material, the hardened volcanic mud which covered it 2,000 years ago and to whose thickness subsequent lava flows**

have added. Early excavations in the city were conducted by digging wells and tunnels into this rock and exploring for ancient treasures.

In 1752 workers tunneling into a large, wealthy villa which would have overlooked the Bay in antiquity discovered a large number of what appeared to be sticks of charcoal, some of them bundled together. Upon closer inspection, these sticks proved to be rolls of the ancient writing material papyrus. Numerous attempts to open these rolls and read their contents failed, due to their extreme fragility and the fact that they were burnt by the ca. 300 degree Celsius volcanic flow, compressed by the weight of rubble and mud, and congealed by water. Eventually, several hundred of the rolls were partly cut apart and partly unrolled. Most turned out to be works of Epicurean philosophy, with books by the first century B.C. Epicurean philosopher Philodemus of Gadara, who came to Italy around 80 B.C., especially well represented. Apparently, the Villa of the Papyri contained an extensive library, a significant part of which was formed by a library of Epicurean texts, some of which were present in more than one copy.

The difficulties involved in unrolling, reading, and interpreting these texts were formidable. Naples was not a particularly hospitable destination for classical scholars. Finally, the philosophies of the Hellenistic schools were neither well-known nor highly regarded until quite recently. These factors combined to cripple scholarly interest in and use of the Herculaneum papyri. Recently, however, in part due to the efforts of the International Center for the Study of the Herculaneum Papyri, these rolls have been the object of renewed scholarly work and have yielded many findings indispensable for the study of Hellenistic philosophy.

The Philodemus Project is an international effort which aims, supported by a major grant from the National Endowment for the Humanities and by the generous contributions of individuals and participating universities, to reconstruct new texts of Philodemus' works on Poetics, Rhetoric, and Music. These texts will be published, along with translations and notes, in a series of volumes by Oxford University Press.

The Project's Directors are David Blank (UCLA), Richard Janko (University College, London) and Dirk Obbink (Christ Church, Oxford). Individual texts in the series are also being edited and translated by David Armstrong (University of Texas, Austin), Robert Gaines (University of Maryland, College Park), James Porter (University of Michigan), and Costantina Romeo (Sorrento). Other participants in the Project include Daniel Delattre (C.N.R.S.) and Michael Wigodsky (Stanford).

The Project's first volumes are scheduled to be: *On Poems I*, edited and translated by Richard Janko

*On Poems V*, edited and translated by David Armstrong, James Porter, Jeffrey Fish, and Cecilia Mangoni

*On Rhetoric I-II*, edited and translated by David Blank

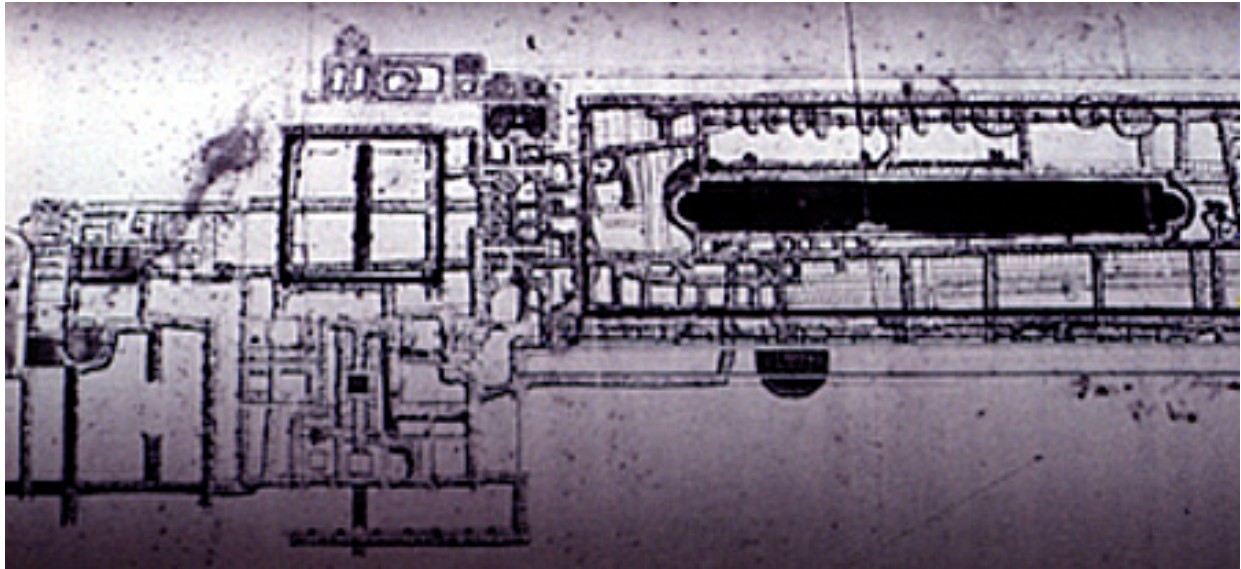
***On Rhetoric III*, edited and translated by Dirk Obbink and Juergen Hammerstaedt**

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**The J. Paul Getty Museum in Malibu, a modern version of the Villa of the Papyri at Herculaneum.**





Plan of the still-buried Villa by Swiss engineer Karl Weber, drawn on the basis of tunnels dug into the Villa in the early 1750's.



A detail from a Pompeian mosaic ("Plato's Academy", now in the national Archeological Museum in Naples -- tkw) shows a meeting of philosophers. Such meetings were held in the villas of prominent Romans, and Philodemus will certainly have participated in some of them; they may also have been held in the Villa of the Papyri at Herculaneum.

**A 5th century portrait of Virgil with a *capsa* or travelling box for papyri.**







**A detail from a Pompeian fresco shows an open capsa. Some papyri were found in such a box near the entrance to the long peristyle of the Villa's garden. Perhaps there was an attempt to remove these papyri to safety before they were buried by the volcanic mud.**



**A now lost relief from Trier shows a shelf of papyrus rolls (4th century). Wooden shelves holding papyri were found in one of the rooms just inside the entrance to the Villa from the long peristyle.**

# Herculaneum Papyri before Unrolling

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An unopened papyrus roll from Herculaneum. Many such rolls, mostly those less tightly stuck together than this example, were taken apart with greater or lesser success in the later 18th and 19th centuries. Their outer layers were cut off to expose the central windings, which were often less badly damaged than the exterior portions and could be unrolled on Piaggio's machine (pictured below). Each roll, or each of the

pieces into which they had fallen or been cut by ca. 1806 was given an inventory number: *P(apyrus) Herc(ulanensis) 1234*. Our task now is to discover to which originally whole roll each of the inventoried pieces belongs, and then to determine its place in that original roll.

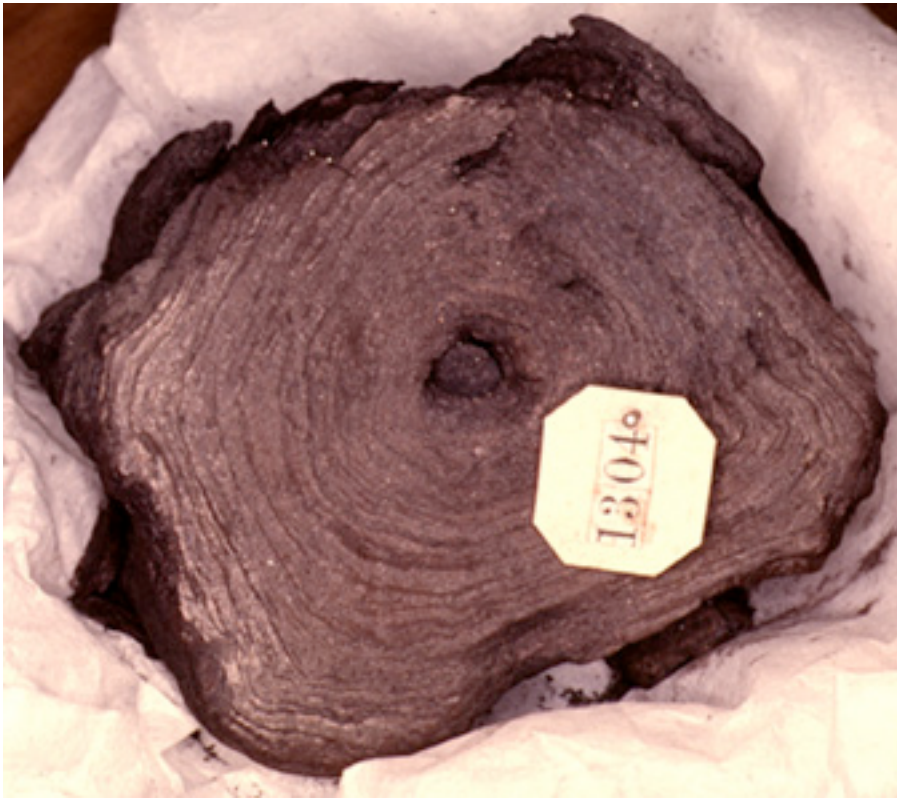


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Six papyrus rolls compressed into one lump by the weight of debris in the Villa.

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**The end of a carbonized papyrus roll with small umbilicus, the central stick around which the papyrus was wound.**

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**Pieces of a small, flat umbilicus (ca. 1 cm. in width).**

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Piece of a large umbilicus (ca. 2 cm. in diameter).

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The machine invented by Fr. Antonio Piaggio in 1756 for unrolling papyri. A papyrus roll is visible on the support at the bottom of the machine; its leading edge is pierced by silk threads which were attached to the screws at the top of the apparatus. As the edge of the papyrus was allowed slowly to separate from the layers of papyrus beneath it, the threads could be tightened so as to take up slack and keep a light and easily regulated pull on the papyrus' edge. The papyrus would unroll more or less continuously from the outside of the center of the roll (the *midollo* or 'marrow'). The layers of a piece cut off from one side of a roll (a *scorza* or 'bark') would come off separately onto the membranous strips coated with glue which would serve as a backing and keep the pieces of papyrus from further disintegration.

## The Papyrus of Rhetoric I

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The papyrus roll preserving this book originally contained 4,000 standard lines (ca. 32-38 letters) written in 237 columns, each with ca. 37 lines of ca. 16 letters. The roll was separated into a number of parts, each of which is called a 'papyrus' and bears its own inventory number (e.g., *PHerc.* [=Herculanean Papyrus] 1427), though it represents only part of the original roll:

*PHerc.* 1427 contains the last seven columns (along with fragments of four columns preceding them) and subscription--thus, the interior portion of the roll, the *midollo* or 'marrow', which could be unrolled continuously on Fr. Piaggio's machine;

*PHerc.* 234, 250, 398, 410, 426, 453, 1601, 1619 are all pieces cut from the external portions of the roll. Each of these 'papyri' was a series of layers of papyrus, written on their internal surface, a so-called *scorza* or piece of 'bark'. In the early 19th century each such stack was given to a draftsman who would draw its innermost surface, then scrape that layer off (destroying it in the process) in order to draw the layers underneath. These drawings (*disegni*) are our only source for the text of the interior layers. The outermost piece (sometimes two pieces) is all that survives of the original.




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*PHerc.* 1427, cornice ('frame') 1: the left hand portion contains four 'fragments', which are not connected (they have been mounted in such a way as to seem to form the tops and bottoms of two successive columns), but come from the



portion of the roll immediately preceding the continuous columns which are seen



on the right; on the right are the first four vertical columns of text.

*PHerc. 1427*, cornice 1, col. 4, the top of the column, including a correction written in the margin and over an erasure by the scribe: the text reads (the ends of the first three lines, now mutilated in the papyrus, are known from drawings made in ca. 1798):

parafero/nt[[it]]vn.

\_\_e)gw\ me\n ga\r [[m]] oi)=mai

dio/t[i], ka)\n lo/gwi pote\

'pei/qein' sunxwrh/s[hi] tina\[s

i)diw/tas, a)ll' ou)x o/(ti g[e] 5

be/lteion tw='n' texn[i-

tw=n e)/stai dedeixw/[s,

ou)de\ kata\ to\ i)/dion tou=

le/gein ou)de\ pukno\n



(>ou(/tws, w(s e)kei=noi. pol-) 10 {this line is not included in the photo}

Philodemus here criticizes various arguments which had been thought to show that rhetoric is not a proper 'expertise' or subject of expert instruction.

Translation of lines 2-10: 'For I think that, even if one allows that some laymen sometimes persuade by speech, one will still not have shown that they do so better than the experts, nor indeed that they do so in the proper sense of "speaking", and also not as frequently as the experts do'.



*PHerc. 1427*, cornice 2, col. 7, the ornamental flourish (*coronis*) indicating the end of the book's text (the photo on the left is unretouched, that on the left has been digitally enhanced in its contrast and brightness, using standard tools in Adobe PhotoShop”).

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**PHerc. 1427, cornice 2, end, with the last lines of the subscription indicating the name of the work (*On Rhetoric*), its genre (*hypomnematikon*), and book number (A [=1]), along with the number of lines (4,000) in the book and the number of columns ([2]37) in this copy.**

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**PHerc. 398, the outermost piece, all that survives of a stack of scorze. Note that the surface is not continuous, as upper layers have flaked off over time to expose layers beneath them, which are closer to the outside of the original roll. Seven of the interior layers of this stack were drawn in 1839, then each was destroyed as it**



was peeled off to reveal the layers exterior (beneath) it. The photo on the left is unretouched, that on the right has been digitally enhanced.

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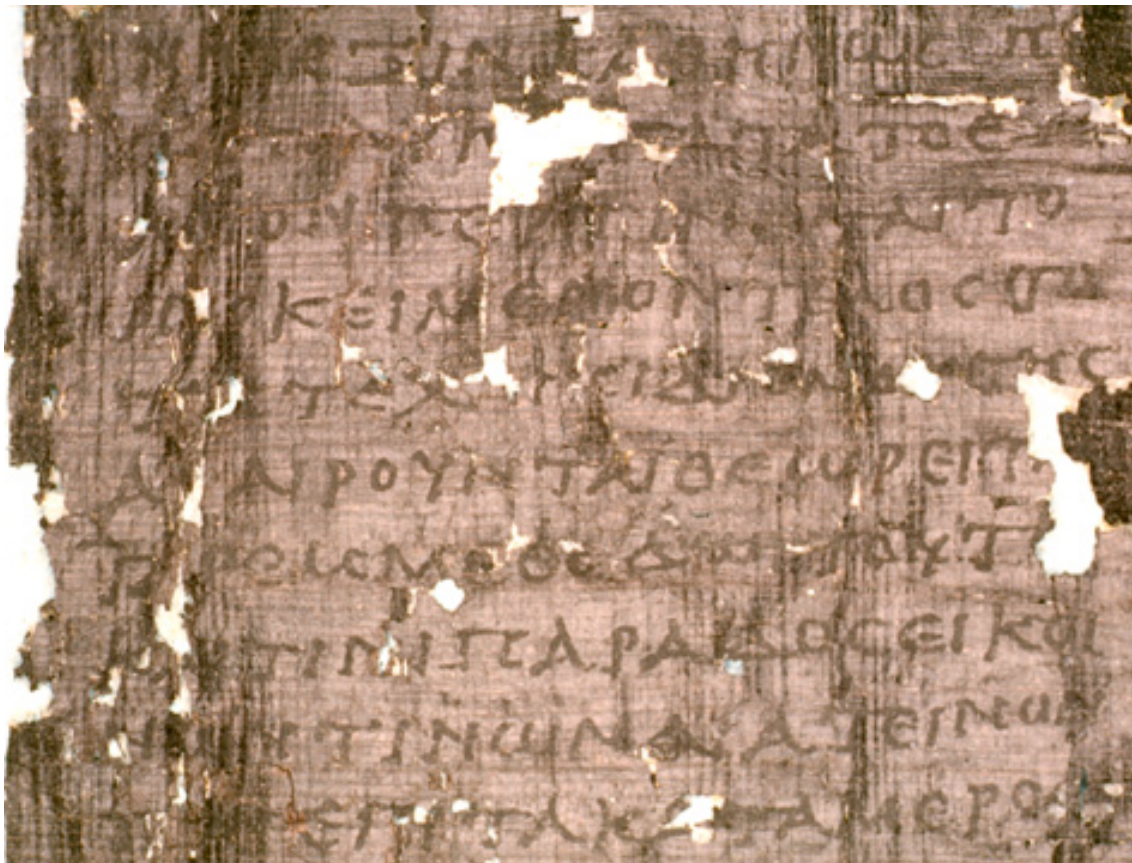


*PHerc.* 426, top, the outermost piece of a stack of *scorze*.

## Papyri of Rhetoric Ila

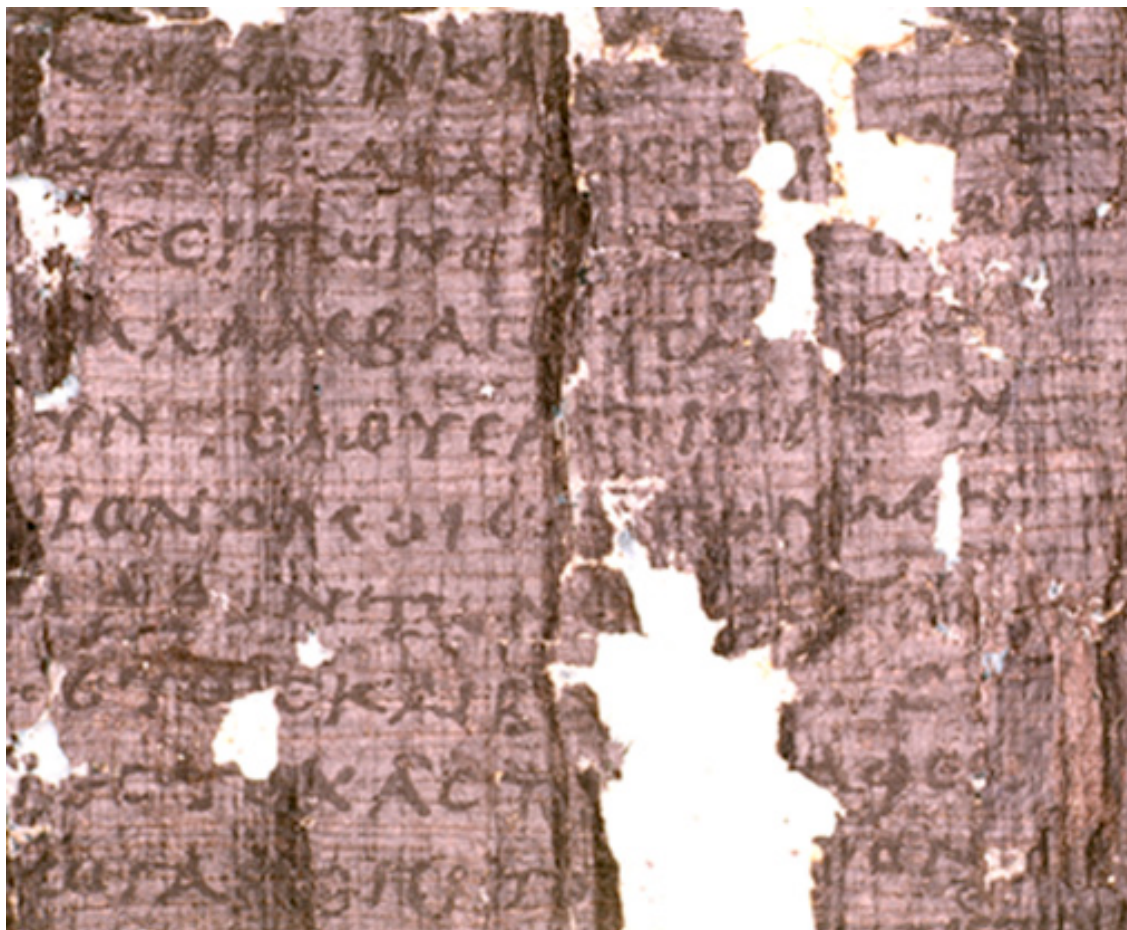
The second book of Philodemus' treatise *On Rhetoric* survives in two copies, here labelled 'Ila' and 'Ilb'. Copy Ila is preserved in a roll whose last portion ('midollo' or 'marrow', the last, interior windings of the roll), *PHerc.* 1674, consists of 12 'fragments' and 58 continuous columns of text. At the end of this roll is a notice giving the title, the generic indication 'hypomnematikon', and the number of lines (at least 4,200). The last ten columns of this roll overlap with the first eight of *PHerc.* 1672, which is labelled as book 2 of Philodemus' *On Rhetoric*. Thus, 1674 is another copy of the same book as 1672, only the latter's text continues for another 32 columns before reaching the end of the book. Apparently, the copy in *PHerc.* 1674 ran over onto a second papyrus roll, which does not survive, while the copy in *PHerc.* 1672, which is more compactly written, was made to fit onto one papyrus roll.

Several other pieces (*scorze* or 'bark') of the roll whose end is the midollo *PHerc.* 1674 have been identified: *PHerc.* 408, 425, 1079, 1086, 1580.



**PHerc. 1674 cornice ('frame') 8, column 30, lines 7-16**

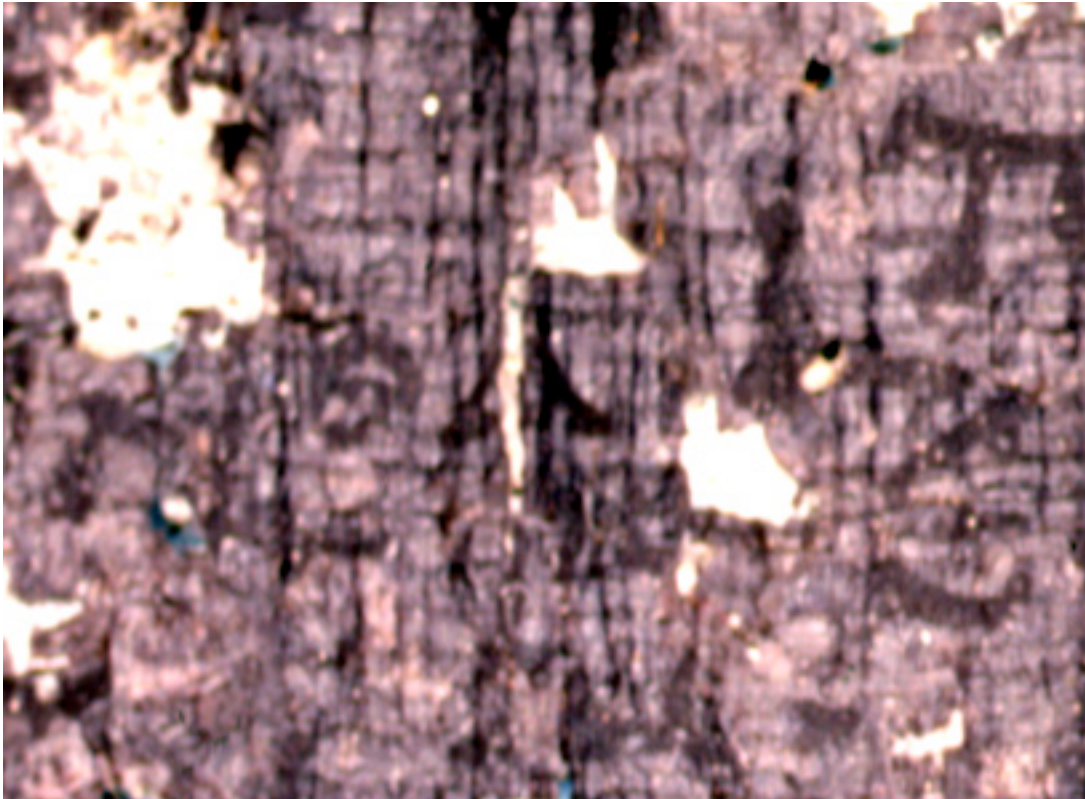
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***PHerc. 1674* cornice 9, column 38, lines 7-16**

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***PHerc. 1674* cornice 11, column 52, lines 10-12: At this point Philodemus begins his discussion of the Epicureans in Rhodes and Cos who argued against Zeno of Sidon claiming that, according to the founders of Epicureanism, no part of rhetoric was an expertise. The end of the preceding section of the text is marked with a dipole (>), and the new argument (beginning with the word enioi, of which the first letter is visible in this photo), which was evidently of particular interest, is marked in the margin with the word 'Here' ([e]|nqa|de).**



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**The middle portion of *PHerc. 1079*, the last remaining piece of a stack of scorze. Twelve of the layers above this one were drawn before 1839, but destroyed in order to get to the layers beneath them. Note that virtually no writing is visible on the badly damaged surface of this layer.**



The upper portion of *PHerc. 1580*, the outermost layer of a stack of *scorze*. Again, the condition of the writing on this piece is rather disastrous.

## Papyri of Rhetoric IIb

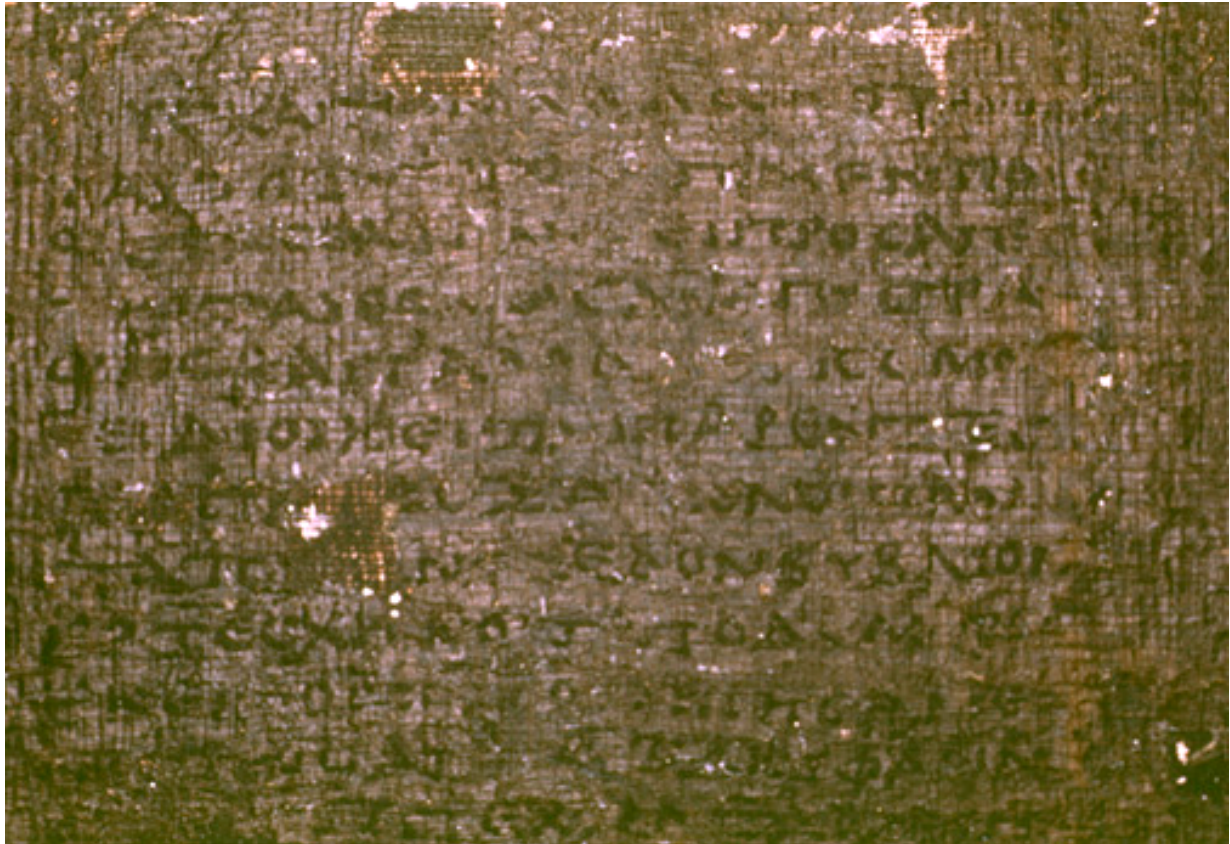
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The second book of Philodemus' treatise *On Rhetoric* survives in two copies, here labelled 'IIa' and 'IIb'. Copy IIa is preserved in a roll whose last portion ('midollo' or 'marrow', the last, interior windings of the roll), *PHerc. 1674*, consists of 12 'fragments' and 58 continuous columns of text. At the end of this roll is a notice giving the title, the generic indication 'hypomnematikon', and the number of lines (at least 4,200). The last ten columns of this roll overlap with the first eight of *PHerc. 1672*, which is labelled as book 2 of Philodemus' *On Rhetoric*. Thus, 1674 is another copy of the same book as 1672, only the latter's text continues for another 32 columns before reaching the end of the book. Apparently, the copy in *PHerc. 1674* ran over onto a second papyrus roll, which does not survive, while the copy in *PHerc. 1672*, which is more compactly written, was made to fit onto one papyrus roll. This was the second roll whose midollo was unrolled using the 'machine' of Father Piaggio (in 1756); Piaggio was so pleased with the way it came off the roll in a continuous sheet, that he insisted in



a lengthy memorial to the Bourbon Secretary of State that this papyrus not be cut into shorter pieces for display on the museum wall, but rather preserved as one piece and displayed in a specially-built wooden case.

Several other pieces (*scorze* or 'bark') of the roll whose end is the midollo *PHerc.* 1672 have been identified: *PHerc.* 408, 409, 1117, 1573, 1574. Some of the fragments grouped under these inventory numbers represent the second copy of bits of text also found in *PHerc.* 1674 and in the fragmentary initial parts of that same roll.

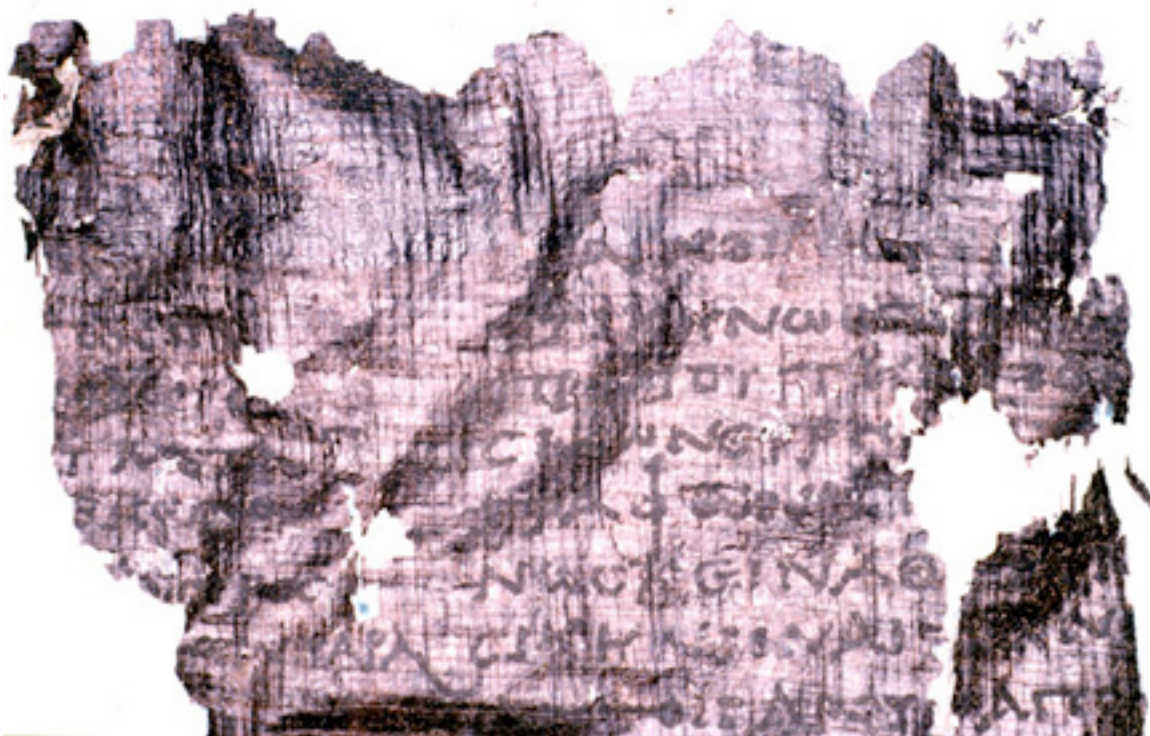


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*PHerc.* 1672 column 10, lines 1-12 (tentative reconstruction): e)mpei/-|| rous kai\ tw=n a)llwn, o/(ti ou) | tau/thi tou=to [le/]gomen pa| ri/stasqai, plh\[n] ei) prosa/ge| tai tau=q' o(/mws dia\ th=s gra| fh=s. kai\ ta)=lla peri/semn[on] | [[n]] ei) dioikei=tai, pare/ntes | ka[i\] pa[ra]deja/menoi pa/n| ta to\ pa=n sxedo\n bubli/on | katesxhko/ta, to\ de\ me/ros | e)kei=no mo/non hghsa/me| noi pros au(tou/s, di' ou(= f[[a]]hsi[[n]] | r(htw=s ta)/texna [[ta]] me/rh |  
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***PHerc. 1574***, a stack of *scorze* which were separated by attaching goldbeater's-skin to the back of each successive piece and removing it from those on its interior side; unlike the method of beginning from the interior layer and scratching away each successive layer, this method preserves the internal layers. Note that the outline of each successive piece is not identical, presumably due to the loss of material at the edges, which stuck to other layers.

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The top portion of the first (presumably the outermost) fragment of ***PHerc. 1574***.

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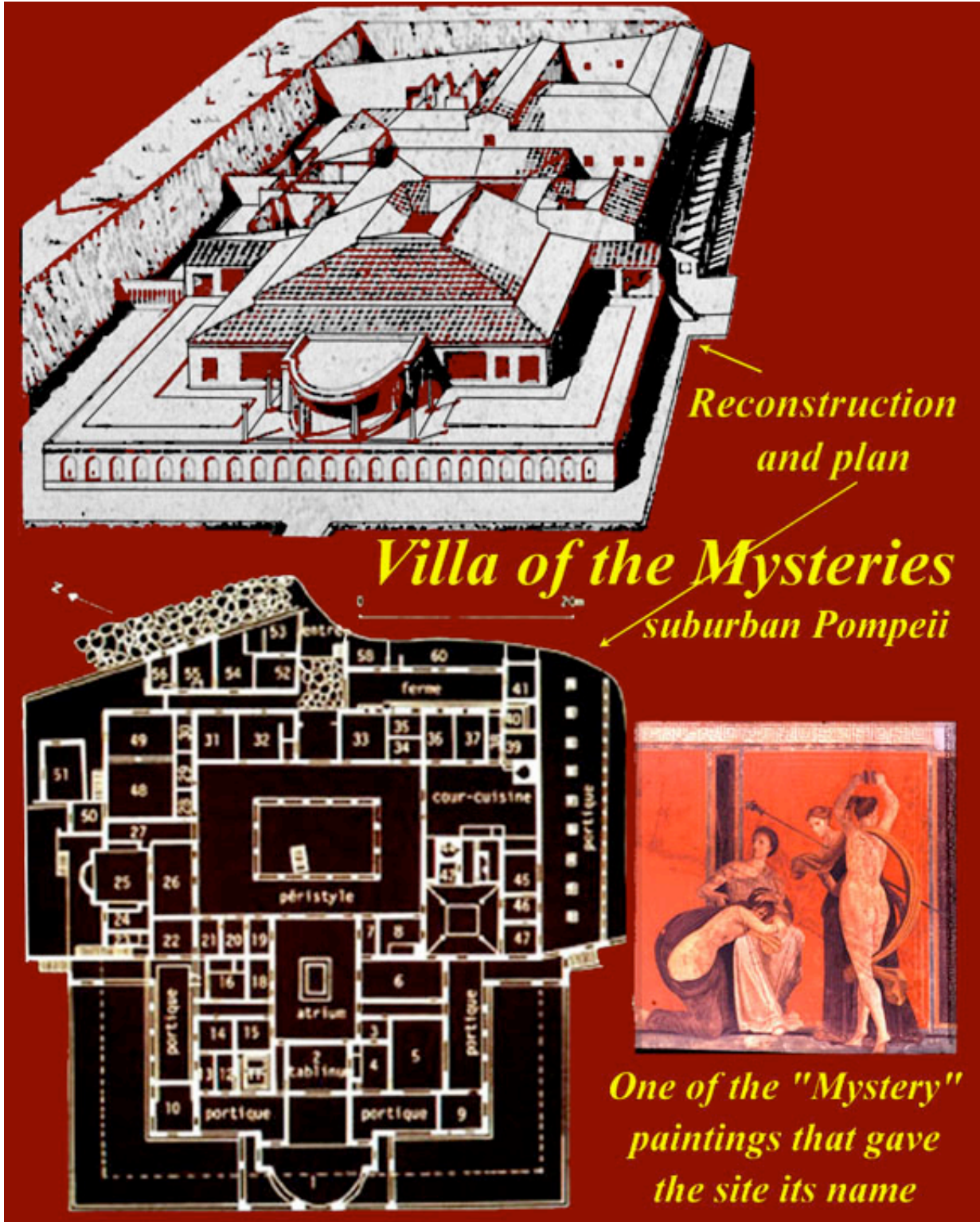
***PHerc. 1573*, the outermost layer of a stack of scorze: this is what remained after each of the interior layers of the stack had been copied and scraped away.**

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The top half of the surviving (outermost, but drawn as the last-numbered fragment) layer of the stack of *scorze* inventoried as *PHerc. 1117*.

## Unit 6



# ***Villa of the Mysteries, Pompeii***



Villa of the Mysteries, Pompeii

## ***The Mystery Fresco Cycle***

This villa, built around a central peristyle court and surrounded by terraces, is much like other large villas in suburban Pompeii. The Initiation Chamber measures 15 by 25 feet, and is located in the front of the villa on the right side. Note that the reconstruction image on the cover sheet of this handout is a view from the back of the villa. Similarly, the front of the Villa is at the top of the accompanying plan.

The chamber is entered through an opening located between the first and last scenes of the fresco. The frescoes are "second style" and were painted during the reign of Augustus (30 BC to 14 AD).

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The term "mysteries" refers to secret initiation rites of the classical world. The Greek word for "rite" means "to grow up". The rites we see in the Villa of Mysteries seem to be aimed at preparing privileged protected girls for the psychological transition to life as married women. There are few written records about mystery religions and initiation rites.

### **The Frescoes**

At the center of the frescoes are the figures of Dionysus, the one certain identification agreed upon by scholars, and his mother Semele (other interpretations have the figure as Ariadne). As he had been for Greek women, Dionysus was the most popular god for Roman women. He was the source of both their sensual and their spiritual hopes.

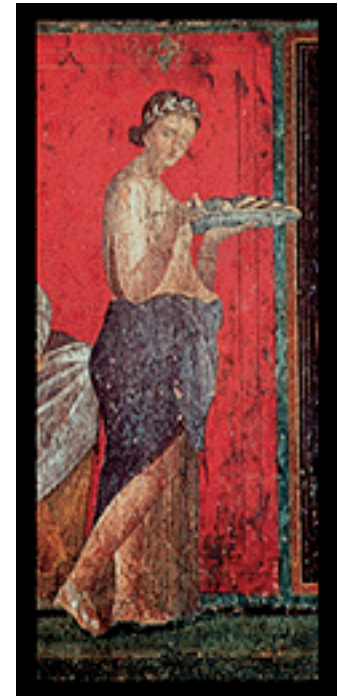
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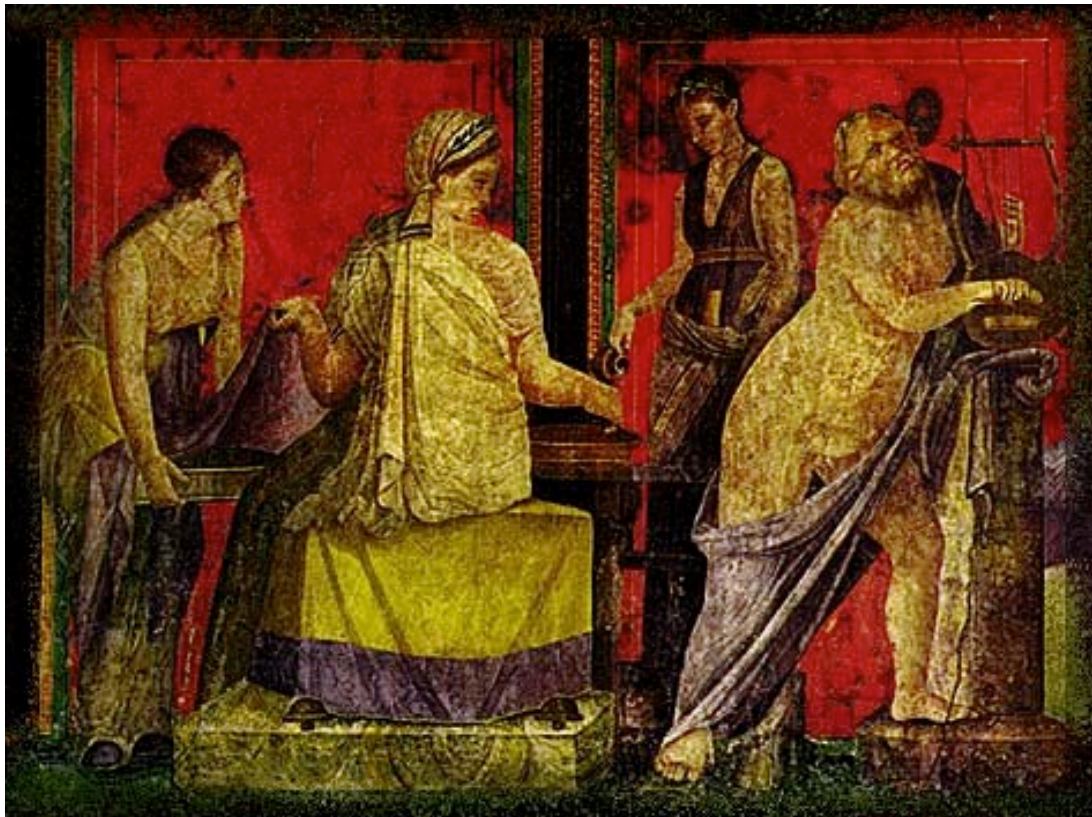




The action of the rite begins with the initiate or bride crossing the threshold as the preparations for the rites begin. The nudity of the boy may signify that he is divine.



To the right, the initiate, now more lightly clad, carries an offering tray of sacramental cake. She wears a myrtle wreath. In her right hand she holds a laurel sprig. She appears to be in the advanced stages of pregnancy.



She

approaches another priestess seated at a table with her back to us, flanked by two attendants. They appear to be preparing ablutions: according to Nor Hall, a veiled basket for the mystery, and poured water for clarity (38). Silenus, the old

drunken god, plays a lyre at far right.

Mythological characters and music are introduced into the narrative. An aging Silenus plays a ten-string lyre that is resting on a column. A young male satyr plays pan pipes, while a nymph suckles a goat.

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Music-making and dancing were part of the mythical ritual of the cult which took place in secluded woods, and lactating women who joined the festivities were moved to feed baby animals, an act thought to be an affirmation of their unity with nature. Ignoring these figures, the initiate looks in terror at something happening

across the room, her cape flying over her head, her feet perhaps poised to run away.

The initiate has a glimpse of what awaits her in the inner sanctuary where the *katabasis* will take place.

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The walls of the room now take a 90-degree turn, and the viewer sees a short wall with a tableau that centers upon an enthroned Ariadne, consort of Dionysus, with the god draped languorously across her lap. The middle top portion of this is damaged and most of Ariadne is destroyed. Scholars have deduced that it is indeed Ariadne based on similarities to other images featuring her and Dionysus in that pose. To the viewer's left, Silenus and two satyrs peer into a bowl, while one holds up a scary mask. To the right, the initiate appears on her knees, about



to unveil a phallus in a winnowing basket, while two priestesses look on. At the far right, a winged figure raises a whip, about to strike. (Some analysts say that the female figure holding Dionysus is Semele, his mother, and that this scene is the prototype of numerous Christian "Pieta" scenes.)

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The figure with the whip (Goddess?) is ready to strike the initiate whose image appears on the next wall (i.e., after another 90-degree turn). The viewer sees the



initiate in two opposing poses: the first disheveled, lying across the lap of a priestess, her arms wrapped around her head as the priestess gently uncovers



her back to take the blows of the whip; the second is in an ecstatic, dancing pose. Naked except for a billowing veil, the initiate raises her arms and plays finger cymbals as she gleefully celebrates her successful navigation of the ritual ordeal and her identification with the god. Behind her, a priestess offers her the *thyrsus*, the symbolic staff of Dionysus. The two themes of this scene are torture and transfiguration, the evocative climax of the rite.



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← This scene represents an event after the completion of the ritual drama. The transformed initiate or bride prepares, with the help of an attendant, for marriage. A young Eros figure holds a mirror which reflects the image of the bride.



This figure variously → has been identified as the mother of the bride, the mistress of the villa, or the bride herself (and, if the last, on the bridal bed).



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← Eros, a son of Chronos or Saturn, god of love.

**Διοτίμα**

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# ***The Mysteries of Dionysus at Pompeii \****

R. A. S. Seaford



The Dionysiac Mysteries of my title are those depicted in the famous fresco uncovered in 1909 in the so-called 'Villa of the Mysteries', just outside Pompeii on the road to Herculaneum. Most surviving ancient painting, with the exception of vase-painting, is from the cities covered by the eruption of Vesuvius in A.D. 79. And of this our fresco is perhaps the finest specimen. But my primary interest is not in its aesthetic but in its religious significance. In fact of course these two aspects of the fresco, the aesthetic and the religious, are not distinct - something which is perhaps difficult to appreciate fully for those brought up in a Protestant tradition.

Painted towards the middle of the first century B.C., the fresco has been fairly well preserved by the volcanic eruption that destroyed its beholders. And inasmuch as the frieze goes around the four walls of a smallish room (22 ft. by 15 ft.), we may, by standing in the middle of the room, find ourselves inside the represented events: an unusually direct relationship with an ancient spiritual document, comparable perhaps to acting in a Greek play. But the immediacy of our aesthetic response will be enriched beyond measure if combined with an understanding of the religious significance of the obscure events on the walls around us.

**This understanding does not come easily. The fresco depicts the process of initiation into the mysteries of Dionysus. And initiation is something that we find difficult to understand because our society has developed in such a way as to have eliminated it, apart from a few vestiges, such as baptism and University Degree Ceremonies. If on the other hand we look at those societies that are commonly called 'primitive' we find initiation ceremonies of various kinds. In particular, we are likely to find a ritual of initiation, which, for want of a better term, I will call 'tribal initiation': this is the ritual by which the young people are converted into full adult members of the tribe or community. It has been documented in various parts of the world: Africa, Asia. Australasia, Polynesia, Europe, North and South America; and although of course no two examples of the ritual are identical, the general similarity between the numerous and widespread cases is so striking that it is worth our while to construct a rough morphology of tribal initiation, that is to say an account of its most general features and structure. Morphologies of this kind have indeed been constructed by comparative anthropologists, most recently and thoroughly by Angelo Brelich.[1]**

**Summarizing the morphology of tribal initiation, speaking, that is, in the most general terms, we may say that the most central and typical features of the ritual are the following: the initiands undergo seclusion at some distance from the community, instruction, purification, beatings, contests, special food, a special dress (notably transvestite or in animal skins), the revelation of sacred and mysterious objects, death and rebirth, contact with the regenerative powers of nature, and finally marriage or the first act of sexual union. All of this is kept carefully secret from all save the initiated. The fundamental importance of this kind of ritual in the life of the community can hardly be overestimated, inasmuch as this is the ritual by which the clan or tribe creates and perpetuates itself and its culture. The novices die as children and are reborn as adults; they learn the myths and ritual of the tribe; they experience the rites which they have from early childhood known as inevitable and yet utterly mysterious and terrifying; they pass from ignorance to knowledge, which may include sexual knowledge; they become full adult members of the tribe; they acquire, in effect, knowledge of the Mysteries.**

**Among societies in a primitive stage of development, tribal initiation usually possesses a central position in the social and religious life of the community. And so when these societies develop and disintegrate, the function of tribal initiation cannot remain unchanged. And in fact it does tend to change in various characteristic ways. Firstly, it tends to lose its central position. But precisely because of its original centrality, and importance, the ritual does not disappear. It persists in various forms, in ritual with a new function derived from the old, or as a shadow of ritual in myth. One characteristic feature of the development or decline of the ritual is the gradual reduction of the number initiated. Originally, it seems that everybody (or at least every man) is at certain age initiated into his kinship group, his clan or tribe. But then the number initiated may decline to a smaller group or a representative individual. (The reasons for his decline are obviously of great interest, but outside our present scope.) The typical smaller group of initiates is the secret society, which may be modeled on the old clan; the**

typical representative individual is the priest-king. Initiation into a secret society is generally of the same type as tribal initiation. And coronation of the priest-king is a specialized rite of tribal initiation. Indeed it may be possible to show that the magic religious powers still conferred by the coronation in Westminster Abbey derive ultimately from the powers conferred in initiation on the rising generation as a whole. We tend to be uninterested in anything that the Greeks have in common with 'primitive peoples', to regard the whole process of comparison as somehow suspect. This is partly because philhellenes have, unconsciously for the most part, taken the Greeks as a model and guarantee of their own supposedly civilized conceptions of what society and religion should be. And yet for two generations it has been recognized by some that certain elements of Greek civilization are best understood in the context of comparative anthropology. The Greeks are not after all set mysteriously apart. I am not a comparative anthropologist; and yet my study of the particular subject of tribal initiation has convinced me (and I am not alone in the conviction) that among the ancient Greeks, a people no longer wholly 'primitive', we find rituals which are both strikingly similar to 'tribal initiation' and different from it in precisely the respect that the observable development of tribal initiation leads us to expect at an advanced stage of that development. This is to say that in the process of the decline of initiation the Greeks stand somewhere between our own society, which has lost all save a few traces of initiation, and those primitive societies in which tribal initiation has retained its central importance. Once fully appreciated, this point sheds a flood of light on the origins of numerous features of Greek myth and religion, of which we are limited here to a small sample. Initiation into the Greek mysteries is, I believe, derived ultimately, by a characteristic process of development, from tribal initiation. Not only is almost every item of our morphology of tribal initiation found also in initiation into the Greek Mysteries, but furthermore the structure and function of the two kinds of initiation are closely related.

The Mysteries of Dionysus were not the only Mysteries into which one might be initiated in the Graeco-Roman world. There were also the famous Mysteries at Eleusis, for example, as well as the Mysteries of imported Oriental gods such as Sabazios, Isis and so on [of course, including the Christian stuff – tkw]. All these initiations, because they are all derived ultimately from the same kind of ritual, resemble each other, and because they resemble each other they tend to fuse with each other: one initiatory cult may contain features drawn from another initiatory cult sacred to another deity (an obvious example is the peripheral association of Dionysus with the Mysteries of Demeter at Eleusis). But the deities are of secondary importance; the initiations themselves, in the name of whatever deity they are performed, exhibit the same basic pattern: the fate of the initiand is radically altered by a ritual in which he is purified, he is instructed, he sees and hears sacred things, together with certain other features such as the eating of a special meal and the assumption of a special dress.

I must pause here to clarify two basic points. Firstly, the word 'initiation' implies initiation into something. I have spoken of initiation into the Mysteries of Dionysus. In the ritual of tribal initiation it is perfectly clear what the novice is being initiated into: he is being initiated into the clan or the tribe, into the adult

community. But what happens when this community loses its coherence, for example when all power becomes vested in a smaller group within it, when the community disintegrates in one way or another? - that is to say, when the entity into which the novice is initiated ceases to be a coherent entity at all? What appears not to happen in these circumstances is the simple disappearance of the ritual: it is too important and significant for that. The ritual survives, but with a new function: it may effect entry into a smaller group within the community - the secret society, for example - or it may cease to effect entry into any group at all: that is, while no longer conferring social benefits, no longer changing the social status of the initiand (making him a full adult member of the community), it may nevertheless continue to confer the magical and religious benefits that it has always conferred. Thus there is a sense in which we can talk without absurdity about initiation rites where nobody is being actually initiated into anything very definite. To illustrate this point it might be helpful to take one of the few remaining examples of initiation in our society, the University Degree ceremony. An MA ceremony, for example, is actually an initiation into something, into the community of MAs. This act of incorporation once had far more significance than it does today, because the MAs once formed a more definite, coherent body than they do today. Indeed, I venture to suggest that the ceremony nowadays is generally conceived not as an entry into a guild of learned men, but as a piece of ritual or a picturesque tradition, valued for its own sake: the society of MAs is there in the background, but with no more than a shadowy and incoherent existence.

The second point concerns primitive conceptions of life and death, which are entirely different from our own. (Here I must perform even more dangerous feats of abstraction and simplification, in an area in which I have no detailed knowledge.) Primitive society tends to be divided into various grades, of which the most typical are CHILD, ADULT, ELDER, and ANCESTOR. In general, transition between the grades is effected by a rite of passage, of which the most important tends to be what we have called tribal initiation, which effects the transition between child and adult. Usually tribal initiation requires the death and rebirth of the initiand - and often not as a metaphor: in the eyes of all those concerned the initiand actually dies and is reborn as a new person; the child dies and an adult is born. If the most crucial of transitions is not physical death (what we call death) but the momentous transition through death from child to adult, then there is a sense in which tribal initiation is initiation not just into the adult community, but into the adult community of living and dead. The adults, the elders and the ancestors are often loosely associated with each other: e.g. in the ritual of tribal initiation the older men (the initiators) are often found impersonating or embodying the ancestors.

Now, when tribal initiation develops in the ways that I have mentioned, what happens? Firstly, the idea that the initiand dies and is reborn may be weakened, or disappear altogether. Secondly, as the ritual ceases to be an entry into the community of the living, it may nevertheless of course continue to be an entry into the community of the dead. Ceasing to be a preparation primarily for life, it becomes a preparation primarily for the afterlife. This is the fundamental fact underlying most mystery-religions. Scholars sometimes argue about Dionysiac



and other mysteries, as to whether they concerned the afterlife or not. If we bear in mind the origins of mystery religion, the ambiguity of the evidence for whether the mysteries concerned the afterlife or not is precisely what we expect. For example, initiation into the Dionysiac secret society (or '*thiasos*') may be incorporation into an actual living community, which is nevertheless also a community of the next world. It secures the fate of the initiated in this world and the next: when compared with the unforgettable experience of his initiation, the physical death of the initiate hardly counts as a transition at all. (TKW note: c.f., Christian "Confirmation" – "born again?", Jewish Bar Mitzva, etc.)

To be initiated into the Eleusinian Mysteries was not to be initiated into a clearly defined community. But it did ensure a happy existence, particularly in the next world: 'Happy is the man' says the Homeric Hymn to Demeter (480-82) 'who has seen these Mysteries [the Eleusinian]; but he who is uninitiated, who has no part in the Mysteries, does not have a share of the same things after death.' In Aristophanes' *Frogs* Herakles tells Dionysus of the [Eleusinian] initiands whom he will later see in the underworld enjoying the benefits conferred by initiation: they are grouped in bands, in *thiasoi*. This suggests that although the Eleusinian Mysteries were primarily a ritual conferring benefits on the individual, they were also to some extent an initiation in the full sense: that is, they effected the initiand's entry into a community, a *thiasos* (just as Dionysiac initiation effected entry into the Dionysiac *thiasos*) - albeit these Eleusinian *thiasos* had as far as I know a shadowy existence, confined to the enactment of the ritual and to the next world.

The *thiasos* is associated especially but not exclusively with Dionysus. On the one hand there are real Dionysiac *thiasoi* - secret associations of people meeting and performing ritual in his honour - and on the other hand there are mythical Dionysiac *thiasoi* - for example those in Euripides' *Bacchae* - which are of course mythical pictures of real *thiasoi*; and even the actual *thiasoi* tended to conceive of themselves in mythical terms, as Nymphs and satyrs, for example, the companions of Dionysus. The characteristic features of the mythical as of the real *thiasoi* are the performances of dances (particularly ecstatic dances), a strong sense of solidarity, a distinctive tradition, a distinctive ritual, and distinctive accoutrements such as the thyrsus and fawn-skin. The female *thiasos* is composed typically of Maenads, the mythical male *thiasos* (and sometimes also the actual male *thiasos*) of satyrs. Sometimes, especially in myth, the *thiasos* is imagined as united by kinship.

The Dionysiac *thiasos* is of course a religious association; but the word *thiasos* also occurs in fifth-century Athens to denote a social grouping, a subdivision of the *phratry*: that is to say it refers to a social grouping based nominally at least on kinship (the *phratry* is nominally at least a group of kin). The French scholar Louis Gernet believed that the religious associations known as *thiasoi*, like those known as *orgeônes*, were derived from, or modeled on, ancient social groupings - units of society like the *phratries*.<sup>[2]</sup> These social groupings, based largely on kinship, had religious as well as social functions (the two being hardly separable); as Society developed the social *thiasoi* disintegrated; but because of their fundamental hold on the emotions of the people, they did not simply

disappear: their religious functions persisted; they survived, no longer as kinship groupings with religious functions, but as purely religious associations. People related to each other not by kin but by sentiment meet to perform the ancient collective clan rituals, the rituals of the old order. This is why, in myth and in reality, the Dionysiac *thiasos* appealed in particular to the humble and downtrodden, notably to the women of a fiercely patriarchal society. Those who had no part in the society of the day found a sense of belonging in the *thiasos*, in the more immediate and familiar social relations and ritual of the society of yesterday. And so the *thiasos*, although a merely religious association, an intense shadow of its former self, might nevertheless come into conflict with the authorities of the day: this is the conflict embodied in Euripides' *Bacchae*.

Our hypothesis is that initiation into the Dionysiac *thiasos* is derived from a ritual both ancient and fundamental; the initiation of the youth as full members of the clan. The connection between this hypothesis and our fresco lies not just in the interpretation of certain details, nor just in the principle that a full understanding of anything of this kind requires some account of its origins and development. There is more to it than that: it is only by reference to the traditional power and significance of initiation, which derives from its social origins, that we can understand how a ritual of the type found in this fresco and elsewhere exerted such a profound, widespread and persistent attraction, here, in the fresco, in scene F, is a naked girl being whipped; there, in scene C is a satyr giving suck to a fawn; between them, in scene E, a drunken god sprawls against his friend. Now this is a splendid villa, its owners people of urbane and sophisticated taste. How seriously did they take the fresco? Would they see it rather as we see a painting of a rustic ritual by Poussin? Or should we go further and say that the painter clearly had an interest in the rituals for their own sake, and that the owner of the villa was probably a connoisseur of the mysteries of Dionysus? We should say neither of these things; this is not mere connoisseurship. Unlike any other painting I know, the fresco expresses the emotions of an actual ritual, a religious experience.

I have said that the Dionysiac *thiasos* appealed in particular to the powerless and the oppressed. That seems to be true in general of the classical period of Greek history. Here, in first-century BC Pompeii, we find it in more splendid circumstances. In expanding up the social scale Dionysiac mystic ritual exhibits a typical tendency, exemplified also by early Christianity.

The best of the early evidence for initiation into the Dionysiac mysteries is provided by Euripides' *Bacchae*. In particular, it has never been realised that the change of personality and dress undergone by Pentheus in the course of the play is based on the ritual of initiation into the Dionysiac *thiasos*: an allusion recognisable at least to those in the audience who had been themselves initiated. In the Hellenistic and Imperial periods evidence for the Dionysiac *thiasoi* increases - inscriptions, references in ancient authors, tomb reliefs, paintings and so on - and in particular there is a great number of explicit depictions of the ritual of initiation. This growth in the evidence reflects the spread of the cult, the growth in the number and importance of *thiasoi*, and the profanation and vulgarisation of the mysteries.' Thus the Dionysiac initiations in Rome, according

to Livy, were at first confined to the women and known only to a few; later they came to be known generally, he says, among both men and women. This passage of Livy (39.8ff) is actually of particular interest. It concerns the suppression of the Dionysiac mysteries throughout Italy by the Roman authorities in 186 BC, four generations before the painting of our fresco. Apart from being an excellent illustration of the tendency of the Mysteries to come into conflict with the authorities of the day, it also provides evidence for the various details of the cult in Italy.

Livy's account is the official version. This means of course that on any point that bears on the evaluation of the cult we cannot trust a single word of it. Connoisseurs of the reactions of state authorities to anything that threatens to undermine their dominance will find here a particularly choice example: in fact it exhibits striking points of similarity to the example I have already mentioned, King Pentheus' reaction in Euripides' *Bacchae* to the spread of Dionysiac religion in Thebes. And it does so because of course the *Bacchae* is a dramatic reflection of the same phenomenon: the main difference being that, unlike Dionysus in the play, the Italian priests of Dionysus, once imprisoned, proved to be incapable of a miraculous escape (though the Roman authorities did take precautions against suicide in jail). Livy's view of the cult is much the same as the consul's, whose speech he reports; 'This Dionysiac mystery-cult,' according to the consul 'is a growing evil; its adherents grow more numerous every day it weakens loyalty to the state; it is a conspiracy; it is the sole cause of all the evils of recent years; and unless we are vigilant, it will take over the state (for that is their aim).. .' This kind of rhetoric is familiar enough in contemporary politics. 'The rites themselves take place by night, and so lead to sexual abuses.' That is also what King Pentheus says in the *Bacchae*. 'One should never allow foreign religions into the state.' Again, very much like Pentheus. The consul even goes on to say that the male adherents are 'men very like women' (*simillimi feminis mares*); - and that, you may remember, is an accusation made by Pentheus against Dionysus.

Unlike Pentheus, the Roman authorities succeeded in suppressing with considerable brutality the Dionysiac mysteries, and rewarded with money and honour the informers who were therefore no doubt only too happy to contribute to the official fictions. Nevertheless, as our fresco for example shows, the Mysteries were not finally eradicated from Italy; though perhaps they never regained support in a form that threatened loyalty to the state; a quiet unexuberant cult within the *familia* would be tolerated. Certainly one of the few things that we can be certain of from Livy's account is that the cult had indeed to some extent threatened traditional loyalties, and that the alleged conspiracy (*coniuratio*) reflects the reality that the initiates were actually initiated into actual communities or thiasoi.

Livy's account of the ritual is an absurd picture of every kind of sexual abuse, murder, even the forgery of wills. But he gives certain details which, because they are not designed to denigrate the cult, may reflect reality. For example, he says that among the leaders of the cult in 186 BC was a Campanian. Campania was the part of Hellenised Southern Italy nearest to Rome, and so we would expect it to be a source of the Greek Mysteries in Rome; and indeed our fresco is just one

indication of the continuing strength of the Mysteries in Campania. Livy also says that the cult was originally confined to women, but by 186 BC there were a few men, and a few *nobiles* of both sexes. Initiation required a certain preparation, consisting of at least a meal and purification. There appear to have been two grades of initiate, the first grade consisting of those who had merely made their prayers from the sacred formula (*ex carmine sacro*), the priest dictating the words. Another detail which may derive from reality is the youth of those initiated (boys under 20, as Livy explains it, being desired for the purposes of vice and corruption).

Livy says that if you were initiated you were quite likely to be murdered in the course of initiation, and your body would probably never be discovered. It is curious therefore to read in the same passage that the cult was growing so rapidly in popularity. Still, the absurdity may be based on a reality. If the initiate was conceived as suffering death in order to be reborn as a member of the Dionysiac community, then it is easy to see how this might confirm the suspicions of those anxious to denigrate the cult, just as the early Christians' celebration of the Eucharist caused them to be accused of cannibalism. The accusation of sexual abuses was probably no more justified than the same accusation made by Pentheus. But again this may be an exaggeration and distortion of a less shocking reality, as we shall see when we turn, as we must now do, to the fresco.

The Villa is composed of three sets of living quarters grouped around a central atrium. The fresco is in the largest room (probably a dining room) of one of these sets. The figures, which are slightly smaller than life size, have been painted over an architectural background. There are several scenes, and though they are in sense distinct from each other, they are not contained (as so often in Roman wall painting) in separate panels. In fact the continuity of the scenes has been expressed by overlap between them in relationship to the architectural background.

Now the fresco is not the only surviving representation of the Dionysiac Mysteries. But the number of the scenes and the apparent continuity between them, as well as their size and good state of preservation, all this makes the fresco the most important surviving representation. It also presents us with immediate problems. In what sense are the scenes continuous? I mean, are the various events to be regarded as occurring simultaneously or successively? Or are they merely an incoherent collection of typically Dionysiac scenes? If the frieze is continuous, where does it start? To these and related questions my answers will emerge from my exposition. I ask them here imply as a warning that others have answered them differently. In fact the work done on the fresco constitutes an astonishing variety of opinion on almost every element of it. And I do not even have the time to comment on every significant detail.

The problem is of course that the object of our enquiry is itself a mystery. The secrets of the Mysteries were fully known only to those who had been initiated into them. We have to help us no ancient text which expounds these secrets. The full significance of the fresco is therefore, you will quite rightly say, necessarily



beyond our grasp. But we do have a considerable number of allusions to the Mysteries, pictorial and literary illusions recognisable even to the uninitiated, that is to say ourselves. And there is a point at which allusion becomes profanation. Aeschylus in the *Oresteia* alludes persistently to the Eleusinian Mysteries, on the principle expressed by his watchman, *manthanousin audô* - 'I speak it to those who understand'. But there were of course plenty of initiated among the audience, and Aeschylus was accused of profaning the Mysteries. The Dionysiac Mysteries, with their spread and growth in the Hellenistic and Imperial periods, appear to have been subject to a considerable degree of profanation, most of it pictorial. On the basis of such allusion and profanation everybody agrees on the fundamental point, that at least the central scenes of the fresco represent an initiation into the Mysteries of Dionysus. It appears that the central group of the fresco is the one immediately facing us as we enter by the larger of the two doors, the seated couple, Dionysus and his wife (or his mother). Although the top part of the group is lost, it is possible to identify the couple, from similar depictions elsewhere, as Dionysus and Ariadne, the partners in a sacred marriage *hieros gamos*. Consider now the adjacent scene: in the foreground of this scene a crouching woman appears to be about to remove a veil from a basket. This basket is recognisable as the *liknon*, a winnowing-basket in the shape of a cradle; it reappears in ancient art and literature with a sacral use, notably in the Mysteries of Dionysus, where we find it containing secret holy objects (or *sacra*,) - usually a *phallos* and fruit, which are revealed to an initiand in the course of initiation, sometimes by the removal of a veil from the *liknon*. We may therefore infer that the crouching woman is about to unveil the contents of the *liknon*, and that this is an act of initiation into the Dionysiac Mysteries. The initiand in this case can be none other than the kneeling half-naked girl, who is being flagellated (across the corner of the room) by the winged figure next to the *liknon*. Notice that her eyes are shut. The words 'mystery' and 'mystic' derive from *muein*, referring to the closed eyes of the candidate for initiation. What is the point of the revelation of the *phallos*? My guess is that it is derived from a feature of tribal initiation: sometimes the sacred objects revealed in tribal initiation are models of the genital organs, which may then be used to instruct the young in the secrets of sexuality and reproduction. Whatever the truth of that, it is easy to see how this sexual content of the Mysteries would fuel the authorities' suspicions of sexual abuses.

Why is the poor girl being flagellated, and who is the winged female figure flagellating her? A few examples of ritual beating and flagellation are known from the Greek and Roman world: e.g. at the Roman *Lupercalia* and in the female cult of Dionysus at Alea in Arcadia. And these cases have been cited to demonstrate (unnecessarily perhaps) that this is a ritual flagellation, perhaps designed to confer fertility on the victim. It was however pointed out in 1965 that no clear parallel had yet been produced for flagellation forming part of a ritual of initiation.[3] Now there are in fact numerous examples of flagellation and beating forming part of the ordeal of the initiand, but outside the Greco-Roman world. This kind of ordeal is one of the most typical and widespread undergone by the candidates in tribal initiation, where it may have the dual function of an ordeal and a fertility ritual. Given our hypothesis that initiation into the Mysteries is derived from tribal initiation, it is satisfying to discover flagellation as an initiatory

ritual here in our fresco. Still, even though our evidence for the Mysteries is admittedly sparse, it would have been more satisfactory to find at least a second example of flagellation in Greek initiation ritual. This has now been provided in spectacular fashion by Angelo Brelich,[4] who, without making any mention of our fresco, has demonstrated that the most famous example of flagellation in antiquity, the flagellation of the Spartan boys at the altar of Artemis Ortheia, is along with other features of the cult derived from tribal initiation. Sparta was one of the most socially conservative areas of the Greek world, and the flagellation of the Spartan boys, whether it was still actually conceived as a *teletê* (initiation) or not, preserved its social significance: that is to say it was, at least in the early period before it became a tourist attraction, an official ritual undergone for the good of society by the young men, 'the *ephebes*', and not a means of entry into a secret community on the margins of society.

As to the identity of the winged figure, an astonishing number of suggestions have been made: Artemis, Iris, Isis, Lyssa, Nike, Tyche, Telete, Aidos, a Fury, Ananke, Agnoia, Adresteia, Nemesis, Hestia, and Dike. The question of her identity is of course inseparable from the question of what she is doing, and the question of what exactly she is doing cannot be settled without consideration of what the function of ritual flagellation tends to be elsewhere (particularly in initiation ritual). This point well illustrates the distinction between the subjective and the objective method. Rather than merely contemplating the picture and prompting our imagination to provide us with a solution, we discover that in general flagellation tends to have the function of an ordeal and a fertility ritual, and that it may be both at once, particularly in initiation ritual. Thus the first theory to be dismissed, put forward by one Pottier, is that the figure has just flow down with her whip to abolish the *obscene sacra* as unworthy of the Augustan age.[5] In the same way Zuntz, for no apparent reason, said in his British Academy Lecture on the subject that the flagellation conveys a deprecation of extra-marital sexual relations.[6] Now we are of course dealing with a divine female, no ordinary *flagellator*; but this means, not that the flagellation cannot be compared with any other ritual flagellation, but rather that the female divinity expresses some part of the ritual flagellation. I mean that here, as in general in Greek religion, we may reasonably expect the divinity to be at least partly an expression of the ritual; she emerges out of the ritual, not the other way round. We should, therefore, I think, dismiss the candidature of the punishing or avenging deities such as Nemesis, Dike or a Fury; because punishment, the usual function of flagellation, is not the function of ritual flagellation.

This point is supported by the occurrence of a winged female in other depictions of the unveiling of the Dionysiac *sacra*, in which at the moment of revelation of the *sacra* she is turning away or even running away, and making a defensive gesture with her left hand (and it appears that the crouching woman revealing the *sacra* may be trying to restrain her). Now we notice that the winged female in our fresco too is making the same defensive gesture with the left hand towards the *sacra*. Surely it is the same deity. But why should Dike, Nemesis and so on run away at the revelation of the *sacra*? The most plausible candidates left in the field, it seems to me, are *Aidos* (Modesty) and *Agnoia* (Ignorance). *Aidos* because Modesty might be repelled by the sight of the *phallos*, *Agnoia* because Ignorance

would be put to flight by the revelation. Both these deities might be regarded as embodying the initiand's emotion just before the *sacra* are revealed to her. In most pictures of the revelation the *sacra* have been revealed; our fresco, on the other hand, depicts the moment just before revelation. Ignorance is still in command. The candidature of Agnoia (Ignorance) has been made even more plausible by further iconographical parallels adduced by Karl Lehmann.[7] On a fourth-century AD mosaic in Algeria a female makes towards the revelation of the Dionysiac *sacra* a defensive gesture reminiscent of those we have already seen, and very similar to the gesture made by another female in a second-century AD tomb-painting from Hermoupolis in Egypt. This latter female appears to be urging Oedipus to kill his father Laios; and the letters above her head identify her as AGNOIA, Ignorance.

Agnoia is the deity who speaks the prologue of Menander's *Perikeiromene*. Lehmann's identification of her with the winged flagellator of the fresco has so far as I know been neither accepted nor refuted. But consider how appropriate she is here. Firstly, she is winged: when all is suddenly revealed, Ignorance is just as suddenly nowhere: she has taken flight. Secondly, being Ignorance, she must reject knowledge of the *sacra*. Thirdly, she tortures the initiand. The ignorance of the initiand, just before the final moment of revelation, her fear and trembling, are regarded as an ordeal. As is normal in tribal initiation, the terror of the initiand is based on his ignorance of what is to come. An ordeal too is the ritual flagellation of the initiand. The flagellation by Ignorance represents, I think, an assimilation of these initiatory ordeals to each other. The terrified ignorance of the initiand is conceived as a divine flagellation.

The terror of the initiand seems also to be the subject of another scene on the other side of the sacred marriage. What is going on here? When the fresco was first discovered, it was thought that the young satyr was drinking from the cup. But that is very unlikely: he seems rather to be looking intensely into the cup; and the whole context of the scene, as well as the solemn expression on Silenos's face, the holding up of the mask behind him, and the terror of the girl across on his right, all this suggests that some ritual is here being celebrated, not an idyllic drinking scene. It is now generally believed that the scene is one of lecanomancy, divination by the observation of images seen in a liquid in a basin, or of catoptromancy, divination by images seen reflected on a shining surface. The satyr-medium tells Silenos what he sees. Silenos then interprets it, as an oracle, to the girl; and it is by the content of this oracle that the girl is terrified.

These are not the only interpretations of the scene; it still remains a mystery. Without being able to banish ignorance entirely, I want to make a few points that have not been properly appreciated in the controversy that has surrounded it.

Firstly, the scene is surely a unity. The composition of the figures is such that, as in the corresponding flagellation scene, it is difficult to believe that several unrelated actions are taking place in it. Consider the Silenos-mask held up behind the seated Silenos. We find Silenos-masks, in representations of the Dionysiac *thiasos*, in a purely decorative role or as a disguise. But here the mask is deliberately held up, held up to some purpose. What purpose? The only ritual

function that the Silenos-mask has in depictions of the Dionysiac *thiasos* is, as far as I know, as a *sacrum*, one of the sacred objects of revelation. In particular, in the cameo the object revealed is not a *liknon* containing fruit and *phallos* but a Silenos-mask. We may therefore tentatively infer that in the fresco too the mask is an object of revelation, like the *liknon* and its contents in the corresponding to the scene on the other side of the sacred marriage; and we may tentatively dismiss those theories according to which the mask is apotropaic (to ward off evil spirits) or an expression of the prophecy. For these theories are unsupported by the objective considerations.

If the mask is an object of revelation, how does it relate to the rest of the scene? A minority of scholars believes that the mask is seen by the young satyr reflected in the bowl. This is I think correct. As for the startled girl across the corner, I imagine that she has been startled not by what Silenos says,[8] but by her direct vision of the mask. (We find fear at Silenos' masks depicted elsewhere, though with the notable exception of the cameo, not in a Dionysiac ritual.) I should also say at this point that in tribal initiation masks are frequently used to inspire fear in the novice, usually worn by the initiators, but sometimes as sacred objects.

If this scene is one of revelation of the mask, what becomes of the theory that it is a scene of divination? The divination theory, though generally held, is in fact far from certain. Nobody can agree on what the content of the oracle is, on why the girl should be startled by it, and on what the function of an oracle is in an initiation. Let us at least try the theory that the scene is one of revelation of the mask. Now if it is, then there is a thematic as well as a formal correspondence with the scene of revelation and flagellation on the other side of the sacred marriage. How detailed this thematic correspondence is depends on our detailed interpretation. If it is a scene of revelation of the Silenos-mask to the initiand, who is the initiand? Is it the startled girl, who may have seen the mask directly, or is it the young satyr, who sees it reflected in the bowl? The fresco as a whole seems to concern the various stages of female initiation: all the human figures in it are female, the only male figures being Dionysus and his mythical following (Silenos and the satyrs). Has the female initiate intruded on the mysteries of the male *thiasos*, and seen the terrifying sacred mask, which even the satyr-initiand has as yet seen only indirectly? If so, she has a male Counterpart in Pentheus, who spied on the secret objects of the female *thiasos* (Theocr. Id. 26), thereby incurring the fury of the Maenads.

Here we must pause to discover what the part played by mirrors and reflection may have been in Dionysiac ritual. First of all, we should remember that even the best of ancient mirrors gives a more obscure image than a modern mirror. The mirror is in fact one of the sacred objects of the Dionysiac Mysteries, associated in particular with another sacred object, the *rhombos*. The *rhombos* seems to resemble the bull-roarer, a piece of wood attached to a string by which it was spun in the air, thereby producing a roaring sound. The bull-roarer is a widespread feature of tribal initiation ritual, in which it is spun where the novice cannot see it, and so terrifies them with its sound unseen. It seems likely that this was the function of the *rhombos*, or at least its original function, in Greek initiation too. But what of the mirror? If it had a function, then its function must



have been reflection. This is the function of the bowl acting as a mirror in our view of the Mysteries at Pompeii.[9] Certainly, the satyr would have seen a confusing image. The crucial question is - what might be the function in initiatory ritual of this confusing reflection?

This question is perhaps unanswerable. Still, I cannot resist suggesting that the answer might be found in some of the allusions to the Mysteries that I have mentioned before, in this case allusions in theological writings, usually Christian. As an example I take a passage which will be already familiar to you.

'When I was a child I spake as a child; I understood as a child; I thought as a child; but when I became a man, I put away childish things. For now we see through a glass darkly, but then face to face; now I know in part; but then I shall know even as I am known.' (Paul, I. Cor. 13)

Why should the image 'for now we see through a 'glass darkly, etc.' be thought to be analogous to the passage from childhood to adulthood? Elsewhere Paul alludes to the Pagan Mysteries,[10] or at the least uses language derived from them: a Greek audience would be expected to understand. The Greek for 'through a glass darkly' is *di esoptrou en ainigmati*: we see 'through a mirror in a riddle'; a curious conjunction of images. The passages that have been adduced from the Judaic tradition are inadequate to explain this passage fully. The important point is that the function of the mirror in this context is negative, it is an agent of obscurity: now we see merely through the mirror, but then we shall see directly, face to face. Ancient mirrors do not achieve the clarity of modern. Riddles are also agents of obscurity. By asking somebody a riddle you stimulate him by deliberately confusing, partial revelation of the thing to which you refer. The riddle is in this respect like the ancient mirror. And so the phrase 'through a mirror in a riddle is not such an ill-assorted pair of images as it might seem. Furthermore, riddles asked of the initiand are a typical feature of tribal initiation; and there is also evidence for their occurrence in Greek initiation.[11] Perhaps the negative function of the mirror in Paul is derived from initiation into the Greek Mysteries. If this is the point of Silenos' bowl, then the partial revelation of the mask corresponds to the partial revelation of the liknon to the terrified initiand in the formally corresponding scene on the other side of the sacred marriage. Still, I do not conceal from myself the difficulties in this hypothesis and its highly speculative nature.

Just as the two "fright" scenes correspond, so to do the two "music" scenes. In one scene Silenos plays the lyre. In the corresponding scene a Maenad (or perhaps the initiand – tkw) dances and plays the cymbals. Both scenes form the same sharp contrast with the suffering of the initiand in the scene adjacent to them. The terrified girl almost impinges on the idyll next to it. And the ecstasy of the dancing Maenad makes a striking contrast to the suffering of the flagellated girl beneath her. What is the point of this striking contrast in a picture of Dionysiac initiation? We remember that Dionysiac initiation is entry into the Dionysiac community, the *thiasos*, even though that *thiasos* may have only a shadowy or mythical existence. You might through initiation become a mythical follower of Dionysus, a Maenad or a Satyr. And once you were initiated the terrors of initiation were over. Might not the contrast so beautifully expressed in our

fresco be an expression of the emotions of the initiand as she passes from the terrified ignorance of initiation to the idyllic certainty of the initiated *thiasos*?

For the subjective experiences of the initiand into the Dionysiac Mysteries we have hardly any evidence; but we are better informed for the Eleusinian. 'The soul on the point of death', writes Plutarch, 'has the same experience as the initiand in the great mysteries . . . at first wanderings and wearisome hurrying to and fro, and unfinished journeys half-seen as through a darkness; then before the consummation itself all the terrors, shuddering and trembling, sweat and wonder; after which they are confronted by a wonderful light, or received into pure regions and meadows, with singing and dancing and sanctities of holy voices and sacred revelations, wherein, made perfect at last, free and resolved, the initiand worships with crowned head in the company of the pure and undefiled... [12] Here we are reminded of the happy thiasoi of Eleusinian initiates in the underworld in Aristophanes' *Frogs*, in the myrtle groves, surrounded by a great light.

This interpretation of scenes C and G, if it is correct, coheres splendidly with our interpretation of the adjacent scenes with which they contrast. The flagellation and the girl startled by the mask express the ignorance, terror and suffering of the initiands just before the final consummation (*pro tou telous autou*), after which they take their place in the *thiasos*, joyful in the certainty of their salvation.

In general, I have said, the Mysteries ensure happiness for their initiates in this world and the next; and I do not think that our fresco is an exception. The next world is conceived in terms of the joy and *eudaimonia* acquired in the final stage of initiation. That is why the joyful Dionysiac *thiasos* of Maenads and Satyrs is so frequently depicted on tombs, notably in the imperial period, but also as early as the 7th century B.C. The initiate becomes a member of the *thiasos* [a Satyr perhaps, or a Maenad] - in life and in death. As an example of the latter I cannot resist quoting a Latin verse epitaph from Philippi:[13] 'while we live in pain, you live renewed in the Elysian fields': *nunc seu te Bromio signatae mystides ad se florigero in prato congregant in satyrum*. The text and precise interpretation of these lines is uncertain, but the general picture is clear; the dead youth is imagined in the next world as a Satyr, surrounded by welcoming Maenads in a field full of flowers.

Is our initiand's passage through suffering to permanent joy conceived as a passage through death to new life? The possibility can be neither affirmed nor excluded. The flagellation and beating of tribal initiation is often conceived as affecting the death of the victim. And this seems to have been the case also with the flagellation of the Spartan boys at the altar of Artemis Ortheia. Perhaps our initiand's experience is comparable to the experience of Apuleius (*Met.* XI 23) when he was initiated into the Mysteries of Isis: *accessi confinium mortis et calcato Proserpinae limine per omnia vectus elementa remeavi*. 'I approached the confines of death and trod the threshold of Proserpina [queen of the underworld] and then returned, carried through every element.' If so, then perhaps the fear of the startled girl might be at some hint of her own impending death. And it is easy to see how this sort of thing would, in the official version preserved by Livy, by a

slight change become the absurdity that the initiand was actually killed in the ritual, but his body never found.

The lyre-playing Silenos and the cymbal-playing Maenad form the boundaries between the human and the divine. The area within these figures, the scenes that we have already discussed, are dominated by divine beings (the flagellator, the sacred couple, the mythical *thiasos*): the scenes outside these figures, on the other hand, the scenes that remain to be discussed, are entirely human.

Let us take first the ones on the left of the lyre-playing Silenos. I do not want to go into them in detail. In Livy's account of the Mysteries we discerned three rituals preparatory to actual initiation: a meal, purification, and the making of prayers according to the *carmen sacrum*, the priest dictating the words. This coheres with what we know about the typical preliminaries to initiation elsewhere; and all three features are also found as typical features of tribal initiation. And so I would guess that these are also the three events of the first two scenes of the fresco. Two points cannot escape comment: firstly, the reading is done by a child. This presents no difficulty, inasmuch as we know of instances of child-priests of Dionysus; and Demosthenes (XIX 199) says of Aeschines that as a child he 'read the books out for his mother as she performed initiations'. The second question is whether we are to regard any of the figures in these scenes as the initiand: the woman entering from the left perhaps? or the seated woman with the scroll? This question seems to me simply unanswerable.

Finally there are the two last scenes of the fresco, on the other side of the central group, which are separated from each other, and from the continuous frieze, by a window and doorways. When the fresco was first discovered it was thought by some that these scenes had nothing very much to do with the main frieze, that they were decorative scenes of domestic life, designed to fill the gaps left on the wall. About twenty years later, in 1928, it was suggested that in fact these scenes, so far from being a mere decorative appendage, were vital for our understanding of the fresco as a whole.[14] One was recognized from similar depictions elsewhere as showing the adorning of the bride, a preliminary to the marriage ceremony. As such it bears an obvious relation to the other of the two scenes, which shows a woman seated on the marriage bed. It was also pointed out that various features of Dionysiac initiation are appropriate to a wedding, especially the preliminary purification, the sacred marriage of Dionysus and Ariadne, the flagellation imparting fertility, and the revelation of the phallos. Indeed, the Greek wedding and Greek initiation had a common terminology (they were both called *telete*" for example) and a number of shared features: e.g. we know that the ritual formula *ephugon kakon, heuron ameinon* (I have fled the worse and found the better) was spoken by a child both at the wedding ceremony and at the Sabazian initiation rituals in Athens.

Such similarities can be explained by saying that both initiation and marriage are important rites of passage, and that e.g. the formula *ephugon kakon, heuron ameinon* is appropriate to any such transition to a more desirable state. But in fact the two rituals are not merely similar: they interpenetrate each other. For example, Firmicus Maternus (104) says that not only the words but even the ritual

of marriage was used in the pagan Mysteries: the newly initiated was hailed as a bridegroom: *khairē numphie, khairē neon phōs* (Hail bridegroom! Hail new light!). A few Athenian vases survive of the fourth century BC in which a bride is shown surrounded by the Dionysiac *thiasos*. And in the Dionysiac worship of the time of Diodorus Siculus (contemporary with our fresco) it appears that the unmarried women were mere *thyrsus* carriers, and only the married women proper Maenads. In tribal initiation, we remember, the passage from childhood to adulthood is also the passage into marriage, or at least into the first act of sexual union. Greek initiation and Greek marriage are associated with each other because originally they were still more closely associated with each other: initiation into adulthood and marriage were two elements of the same celebration. Our fresco shows that a Pompeian initiand might be imagined as a bride, or that a Pompeian bride might also be an initiand, or at least that she might be imagined as an initiand. Perhaps also the room of the frieze was the room in which wedding celebrations were held.

Initiation into the Mysteries was associated not only with the marriage of the initiand, but also with the sacred marriage, in which at least one of the marriage partners was divine. One example of this is our fresco. Another is the Eleusinian Mysteries, in which (though some scholars have denied it) a sacred marriage was celebrated between Zeus and Demeter. How do we explain this? My answer will again refer to the origins of the ritual. I believe that in keeping with the tendency of initiation ritual to devolve on to a representative individual who is priest, king or god, the sacred marriage embodies the persistence of the practice of marriage or sexual union at initiation - except that this practice, once general, is now performed by a representative pair, who are divine inasmuch as they embody the divine powers once conferred on the initiands as a whole.

Returning once again to the fresco, we are now in a position to see that the link between the human marriage on the one hand and the initiation and divine marriage on the other is neither fortuitous nor arbitrary. The sacred marriage, which is derived from human marriage at initiation, is here in a sense reunited with it. By virtue of her marriage the bride is conceived as entering through suffering into a divine and blessed state, in which she participates in the mysteries of sex embodied in the marriage of the divine couple. It is a conception of marriage which, originating in tribal initiation, has not shaken off the traces of its origin.

The fresco falls into three parts: firstly the preliminaries; secondly the initiation itself, in which the initiand moves into the sphere of the divine (the mask and bowl, the sacred marriage, the revelation and flagellation, the dancing Maenad); and thirdly the adorning of the bride and the assumption of the marriage bed. These three stages should, I think, be regarded as succeeding each other, but not in the manner of a comic strip: they do not appear to depict the successive experiences of the same initiand (in fact the various figures who appear to be initiands are carefully distinguished from each other by dress), but the successive stages of the transition from girlhood to matronhood.



This tripartite arrangement of the fresco is probably derived from the ordering of the Mysteries themselves. Livy, we recall, appears to distinguish a preliminary grade of adherents, and this is in keeping with what we know about the Mysteries in general. In this respect, as in others, we are better informed about the Eleusinian Mysteries: here there appear to have been effectively three stages of participation in the ritual itself. Firstly, the preliminaries, notably purification, by which one became a candidate for initiation. Secondly, the initiation itself. And thirdly, *epopteia*. What was *epopteia*? The word means both 'onlooking' and 'supervision'; the *epoptai* were the initiated, who looked on and supervised the initiation of others. I must resume here the passage of Plutarch about the Eleusinian Mysteries which I quoted before to illustrate the subjective experience of the initiand: the initiands have been through the terrors of initiation, and are at last 'perfect, free and absolved, worshipping with crowned heads in the company of those pure and undefiled, looking down on the impure, uninitiated multitude of the living as they trample one another under foot and are herded together in thick mire and mist.'

Consider now the woman on the marriage bed. She is regarded by some as the initiand herself, by others as the mother of the initiand; and certainly she appears a little older than the initiands of the previous scenes. But of course, if our view of the way in which the scenes cohere is correct, to ask for her particular identity is beside the point. The point is that she embodies the final stage in the transition from girlhood to matronhood. At the conclusion of the sequence she sits alone, her calm and thoughtful gaze directed back across the room towards the flagellation, towards the ordeal of initiation which she has herself endured, and on which she can now look back in serenity.

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#### Notes

1 *Paidēs e parthenoi*, Rome 1969. The morphologies are based, not on the idea that there was an original initiation ceremony somewhere in the world which has influenced all the others, but on the assumption that similar sets of circumstances may produce similar results, in society as well as in the logical and material world; the difference being that the study of society cannot, of course, achieve the same precision and certainty as logic, physics and chemistry.

2 L. Gernet, *Anthropologie de la Grèce antique*, Paris 1968, p. 48 f.

3 R. Turcan, *Latomus* 24(1965), p. 109.

4 *Paidēs e parthenoi*, chap. 1.

5 Pottier, *Rev. arch.* 53 serie 2 (1915), p. 344.

6 G. Zuntz, *Proc. Brit. Acad.* 49(1963), p. 197.

JRS 52 (1962), pp. 62-8.

8 Silenos need not in fact be saying anything: he is often given an open mouth, e.g. in the mask in this very scene.

9 The fact that it is a bowl, presumably a drinking-bowl, rather than a mirror, is of little significance. There is evidence that cups, *pocula*, were used as mirrors in ancient ritual in order to give distorted and therefore frightening images. Just as in the Archarnians (1128-9) Lamachos performs a little catoptromancy on his shield, so Silenos uses for ritual purposes whatever comes most easily to hand - his drinking equipment. (The light colour in which the bowl is painted is consistent with its being made of reflecting metal.)

10 See for instance A. E. Harvey, *Companion to the New Testament*, London 1971, p. 643; R. Bultmann, *Theology of the New Testament* London 1965, vol. 1, pp. 278, 300, 348. On Corinthians see e.g. A. T. Robertson and A. Plummer, *International Critical Commentary*, Edinburgh 1911, pp. 35, 289. A. E. Harvey in *JTS* for 1980, 320 ff.

11 Esp. Demetr. El. 100-1 (cf. Plut. fr. 178): see further O. Casel, *De philosophorum Graecorum silentio mystico*, 1919, pp. 36, 60, 63. 92 f., 120 f., 122.

12 Pentheus' experiences in Eur. *Bacchae* 616-37 are strangely similar. and surely derive, like other features of his behaviour, from the Dionysiac Mysteries. Retain *phôs* in 630, with *kelainôn* in 628: see my forthcoming article in *CQ* 31(1981).

13 *Carmina Latina Epigraphica* (ed. Buecheler) 1233 = CIL III 686 (Philippi).

14 M. Bieber, *JDAI* 43 (1928), pp. 298 ff; also J. Tony, *JRS* 19 (1929), pp. 67 ff.  
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[And it was slightly modified by tkw to make the scene referrals more easily understood – tkw]

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## Unit 7

# THE MAIN RUSTIC VILLAS in Campania

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Below are brief descriptions of the most important rustic villas in the ager Pompeianus which lie in the territory covered by the Soprintendenza archeologica di Pompei (excluding Villas A and B in Oplontis, which are described separately).

**Villa of Lucius Arellius Successus, Boscotrecase.**

Only partially excavated in 1898-99, it contained some rooms with wall paintings which seem to have been in the I style and several workrooms including a wine press and a kitchen with an oven and a large mill which is on display in the Antiquarium of Boscoreale. The site was filled in following the excavation.

**Villa of Agrippa Postumus, Boscotrecase.**

Only partially excavated in 1903-1905, this was a large residential villa with a spacious peristyle and rooms decorated with high quality wall paintings in the III style, now in the Naples Archaeological Museum and the Metropolitan Museum, New York. The servants' quarters included a large ergastulum with an iron bracket to which slaves would have been chained. The villa was covered by lava in 1906.

**Villa 1 in the locality of Boccia al Mauro, Terzigno.**

Only partially excavated as from 1981, it is located inside a quarry which is still being worked. It features a large wine cellar containing no less than 42 urns (dolia), a threshing floor, a portico and a barn used for storing animal fodder. The residential quarters are still to be excavated.

**Villa 2 in the locality of Boccia al Mauro, Terzigno.**

Located in the same quarry, this villa had a wine cellar, a room with a winepress and a large kitchen. Five skeletons came to light of people who met their deaths carrying gold ornaments, silverware and sums in cash.

**Villa 6 in the locality of Boccia al Mauro, Terzigno.**

Located in the same quarry, among its workrooms this villa had a winepress with a large basin (lacus) for collecting the must, and also residential quarters with fine decorative schemes in the II style. Excavations are still in progress.

**Villa of Marcus Livius Marcellus, Boscoreale.**

Only partially explored by means of excavation and tunnelling, it lies under the present-day town. It is featured in the Antiquarium of Boscoreale, together with material found here. The site was filled in following its investigation.

**Villa on land of Vito Antonio Cirillo, Boscoreale.**

Only partially excavated in 1897-1898, it included a room with a winepress. Here was found an interesting wall painting from a lararium featuring a scene of a sacrifice with a snake, now in the Field Museum of Chicago. The site was filled in following the excavation.

**Villa on land of Acunzo, Boscoreale.**

Only partially excavated, this was a small farm with a tavern (caupona ) where the "house wine" could be purchased. The bronze statuettes from the lararium are in the Walters Art Gallery of Baltimore. The site was filled in following the excavation.

**Villa of Publius Fannius Synistor, Boscoreale.**

Excavated at the turn of the 20th century, this was a large residential villa with rooms decorated with outstanding wall paintings in the II style, now in various museums including the Naples Archaeological Museum, the Metropolitan Museum, New York and the Louvre in Paris. Next to it were the farm buildings including a press and a mill for olives. It is featured in the Antiquarium of Boscoreale, together with material found here and reproductions of the most important paintings. The site was filled in following the excavation.

**Villa in the locality of Villa Regina, Boscoreale.**

A smallholding with a wine cellar and room with winepress. It can be visited, being next door to the Antiquarium of Boscoreale, where a lot of the material found here is exhibited.

**Villa on land of Risi Di Prisco, Boscoreale.**

Only partially investigated during 1988 and 1989, it revealed an interesting domestic shrine with a marble image of a goddess adorned with miniature gold jewels, on display in the Antiquarium of Boscoreale.

**Villa of Asellius, Boscoreale.**

A residential villa with refined living quarters set round a large peristyle. There is no sign of the farm buildings, which were probably separate. Some panels from the wall paintings in the IV style have been conserved, while other rooms were decorated in the II style. The site was filled in following the excavation.

**Villa della Pisanella or of the Silver Treasure, Boscoreale.**

The most important and famous of the villas in the region round Pompeii. Completely excavated at the close of the 19th century, its fame derives from the rich hoard of silverware, jewels and coins found hidden in the vat of the torcularium (winepress). The silverware and jewels are now in the Louvre in Paris. The pars fructuaria (produce sector) included a room with two presses, an extensive wine cellar containing 84 urns (dolia), and two rooms for milling and pressing olives. A selection of the numerous objects found here are displayed, together with a model reconstruction of the villa, in the Antiquarium of Boscoreale.



**Villa of Numerius Popidius Florus, Boscoreale.**

Excavated in 1906, the villa had residential quarters with wall paintings in the II and IV styles, bath quarters and a winepress. Some of the wall paintings are displayed in the Antiquarium of Boscoreale and the Getty Museum of Malibu. The villa has been partially covered up and obliterated by a modern building.

**Villa in the locality of Cangiani, Boscoreale.**

Only partially excavated from 1993 onwards, following its discovery by chance during clearance work on a canal. It had a large threshing floor, rooms on two storeys and a wine cellar.

**Villa on land of Agricoltura, Pompeii.**

Only partially excavated, it had residential quarters with wall decorations in the III style, a thermal quarter and a large winepress with a picture of Bacchus. The site was filled in following the excavation.

**Villa on land of Imperiali, Pompeii.**

Residential villa with refined living quarters set round a large peristyle and farm buildings which have been only partially excavated on account of adjacent modern buildings. Here were found an interesting series of statuettes and a relief featuring Isis and the divinities of the Isiac cult. The site was filled in following the excavation.

**Villa on land of Brancaccio, Pompeii.**

A modest farmstead possessing a mill for olives (trapetum). The site was filled in following the excavation.

**Villa on land of Prisco, Pompeii.** A modest farmstead with a funerary monument standing next to it. It possessed a winepress, a small baths suite with mosaic flooring, some bedrooms and a triclinium. The site was filled in following the excavation.

**Villa on land of Ippolito Zurlo, Pompeii.**

Rustic villa with refined living quarters (triclinium and bedrooms) decorated in the IV style and a small domestic shrine. In the farm quarters there was a wine cellar and room with winepress, decorated with a picture of Bacchus and Silenus. Some of the wall paintings are now in the Louvre in Paris and the British Museum in London. The site was filled in following the excavation.

**Villa next to the Cemetery, Pompeii.**

Discovered recently during preliminary digging for enlargement of the cemetery, it has only been partially investigated. It is currently filled in until excavations can be completed.

**Villa B below the Canale Conte di Sarno, Pompeii.**

Discovered in 1992 during clearance work on the canal, it has only been partially excavated, revealing a peristyle with its tile roofing still in place, and some adjacent rooms. The site was filled in following the excavation.

**Villa on land of Cirillo, Pompeii.**

Only partially investigated in 1987 following its discovery by chance during preliminary digging. It had a peristyle with its tile roofing still in place. The site was filled in following the investigation.

**Villa on land of Vitiello, Pompeii.**

Only partially excavated at the beginning of the 20th century, it had refined living quarters with wall paintings in the II and possibly also I style, baths quarters with pictures of scenes from the palaestra, now in the Naples Archaeological Museum, and a winepress. The site was filled in following the excavation.

**Villa on land of De Martino, Pompeii.**

Only partially excavated in 1923, it had refined living quarters with elegant flooring on the upper floor and downstairs a garden (viridarium ), servants' quarters, bedrooms, a kitchen and a bakery. Among the objects found here was fishing equipment in a wickerwork basket. The site was filled in following the excavation.

**Villa of C. Sicilius, Torre Annunziata.**

A residential villa partially investigated in 1841-42 during the construction of a railway line, which resulted in its destruction.

**Villa on land of Matrone, Pompeii.**

Excavated at the turn of the 20th century, this was a residential villa standing either on the sea or on the mouth of the River Sarno. It had a large peristyle and elegant living quarters decorated with wall paintings in the IV style, a spacious garden adorned with statuettes and fountains in which the statue of a seated Hercules was found, now in the Naples Archaeological Museum, while the rest of the furnishings comprising sculptures and paintings are in the museums of Boston, Chicago, Providence and New York. The site was filled in following the excavation.

**Villa of Marcus Cellius Africanus.**

Excavated during the 1930s, this was a small farmstead standing either on the sea or on the mouth of the River Sarno. It had rooms decorated with wall paintings in the IV style and a winepress. The site was filled in following the excavation.

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## **Boscoreale**

### **THE HISTORY OF THE EXCAVATIONS OF BOSCOREALE**

In the area of Boscoreale, at the north of Pompeii, several excavations began between the end of the 19th century and the first decades of the 20th century: private individuals, usually landowners, carried them out. The aim of the excavations was above all to discover and to recover frescoes, floor ornaments

and valuable objects, now preserved in several museums (the National Museum of Naples, the Louvre in Paris, the Metropolitan Museum in New York), or in private collections.

In this way a series of *villae rusticae* (about 30) were brought to light during the 1st century A.D. They were part of a dense network of smallholdings situated on the lower slopes of the volcano and on the adjacent plain of Sarno. These small- and medium-sized properties were family-run or employed a few slaves. Some estates had elaborately decorated residential quarters for occasional visits of the rich owners, and separate quarters for the farming operations and the servants. The eruption in 79 A.D. buried the area in volcanic debris, so that the buildings and implements have been well preserved. Excavation records provide a clear picture of the various stages in the main agricultural activities of the region, above all wine growing (some of which was exported) and olive oil production, which mainly catered for local demand.

After every exploration the buildings were usually covered with earth except for some of them ("Villa della Pisanella") that were repeatedly plundered; therefore, only little remained in situ.

## THE VILLAS IN BOSCOREALE

### Villa of the Pisanella

The "Villa of the Pisanella", excavated between 1895 and 1899, is now buried again. Its structure is made up of a "pars urbana" reserved to the owner, (living rooms decorated in 3rd style, bath facilities) and a "pars rustica" with dormitories for the servants, a bakery, a stable, a winepress ("torcularium") and an oil press ("trapetum"). From the storehouses we can infer that the villa managed about 24 hectares of land. The owner was perhaps Lucius Caecilius Iucundus, a famous banker from Pompeii. In 1895 a treasure of silverware was found here, now partly at the Louvre and partly in the Collection Rothschild. The treasure was made up of 1037 gold coins (102.800 sesterces worth) and of a set of silver serving dishes of 108 pieces of Augustan Age. The most important pieces are two cups representing "Tiberius' Triumph" and "Augustus on the throne", glasses with eroti, animals and skeletons of philosophers, two jugs with sacrificing Victories, a patera with the bust of Africa and two phialai relief busts-portraits. Besides, several specimens of the "instrumentum domesticum" ( domestic implements) were found here.

### Villa of Fannius Synistor

The Villa of Publius Fannius Synistor was excavated in 1900 on Fondo Vona, in Boscoreale. Its attribution comes from a name inscribed on a metal vase. It could be a property of L. Herennius Florus, from the discovery of a seal.

The villa was decorated by beautiful frescoes in Pompeian second style, similar to the ones in the Villa of the Mysteries and dating back to about 40-30 B.C. The

most beautiful walls were preserved in the museums of Naples, Bruxelles, Mariemont and Amsterdam.

A row of decorated rooms was along the north side of the courtyard: a cubiculum with city views and architectural sceneries; an oecus, opposite to the entrance, decorated by a megalography painted on the background columned arcade. Here, in the middle of the wall, there were paintings of Venus with Amore, on the left Dionysus and Arian, on the right the Three Graces; Macedonian and Hellenistic kings together with the philosopher Menedemo from Eretria were painted on the red background sidewalls. Winged figures were painted on the external side of the oecus' entrance.

### **Villa Regina**

This rustic villa is made up of various rooms on the three sides of an open courtyard with a wine cell with 18 dolia.

Some plaster casts of wooden frames of doors and windows are here preserved. Among the rooms of the villa we particularly point out: a large arcade delimiting the open courtyard; a room used as a storehouse and temporary kitchen where most of the implements of the villa were found, placed on shelving and in a cupboard; the torcularium with the rests of the wooden press and the fixtures for its supporting, the crushing tanks and the container for the must harvest; the triclinium, with frescoes in third and fourth style; the kitchen, not in use at the moment of the eruption, with a brick oven and a furnace in the middle of the room; a back-room with a water tank, surmounted by a fictile; the barn for the preservation of hay, cereals and legumes, next to the open threshing-floor.

The villa, that had also an upper floor, belongs to the 1st century B.C. and was enlarged in two different periods of the Augustan and Julius-Claude age. During the excavations a cart (plaustrum) was found in the arcade, and the tracks left on the ground by the wheels are still evident in a little path next to the villa.

The area surrounding the villa is made up of the same soil as in 79 A.D. and it preserves traces of the ancient cultivations. Casts of vine-roots have been made.

Close to these ones, vines for a demonstrative reconstruction of the vineyard installation have been planted.

Along the excavation walls, the stratigraphy of the ground clearly shows the succession of the sediments of "piroclastico" materials determined by the 79 A.D. eruption, that caused the destruction of the small farm.

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***Reconstruction of a Cubiculum (bedroom) from the Villa of P. Fannius Synistor, ca. 40–30 B.C.; Republican; Second Style, Roman Fresco; Room: 8 ft. 8 1/2 in. x 10 ft. 11 1/2 in. x 19 ft. 7 1/8 in. (265.4 x 334 x 583.9 cm)  
Metropolitan Museum, New York***

Room M of the Villa of P. Fannius Synistor at Boscoreale, buried by the eruption of Vesuvius in A.D. 79, functioned as a bedroom. The rear wall shows rocky terrain with balustrades and an arbor above, a small cave or grotto sheltering a fountain, and a small figure of Hekate below. In the center of the wall, between two columns, a parapet embellished with a yellow monochrome landscape supports a glass bowl filled with fruit. The side walls of the room are loosely symmetrical. Each wall is subdivided into four sections by a pilaster that defines the area of the couch and by two ornate columns. The paintings depict enclosed courtyards in which we glimpse the tops of statuary, rotundas, and pylons as well as vegetation. These precincts alternate with townscapes combining colonnaded buildings and projecting terraces.

## Boscoreale: Frescoes from the Villa of P. Fannius Synistor

Boscoreale, an area about a mile north of Pompeii, was notable in antiquity for having numerous aristocratic country villas. This tradition endured into the time of the Bourbon kings, as is attested by the region's name, the "Royal Forest," which implies that Boscoreale was a hunting preserve. Some of the most important wall paintings surviving from antiquity come from a Roman villa at Boscoreale built shortly after the middle of the first century B.C. The villa, which was buried by the eruption of Vesuvius in 79 A.D., is referred to as the Villa of P. Fannius Synistor, one of its owners during the first half part of the first century A.D. Excavated in the early 1900s, the villa's frescoes are among the most important to be found anywhere in the Roman world.

The villa at Boscoreale is a variant of the so-called *villa rustica*, a country house of which only a small part functioned as a farmhouse (*pars rustica*). The majority of the villa served as a residence for the owner, a member of that class of wealthy Roman citizens who owned more properties of this kind and used them as country houses. The painted decoration of the villa at Boscoreale, which was executed sometime around 40–30 B.C., attests to the original owner as a rich man with exquisite taste. The fact that the mid-first-century B.C. decoration was not replaced by another, more contemporary, decoration in the first century A.D. is a clear indication that there was already an awareness of the quality of the frescoes in antiquity.

The surviving paintings are extremely fine examples of the late Second Style, the most renowned style in Roman wall painting. Throughout the frescoes from the villa at Boscoreale there are visual ambiguities to tease the eye, including architectural details painted to resemble real ones, such as rusticated masonry, pillars, and columns that cast shadows into the viewer's space, and more conventional trompe l'oeil devices, such as three-dimensional meanders. Objects of daily life were depicted in such a way as to seem real, with metal and glass vases on shelves and tables appearing to project out from the wall. Cumulatively, these trompe l'oeil devices reveal the Republican owner's evident pleasure in impressing guests at his comfortable summer retreat.

Luxury villas, like the one at Boscoreale, were often the setting for conspicuous consumption of Hellenistic art and culture by the Roman aristocracy. Although in public life, a senator aimed to cut a severe figure of traditional Roman values— austere, practical, conservative—his household and his villas were the settings for extravagant displays of refined living—of building, decorating, eating, and philosophizing. The inspiration for this came from the Greeks in the east, including the repertoire of ideas and the artists, decorators, and intellectuals. Roman villa architecture combined the core of a Roman house with peristyles and gardens borrowed from Greek gymnasia, palaces, and sanctuaries. The Roman aristocracy aimed to evoke the culture of Athenian academies, the charmed world of the Hellenistic pastoral, and the magnificence of Alexandrian palaces. Portraits of Greek philosophers and writers represented learning; statues of satyrs and nymphs re-created an idyllic Dionysian landscape; and wall

paintings, rich in Greek myth and dynastic portraiture, provided majestic interiors.

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The reconstructed bedroom, or *cubiculum*, from the Villa of P. Fannius Synistor renders a particularly vivid picture of Roman luxury in the first century B.C. The frescoes that decorate its walls belong to the so-called Second Style of Roman wall painting that combines lightly ornate architectural features with more naturalistic landscape scenes, giving the impression of opening onto an architectural vista. Original and unique for their completeness of preservation and degree of detail, they are testament to the grandiose pretensions of the Late Republican landowner.

Each painted scene is framed by Corinthian columns with gilded capitals and scarlet shafts rising from a calyx of gilded acanthus leaves. Spiralling golden tendrils wind their way around the shafts of each column. These decorative columns most likely refer to architectural prototypes made of marble and entwined by bronze tendrils, of the type described in ancient literary sources.

The walls of the *cubiculum* are painted in such a way as to conceal the fact that they are walls, and to make them appear as views of the grounds of the villa or as an idealized version of the villa. On the rear wall, where is the only window in the room, a rocky terrain surrounds a small grotto with a fountain. Streams of water trickling down the ledges of the grotto are caught in a stone trough at the mouth of the cave, which is overgrown with dense ivy. Clusters of grape hang from an arched trellis, and a small, faintly detectable statue of Hekate stands in the interior of the grotto. In the center of this same wall, a parapet embellished with a yellow monochrome landscape supports a glass bowl heaped with luscious fruit. Above the bowl, a parrot perches on the edge of a black curtain.

On the left wall of the *cubiculum* is a shrine known as a *syzygia*, which consists of a short entablature supported by two pillars. A bronze statue of Diana-Lucina holding a flaming torch in each hand stands inside the shrine, and various cult objects—golden bronze hydrias, a round altar, and pomegranates—are situated in front. To the left and right of this scene is a vast complex of pastel-colored buildings, in the midst of which is a portal elaborately decorated with ivory leaves inlaid with tortoiseshell. The lighting in all of the *cubiculum*'s frescoes is consistent such that every detail is rendered on the assumption that light enters the room from the window and shadows are cast toward the entrance.





***Standing woman holding a shield: From Room H of the Villa of P. Fannius Synistor at Boscoreale, ca. 40–30 B.C.; Late Republican, Roman Wall painting; Fresco: 70 x 40 1/4 in. (177.8 x 102.2 cm) Rogers Fund, 1903 (03.14.7)***

**This fresco from the villa at Boscoreale depicts a woman clad in a white chiton and blue cloak, and holding a gold shield in her right hand. The front of the shield shows the image of a standing nude male figure who is adorned with a white headband, the same as those worn by Hellenistic dynasts. This small male figure has been**

**described as a reflected image on the shield, a popular motif in Hellenistic art. However, since there is no image in the fresco cycle that corresponds to a reflection, the figure should be understood as an apparition, which, in antiquity, was viewed as prophetic. The small apparition with a portrait-like head in this particular fresco may refer to a Hellenistic royal heir, and the**



**woman bearing the shield may represent a priestess or prophetess.**

## ***Third Style wall paintings from the villa of Agrippa Postumus at Boscotrecase***

In antiquity, numerous Roman villas dotted the coast along the Bay of Naples. One of the most sumptuous must have been the villa at Boscotrecase built by Agrippa, friend of Emperor Augustus and husband of his daughter Julia. In 11 B.C., the year after Agrippa's death, the villa passed into the hands of his posthumously born infant son, Agrippa Postumus. As the child was only a few months old, Julia would have overseen the completion of the villa. The frescoes, which are among the finest existing examples of Roman wall painting, must have been painted during renovations begun at that time. Most of the panels feature delicate ornamental vignettes and landscapes with genre and mythological scenes set against richly colored backgrounds. On the basis of their remarkable similarity to paintings in the Villa Farnesina in Rome, the Boscotrecase frescoes most likely were executed by artists from the capital city.

The frescoes from Boscotrecase are masterpieces of the Third Style of Roman wall painting, which flourished during the reign of Augustus. While earlier artists focused on creating an illusion of architectural depth with solid architectural forms, the artists at Boscotrecase presented the idea with whimsical, attenuated, and highly refined elements. At Boscotrecase, spindly canopies rest on improbably thin columns that seem to be made of alternating vegetal and metal drums. These almost weightless columns embellished with jewel-like decorations support pavilions, candelabra, and tripods. Other frescoes from the villa depict mythological scenes and Egyptianizing panels, ensembles that are at once colorful and complex. The occupants and those who visited the villa at Boscotrecase were not greeted by grand vistas of architectural splendor, but by slender, elegant, and especially decorative architectural forms, playfully alluding to contemporary cultural and political concerns.

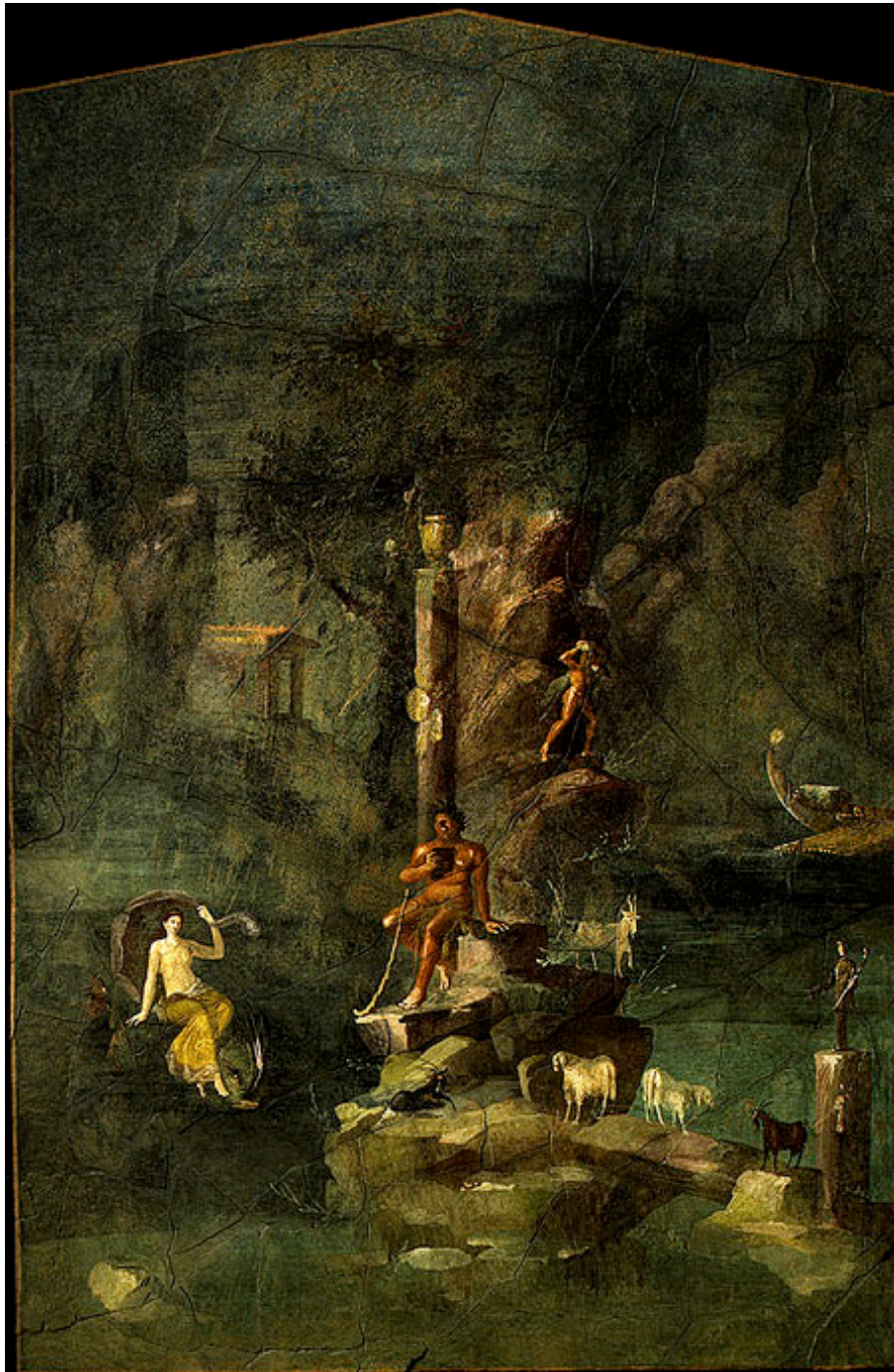


***Wall with painting  
Painted plaster. 3,03 x 3,25 m.  
Third Style (1-25 AD).  
From Boscotrecase. Villa of  
Agrippa  
Postumus, cubiculum 16.***

The villa, excavated between 1903 and 1905 by the owners of the plot where it was found, was soon after buried again by an eruption of the Vesuvius. The wall decoration of

cubicula 15, 16, 19 and 20, attributable to a phase of the Third Style dated to the first quarter of the 1st century A.D., was partially detached and divided between the Metropolitan Museum of New York and the Naples Museum. The red-background frescoes in this room all come from cubiculum 16, while two black-background fragments of the decoration of cubiculum 15 are displayed in room LXVIII.

The ensemble of the paintings - a wall with picture (a), a panel, two partitions and a landscape cut out of another wall, provide sufficient elements to make it possible to reconstruct the overall pattern of the decoration. Its simplicity and the stylization of the painted architectures highlight the central pictures framed by false aedicules and flanked by monochrome panels.



The painting, of considerable size, is the central element of a Third Style wall graced by slender columns and pillars with calligraphic polychrome ornaments and plant motifs. A large picture painted in sober pastel colors on a white background takes up the central aedicule, which is surmounted by diminutive cranes functioning as acroteria.

The scene takes place near a rural sanctuary distinguished by a sacred tree and a column with a ritual vase on the abacus. At the base of the latter is a female deity on a throne, possibly Cybele. The static figure of a shepherd watches over his flock of

goats on the left, while on the right a small cortege made up of two women and a child proceeds toward the sanctuary bearing boughs or torches. Behind them is an ithyphallic Priapus accentuating the idyllic and sacred character of the landscape. In the background, the slender profile of a small temple with pronaos stands out. It is fronted by a fenced garden near which a traveler has sat down to rest.

***Polyphemus and Galatea in a landscape, last decade of the 1st century B.C.; Early Imperial, Augustan; Third Style, Roman Rogers Fund, 1920 Metropolitan Museum, NY***

This fresco once decorated the west wall of bedroom 19, the Mythological Room, in the Imperial Villa at Boscotrecase. Third-Style Roman bedrooms were often adorned with mythological scenes that apparently imitated the framed paintings that hung in Roman houses. This example shows the Cyclops Polyphemus as the unsuccessful suitor of the lovely sea nymph Galatea, who rides a dolphin at the lower left. Polyphemus is seated in the center of a rocky outcrop, professing his desire for Galatea with a melody on his panpipe, but to no avail. As told by Ovid, Galatea hid with her lover Acis, the son of Pan, while she listened to the Cyclop's song, but he discovered them and rose in rage, crushing Acis under a boulder as he tried to escape. This wall painting





comes from a bedroom in the imperial villa uncovered between 1902 and 1905 near the modern town of Boscotrecase, not far from Pompeii. The walls were predominately red and a large mythological painting filled the center on each side of the room. The painting seen here combines two separate incidents in the life of the monstrous, one-eyed giant, Polyphemus. In the foreground he sits on a rocky projection guarding his goats and gazing at Galatea, the beautiful sea-nymph with whom he is hopelessly in love. Behind and above to the right, he is seen again, hurling a boulder at the departing ship of Odysseus, who has escaped with his men from the giant's cave after

blinding him. The landscape painting in the same room includes two consecutive incidents in the story of Perseus and Andromeda. At the front Perseus flies in to rescue the princess who is chained to a rock at the mercy of a seamonster; above to the right the happy couple are welcomed by her grateful parents. The fortunes of love and the ever-present sea are the themes linking these two works. The combination of disparate episodes in one panel was a bold innovation when these were painted. The translucent blue-green background tone unifies these magical landscapes and must have brought a sense of coolness to the room.



**Roman  
Wall painting;  
Fresco: Rogers  
Fund, 1920  
Aedicula with  
small  
landscape:  
From the  
"Black Room"  
of the Imperial  
Villa at  
Boscotrecase,  
last decade of  
1st century  
B.C.; Augustan  
Roman  
Wall painting;  
Fresco: H. 91  
3/4 in. (233.05  
cm)  
Rogers Fund,  
1920 (20.192.1)**

**Egyptianizing  
scene: From the  
"Black Room" of  
the Imperial Villa  
at Boscotrecase,  
last decade of 1st  
century B.C.;  
Augustan  
Roman  
Wall painting;  
Fresco: H. 91 3/4  
in. (233.05 cm)  
Rogers Fund,  
1920 (20.192.3)**

## Nola

Archaeological remains at Nola date back to the Bronze Age. The [post-Bronze Age –tkw] city of Nola was originally founded as Hyria, in 801 B.C.E. composed of Greeks and Calcesesi, a pre-Italic, Ausonian people. Later it was taken over by Etruscans as they expanded from the seacoast into the Campanian hinterlands. The expansion of the Oscan tribes out of the Apennines led to a war against the Campanian Etruscans, 524-474 B.C.E.. The Sabelli then followed in another wave of Oscan expansion, seizing Campania (450-420), Lucania (420-390), and Bruttia (c. 356). Hyria was then renamed Nuv-la, “New City,” and became the capital of the Oscan Samnite confederation around 400 B.C.E. In 327 B.C.E., 2000 Nolans and 4000 Sanniti were sent to capture Neapolis and Palepoli. The following year Neapolis expelled the Samnite garrison and allied with Rome. A border war continued for a few years until the Romans decided to launch an invasion into Samnite territory. In 320 the Romans suffered a crushing defeat at the hands of the Samnites at the Caudine Forks. A lull occurred until the Samnites renewed the war against Rome in 316. They invaded Latium, winning a pitched battle at Lautulae near Terracina, devastating much of Latium and advancing as far as Aricia, the center of the Latin League. But in 315 the Romans defeated the Samnites, capturing Nola, which in the following year was made a Roman municipium. The Second Samnite War then concluded in 304 B.C.E. At the conclusion of the Third Samnite in 290 B.C.E. Nola and Avellino held the status of being allies of Rome. Nola remained loyal to Rome against Hannibal, whereas Avellino defected. Nola revolted during the Social War and was subjugated by Sulla in 89, and then again by Sulla in 82 when Nola and the Samnites sided with Marius.

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## Move Over, Pompeii

*Archeology Magazine*

Volume 55 Number 2, March/April 2002

by Jarrett A. Lobell

One of the world's best-preserved Bronze Age villages has been found at Nola, a few miles from Vesuvius, during routine tests before construction of a shopping center. A catastrophic eruption of the volcano, known to have taken place between 1800 and 1750 B.C., left this "Prehistoric Pompeii" in a state of remarkable preservation.

For more than 250 years, archaeologists have been working around the Bay of Naples to uncover the lives of the inhabitants of Pompeii, Herculaneum, and the surrounding towns and villas buried by the eruption of Vesuvius in A.D. 79. But near the city of Nola, archaeologists found the homes and possessions of the region's much earlier residents.

Although much of the structure of the prehistoric huts was destroyed by the eruption, falling ash and volcanic mud hardened to create a kind of mold of the village in reverse, much like the casts of the victims of Vesuvius' more famous



eruption. In addition to the remains of actual huts, which go far beyond the usual post holes, director Giuseppe Vecchio and his team have also excavated a rich array of finds that reveal much about domestic life at the time. Since Nola is only 7.5 miles from the volcano, people probably did not have time to pack before the eruption, and left behind cooking utensils, drinking cups, hunting tools, a hat decorated with wild boars' teeth, and a pot waiting to be fired in the kiln. Evidence for their diet has also been found, including pig, sheep, and cow bones, pots full of grain, and a pen, elevated six feet off the ground and filled with the bones of pregnant goats. So far no human remains have been found at Nola--only several footprints preserved in the mud--but scholars believe the skeletons of a Bronze Age man and woman discovered nearby about five years ago may be associated with the prehistoric eruption as well. Excavation is ongoing, with plans to reconstruct the village at a nearby museum and perhaps open the site to tourists.

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[www.archaeology.org/0203/newsbriefs/bronzeage.html](http://www.archaeology.org/0203/newsbriefs/bronzeage.html)

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*Antiquity Magazine*

## **A First Pompeii: the Early Bronze Age village of Nola-Croce del Papa (Palma Campania phase)**

CLAUDE ALBORE LIVADIE\*

In May 2001, in the immediate outskirts of Nola (an important city some 25 km from Naples), an Early Bronze Age village was discovered buried by an unexpected eruption of Vesuvius (the Pomici di Avellino eruption of 3550 BP). Three huts were found 6 m from the surface, originally part of more extensive settlement, next to an enclosed area which included a threshing floor, some covered structures and an animal pen made out of wattle and daub (FIGURE 1). The humidity of the soil had conserved not only human footprints, but the hoof marks of domestic animals (sheep, goats, cows and pigs) in the enclosures whence they had fled at the time of the eruption (FIGURE 2). Nine 4-months pregnant goats were discovered in the animal pen, and four others were tied to the fence. An adult dog had taken refuge under the eaves of the thatch of one of the huts. All other inhabitants had fled at the time of the eruption, perhaps taking with them their most precious possessions, since some personal items were not found (bronze arms in particular); one exception was a head-dress made from plaques cut from the distal end of young pig tusks (FIGURE 3). This must have been a typical local style, as other partly finished plaques were found in the two other huts or abandoned in the animal enclosures.

The living structures, orientated northwest-southeast, had a horseshoe shape, with the opening in the straight side, partly projecting above the entrance in a sort of porch. They had varied dimensions: hut 4, 15.6x4.6 m and 4.3/4.5 m high; hut 3, 15.2x9.0 m and 5 m high; hut 2, 7.5x4.5 m and 4.3/4.5 m high. The door, hung on the south wall, opened inwards. The walls were continuous with the roof because of its very steep incline (45%). They were constructed of small posts placed about every 40 cm, reaching down to the ground, with small wooden joists placed horizontally every 25 cm. The small posts and the joists were tied together with cords, which still remained visible in the ashes. Some axial posts supported the roof. Some posts were placed laterally all around the internal wall, which held in place a vertical trellis made of panels of wooden branches placed lengthwise that allowed the roof to distribute some of its weight. Between the trellis and the true and proper wall the cavity was used as a storage area separated from the living area. There might have been a loft in at least one of the huts, reached by means of a triangular ladder. Internally, one or two partitions divided the area into two or three inter-communicating zones. In the longest hut, a narrow opening separated the liv-



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The discovery recalls Akrotiri, Pompei or Ceren (Salvador) — three sites devastated by a volcanic eruption, where the image of daily life has been captured. At Nola, after the fall of grey pumice that covered the huts without causing their collapse, a wave of mud penetrated slowly within the structures, providing a counterforce to the pumice accumulated on the outside and allowing their preservation to a height of c. 1.30 m (FIGURE 4). The consolidated mud has produced a cast of the inside of the huts and a negative of everything found there: some wood and wickerwork containers, some cloth or the ties which either suspended containers or linked together the elements of construction. Additionally, the bundles of straw which covered the huts, the leaf impressions of oak and fern and the casts of cereals and other vegetable remains (including mushrooms) were perfectly understandable, all fossilized by the mud of the eruption.

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Complete assemblages of ceramic objects survive; the larger two huts had almost 100 coarse pots, some decorated with parallel incisions and netting, others with excised triangles. Sometimes a white paste was employed to infill the decoration, as in the later Apennine style. Some vessels still had their contents: almonds, flour and grain. Near hut 4, two pre-term fetuses of 4.5 and 6 months respectively were buried in a crushed pot. Earlier level huts, on the same orientation, and metalworking were found under the settlement.

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The first archaeobotanical analyses have produced carbonized macro-remains and impressions in the ash of cereals (*monococcum*, *dicoccum* and barley), fruit, nuts (almond *Amygdalus communis*) and other vegetable matter (olive stone and acorns). Numerous remains of carbonized woods belong to beech, black hornbeam and fig; these give the impression of a human landscape with fruit trees, pasture and cultivated fields not far from a mixed beech woodland.

*Acknowledgements.* The 1000-sq. m excavation was directed by the writer in collaboration with Dott. Giuseppe Vecchio of the Soprintendenza per i Beni Archeologici delle Province di Napoli e Caserta. A project co-ordinated with the Soprintendenza aims to preserve the structures *in situ* while the rich information is being studied by a laboratory team of Italians and foreigners.

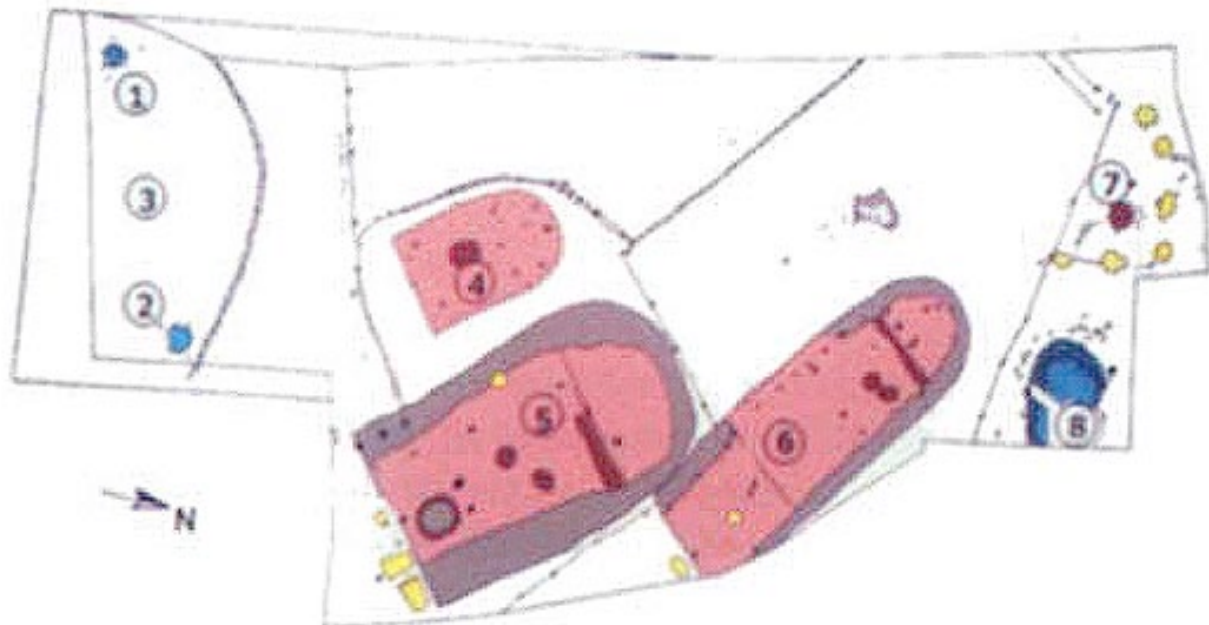


FIGURE 1. General plan of the site of Croce del Papa (drawn by Emilio Castaldo). 1, 2 Wells; 3 Subcircular enclosure, threshing floor; 4 Hut 2; 5 Hut 3; 6 Hut 4; 7 Cage with goats; 8 Waterhole.



**FIGURE 2.** *In the foreground, prints left by men and bovines; in the background, an animal pen with pregnant goats.*



**FIGURE 3.** *Reconstruction of the pig's tusk head-dress.*





FIGURE 4. *General view of Huts 3 and 4 under excavation.*



FIGURE 5. *Hypothetical reconstruction of the inside of Hut 4 (drawn by Emilio Castaldo).*

## Oplontis



The site of Oplontis is in the middle of the modern town of Torre Annunziata.

The name Oplontis is only known to us from the Peutingerian Tabula , a 13th century copy of an ancient map showing the road network in Italy at the time of the Roman Empire. On the map the toponym Oplontis refers to some buildings between Pompeii and Herculaneum. This name was given to a series of archaeological finds which in

actual fact stood on the outskirts of Pompeii: a residential villa, known as the 'Villa of Poppea'; a rustic villa, attributed to L. Crassius Tertius, in which were found the bodies of numerous victims of the eruption and also a large hoard of gold and silver coins, as well as valuable gold jewellery, and a bathing establishment nearby the Oncino, beneath what is now the Terme Nunziante, attributed by the archaeologist A. Maiuri to the consul

***Strongbox, Oplontis → This unique piece was found in the peristyle of the Villa of Lucius Crassius Tertius. The wooden framework of the box is covered by iron leaves, and is inscribed with the names of three characters, possibly the artisans who created the box: Pytonymos, Pyteas, and Nicocrates.***

**Marcus Crassus Frugi. The main monument, and the only one open to**



the public, is the Villa of Poppea, inserted in the “Patrimony of Humanity” of the UNESCO: it is a grand residence dating from the middle of the 1st century BC. It had been enlarged during Imperial times and was undergoing restoration work at the time of the eruption. There are various grounds for attributing it to Poppaea Sabina, the Emperor Nero's second wife, and it was undoubtedly part of the estates of the Imperial family.

Systematic excavations at Oplontis between 1964 and 1984 unearthed several important villas, most notably “Villa B,” a house that is now known to be the Villa of Lucius Crassius Tertius. Inside the Villa, excavators found piles of jars called *amphorae*, which were known to hold goods such as wine, oil, and other agricultural products. Because of the presence of the amphorae, the building was thought to be a sort of business center where these goods were manufactured, processed, and sold.

These finds, together with some public baths that were excavated there in 1834, help identify Oplontis as a middle-sized town. Though it was peripheral to Pompeii and under its administrative control, Oplontis had sufficient infrastructure to suggest that it was a well-developed residential center.

Like those in Pompeii, the residents of Oplontis began feeling the effects of the first phase of the eruption by mid-day on August 24. They felt the tremors, saw the volcanic column rise above Vesuvius, and quickly sought shelter from the thick rain of pumice that strong southeast winds began dropping on the area. The weight of accumulating pumice caused the village's flat roofs to collapse, forcing many individuals to seek refuge in the Villa of Lucius Crassius Tertius. Others sought refuge by the sea, but met the same fate as those who fled Herculaneum.

Oplontis and its residents finally fell victim to Vesuvius around one o'clock in the morning of August 25. The first volcanic surge dropped incandescent, fast-moving clouds of material on the town, killing those who had not yet succeeded in fleeing the area of the eruption.





***Another grisly display: Skeletons, Oplontis***

***At least 74 people sought refuge in one room of the Villa of Lucius Crassius Tertius. It is impossible to ascertain how many of these people were inhabitants of the villa and how many were simply seeking shelter on their way to the sea. At least half of them were found with nothing on them, identifying them, in all probability, as the workmen of the villa.***



# Oplontis – Villa of Poppea

The Villa of Poppea was built during the 1st century B.C. and then enlarged in the Claudian age. The Villa is magnificent for its dimensions, the quality of its frescoes and the numerous marble sculptures.

The Villa is thought to have belonged to Poppaea Sabina, emperor Nero's second wife because of an inscription on an amphora to Secundus, a freedman of Poppea. Indeed, the imperial family used to spend some time on the Campanian coast, as many patrician families, to enjoy the healthy climate, as shown by the sumptuous residential villas here found.

The Villa was uninhabited at the moment of the eruption. There were neither furnishings in the rooms nor in the kitchen. Many objects found, such as columns and oil-lamps, were piled up in few rooms. Building material and work in progress prove that they were repairing the damages caused to the Villa by one of the frequent earthquakes in the Vesuvian area.

The building lies east to west and comprises the original central section overlooking the garden, onto which were added two wings and a portico.

The original entrance and the front are not excavated and are situated beyond the 16th century artificial canal of Conte di Sarno, under the modern built-up area.

The Villa, surrounded by large gardens, has a thermal quarter and productive places, such as the one for treading grapes and producing wine.

The pictorial decoration created perspective effects and relations between the reality and the unreality, by mixing sham doors and columns with the real architecture. Details of decorations were numerous and of high quality. They represented masks, fruit baskets, torches and birds.

The Villa was originally adorned with many sculptures, predominantly Roman copies of the Hellenistic originals from the 2nd - 3rd century B.C..

The eastern side has been almost completely excavated, while part of the western side lies under a modern road and a military building, the old Real Fabbrica d'Armi.

## THE ATRIUM (ROOM 5)

This was the heart of the original building, dating from the middle of the 1st century BC, where the members of the household spent most of their time. In the ceiling, which has been rebuilt, the central opening or compluvium, allowed rain water to collect in the tank below, impluvium. The white mosaic flooring features a polychrome border around the impluvium. The striking wall paintings are some of the best specimens extant of the II style of Pompeian wall paintings. The illusionary architectonic perspective features colonnades, ceilings, and far off shrines, landscapes and cities glimpsed through doorways and porticos, the overall effect being enhanced by contrasts of light and shadow and the use of bright colours and artistic embellishments.



## THE VIRIDARIUM (AREA 20)

The *viridarium* was a large grassy area with fruit trees, surrounded by a drainage canal made from mortar mixed with crushed potsherds (*cocciopesto*). The walls are adorned with garden scenes on black and red backgrounds, with plants and birds particularly in the lower section painted to achieve a striking effect of perspective.



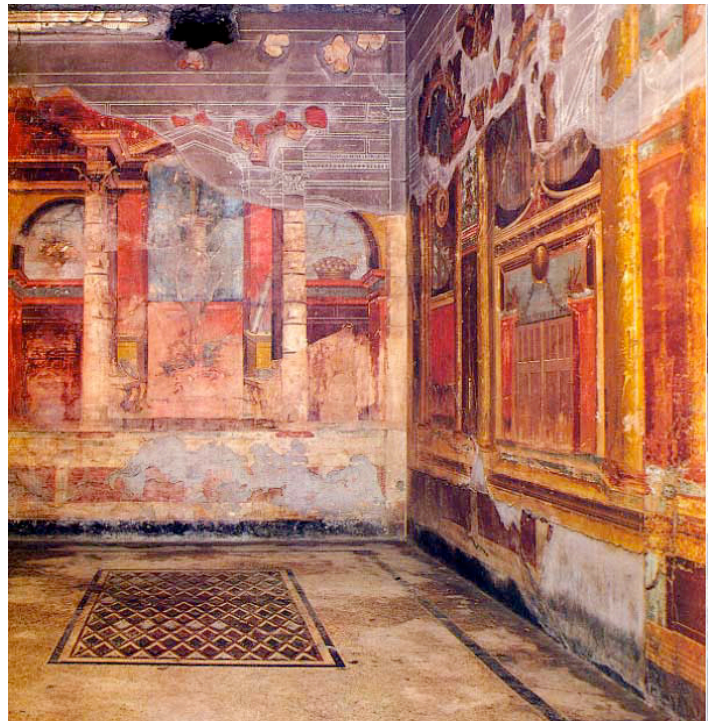
### **THE OECUS (ROOM15)**

This was one of the most magnificent rooms in the Villa, probably the oecus or banqueting hall. Its walls were entirely covered with frescoes, and it commanded a fine view over the sea, which in Roman times was closer than today. The white mosaic floor features a black border round the walls and inserts of variously coloured marble. The wall paintings, displaying fine workmanship and a subdued range of colours, contribute to the overall effect of spaciousness.



### **THE TRICLINIUM (ROOM 14)**

This large, sumptuously decorated dining room had couches along the walls for the diners and the table down the centre of the room. The white mosaic floor shows a transition from a sort of vestibule to the dining area itself. The walls are decorated in the II style, with trompe l'oeil colonnades, conical tempietti, corridors with doors in them and a gate opening onto a garden or sacred grove.





### THE PORTICOS (ROOM 13) (Below)

Two symmetrical porticos link the rooms on the southern side of the villa. The white mosaic floor features perpendicular rows and lateral bands of black tesserae. The wall is decorated with panels in the IV style (black socle, red central band and white upper section adorned with elements of architectonic perspective and garlands). The columns are white and fluted or decorated in white and red fish-scale pattern. The walls between the columns are built in opus craticium, using wooden frames filled in with stone rubble and mortar.



### THE CUBICULUM (ROOM 11) (Right)

The cubicula were the bedrooms, of which this villa had many. In the one here shown you can see the domed alcoves in the walls where the beds stood. The walls and ceiling were elegantly decorated with paintings in the 2nd style and stucco work.





**Small Peristyle (now roofed for protection from the elements) (below)**



Large Peristyle with garden

### **THE PASSAGE (Cryptoporticus) (ROOM 46)**

This linked the main part of the villa with the swimming pool area. Its flooring is in *cocciopesto*, and it has stone benches along the walls and large windows interspersed with frescos in the IV style. The ceiling, whose panelled truss work has been carefully reconstructed, is of particular interest because its rich imagery recalls similar decor in Nero's Domus Aurea in Rome. It is not difficult to imagine how this sumptuous room would have heightened the visual impact of the large swimming pool .



### **THE HALL (ROOM 69)**

This great hall represents the main nucleus of a series of rooms opened on the western side of the pool. On the eastern side there are traces, in the floor, of the basis of two high columns. The grandeur of the columns gave the room a monumental sight. The walls were covered, at the basis, with coloured marbles, while the upper part had a white background. The floor, partially





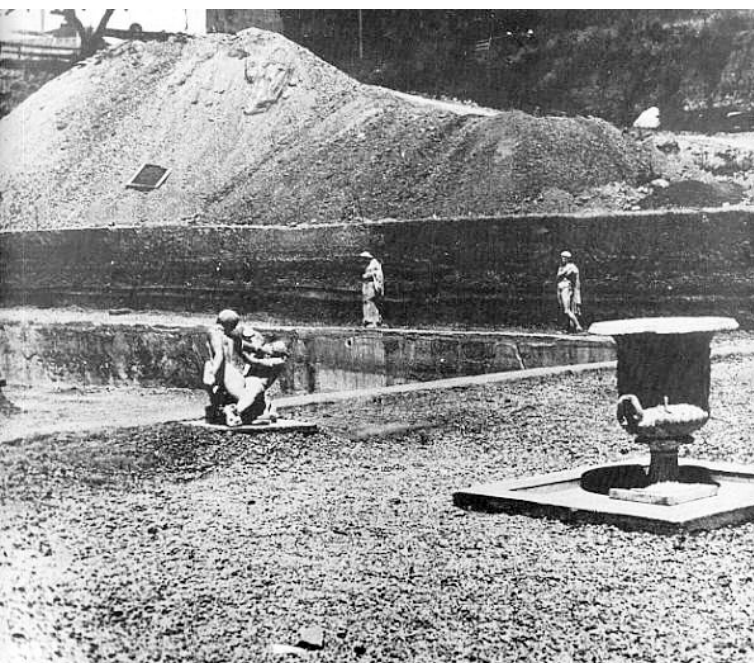
preserved, is a beautiful example of opus sectile, composed of marble tiles of different types and colours. At the southern and northern side there are symmetrical rooms with the same floor and ceiling decoration. These rooms were probably destined to guests.

## THE POOL



The large pool (61 metres long and 17 wide) is floored in cocciopesto; it was entered down steps in the south-east corner, and its sides were decorated with white stucco panels. It was designed to be part of a luxuriant natural environment, surrounded by a lawn in which paleobotanic studies have identified the remains of plane trees, oleanders and lemon trees, further enhanced by pillars bearing marble sculptures. On the western side a colonnade runs down virtually the whole length of the pool, making a pleasant walkway and linking the various rooms that opened onto the pool. The bright tones of the wall paintings, with the calligraphic precision of the IV style on a white background, the elegant columns with Corinthian-style marble

capitals and the white mosaic floor with black bands and inserts in coloured



marble give a sensation of airiness and light, which would have made a striking effect with the reflections off the water and the greenery all around.

Statuary and artifacts found around the pool during excavation have since been move to the National Archeological Museum in Naples.

### **PORTICOS (ROOM 33-34)**

The two porticos, on the northern side of the villa, with columns covered with white plaster and thin flutings, stand by the structure of the oecus (room 21), creating a magnificent and monumental façade. At the basis of the columns, in the ground, there is a drainage canal in cocciopesto. The portico has a mosaic floor with white tesserae and a black strip along the walls. The wall decoration is of the 4th style: the lower part has a black background with decorations of plants, birds and crockery. The middle part alternates red and yellow panels with decorations of architectural structures in perspective; the upper part, with a white background, has an aedicule and sections decorated with little frames. Four statues of centaurs and the little statue of the child with the goose were found in



one of the porticos and wait for a new placing.



## Oplontis VILLA B (Villa of Lucius Crassius Tertius)

The Villa, still closed to the public, is noteworthy for its destination, different from that of the Villa of Poppea, for the materials here found, and for the contribution that the results of the excavations offered to understand, in the particular case of Oplontis, the relation between villas and territory.

The Villa, also called " Villa of Lucius Crassius Tertius" from a bronze seal, dates back to the end of the 2nd century B.C.. It came to light accidentally in 1974, while they were building a school.

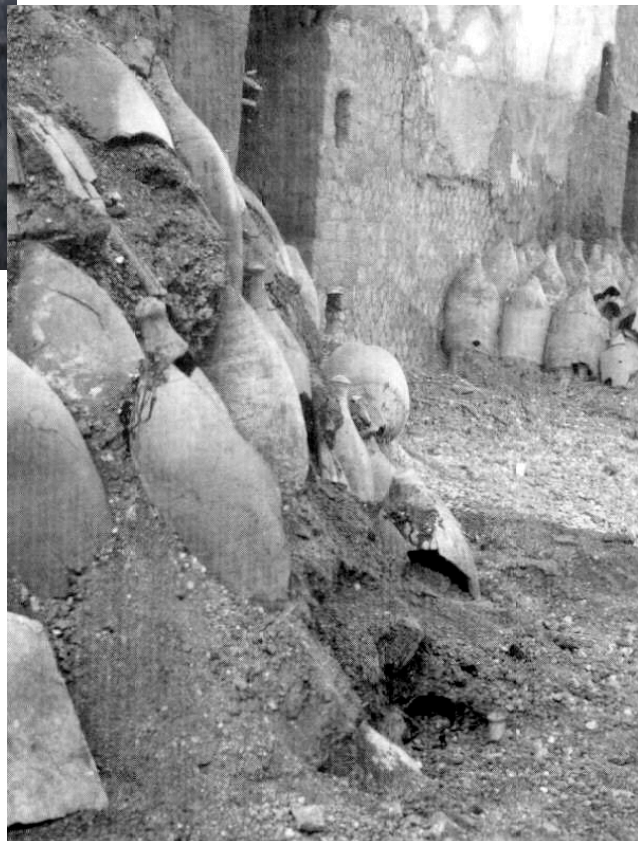


← The central nucleus of the building is composed of a portico with two ranges of Doric columns in grey tufa from Nocera.

Along the wings of the peristyle, completely rebuilt by placing in the primary position drums and capitals, there is a series of rooms, probably a storehouse, as it is supposed by the objects here found (weights, furnishing, pottery, carbonized straw, a great deal of small and unripe pomegranates, probably

used for tanning).

The wings of the peristyle were used as storehouse for containers: more than 400 amphorae, most of which used for wine, laid on the wall, upside down and one in each other. This datum, together with the finding of a stone stove with a pot containing resin of conifers (used to cover the inner faces of the amphorae) explains the function of the building. Probably, it was a farm for the working of agricultural products and for the bottling and



sale of wine produced elsewhere, as proved by the absence of grape presses and proper equipment.

Other domed rooms, aligned on the south side, are likely to have the same function of storehouse. In one of these rooms 54 people were found. They did not live in the villa.

Along with them and other material, a great deal of jewellery, silver and gold coins have been found.

Other jeweller's wares were found in a wood box, fallen from the top floor.

The top floor, on the south side, is occupied by a luxury flat, probably the residence of the *dominus*. Here, some rooms are decorated with painting of the IV style, among which there is a rare exemplar of the so called "architectural" II style, dating back to the Republican Age.

On the north side of the building two-storied small houses came to light. They were independent and faced a road separating the villa from other building structures on the opposite side. They were probably small shops, linked to a flat at the top floor. In this case, the villa may be considered as a part of an *insulae*, delimited by roads, and this reproduces the same territorial situation of Stabia.

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## **Amalfi villa, buried by Pompeii eruption, is unearthed**

By Hilary Clarke in Rome (Filed: 22/11/2005, Telegraph, U.K.)

An archaeological dig on the Amalfi coast has revealed the first luxury villa to be built in the idyllic fishing village of Positano, a popular haunt of today's rich and famous.



***Fresco in Positano: A fresco on a wall of the villa found in Positano***

**Two storeys of a first century millionaire's abode have been found under a church which was hidden for 2,000 years by the same volcanic eruption that devastated Pompeii in 79AD.**

**During renovation work on the church's crypt last summer, roof beams were found poking up just a few inches down.**

**They revealed an enormous building that certainly would have belonged to an important person in Imperial Rome.**

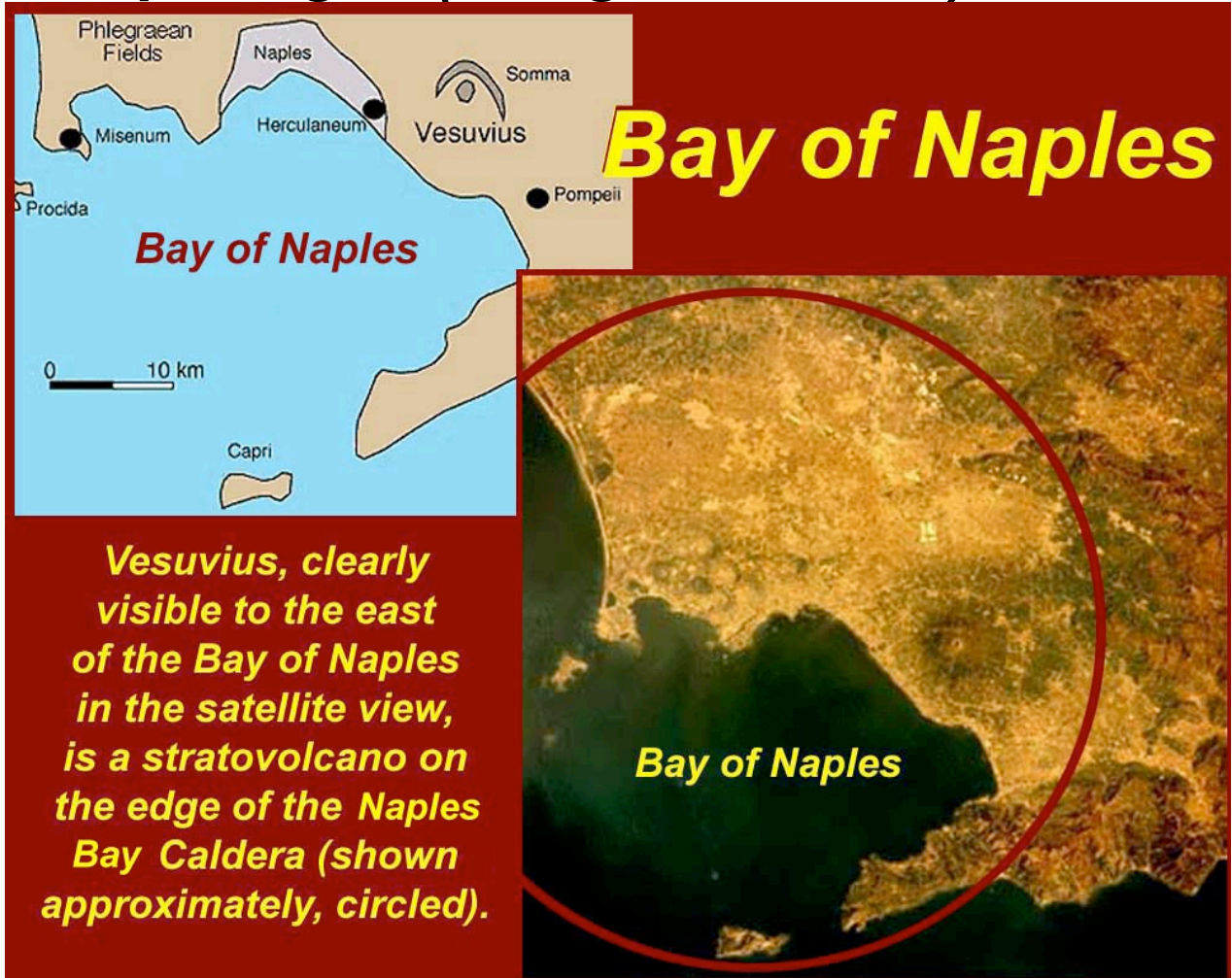
**A subsequent initial dig by archaeologists unearthed, about 6ft below the ground, two storeys of remarkably brightly-coloured wall frescoes and marble mosaics of mythical characters. They had been perfectly preserved.**

**The villa, which looked directly out on to the Mediterranean, is believed to have several terraces although more digs will be needed to see exactly how far it stretches.**

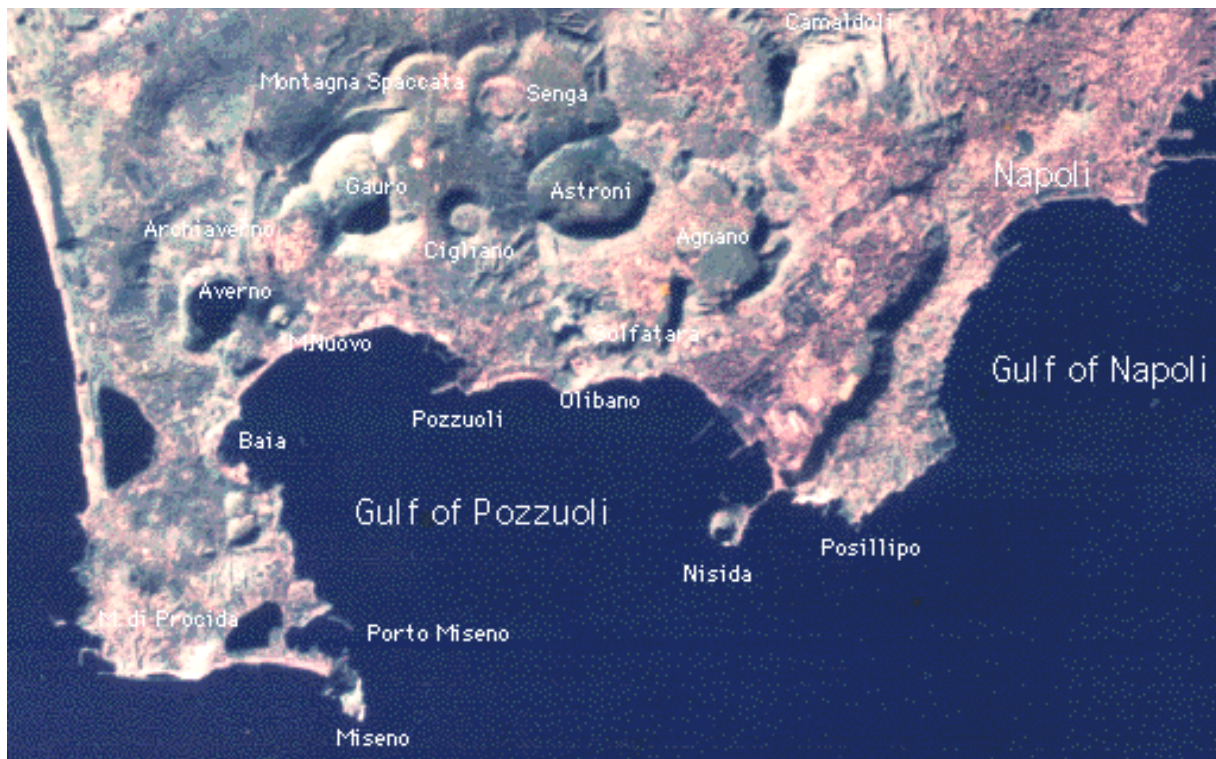


## Unit 8

# ***Campi Flegrei (Phlegrean Fields)***







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Based mostly on the papers of Scandone et al (1991), and Lirer et al (1987)

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## Introduction

**Campi Flegrei (Phlegrean Fields) is a quaternary caldera located west of the city of Naples in an area of regional extension. The erupted products range in composition from K-basalts to alkali-trachyte, phonolite. The complex has been active since at least 47000 a bp, and it is surrounded by three other quaternary volcanic centers:**

- \* a) Ischia Island whose activity ranges between 132000 a bp to the present;
- \* b) Procida Island whose products have ages between 40000 and
- \* c) Vesuvius whose oldest outcropping products have been dated at 25000 a bp .

**According to several authors, activity in Campi Flegrei itself has been dominated by two eruptions that produced widespread ash-flow deposits: the 'Campanian Ignimbrite' (CI) at about 34000 yap, and the smaller 'Neapolitan Yellow Tuff' (NYT) about 12000 years ago.**

**The area and its eruption products have been intensely studied since the XVIII century, and, as a consequence, many theories have been postulated about their origin. Breslau (1798) identified the CI and considered it to be the product of mud eruptions from centers scattered across the Campanian plain.**

Cache (1848) first considered that the CI was erupted from Campi Flegrei; later (1890) he changed his mind and approached the view of Breislak. De Lorenzo (1904) subdivided the activity of Campi Flegrei into three periods including the CI in the first, the NYT in the second, and the products of the recent activity inside the caldera in the third. Zambonini (1919) was the first to interpret the CI as a deposit related with an ash-flow mechanism of deposition.

Rittman et al (1950) postulated the existence of a central volcano (the Archiflegreo) which was destroyed by the eruption of the CI and the following caldera collapse; according to Rittman et al. the subsequent activity produced several other collapses of lesser extent.

Rosi et al (1983), and Rosi and Sbrana (1987) have argued for the existence of a ring fracture surrounding Campi Flegrei, and interpret the pipernoid tuff of Camaldoli and some breccia deposits called Museum Breccia (Johnston-Lavis, 1889) as the proximal deposits of the Campanian Ignimbrite. They agree with Rittmann about the formation and limits of a caldera in Campi Flegrei. Other authors (Di Girolamo, 1970, Barberi et al, 1978, Di Girolamo et al, 1984, Lirer et al, 1987) believe that the Campanian Ignimbrite was fed through an arcuate fracture on the northern edge of Campi Flegrei; this eruption resulted in the collapse of a large area including Campi Flegrei and part of the gulf of Naples.

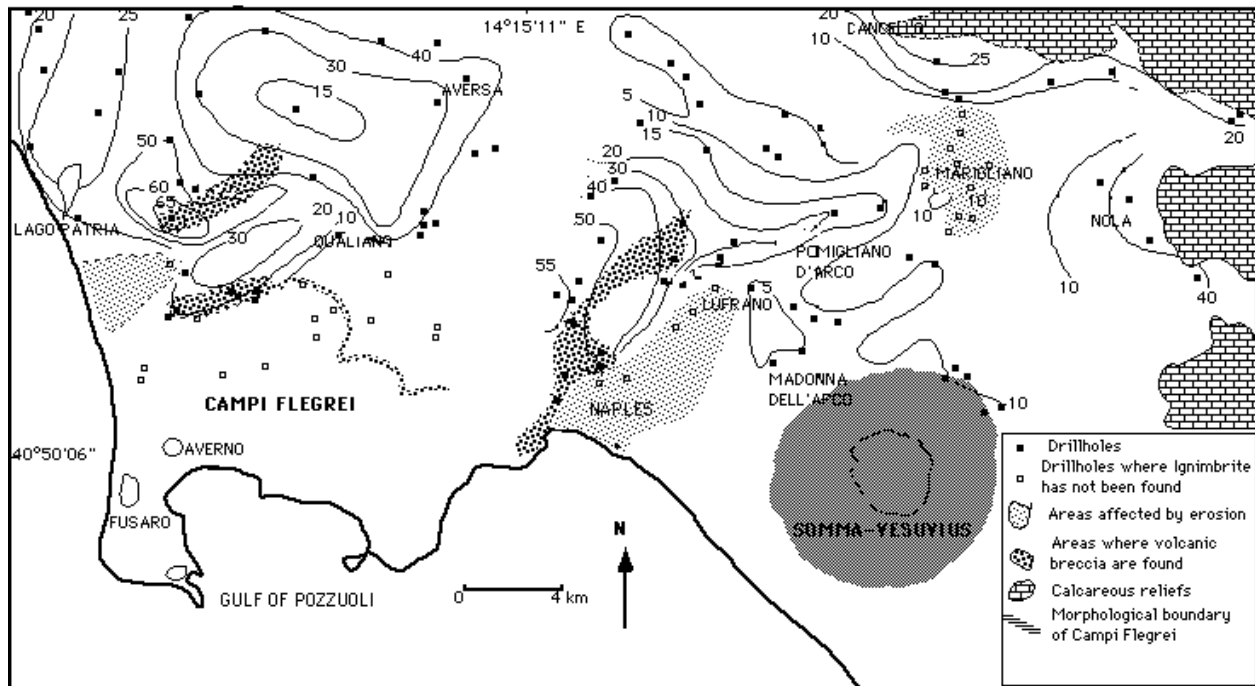
According to Lirer et al (1987), the Campi Flegrei caldera was mainly formed after another voluminous eruption which produced another major pyroclastic deposit, the Neapolitan Yellow Tuff. Scandone et al (1991) suggest that the Campanian Ignimbrite was fed through a NE-SW fracture bordering the present Posillipo Hill and continuing into the Acerra depression. These authors share Lirer et al (1987) view that the Campi Flegrei caldera was formed after the NYT eruption.

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### The Campanian Ignimbrite

The Campanian Ignimbrite (CI) has an average composition of a trachyte . Di Girolamo (1970) identified some spatial variation in the chemical composition of scoria and pumice suggesting an eruption from a zoned magma chamber with the emission of progressively more mafic products.

According to Di Girolamo (1970), the mafic products cover areas of lesser extent than the more acid members, suggesting a decrease of explosivity in the course of the eruption. A detailed geological map of the Campanian Ignimbrite has been made by Di Girolamo (1968); isopleth distributions of lithics and pumice have been reconstructed by Barberi et al (1978). Scandone et al (1991) have drawn new isopachs based on the interpretation of data of drillholes in the Campanian plane.



### ***New Isopach map based on drill holes***

Both Di Girolamo (1968) and Barberi et al (1978) consider the CI to be the result of a unique eruption, even if lateral facies variations are observed. The more striking lateral variation is a change in color from a poorly welded grey deposit to a more welded yellow one. This change is explained in terms of a secondary mineralization and welding produced by zeolitization (Di Girolamo, 1968). On average the deposit is made up of pumice and black scoriae, with a different degree of flattening, embedded in an ashy matrix with subordinate lithics and crystals. Columnar jointing and fumarolic pipes are often observed.

Di Girolamo (1968) identifies also a gradual vertical facies variation: the lower part of the deposit is made up of a more welded ash matrix with iso-oriented, collapsed black scoriae, a relative high density and high unconfined compressive strength; toward the upper part, the deposit is more incoherent, the scoriae have progressively lesser flattening and are chaotically dispersed in the matrix. Di Girolamo (1968) uses different terms to characterize the different degree of welding and density; they are from the bottom to the top: piperno, pipernoid tuff, tuff, "cinerazzo" (a local name for loose ash).

Outcrops, where the base of the CI is visible, are found along the margin of the Campanian Plain. The occurrence of a pumice-fall deposit at the base of the CI is observed only on the eastern side of the Campanian Plain. About 80 % (volume) of the pumice-fall deposit is made up of angular pumices with the remaining 20% of lithics (predominant) and crystals. The pumices have a light grey colour, sometimes grading to reddish in the upper part. Crystals are mostly sanidine with accessory biotite and piroxene. An increase in the ratio lithics/pumice is observed in the upper part of the deposit. An ash layer (~70 vol.% coarse-ash) of variable thickness (~10- ~100 cm) is sometimes found above the pumice deposit.

It is made up by up to 90% vol of pumice and glass shards, and about 10% vol of lithic fragments and crystals (sanidine, biotite, piroxene, and, occasionally, magnetite).

The initial phase of the eruption of the Campanian Ignimbrite was characterized by a sustained eruption column which deposited a pumice-fall deposit to the east of the source area, thus confirming the suggestions made by Thunell et al (1979) and Sparks and Huang (1980).

The Campanian Ignimbrite crops out along the border and in dwelling and quarries of the Campanian Plain . The middle of the plain is covered by the products of the recent activity of Campi Flegrei and Vesuvius, and by alluvial terrains. As mentioned in the introduction, Rosi et al (1983) and Rosi and Sbrana (1987) suggest that the lithic breccia and the Piperno found in Campi Flegrei are lateral facies of the Campanian Ignimbrite. Lirer et al (1991), Perrotta et al (1993) suggest that these deposits have been produced by later eruptions.

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#### Activity after the eruption of the Campanian Ignimbrite

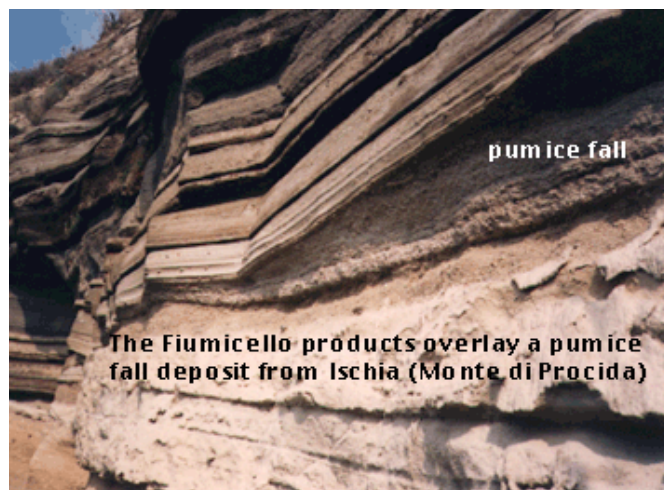
After the eruption of the CI (wherever it occurred) the volcanic activity in the Campanian plain started to localize on one side at Vesuvius volcano, and onto the other side over a large area extending from the area where presently there is the town of Naples as far as Procida Island.

#### Procida and Monte di Procida

The island of Procida (figure below) is only a kilometer away from Monte di Procida, the western edge of Campi Flegrei. The erupted products of Procida and Monte di Procida range in composition from K-basalts to alkali-trachyte.

The age of the eruptions that occurred within this sector span between 40 and 14 ka corresponding to the products of Vivara and Torre Gaveta volcanoes. The activity covers a relatively long period before and after the eruption of the Campanian Ignimbrite. Scandone et al (1991) tentatively identified the products of the CI as the "S. Martino pyroclastic flow". Rosi et al (1983,1987) identify the CI as the products of the Museum Breccia.

The activity of this sector is mostly characterized by explosive eruptions of limited energy as the products are not deposited over large distances (at most a few kilometers). Pyroclastic flow deposits are strongly controlled by





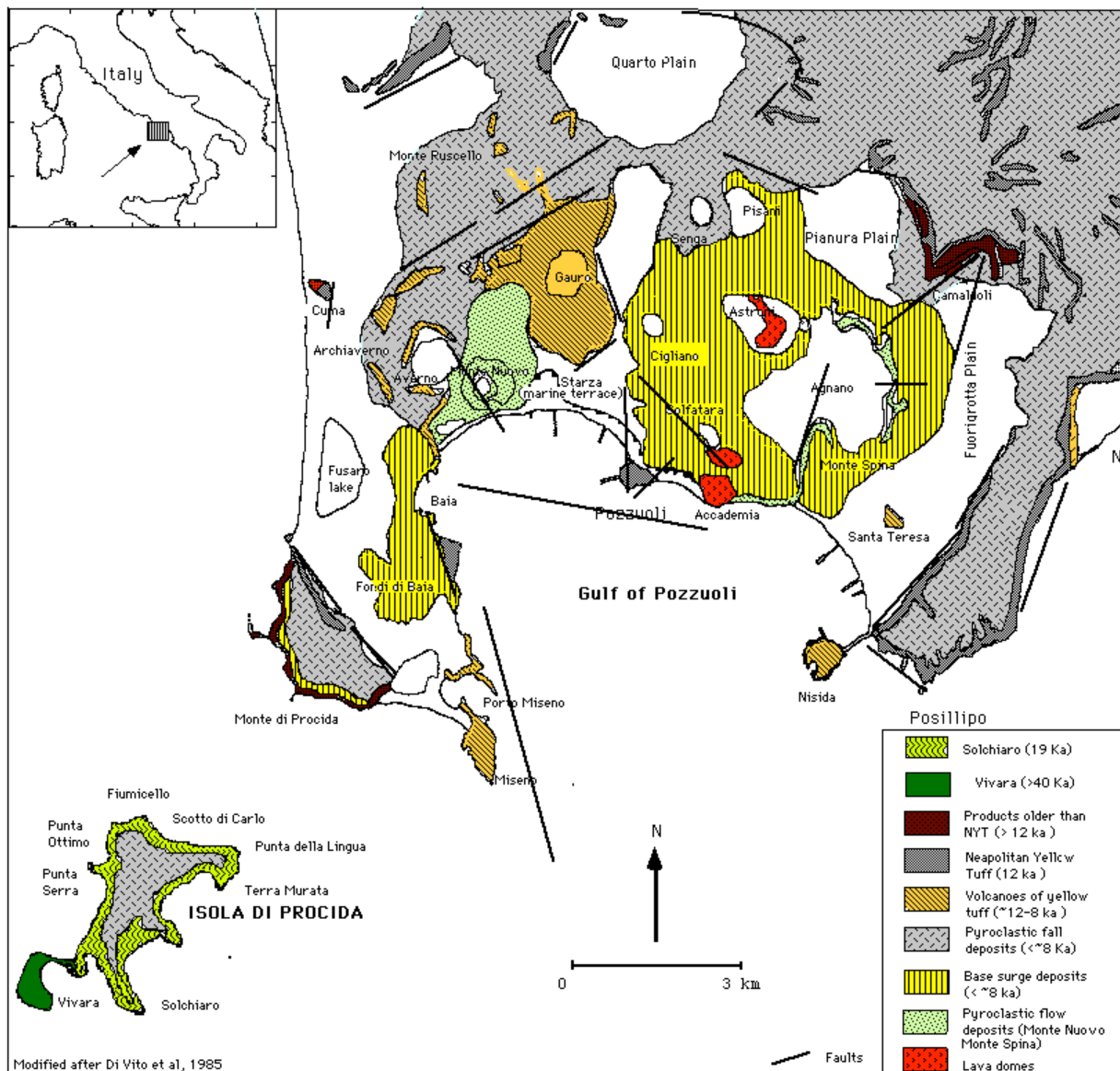
topographic highs and often the products pinch out on reliefs of a few tens of meters.

The oldest volcano is the islet of Vivara which raises above sea-level as an isolated cone. Two lava domes (Punta Ottimo, and S. Martino) were emplaced in the oldest period along with a partially dismantled scoria cone (Miliscola). The areal extent of this scoria cone must have been conspicuous as evidenced by a positive gravity anomaly coincident with it (Cassano and La Torre, 1987). After these eruptions, there was the deposition of several pumice layer of uncertain origin (probably from Ischia). The Fiumicello eruption occurred at about 31000 y BP; the center is probably on Procida Island where are found the most thick deposits with a surge facies. The deposits of this eruption are found on Monte di Procida as sequence of alternating grey ashes and black lapilli. Th flow unit is characterized by black scoriae embedded in an grey pumiceous and ashy matrix; it is strongly controlled by topographic highs and in places (Torregaveta) has been strongly eroded by the overlaying Museum Breccia made up by lithic fragments and pumice lapilli (see detail).

The last eruptions on Procida were that of the Museum Breccia (~18000 a BP according to Perrotta and Scarpati, 1993) and Solchiaro (~17000 a BP) which erupted also the less differentiated products (K-basalt). On the mainland, the last eruption before the Neapolitan Yellow Tuff event was that of Torre Gaveta.

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## Campi Flegrei



A schematic geological map of Campi Flegrei is given in the figure above. On the eastern edge of Campi Flegrei, on Camaldoli hill, the products of the activity of Campi Flegrei are exposed. The oldest products are the so-called Torre-Franco tuffs that comprise a series, 50 m thick, comprising ash-beds with cross-laminations that alternate with pumice and scoria deposits interbedded with paleosols.

Above another paleosol is the Piperno-Museum Breccia formation. The Piperno is a welded ash with abundant fiamme and some pipe-structures that pass into the overlying breccia. As mentioned before Rosi et al (1983,1987) identify the Piperno-Breccia Museum as the proximal facies of the CI and suggest that the eruption of the Campanian Ignimbrite was responsible of the formation of the Campi Flegrei caldera. According to these authors, after the CI the area was invaded by the sea.

**A subsequent activity occurred and filled the caldera depression until the eruption of the Neapolitan Yellow Tuff. On the eastern side of the caldera, above the Piperno there is a 70 meter thick sequence of Whitish Tuffs (16 ka) overtopped by the Neapolitan Yellow Tuff.**



**The eruption of the Neapolitan Yellow Tuff (NYT) occurred at ~12000 y BP. Rittman (1950) suggested that the extensive deposits of yellow tuff that crops out around Campi Flegrei and in the town of Naples were the results of different eruptions. Lirer and Munno (1976) and Di Girolamo et al (1984) proposed that all the deposits of yellow tuff outcropping outside and on the rim of Campi Flegrei were the results of a unique eruption that produced the collapse of the Campi Flegrei caldera (Lirer et al, 1987).**

**Rosi et al (1983), and Rosi and Sbrana (1987) followed the views of Rittman (1950) and suggested that different eruptions were responsible of the deposition of the Neapolitan Yellow Tuff. Recently, Scarpati and Cole (1993) suggested the uniqueness of the Neapolitan Yellow Tuff deposit based on a detailed stratigraphic, granulometric and geochemical study of the different outcrops.**

**Scarpati and Cole (1993) suggest that the eruption of the Neapolitan Yellow Tuff was firstly characterized by the deposition of a phreato-plinian deposit of alternating pumice and ashes, followed by the deposition of a huge sequence of surge and pyroclastic flows. The deposits of the NYT are extensively found on the**

rim of the caldera and within it, as evidenced by geothermal and water-well drill-holes. A conservative estimate of its volume is between 10 and 20 km<sup>3</sup> of DRE. After the NYT eruption, every activity outside the caldera ended (Procida, Monte di Procida, Naples) and the following activity emplaced only within the caldera structure, frequently along its rims and sometimes involving intra-calderic collapses (Lirer et al, 1987).

Scandone et al (1991) suggest that after the eruption of the NYT the inner part of Campi Flegrei was invaded by the sea and all the subsequent eruptions occurred along the border of the caldera. The major volcanic edifices built during this period have been eroded on the side facing the sea.

Several major eruptions occurred between 11 and 9 ka ybp. These were the eruptions of Gauro (10 ka bp), Archiaverno and of Agnano Pumices (9 ka), Monte Ruscello and probably the volcanoes along the northern margin of the caldera (Montagna Spaccata, Pisani, etc.) and Nisida, on the eastern flank.

All these eruptions occurred along the rim of the caldera and many of these volcanoes are made up by lithified yellow tuff that has been interpreted as an indication of water-magma interaction (Di Girolamo et al, 1984). Other eruptions occurred along the western flank of the caldera, and they were Baia and Fondi di Baia, Miseno and Porto Miseno

An uplift of the caldera floor occurred between 10 and 5 ka bp (Cinque et al, 1985). A marine terrace (La Starza) raised to an height of about 40 m presently borders the northern shore of the gulf of Pozzuoli. The uplift was accompanied and followed by renewed volcanic activity whose centers are slightly shifted toward the center of the caldera.

Local collapse during this phase resulted in the Agnano caldera which was formed by several eruptions. Other major eruptions whose products are well exposed, occurred at Cigliano, Agnano-Monte Spina (4000 abp), Astroni (3700 abp) and Averno (3700 abp), Solfatara and Monte Olibano . The last eruption in the area occurred in historical time and was that of Monte Nuovo (1538 AD).

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#### Recent activity: Ground deformation

Since 1800, sea-level measurements made in the ruins of a roman market (Serapeo) have indicated a slow sinking of the area. (These slow movements of the ground have been locally called "Bradisismo" from the Greek bradi=slow, seism=movement). Already in roman times there was evidence of sinking of the ground. The Serapeo, built near the sea-shore, had its floor elevated, two centuries after its first construction, because of the invasion of the sea.

Levellings made at the beginning of this century showed that the maximum sinking was occurring in the city of Pozzuoli and regularly decreased eastward and westward along the coast. This slow sinking of the ground continued until



**1968. In the periods 1970-1972 and 1982-1984 two important episodes of inflation occurred in the Pozzuoli area (Berrino et al, 1984).**

**These episodes produced 170 cm (inferred with respect to the previous levelling) and 182 cm, respectively, of uplift at the point of maximum deformation (located in Pozzuoli). The inflation geometry is the mirror image of the slow sinking observed until 1968; it has a circular symmetry around Pozzuoli and regularly decreases toward the margin of the caldera.**

**The inflation which occurred in 1970-72 had a partial recovery of some 20 cm; similarly, a deflation of about 70 cm has occurred since the end of 1984. One particular feature is the constancy of the areal extent of the deformation.**

**Repeated levellings (Berrino et al, 1984) showed that the bell-shaped form of the deformation did not change appreciably during 1982-1984: although it displayed a marked vertical variation, its horizontal extent remained the same.**

**This pattern is not compatible with magma migration toward shallow depth, for which a decrease of the areal extent of the inflation would be expected. Scandone et al (1991) suggest that the deformation is strongly controlled by the caldera structure and this explains the constant planimetric geometry for inflation and deflation episodes.**

**The slow sinking of the ground observed until 1968 is possibly related with the compaction of the loose pyroclastics that make up the caldera floor. In this sense it represents the normal dynamics of the area. On the contrary the sharp inflation episodes must be considered as anomalous events related with a pressure increase either below the caldera structure or within the loose pyroclastics.**

#### **Recent activity: Seismicity**

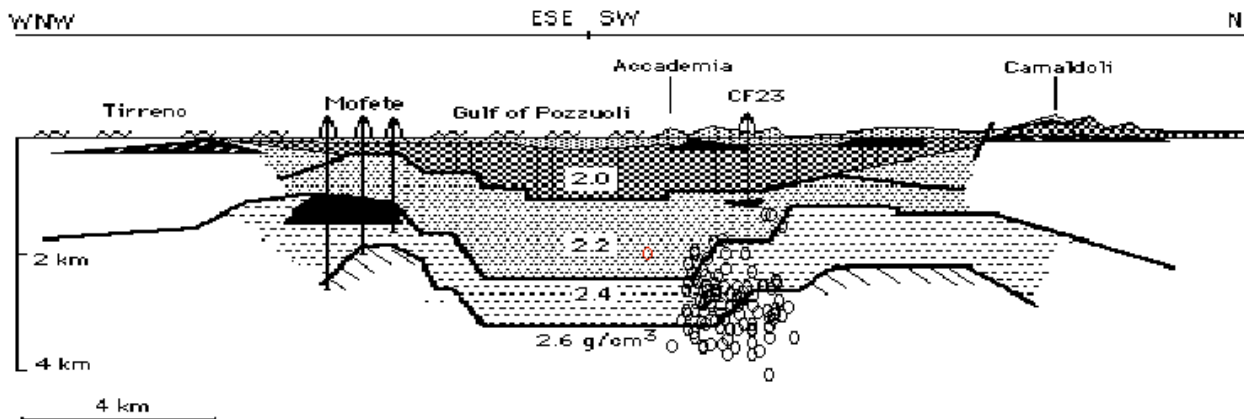
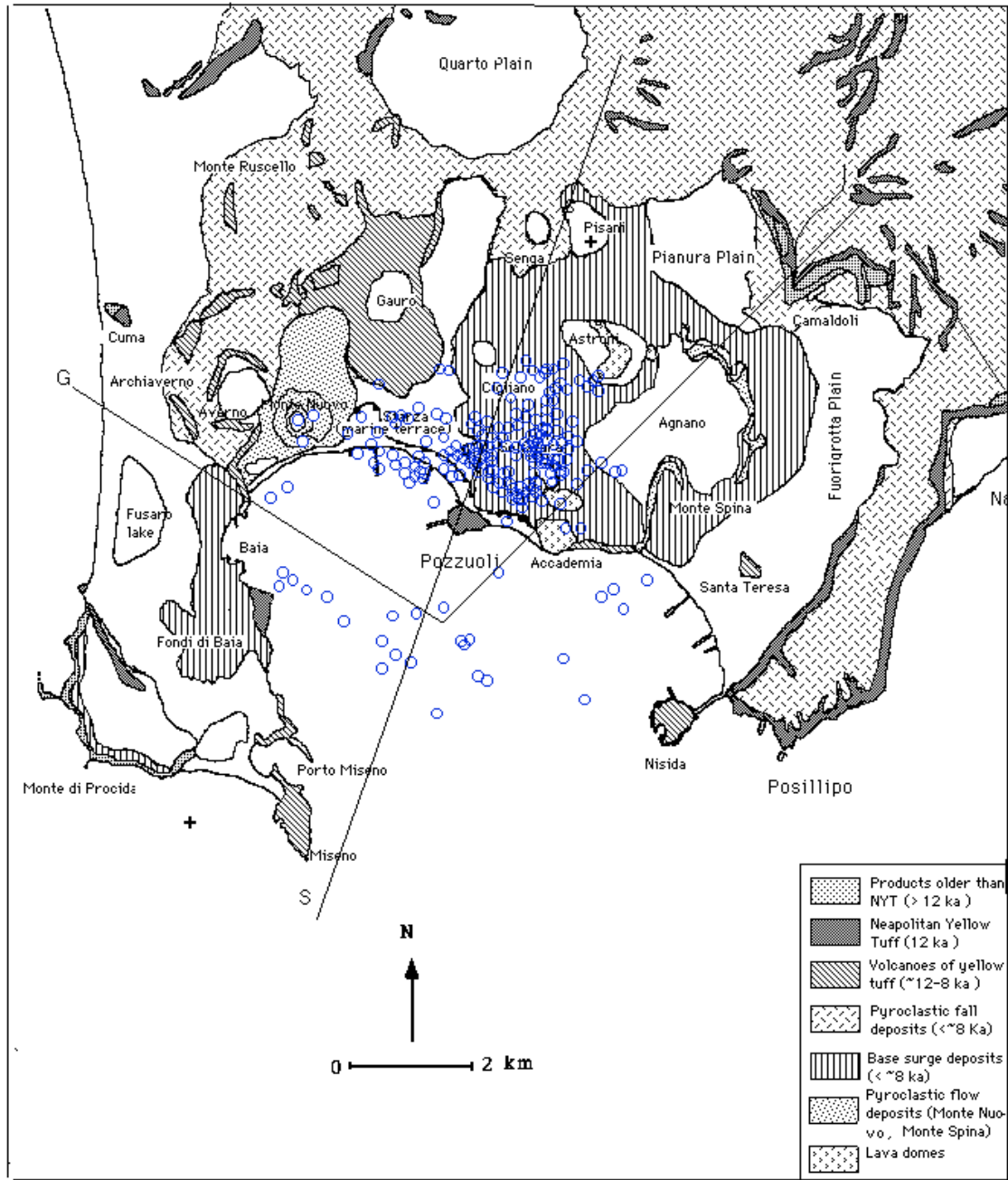
**A seismic crisis began in 1983, some months after the beginning of an inflation of the ground. Earthquakes occurred mostly in the coastal region around Pozzuoli, only a few, deeper events occurred within the gulf; however they did not extended outside the border of the Campi Flegrei caldera. Hypocenters were located between a few hundred meters until ~5 km depth. The maximum observed magnitude was 4.0.**

**A distinctive areal difference was observed in the pattern of seismicity. Earthquakes with the shallowest foci occurred mostly as swarms and were located in an area west of Pozzuoli; earthquakes located in the eastern area, however, had higher magnitudes, occurred as single or double events, and generally had deeper hypocenters. The events occurring in the gulf resembled those of the eastern area, but with generally lower magnitudes.**

**Aster and Meyer (1988) made a tomographic study of the crustal structure of the caldera by a simultaneous tridimensional inversion of velocity and hypocenters of earthquakes. They found that the central part of the Pozzuoli caldera has an anomalously high  $v_p/v_s$  ratio and low  $v_p$  and  $v_s$ , indicating an incompetent highly**

**fractured medium, saturated with liquid water, and that areas of anomalously low  $v_p/v_s$  occur on the borders of the caldera depression.**

**The relocations of the deepest earthquakes showed an inward-dipping elliptical zone of hypocenters, interpreted as a ring fault. The hypocenters of earthquakes occurring in the gulf of Pozzuoli have not been plotted in figure because they fall far from the trace of the structural profile; however they are generally deeper than 3 km and possibly lie on the downward continuation of the south-western fault zone of the caldera so suggesting a funnel-shaped caldera.**





## **BAIA**

### **← The Baia Castle**

**TO THE RIGHT OF AVERNUS, AT THE VERY END OF THE BAY OF POZZUOLI, WE CAN SEE THE LARGE INLET OF BAIA, NAMED AFTER BAIOS, ONE OF ULYSSES COMPANIONS, WHO WAS BURIED HERE. THE FIRST BUILDING WE ENCONTER, ON**

**THE PROMONTORY, IS THE CASTLE. BEFORE GETTING THERE, HOEVER, OUR EYE IS CAUGHT BY VAST SHADOWS UNDERNEATH THE SEA-SURFACE. THEY SEEM TO BE ROCKS, BUT THE PATTERN IS SO REGULAR THAT WE ARE TAKEN ABACK.**

**WE ARE IN FACT IN THE PRESENCE OF AN ENTIRE CITY, SUBMERGED BELOW SEA-LEVEL AS A RESULT OF THE RECURRENT BRADYSEISM OF THE AREA. WE CAN CLEARLY MAKE OUT FROM ABOVE THE "CARDINES" AND THE "DECUMANI", THE PALACES AND SWIMMING POOLS . THERE IS EVEN A LARGE THEATRE, AS IN ANY SELF-RESPECTING ROMAN TOWN. IT IS SAID THAT CALIGULA CONSTRUCTED A BRIDGE OF BOATS TO CONNECT BAIA TO POZZUOLI, BUT BEFORE HIM, AUGUSTUS AND ALEXANDER SEVERUS HAD BUILT RESIDENCES THERE, ONE GOOD REASON FOR THINKING THAT THERE MUST HAVE BEEN MANY OTHER VILLAS BELONGING TO ROMAN ARISTOCRATS, ATTRACTED TO THE TOWN ON ACCOUNT OF ITS THERMAL BATHS.**

**THE UNDERWATER DIVERS WHO HAVE VISITED IT SPEAK OF MARVELS. IT MUST CERTAINLY HAVE BEEN RICHLY DECORATED WITH STATUES AND MOSAICS, FOR ON VARIOUS OCCASIONS FINDS HAVE BEEN BROUGHT TO THE SURFACE.**



**THERE HAVE BEEN MANY PLANS TO MAKE IT ACCESSIBLE WITHOUT OBLIGING ITS VISITORS TO DON A DIVING-SUIT. ONE IDEA WAS TO CONSTRUCT AN IMMENSE SPHERE MADE OF PLASTIC, A KIND OF HUGE DIVING-BELL TO KEEP OUT THE SEA, BUT IT WOULD HAVE REQUIRED HERCULEAN EFFORTS, LIKE THOSE WHICH SAVED THE TEMPLES IN THE NILE VALLEY. THE PROJECTS HAVE THEREFORE REMAINED AT THE DRAWING-BOARD STAGE.**

**YET, PRECISELY BECAUSE THIS CITY, WHICH WE PRESUME TO HAVE BEEN BUILT UNDER NERO, LIES SUBMERGED, IT REVEALS MORE ELOQUENTLY THAN ANY OTHER RUIN THE REASON FOR THE DECLINE OF THE AREA. IT WAS MORE WELCOMING, PLEASANT, FERTILE THAN ANYWHERE ELSE IN THE EMPIRE. THE ROMANS LOVED IT, AND EVERYTHING LEADS US TO SUPPOSE THAT THEY WOULD WILLINGLY HAVE TRANSFERRED, ALONG WITH THEIR LARES AND PENATES, MORE PERMANENT INSTITUTIONS...**

**YES THIS REGION, WITH ITS EARTH CONTINUALLY RISING AND FALLING, WAS UNSAFE; IT HELD OUT NO GUARANTEE OF ETERNITY, AND THE ROMANS ABANDONED IT. AN AMERICAN HISTORIAN HAS REMARKED THAT NAPLES HAD SEVERAL NATURAL FEATURES WHICH FITTED IT TO BECOME THE CAPITAL OF AN EMPIRE, BUT ITS INHABITANTS LACKED THE TENACITY AND THE PRATICAL LOGIC OF THE ROMANS, WHOSE CITY WAS WITHOUT A REAL HARBOUR AND SURROUNDED BY MARSHLAND. PERHAPS THE EXACT CONTRARY IS TRUE: IT WAS NAPLES NATURAL DISADVANTAGES WHICH SEALED ITS FATE,AND THE INSTABILITY OF ITS SOIL, WHICH BRADYSEISM AND EARTHQUAKES, HAS CERTAINLY NOT FAVOURED LONG-TERM PLANNING.**

**ON THE OTHER HAND, IT WAS NATURE'S CAPRICIOUSNESS WHICH MADE THE AREA SO BEAUTIFUL AND FASCINATING AND ENJOYABLE. AND NO ONE HAS ENJOYED IT MORE THAN THOSE GREAT CONNOISSEURS OF PLEASURE, THE ROMANS.**

**AT THE FOOT OF THE CASTLE, THE SO CALLED "STOVES OF NERO" ARE VISIBLE, STILL USED AS THERMAL BATHS TODAY. NERO ALSO HAD HUGE OYSTER BEDS CONSTRUCTED IN THE BAY.**

**HERE WE ARE FINALLY ABOVE THE SQUARE SHAPED CASTLE. IT WAS BUILT TOWARDS THE MIDDLE OF THE SIXTEENTH CENTURY BY DON PEDRO DE TOLEDO AS A BULWARK ON THE RUINS OF THE CAESARS' VILLA. SOMETHING MUST HAVE EXISTED ON THIS SITE BEFORE THAT DATE, THOUGH; IN THE FOURTEENTH CENTURY, GROUPS OF PEOPLE MUST HAVE COME HERE INTENT ON PLEASURE, IF WE ARE TO BELIEVE BOCCACCIO, WHEN, IN ORDER TO WORK OFF HIS ANGER AFTER A LOVERS QUARREL WITH FIAMMETTA "MARIA D'AQUINO" , HE INVEIGHS: "PERIR POSSA IL TUO SENO, BAIA / E IL LOCO TUO!" (MAY YOUR BAY PERISH, BAIA, AND YOUR TOWN!) . AT PRESENT, THE CASTLE IS USED BY THE SOCIAL SERVICES DEPARTMENT, BUT DURING**

**THE SUMMER ITS TERRACES ARE USED FOR IMPORTANT CULTURAL EVENTS, SUCH AS CONCERTS, PLAYS, CONFERENCES, ETC.**

**BEHIND THE CASTLE, THERE IS THE HARBOUR, FULL OF CHARACTER. MOST OF THE BOATS ANCHORED HERE ARE OLD BARGES USED FOR TRANSPORTATION: SOME ARE HALFSUBMERGED IN THE WATER, AND OTHERS HAVE BEEN ABANDONED. YET THE SLEEPINESS OF THE PLACE IS ONE OF THE CHIEF ELEMENTS OF ITS CHARM. ON THE QUAYSIDE THE PINK HOSES OF THE FISHERMEN CAN BE SEEN QUITE CLEARLY. PICTURESQUE TRATTORIAS LINE THE LITTLE BAY. THE CIRCULAR CONSTRUCTION ONE CAN SEE AT THE END OF THE QUAY, JUST BEFORE THE NAVAL DOCKYARDS, IS THE TEMPLE OF VENUS. THE INTERIOR IS CIRCULAR, WHILST THE EXTERIOR IS POLYGONAL. IT HAS A VERY LARGE DOME, HALF OF WHICH HAS BEEN DEMOLISHED. FURTHER UP THE HILL, THE DENSE VEGETATION CANNOT HIDE THE REMAINS OF A HUGE ARCHITECTURAL COMPLEX: THIS IS BAIA'S ARCHAEOLOGICAL PARK, ONE OF THE MOST INTERESTING OPEN AIR MUSEUMS. THE REMAINS OF ONE OF THE MOST IMPORTANT ROMAN THERMAL BATHS ARE PRESERVED HERE.**

**OUR HEIGHT ALLOWS US ONLY A BIRD'S EYE VIEW, BUT EXTRAORDINARY FEATS OF HYDRAULIC ENGINEERING CAN BE SEEN FROM THE GROUND. THE TALLEST BUILDING IS THE "TERME DI SOSANDRA", WITH THREE TERRACES AT DIFFERENT LEVELS. THE WALLS DIVIDING THE ROOMS ARE HOLLOW, IN ORDER TO PRESERVE THE HEAT; EACH ROOM IS COMPOSED OF A "CALDARIUM" AND A "TEPIDARIUM" .**

**THE THREE "TERME" ARE CONNECTED BY NARROW STEPS CROSSED OVERHEAD AT INTERVALS BY THE ARCHES OF THE BRIDGES. THE OTHER TWO "TERME" ARE THE BATHS OF MERCURY ITS DOMED ROOF IS THE EARLIEST EXAMPLE OF ITS KIND AND SERVED AS A PRECEDENT FOR THE DOME OF THE PANTHEON IN ROME AND THE BATHS OF VENUS, A RECTANGULAR ROOM WITH AN APSE. HOWEVER, IT IS NOW THOUGHT, AFTER MORE DETAILED STUDY, THAT THESE TWO BUILDINGS WERE NOT THERMAL BATHS AFTER ALL, BUT TOGETHER FORMED A GREAT "PALATIUM" DATING FROM THE IMPERIAL PERIOD. HORACE REFERS TO THE PLACE AS ONE OF THE MOST DELIGHTFUL IN THE WORLD.**

**From <http://www.epomeo.com/page17.html>**

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***Bradyseism sunk Portus Julius, off the coast of Puteoli (Pozzuoli).  
It had already been abandoned and replaced as a military base  
by Misenum at the time of the AD 79 eruption.***

**Portus Julius near Puteoli – sunken Roman port. The straight feature going toward upper right is a canal going toward Lago Averno.**

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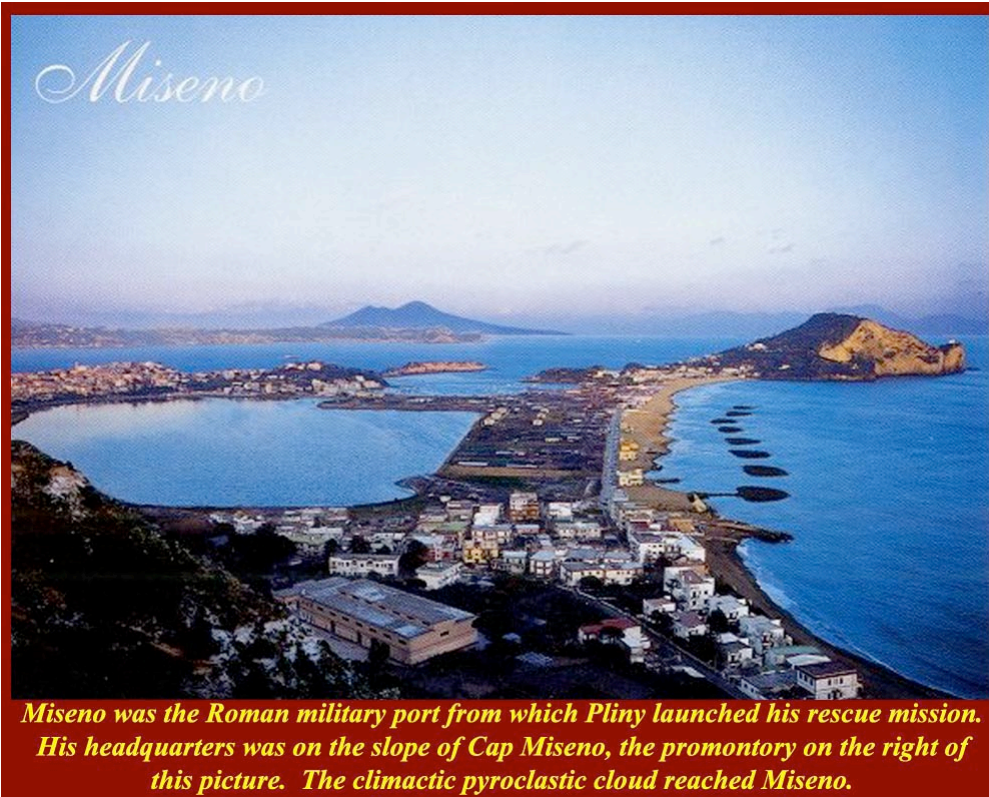
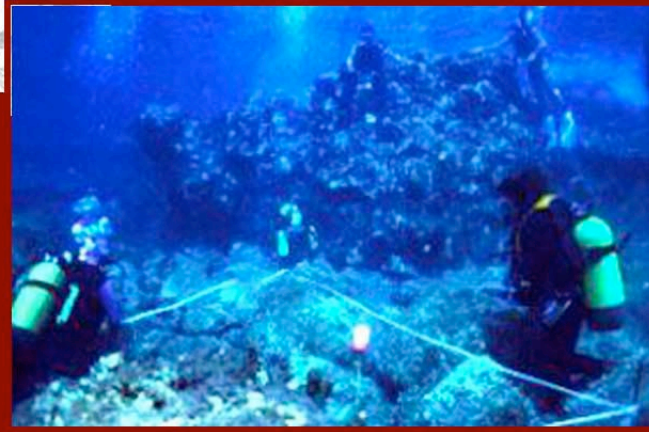




## **Portus Julius**

### **Underwater Archeology**

**Part of the area is open as an underwater park for amateur diving.**



**Miseno was the Roman military port from which Pliny launched his rescue mission. His headquarters was on the slope of Cap Miseno, the promontory on the right of this picture. The climactic pyroclastic cloud reached Miseno.**

**When Portus Julius was**

**abandoned, it was replaced as the Roman naval base on the Naples Bay by Misenum, (now Miseno). In 79 AD, the naval**



***base was commanded by Pliny the Elder whose HQ was on the hill top at the end of the peninsula. Pliny the Younger viewed the eruption from that hill top.***

# BAIAE



*Modern Baia*

**Baiae was an ancient city of Campania, Italy, 10 miles west of Neapolis, on the Sinus Baianus, a bay on the west coast of the Gulf of Puteoli. It is said to derive its name from BciZos, the helmsman of Ulysses, whose grave was shown there; it was originally, perhaps, the harbour of Cumae. It was principally famous, however, for its warm sulphur springs, remarkable for their variety and curative properties (Pliny, Natural History xxxi. 4), its mild climate, and its luxuriant**

vegetation (though in summer there~ was some malaria in the low ground). It was already frequented, especially by the rich, at the end of the republican period; and in Strabo's day it was as large as Puteoli. Julius Caesar possessed a villa here, the remains of which are probably to be recognized in some large substructures on the ridge above the 16th-century castle. Baiae was a favorite residence of the emperors. Nero built a huge villa probably on the site now occupied by the castle. Hadrian died in Caesar's villa in A.D. 138, and Alexander Severus erected large buildings for his mother. Baiae never became, however, an independent town, but formed part of the territory of Cumae. Three glass vases with views of the coast and its buildings were published by H. Jordan in *Archaeologische Zeitung* (1868, 91). The luxury and immorality of the life of Baiae under both the republic and the empire are frequently spoken of by ancient writers.

Near Baiae was the villa resort of Bauli, named for the stalls in which the oxen of Geryon were concealed by Hercules. By some it is identified with the modern village of Bacoli (owing to a presumed similarity to the ancient name), 2 m. S.S.E. of Baiae; by others with the Punta dell Epitaffio, m. N.E. of Baiae (see G. B. de Rossi in *Notizie degli scavi*, 1888, 709). At Bauli, Pompey and Hortensius possessed villas, the former on the hills, while that of the latter, on the shores of the Lacus Lucrinus, was remarkable for its tame lampreys and as the scene of the dialogue in the second book of Cicero's *Academica Priora*; it afterwards became imperial property and was the scene of Agrippina's murder by Nero. It was from Bauli to Puteoli that Caligula built his bridge of boats.

Of the once splendid villas and baths of Baiae and its district, the foundations of which were often thrown far out into the sea, considerable, though fragmentary, remains exist. It is not, as a rule, possible to identify the various buildings, and the names which have been applied to the ruins are not authenticated. At Baiae itself there exist three large and lofty domed buildings, two octagonal, one circular, and all circular in the interior, of opus reticulatum and brick, which, though popularly called temples, are remains of baths or nymphaea. The Punta dell Epitaffio also is covered with remains, while at Bacoli are several ruins to the north of the village a small theatre, called the tomb of Agrippina; under the village the remains of a large villa; to the E. the remains of a large water reservoir, the so-called Cento Camerelle; to the S. another with a vaulted ceiling, known as the piscina mirabilis, measuring 230 by 85 ft. The villa of Marius, which was bought by Lucullus, and afterwards came into the possession of the imperial house, was the scene of the death of Tiberius. It is sometimes spoken of as Baiaeana, sometimes as Misenensis, and is perhaps to be sought at Bacoli (Th. Mommsen in *Corp. Inscrip. Latin.*, x., Berlin, 1883, 1748), though Beloch inclines to place it on the promontory south of Misenum, and this perhaps agrees better with the description given by Phaedrus.

Baiae was devastated by the Saracens in the 8th century and entirely deserted on account of malaria in 1500.

**The Perception of Baiae and Luxuria in the Fourth Century AD:**  
**The Evidence from the Letters of Q. Aurelius Symmachus**

According to the educated elite of the Roman world, the phenomenon of luxuria began in the second century BC in the luxury villas constructed around the Bay of Naples, cratera illum delicatum (Cic., Att. 2.8.2). Of particular notoriety was the town of Baiae, Rome's first resort. L. Annaeus Seneca offers the strongest condemnation of this community in his Epistulae Morales 51. Juxtaposing the behavior at Baiae to traditional virtue, he writes, "...I have had to be satisfied with Baiae; and I left it the day after I reached it; for Baiae is a place to be avoided, because, though it has certain natural advantages, luxury has claimed it for her own exclusive resort (illum sibi celebrandum luxuria desumpsit)." Baiae, then, came to epitomize the corruption of the Roman virtue of otium (= quiet leisure), its infection by luxuria (= excess), among many of the social and political elite of the Roman world. Utilizing this aristocratic archetype of Baiae as a thematic focal point, this essay examines the omnipresent anxieties of the Roman elite over the proper role of otium in one's private life and the threat posed by luxury to one's reputation. Specifically, it treats the persistence of these anxieties into the late fourth-century AD, the Rome of the renowned senatorial orator, Q. Aurelius Symmachus. Although long thought of little use to historians, the collection of Symmachus' letters offers a unique view into the cares and concerns of the late fourth-century senatorial aristocracy. What will become apparent is the dependence of this late-Roman senator on more traditional views of Baiae and condemnations of luxury. Thus, the Baiae of the fourth century AD looks much like the resort town of the first centuries BC and AD.

[The evolution of otium (= quiet leisure) toward luxuria (= excess) carried vast social baggage. The upper class prided themselves on practicing otium, but the next level down, nouveau riches and "new men" regardless of their wealth, were accused of practicing luxuria. As time progressed, however, the old upper class also began to slip into luxuria, and luxuria then lost much of its social stigma. It became acceptable for the upper class to live "luxurious" lives, unless, of course, they did it in the company of members of the lower orders. Within a few generations after the establishment of the Principate by Augustus, the lower order had actually taken over the government (i.e., beginning with Vespasian and his Flavian dynasty), and, thereafter, the distinction between otium and luxuria as a class distinction was not often mentioned within polite society. The "impolite" Christians raised the issue again later, "but that's a whole 'nother story". – tkw]

### **Caligula's Triumph at Baiae**

Probably the most notorious incident from Caligula's reign is the bridge of boats that was built across the Bay of Naples from Puteoli to Baiae, a distance of more than three miles. It is not possible to date the building of the bridge precisely; Dio



put the event in 39, prior to the emperor's departure for Germany. The boats needed for the bridge were built on the spot with additional boats brought in from elsewhere (Sen. *On the Shortness of Life* 18.5; *AJ* 19.5-6; *Cal.* 19,32.1; *Dio* 59.17; *Vict. Epit.* 3.9). The boats were anchored in a double line and earth was heaped upon them to create a road in the manner of the *via Appia*. Dio claims the bridge was meant to be more than a simple passage over the bay and had resting places along it where fresh drinking water could be found.

On the day after the bridge was completed, Caligula, decked out in a purple cloak decorated with gold and gems, put on what he claimed was Alexander's breastplate. Wearing an oak garland and armed with sword and shield, he sacrificed to several gods, among them Neptune and Envy. He entered the bridge on horseback from the Baiae end and charged, full tilt, down the road leading a train of infantry and cavalry. Suetonius identifies the soldiers as Praetorians and says these exercises lasted for two days. Dio says Caligula waited at Puteoli, as if resting from battle, until the exercises were completed when he returned to Baiae.

Both Suetonius and Dio say that a spectacle was reserved for the second day. Caligula drove a chariot of racehorses followed by a train of spoils and hostages, including Darius, son of Artabanus. His retinue consisted of friends and associates, the Praetorians and the general public. Dio says Caligula climbed atop a platform at the center of the bridge to harangue the crowd, contrasting his great exploit with Xerxes' crossing of the Hellespont, pointing out that he had bridged a far wider gap. He congratulated the troops, distributed money and ordered a celebration, which lasted for the remainder of the day and well into the night. When the light faded, torches were placed on the bridge and nearby boats. People were invited from the shore to join the festivities. Unfortunately, things got out of hand. During the drunken revelry, some of the celebrants were thrown into the sea, perhaps getting caught up in a mock sea battle, and drowned. Dio says that Caligula deliberately chucked people into the sea, which was fortunately calm. [1]

Dio saw in the bridge activities a parody of a military expedition followed by a triumph. Josephus and Seneca cite this incident as an example of Caligula's madness: Josephus claimed Caligula found it tedious to cross the bay in a trireme while Seneca thought the episode an attempt to outdo Xerxes. Suetonius, on the other hand, groups the bridge episode among Caligula's good deeds and postulates three theories as to why the emperor built the bridge: first, he was trying to outdo Xerxes, he was attempting to inspire fear among the Britons and Germans or he was trying to confound the prediction of Thrasyllus, who said Caligula had as much chance of becoming emperor as he had of riding over the gulf of Baiae.

The explanation offered by the sources fall flat. If Caligula wanted to dispute a prediction, why not cross the bridge alone instead of with an army? Also, Caligula had been emperor for over two years prior to the events at Baiae and had no need to disprove any prediction concerning his becoming emperor. It is doubtful that word of the construction of the bridge would cause much fear in distant Germany or Britain. The Romans would certainly have recognized the

connection to Xerxes. The appearance of the hostage Darius in a triumphal chariot with Caligula, posing as Alexander, turns the spectacle into a fanciful "what if" the Greek king had captured the king of Persia. The triumphal dress worn by Caligula was the same he wore when he brought back the remains of his mother and brother and what he wore when dedicating the temple of Divus Augustus (*Dio* 59.3.5, 7.1).

The reason why Caligula staged what in all likelihood was a military exercise was to create a closer bond with his soldiers. The building of the bridge followed his falling out with the Senate and the replacement of the consuls in September 39. It was a demonstration of his ability to command his army and show off this support before the Senate. Following the triumph at Baiae, the emperor hastened north to deal with the conspiracy of Gaetulicus, and then proceeded to Germany. [2]

**Footnotes:**

1 - M.P. Charlesworth, *op. cit.*, 113.

2 - M. Kleijwegt, "Caligula's 'Triumph' at Baiae", *Mnemosyne* 47 (1994), 652-71.



*Monte Nuovo seen from Pozzuoli harbor, May 1996*

## **Campi Flegrei caldera, Italy**

### **The 1538 Monte Nuovo eruption**

On 29 Sep 1538, an eruption began which built the cone Mte. Nuovo (123 m) during one week. A modern summary of the eruption has been given by Di Vito et al. (1987), also containing citations from contemporary reports.

The eruption was preceded by a period of uplift in the area that ended a long (at least 1400 years) period of subsidence. Although the beginning of this uplift is not precisely known, the emergence of new land from places formerly occupied by the sea was first noted by residents of Pozzuoli in 1502. This uplift was, from the early 1530's, accompanied by unusual seismicity that reached a first climax in the spring of 1534. Still more earthquakes were felt in the area during the

following 4 years, dramatically increasing during Sep 1538. On the 28th, about 20 tremors were felt between daybreak and nightfall.

Meanwhile, other dramatic changes were taking place. In the area between M. Barbaro, Lake Averno and the coast there was a remarkable uplift of the ground, displacing the coast by several hundred m. Some sources tell of an uplift amounting to about 7 m (a value that is not exaggerated: uplift by up to 6 m occurred during the night preceding the 1994 eruption of Rabaul, Papua New Guinea; volcano 0502-14).

At about 2000 on 29 Sep, a crack opened in the area of maximum uplift, next to the ancient (Roman) settlement of Tripergole. According to contemporary sources, the newly opened vent emitted vast amounts of pumice, fire, and black and white "smoke". Much of the ejecta fell as muddy ash, indicating that water played a significant role in the initial stages of the eruption.

Studies of the deposits revealed a sequence of rapidly alternating eruptive styles reflecting varying degrees of magma-water interactions (Di Vito et al. 1987). The basal Mte. Nuovo deposits are flow (surge) deposits. That the flows were relatively cool is indicated by the lack of welding, degassing pipes and signs of plastic deformation. The flows (or surges) did not flow beyond a few hundred m from the vent. When entering an inlet several hundred m to the W (that was then filled by volcanoclastics with Lake Averno remaining at its N end), the surges obviously did not cause large waves; an ancient temple standing on the shore was not affected by any wave damage.

Vigorous activity of this kind occurred during the first 24 h of the eruption, followed by 2 days of lesser activity. Ash from the initial activity fell over a wide area, as far as Apulia and Calabria, and larger fragments fell even in the Vesuvian region.

The bulk of the new cone was probably built during the first 24 h or little more, and when first climbed on 2 Oct, some kind of "boiling" was observed within the crater. This activity was interpreted by Di Vito et al. (1987) as Strombolian (maybe fountaining from a lava lake).



Activity increased somewhat on 3 Oct (possibly Strombolian followed by hydromagmatic), but was very weak again on 4-5 Oct, and during most of the 6th. The low level activity caused many curious to visit the new volcano on that



Sunday. At 2200 on the 6th, however, a sudden explosion occurred, killing 24 visitors. This explosion apparently broke through the SSE flank of the cone or occurred as a powerful blast of scoria directed southwards. The deposit left by this explosion consists of coarse (50-60 cm diameter) scoria with very limited extent (occurring only in a small depression on the SSE flank) that show no welding or plastic deformation.

← *Alternating deposits of magmatic and phreatomagmatic activity during the late stages of the Monte Nuovo eruption, photographed near the S crater rim in September 1989. The dark scoria deposits below the light-colored phreatomagmatic tephra may be of the lava lake and Strombolian activity of 2-3 October 1538, the upper scoria are*

*probably of the fatal 6 October explosion. Boris Behncke gives scale.*

Following the fatal 6 Oct explosion, all activity of the volcano was limited to fumarolic activity.

Di Vito et al. (1987) give the volume of pyroclastics ejected in the 1538 eruption as about  $2.5 \times 10^7 \text{ m}^3$  DRE, with much of this material being pre-eruption country rock.





***Photo mosaic of the crater of Monte Nuovo, taken in September 1989, from the SW rim. The mountain in the background is the volcano of Gauro.***

Fumarolic activity continued into the mid 19th century. Nowadays, there is no visible activity from the well-vegetated cone.

Above from: <http://boris.vulcanoetna.com/Montenuovo.html>

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Below from: <http://www.comune.pozzuoli.na.it/Itinerario/Oasi/oasis.htm>



## ***Lucrino/Monte Nuovo***

### **The pyroclastic cone of Monte Nuovo**

The Monte Nuovo, the youngest volcano of the Phlegraean Fields, delineated by its wavy hilly contour is situated in the gulf of Pozzuoli, between the residential centres of Arco Felice and Lucrino. Due to its geographical location, it occupies a central position among the volcanic fields of the Phlegraean Fields. It is indeed surrounded by a series of cones, mounts and depressions of volcanic origin.

Beginning from the west to the east in an anticlock-wise direction, one can distinguish in a semicircle, the headland of Monte Miseno, the volcano Fondi of Baia, the lake Averno, the Gauro complex consisting of Monte Barbaro in the south and Monte Corvara in the north which delimit the volcanic basin of the Campiglione, presently occupied by the Carney park, Monte Cigliano and farther north the Senga crater and Montagna Spaccata, the valleys of Astroni and Agnano, Monte Spina, Solfatara and Monte Olibano where the Academy of Aeronautics is situated and finally the isle of Nisida with the crater-like basin of Porto Pavone. Many other groups of volcanic systems have also been identified in the sea.

At its highest point on the eastern side, the Monte Nuovo measures about 134 m. above sea level and its diameter at the base is about 1200 m. In the centre, there is a funnelshaped crater with a maximum diameter of 420 m. which at its lowest point is 14 m. above sea level. The edge of the crater reaches about 100 m. but the southern part of the edge is slightly low (about 85 m.), because of the presence of a radial depression of the cone.

The cone of Monte Nuovo is formed by the deposition around the volcanic mouth, of the pyroclastic materials fragmented and ejected by explosions in a rapid sequence of events that occurred during the 8 days of discontinuous volcanic activity (from 29th of September to 6th of October 1538). Based upon a commonly used classification, this volcano is defined as a cinder cone (ash cone).

The Monte Nuovo is the unique volcano of Campi Flegrei formed in the historic period, the rest of the volcanoes which surround it being of prehistoric origin.

The rapid and violent conflagration which determined the formation of Monte Nuovo also led to the total destruction of the Tripergole village. Indeed, the remains of this village can be found interstratified with pyroclastic products of the eruption. It also provoked a considerable limitation of the surface of the lake Lucrino and filled a small portion of the lake Averno. Thus substantial parts of the port Agrippa and Academy of Cicerone situated near Tripergole were destroyed (A. Maiuri, 1958).

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From <http://www.geowarn.ethz.ch/index.asp?ID=39>  
**The Solfatara Volcano**



The Solfatara volcano is a hydrothermally altered tuff-cone built between 4.6 and 3.7 ka BP. It represents the most active zone of the Campi Flegrei, a caldera related to the Campanian Ignimbrite (35 ka BP) and Neapolitan Yellow Tuff (12 ka BP) eruptions.

Two bradyseismic crises, centred at Pozzuoli, were detected in the caldera in recent times: in 1969-1972 (maximum uplift of 1.7 m) and in 1982-1984 when the area was affected by a maximum uplift of 1.8 m and by several thousands earthquakes ( $0 < \text{depth} < 4$  km, and  $M_d < 4$ ). More recently, two minor sudden ground uplifts and seismic swarms were recorded in 1989-90 and in 1994.

Fumarolic activity occurs in different sectors of Campi Flegrei but concentrates at Solfatara. Two fumaroles called Bocca Grande (BG) and Bocca Nuova (BN) have the highest temperatures (145 to 165°C), while temperatures of other fumarolic vents are close to 100°C.



Fumarolic effluents have similar chemistry, with H<sub>2</sub>O as the main component, followed by Carbon Dioxide and Hydrogen Sulfide. The principal elements of the hydrothermal system of Solfatara are: (1) A heat source which is made up of a relatively shallow (a few kilometers deep) magma chamber; (2) one or several aquifers located over the magma chamber - the degassing magma supplies fluids and heat to the overlying aquifer(s) which dissipate the heat through boiling and



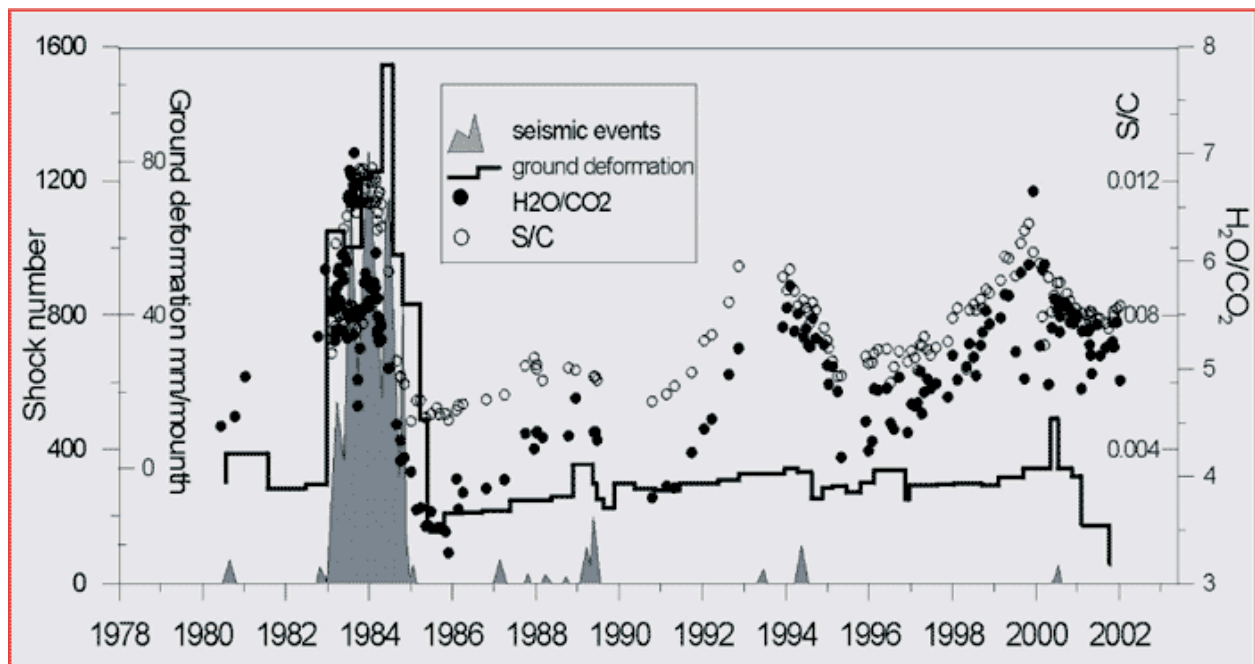
condensation; and (3) an intensely fractured zone, situated above the uppermost aquifer and occupied by a pure vapour phase ('superheated' vapour zone), which is produced through boiling of the underlying aquifer(s).

Gas equilibria in the CO<sub>2</sub>-CO-CH<sub>4</sub>-H<sub>2</sub>O-H<sub>2</sub> system indicate that temperature and PH<sub>2</sub>O conditions in the 'superheated' vapor zone varied from 240°C and 30 bar during the 1982-84 crisis (Fig. 44) , to 210 to 220°C and 3-7 bar at present.

Solfatara, the most active volcanic area of Campi Flegrei, is one of the most famous tourist sites of Italy which and is also intensely urbanized. Four different kinds of natural hazards can be distinguished:

- Gas release during quiescent periods from the entire volcanic cone (about 1,500 tons/day of CO<sub>2</sub>);
- Magmato-tectonic seismic activity related to unrest episodes;
- Hydrothermal explosions;
- Phreatomagmatic eruptions.

At present, the Osservatorio Vesuviano performs the volcanic surveillance of the area. Their activity includes periodic sampling of fumarolic gases, periodic soil CO<sub>2</sub> flux measurements, continuous monitoring of soil CO<sub>2</sub> fluxes, and geophysical monitoring (seismicity, gravity and deformation).



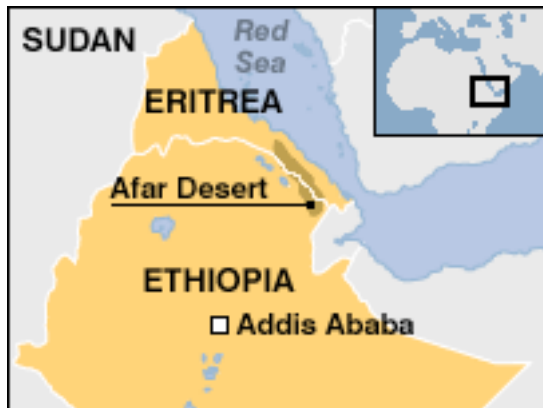
***Observed variations of H<sub>2</sub>O/CO<sub>2</sub> and S/C ratios of the Solfatara di Pozzuoli fumarolic gases since 1980; ground deformation and seismic activity are shown. Osservatorio Vesuviano Napoli (OVNI)***

## Unit 9

### Geologists witness 'ocean birth' (8 Dec 05)

By Roland Pease, BBC science unit, San Francisco

Scientists say they have witnessed the possible birth of a future ocean basin growing in north-eastern Ethiopia.



The team watched an 8m rift develop in the ground in just three weeks in the Afar desert region last September. It is one small step in a long-term split that is tearing the east of the country from the rest of Africa and should eventually create a huge sea.

The UK-Ethiopian group says it was astonished at the speed with which the 60km-long fissure system developed. "It's the first large event we've seen like this in a

rift zone since the advent of some of the space-based techniques we're now using, and which give us a resolution and a detail to see what's really going on and how the earth processes work; it's amazing," said Cindy Ebinger, from Royal Holloway University of London.

#### Earth forces

Professor Ebinger and colleagues described the event here at the American Geophysical Union Fall Meeting. In the far-distant past, oceans such as the Atlantic have formed when supercontinents have torn apart. Indeed, North America and Europe are still moving in opposite directions at about the pace fingernails grow.

Researchers have long recognised that the Afar region, an inhospitable depression in north-eastern Ethiopia, has been contorted by similar forces in recent geological time.

But the event in September is said to be unprecedented in scientific history. It began with a large earthquake on the 14th of the month and continued with a swarm of moderate tremors.

#### Start and stop

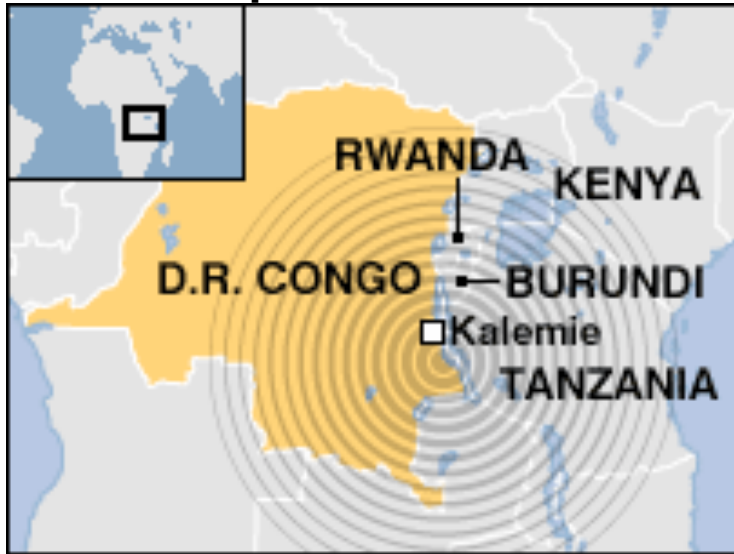
"About a week into the sequence, there was a volcanic eruption," explained Dr Ebinger. "A lot of ash was thrown up in the air, and a lot of cracks appeared in the ground; some of which were more than a metre wide. Using satellite techniques we can see ground deformation, and about a month after the sequence, we could

see a 60km long section had opened up, and it opened up about 8m in its central part. "It appears that we've seen the birth of an ocean basin."

The movements of September are only a small part of what would be needed to create a whole ocean - the complete process takes millions of years - and in other regions of the planet, ocean development has been started only to stall at a later time. But the Afar event has given geologists a unique opportunity to study the rupture process at close quarters.

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## Powerful quake rocks East Africa (6 Dec 05)



A powerful earthquake has hit eastern Democratic Republic of Congo, near Lake Tanganyika and the Tanzanian border.

At least one child died after houses collapsed in the Congolese town of Kalemie, 55km north-west of the quake's epicentre. The shocks were felt in Tanzania, Burundi and Rwanda, and by the Indian Ocean. Hundreds fled in panic from offices in the Kenyan capital.

The quake hit with a 6.8 magnitude at 1219GMT, the US Geological Survey said. The epicentre was about 13km (8 miles) underground, the USGS said, some 975km (600 miles) south of Nairobi.

East Africa's Great Rift Valley runs along a geological fault line, but has largely escaped major quakes in recent years.

Monday, 18 February, 2002, 13:01 GMT

## Volcanoes threaten to divide Africa (Monday, 18 February, 2002)



*Ethiopia: Western escarpment of the southern Red Sea rift*



A plume of hot volcanic mantle rock is rising beneath Africa, trying to split the continent apart. According to international researchers, it could eventually create a new ocean. "The Ethiopian rift is one of the few places in the world where we can see the transition from continental rifting to something that looks more oceanic," Dr Cindy Ebinger told the BBC World Service's Discovery programme. "It's a unique area worldwide." The crack in the Earth's surface runs for 2,000 kilometres from Malawi in the South, through Tanzania, Kenya and Ethiopia, to link-up with the Red Sea and the Gulf of Aden. A look deep into the Earth's interior shows a huge plume of warm soft mantle rock rising diagonally from the



AP

core's boundary and running up beneath Southern Africa towards the Afar region of Ethiopia.

← *More than half of Goma was been consumed by lava.*

### Volcano valley

The mantle super-plume, as it is called, may be responsible for the high elevation of much of Southern and Eastern Africa. It may also account for the line of volcanoes that runs up the Great Rift Valley, including Mount Nyiragongo, which recently sent red-hot lava pouring into the Congolese eastern town of Goma.

For most of its length the East African rift valley is just that: a rift running through a continent. But as it gets further north, its character changes. By the time it joins up with the Red Sea it is more like a mid-ocean ridge, a line of cracks along which volcanic magma rises to create the floor of an ever widening sea. In Ethiopia it is in transition between the two and this gives geologists their best chance of studying how a new ocean forms.

### Earth tremors

Project Eagle (Ethiopian Afar Geophysical Lithospheric Experiment) draws together researchers from Royal Holloway College London, and the universities of Leicester, Leeds and Addis Ababa. The project aims to see deep into the Earth by using many sensitive seismometers to record natural earth tremors and the vibrations from explosive charges detonated in boreholes. The seismic waves travel at different speeds through rocks of different temperatures and densities to bounce off distinct layers. In this way, Dr Cindy Ebinger and her colleagues hope to discover any reservoirs of hot, molten magma within the crust that could feed future volcanoes as well as seeing how the crust is thinned as it is pulled apart. "There are several dormant volcanoes but there has never been a study to monitor volcanoes in the rift," Dr Ebinger explained. "These are dangerous

**because the lava has more silica in it and is resistant to flow, so these are explosive eruptions that can cause death and damage to a large region."**

### **New ocean**

**So far, the indications are that a mantle plume alone is not enough to open an ocean. There needs to be a sideways pull to rift the continent, allowing the hot magma to rise underneath to fill the gap and form the floor of the new ocean. Opinions vary over whether that will actually happen along the East African rift. With the Atlantic Ocean still opening and pushing on Africa from the west and India still colliding with Asia and the Indian Ocean opening to the east, there may be nowhere for the rift to expand.**

**Further north however, the picture may be different, said Professor Peter Maguire, of Leicester University. "We do believe that we are on the transition from continental to oceanic rifting," he explained. "The continent in the northern part of Ethiopia is separating and there will be an ocean penetrating down into East Africa."**



## NATIONAL GEOGRAPHIC NEWS

REPORTING OUR WORLD DAILY

### **Did Huge Volcanic Blasts Snuff Out Dinos?**

Brian Handwerk

for National Geographic News

August 23, 2005

A buildup of gases caused by huge volcanic eruptions may have killed off the dinosaurs, according to new research from one the largest lava flows in Earth's history.

Known as the Deccan Traps, the massive lava deposits in west-central India are over a mile (two kilometers) thick and span an area comparable to Oregon and Washington State combined.

*The geologic formation appeared 65 million years ago—around the time of the Cretaceous-Tertiary mass extinction that wiped out some 85 percent of Earth's species.*

A team of French and Indian geologists recently reported that the Deccan Traps lava might have piled up so quickly that climate-altering sulfuric gases from the eruptions could have made Earth's environment deadly to many species. New tests reveal that one 2,000 foot-thick (600 meter-thick) lava section could have accumulated in just 30,000 years. That's lightning-fast by geologic standards.

#### **Major Eruptions**

"Our working hypothesis is that the majority of the total volume of lava might have been erupted in only a few major events spread over only a small fraction of millennia," said Anne-Lise Chenet of the Paris Geophysical Institute's paleomagnetism laboratory. "Volcanic eruptions can inject large amounts of sulfur dioxide into the atmosphere. If [little] time passes between different volcanic processes, you change the climate and have a big impact on the environment," she said. "That's why we began the study, because we wanted to know how many different volcanic processes [were] necessary to produce the volume of lava [at Deccan Traps]."

The geologic formation is a vast deposit of basaltic lava, which sprawls nearly 200,000 square miles (500,000 square kilometers). The Deccan Traps are believed to have formed during volcanic activity that spanned about a million years. But the new dating results suggest that large portions of lava may have come in spurts much closer together than previously thought.

Chenet described her team's research at a joint meeting of the Geological Society of America and the Geological Association of Canada in Calgary earlier this month.

## **"Smoking Gun" Is Elusive**

**Scientists have found strong links between other mass extinctions and volcanic activity.**

**"At least two other great extinctions may have had massive volcanic activity as a prime cause: the greatest of all extinctions, at the Permian-Triassic boundary 251 million years ago, and the mass extinction at the Triassic-Jurassic boundary 200 million years ago," said Hans-Dieter Sues, associate director for research and collections at the Smithsonian Institution's National Museum of Natural History. "In each of these cases, there are vast areas of volcanic activity far exceeding the Deccan Traps in area and volume." Scientists say the Deccan Traps undoubtedly had a significant impact on the planet, but the volcanic event's precise role in the Cretaceous-Tertiary's great extinction remains unknown.**

**"It would be inconceivable that you could have an eruption on this scale without having some sort of global climate effect," said Thomas Holtz, a vertebrate paleontologist at the University of Maryland in College Park. "Certainly it would have made life difficult for organisms all over the world," he added. "But it is yet to be shown that there was an extinction associated with these eruptions."**

**Holtz suggests that dinosaurs may have been stressed by the effects of the Deccan Traps eruptions. But they survived until the arrival of a city-sized asteroid that plowed into Mexico's Yucatán Peninsula 65 million years ago.**

**The so-named Chicxulub impact clouded the planet's atmosphere with enormous volumes of ash and debris and is commonly thought to be a cause of the Cretaceous-Tertiary extinction.**

**"We have evidence of all sorts of animals, in the sea and on land, occurring right up to the [Cretaceous-Tertiary] boundary. Those species were surviving whatever effects the Deccan Traps produced," Holtz said.**

**Both Holtz and Sues, of the Smithsonian, suggest that a number of events, including the massive lava flows and the subsequent catastrophic asteroid impact, as well as mountain building and changing global sea levels, might have worked combination to snuff out the dinosaurs. "Maybe a massive extinction can't have a single cause," Holtz speculated. "Maybe they are always one-two punches, where something happens to cause environmental stress, species cope to some degree; and then something else comes along that is additionally catastrophic, so that [species] can't recover."**



Chenet, of the Paris Geophysical Institute, agrees that India's ancient volcanic eruptions and the Chicxulub asteroid impact produced a deadly combination. But she suggests that the lava flows might well have finished the job on their own. "Our view is that [asteroid] impact added to the stress already generated by an ongoing massive eruption, enhancing significantly the extent of the extinction, which would, however, have taken place even if the impact had not occurred."

See <http://www.mantleplumes.org/Deccan.html> for a different view of the duration of the Deccan Traps lava flows.

## Deccan Traps, India

17-24N, 43-47E

Elevation: 4,000 feet (1,200 m)

The Deccan Traps are one of the largest volcanic provinces in the world. It consists of more than 6,500 feet (>2,000 m) of flat-lying basalt lava flows and covers an area of nearly 200,000 square miles (500,000 square km) (roughly the size of the states of Washington and Oregon combined) in west-central India. Estimates of the original area covered by the lava flows are as high as 600,000 square miles (1.5 million square km). The volume of basalt is estimated to be 12,275 cubic miles (512,000 cubic km)(the 1980 eruption of Mount St. Helens produced 1 cubic km of volcanic material). The Deccan Traps are flood basalts similar to the Columbia River basalts of the northwestern United States. This photo shows a thick stack of basalt lava flows north of Mahabaleshwar. Photograph by Lazlo Keszthelyi, January 28, 1996.



The Deccan basalts may have played a role in the extinction of the dinosaurs. Most of the basalt was erupted between 65 and 60 million years ago. Gases released by the eruption may have changed the global climate and lead to the

demise of the dinosaurs 65 million years ago. This photo shows the Deccan Traps between Mumbai and Mahabaleshwar. Photograph by Lazlo Keszthelyi, January 27, 1996.



Vocanologists are also trying to understand how such great volumes of lava are erupted. Early models proposed that lava flooded across large areas at extremely rapid rates. Recently proposed models suggested that at least some of the flows are emplaced at gradual rates, lasting months to years. This photo shows the Ajunta Caves, temples carved into the basalts. Note the school group on the platform in front of the caves for scale. Photograph by Lazlo Keszthelyi, January 31, 1996.



## Eruption prediction

Both long-term and short-term methods for predicting eruptions are useful.

**Long-term:** Eruptions can be successfully predicted, but only with an accuracy of decades to thousands of years, depending on the volcano. The method used is recurrence interval, the same method that is used to predict earthquakes. By dating the last few eruptions of a volcano (usually with Potassium/Argon, perhaps with carbon-14 if they are very young), it may be possible to demonstrate that they recur regularly, at a reasonably constant interval. Knowing the time since the last eruption, one can then predict when the next eruption will occur.

Long-term methods such as recurrence interval have not proved to be of much practical value for volcanic eruptions. In contrast to long-term earthquake prediction, which can be used to guide building codes and thereby lessen the damage of an impending earthquake, not much can be done to prepare for an upcoming volcanic eruption. The only really effective strategy is to avoid building towns and cities on the flanks of active stratovolcanoes. People seem unwilling to do this, as is evident from satellite photos of Vesuvius. Another example is Central America: it is estimated that hundreds of thousands of people live within the blast radius of its many stratovolcanoes.

Short-term prediction of volcanic eruptions is much more promising. Ideally, short-term predictions identify the day of an impending eruption, or at least the week. Nearby towns and cities can be temporarily evacuated until the danger is past. Property damage must be accepted; the goal is entirely that of saving lives.

Short-term prediction is based on monitoring a suite of likely volcanic precursors. Gas emissions are sampled; if that is too dangerous, helicopter fly-bys are used to check for any active steaming, rock falls, visible magma, or bulges. All are indicative of near-surface magma movement, but major eruptions aren't always preceded by near-surface magmas. Tiltmeters can detect broader-scale swelling of the volcano, due to pressure buildup associated with deeper magma movement.

The best precursor is seismic tremors. Today, every volcano that shows signs of an upcoming eruption is instrumented with a network of seismometers. Volcanic tremors are caused by countless small rock fractures associated with magma movement through rock. They are usually too small for people to feel. They have a seismic signature that is readily distinguished from earthquakes; the volcano rings like a bass bell when magma moves. The challenge is that magma may move upward and accumulate for months or years before exploding, and it does not simply explode when it reaches some expected depth. Seismic tremors do generally increase in intensity just before an eruption. In a couple of recent

eruptions (notably St. Helens in 1980 and Pinatubo in 1991) seismic tremors have led to successful, timely evacuations.

### **Volcanoes and energy resources**

Volcanoes provide a source of energy that people have barely used. Today, world energy use is 40% oil, 30% coal, 20% natural gas, 5% hydroelectric, and 5% nuclear. Note that 90% of our current energy supply is from non-renewable fossil fuels, so our current pattern of energy use is impossible to sustain.

Each energy source has advantages and disadvantages:

- oil and gas are cheap (compared to some alternative energy sources), but they pollute, producing both carbon dioxide and smog. Global warming from the greenhouse effect is not just scientific alarmism; it is happening, and its economic impacts will be staggering. In addition to supplying energy, oil can be converted to materials such as plastic and fabric.
- coal is even cheaper and is much more abundant than oil and gas, but its use produces even more carbon dioxide than use of hydrocarbons, per unit energy output. Coal burning also releases sulfur that causes acid rain, but investment in scrubbers can reduce that problem.
- hydroelectric power is a cheap and non-polluting source of electricity. It is only a local power source, but national electric grids can redistribute its electric power. Non-polluting does not mean environmentally benign; dams interfere with the sedimentary cycle, changing patterns of sediment erosion and deposition. Most reservoirs have a life expectancy of 100-200 years.
- nuclear power is cheap only if one excludes its indirect costs — particularly that of safe long-term storage of nuclear wastes. It is potentially abundant. Safety concerns have halted production of new nuclear plants in the U.S., but not in Europe.

**A renewable energy source is one whose supply is not depleted by likely usage levels. Oil, gas, and coal are renewed by breakdown of organic matter, but at a rate that typically takes millions of years. Effectively, they are not renewable on human time scales, and their reserves are rapidly diminishing (ex. U.S. oil production peaked in ~1970).**

**The renewable energy sources are hydroelectric, nuclear, solar, and geothermal:**

- hydroelectric power is based on using the hydrologic cycle. Rain and resulting river flow are sustained. Individual dams fill in due to



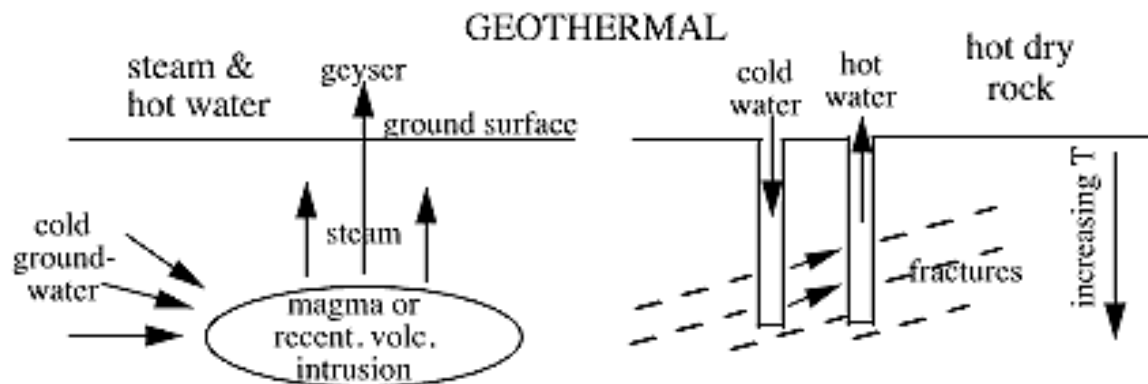
sedimentation in 100-200 years.

- nuclear energy is effectively renewable energy, because the supply of uranium is large compared to its demand for nuclear power plants. Fusion, if it can be made into a practical energy source, can draw on a virtually infinite supply of raw materials (though not quite that of the garbage-fueled reactor of “Back to the Future”).
- solar power, based on photovoltaic conversion of sunlight to electricity, has the virtues of incredibly abundant sunlight and zero pollution. Supply is obviously not constant, but solar could readily become a significant contributor to national power grids. The obstacle is merely economic: it is still more expensive than energy from fossil fuels.

Geothermal energy is the focus of this section, but every energy source must be considered in the context of its alternatives; thus the brief review above. Geothermal energy is renewable, potentially cheap (though only marginally economic at present), and potentially abundant.

Geothermal energy is based on heat, particularly that from volcanism.

There are two types of geothermal energy: (1) steam and hot water, and (2) hot dry rock. This diagram illustrates both.



Steam and hot water are the main sources of geothermal energy used today. They are often cheap, they are non-polluting, and the basic technology is well established. Unfortunately, steam and hot water can provide only a local energy source, not an abundant, widespread energy source. For example, they supply much of the energy needs of Iceland, but Iceland is the world’s most volcanically active country and it needs heat more than gasoline. Within the U.S., only a few localities in the Southwest have potentially usable supplies of steam; Yellowstone too has the supplies, but nobody would suggest converting Yellowstone to geothermal power plants.

The origin of steam and hot-water heat is shallow volcanic magma, or perhaps a volcanic intrusion that is so recent that it is still hot. Groundwater circulation brings cold water in proximity to the magma or hot rock, producing either steam or very hot water, which convectively rises. Geysers are the most spectacular

result of this process, but the real value of steam is in its heat, not its flow. The steam can be used to run generators, and the hot water can be run directly into buildings for hot-water heating. In Iceland, this hot-water heating includes heating of large greenhouses. Most geothermal energy comes from steam. In California, Nevada, and Utah, for example, wells are drilled into active geothermal systems associated with recent volcanic intrusions, and steam is piped to nearby generators.

We can expect hydrothermal (steam) energy use within the U.S. to increase in the next few years, as a result of current research efforts and increasing cost of competing energy sources. The center of the nation's geothermal research is the Energy and Geoscience Institute, which is in University Research Park, adjacent to UU. Geological research includes methods of enhancing groundwater flow to producing wells (ex. by fracturing adjacent rock), and materials research includes attempts to decrease pipe corrosion (a big problem for geothermal facilities).

Already, hydrothermal power is a substantial energy source in Iceland and Japan, both of which have abundant recent volcanism, and it is a significant but minor energy source in the U.S., Mexico, New Zealand, and Italy. It provides 1-2% of current energy needs in several regions, and it can be cheaper than electrical heating.

Hot dry rock is the second potential source of geothermal energy. Like hydrothermal energy, it is non-polluting. Unlike hydrothermal energy, it is potentially extremely abundant but requires new, expensive technology. The feasibility of hot dry rock as a major energy source has not been proved yet.

The idea of hot dry rock is to tap the natural thermal gradient as a source of hot water. In most areas, temperature increases beneath the ground surface at a rate of  $\sim 25^{\circ}\text{C}/\text{km}$ . Groundwater at the bottom of a 1-km borehole is therefore  $\sim 25^{\circ}\text{C}$  hotter than surface water, and it only takes a  $25^{\circ}$  temperature contrast to run some electric generators. In order to produce the large amounts of water needed, a single well is insufficient. As shown in the figure above, an alternative is to pump cold water down into an adjacent well; this water will flow through fractures connecting the two wells, heating as it does so, and replenishing the supply of hot water. Thus, the hot dry rock technique is not really dry; it uses groundwater, but it does not need an active hydrothermal system.

In practice, hot dry rock is not as easy to exploit as it sounds, mainly because the fractures may not cooperate, funneling water from one well to the next. There is a chance, however, that this technique will be refined enough in coming years to be a popular energy source.

Hot dry rock taps the same deep heat of the earth that volcanoes do, but it does not require a volcanic area. We may well see, however, that its first energy production will be in volcanically active areas, where geothermal heat is most abundant and shallower wells can be used. Alternatively, the next generation of geothermal energy production may employ some combination of hydrothermal and hot dry rock approaches.

Source: <http://www.mines.utah.edu/geo/courses/UOnline/modules/M12b.html>

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[http://www.nytimes.com/2006/03/14/science/14obox.html?\\_r=2&oref=slogin&oref=slogin](http://www.nytimes.com/2006/03/14/science/14obox.html?_r=2&oref=slogin&oref=slogin)



## Hot and Fluffy in Yellowstone

By HENRY FOUNTAIN Published: March 14, 2006

← *Steamboat Geyser in Yellowstone's Norris basin, National Park Service Photo*

In 2002 and 2003, the Norris Geyser Basin in Yellowstone National Park went nuts. The basin, the hottest of the park's hot spots, grew hotter still. Several geysers erupted after having been quiet for years. Others erupted more frequently. Some grew so hot that the water boiled off and they became steam vents.

Yellowstone is one of the most geothermally active places on the planet. Most of the park consists of the caldera of a volcano that last blew up 640,000 years ago. So scientists knew something was happening in the vast plumbing system of partly molten rock, or magma, that underlies the region and causes slow but near-constant ground movement.

Geophysicists with the United States Geological Survey now say they have a good idea of precisely what was going on. Using radar data from a European satellite, they report that an area near the basin rose up about an inch a year over five years. The uplift probably caused increased fracturing near the surface that would account for the unrest at Norris.

The satellite makes multiple passes over the same area and compares the data to detect changes. "It can give a pretty good idea down to the subcentimeter level of what parts of the earth are going up or down," said Charles W. Wicks, the lead author of the study, which Nature published on March 2. "Yellowstone is a very good target," he added. "It's always doing something."

The area around the basin started rising in 1995, and the rest of the caldera began subsiding two years later. Both movements stopped around 2002-2003, although new measurements now show that the whole caldera is rising.

As for what caused this pattern of movement, Dr. Wicks said the best model involved magma rising to within 10 miles of the surface at a spot in the caldera called Sour Creek dome. "There it encounters a kind of a plug," he said, consisting of rock from long-ago lava flows. The magma is deflected horizontally and expands under the Norris region. "It's like a pillow down there that fluffs up and causes the surface to rise," Dr. Wicks said.

The question remains whether the movement and the resulting unrest in the geyser basin was a one-of-a-kind event or part of a cycle. "I suspect that this is probably a normal thing," Dr. Wicks said. "But we've only been able to monitor it like this since 1992. The next 20 or 30 years will probably tell."

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## **Super Volcano Will Challenge Civilization, Geologists Warn**

**By Robert Roy Britt**

LiveScience Senior Writer

posted: 08 March 2005

06:30 am ET

The eruption of a super volcano "sooner or later" will chill the planet and threaten human civilization, British scientists warned Tuesday.

And now the bad news: There's not much anyone can do about it.

Several volcanoes around the world are capable of gigantic eruptions unlike anything witnessed in recorded history, based on geologic evidence of past events, the scientists said. Such eruptions would dwarf those of Mount St. Helens, Krakatoa, Pinatubo and anything else going back dozens of millennia.

"Super-eruptions are up to hundreds of times larger than these," said Stephen Self of the United Kingdom's (U.K.) Open University.

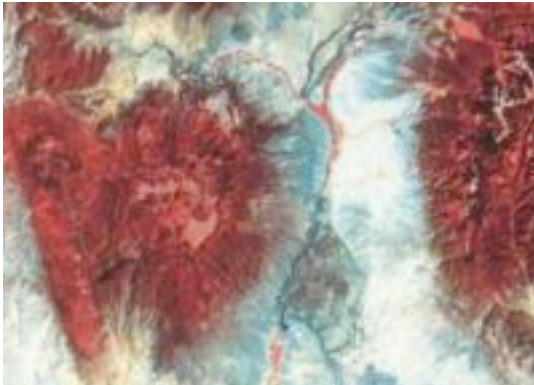
"An area the size of North America can be devastated, and pronounced deterioration of global climate would be expected for a few years following the eruption," Self said. "They could result in the devastation of world agriculture, severe disruption of food supplies, and mass starvation. These effects could be sufficiently severe to threaten the fabric of civilization."

Self and his colleagues at the Geological Society of London presented their report to the U.K. Government's Natural Hazard Working Group.

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## Super Evidence



In the Jemez Mountains, near Santa Fe, New Mexico, sits the Valles Caldera -- the circular feature at left in this false-color satellite image (vegetation is red). It's about 15 miles (24 kilometers) wide, made by two super-eruptions 1.6 and 1.1 million years ago.

The rocky mound, right, the result of the older eruption, is 820 feet (250 meters) thick.

"Although very rare these events are inevitable, and at some point in the future humans will be faced with dealing with and surviving a super eruption," Stephen Sparks of the University of Bristol told *LiveScience* in advance of Tuesday's announcement.

What's in Store

### Supporting evidence

The warning is not new. Geologists in the United States detailed a similar scenario in 2001, when they found evidence suggesting volcanic activity in Yellowstone National Park will eventually lead to a colossal eruption. Half the United States will be covered in ash up to 3 feet (1 meter) deep, according to a study published in the journal *Earth and Planetary Science Letters*.

Explosions of this magnitude "happen about every 600,000 years at Yellowstone," says Chuck Wicks of the U.S. Geological Survey, who has studied the possibilities in separate work. "And it's been about 620,000 years since the last super explosive eruption there."

Past volcanic catastrophes at Yellowstone and elsewhere remain evident as giant collapsed basins called calderas.

A super eruption is a scaled up version of a typical volcanic outburst, Sparks explained. Each is caused by a rising and growing chamber of hot molten rock known as magma.

**"In super eruptions the magma chamber is huge," Sparks said. The eruption is rapid, occurring in a matter of days. "When the magma erupts the overlying rocks collapse into the chamber, which has reduced its pressure due to the eruption. The collapse forms the huge crater."**

**The eruption pumps dust and chemicals into the atmosphere for years, screening the Sun and cooling the planet. Earth is plunged into a perpetual winter, some models predict, causing plant and animal species disappear forever.**

**"The whole of a continent might be covered by ash, which might take many years -- possibly decades -- to erode away and for vegetation to recover," Sparks said.**

**Yellowstone may be winding down geologically, experts say. But they believe it harbors at least one final punch. Globally, there are still plenty of possibilities for super volcano eruptions, even as Earth quiets down over the long haul of its 4.5-billion-year existence.**

**"The Earth is of course losing energy, but at a very slow rate, and the effects are only really noticeable over billions rather than millions of years," Sparks said.**

### **Human impact**

**The odds of a globally destructive volcano explosion in any given century are extremely low, and no scientist can say when the next one will occur. But the chances are five to 10 times greater than a globally destructive asteroid impact, according to the new British report.**

**The next super eruption, whenever it occurs, might not be the first one humans have dealt with.**

**About 74,000 years ago, in what is now Sumatra, a volcano called Toba blew with a force estimated at 10,000 times that of Mount St. Helens. Ash darkened the sky all around the planet. Temperatures plummeted by up to 21 degrees at higher latitudes, according to research by Michael Rampino, a biologist and geologist at New York University.**

**Rampino has estimated three-quarters of the plant species in the Northern Hemisphere perished.**

**Stanley Ambrose, an anthropologist at the University of Illinois, suggested in 1998 that Rampino's work might explain a curious bottleneck in human evolution: The blueprints of life for all humans -- DNA -- are remarkably similar given that our species branched off from the rest of the primate family tree a few million years ago.**

**Ambrose has said early humans were perhaps pushed to the edge of extinction after the Toba eruption -- around the same time folks got serious about art and tool making. Perhaps only a few thousand survived. Humans today would all be**

descended from these few, and in terms of the genetic code, not a whole lot would change in 74,000 years.

### **Sitting ducks**

Based on the latest evidence, eruptions the size of the giant Yellowstone and Toba events occur at least every 100,000 years, Sparks said, "and it could be as high as every 50,000 years. There are smaller but nevertheless huge eruptions which would have continental to global consequences every 5,000 years or so."

Unlike other threats to mankind -- asteroids, nuclear attacks and global warming to name a few -- there's little to be done about a super volcano.

"While it may in future be possible to deflect asteroids or somehow avoid their impact, even science fiction cannot produce a credible mechanism for averting a super eruption," the new report states. "No strategies can be envisaged for reducing the power of major volcanic eruptions."

The Geological Society of London has issued similar warnings going back to 2000. The scientists this week called for more funding to investigate further the history of super eruptions and their likely effects on the planet and on modern society.

"Sooner or later a super eruption will happen on Earth and this issue also demands serious attention," the report concludes.

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# Tambor

THE CHRISTIAN SCIENCE MONITOR  csmonitor.com

<http://www.csmonitor.com/2006/0302/p14s03-sten.html>

from the March 02, 2006 edition



← **AMONG THE ASHES:** Researchers dig for clues to a civilization that lived near Mt. Tambora before it erupted in 1815, burying settlements under 10 feet of ash. The eruption on the Indonesian island of Sumbawa is ranked as the biggest in recorded history - at least four times bigger than Mt. Krakatoa in 1883, and 200 times as powerful

as Mt. St. Helens in 1980.

**PHOTO COURTESY OF THE UNIVERSITY OF RHODE ISLAND**

## Scientists unearth 'Pompeii of the East'

By Peter N. Spotts, *Staff writer of The Christian Science Monitor*

NARRAGANSETT, R.I. – The eruption started modestly. On April 5, 1815, after two years of puffs and burps, Mt. Tambora launched a thick column of ash, pumice, and gas into the sky. For people living near the foot of the massive Indonesian volcano, the view was spectacular, but the fallout was merely a nuisance - good for the soil.

Five days later, however, in the early evening, Tambora exploded in the largest volcanic eruption in [recorded] history. For the first three hours, ash and dust hurtled into the sky in a roiling cloud some 26 miles tall. Then, much of the cloud collapsed back onto the mountain, sending a thick, searing avalanche of ash,



dust, and rock tumbling down the slopes at Autobahn speeds, burying everything in its path.

Now, a team of US and Indonesian volcanologists say they have unearthed evidence of a town buried under the eruption's debris. They suggest that it may be the political center of the small kingdom of Tambora, which had a population of roughly 10,000 at the time of the eruption.

So far, the team has unearthed the charred beams of a house and the remains of two occupants, some bronze and iron tools, and uniquely decorated ceramic and porcelain vessels. They've also found glass artifacts fused and distorted by the heat of the debris that swept through the area. The ceramics hint that Tamborans had some sort of direct or indirect ties with Cambodia and Vietnam, according to Haraldur Sigurdsson, a University of Rhode Island volcanologist who led the effort.

The ties may have been cultural as well. According to records gathered by British officials at the time, Tamborans spoke a language that appeared unrelated to any other Indonesian dialect. It seemed more closely related to the Mon-Khmer family of languages spoken throughout Southeast Asia. Tambora, Dr. Sigurdsson says, "could be the Pompeii of the East."

Based on the evidence so far, some researchers are skeptical that Tambora was a kingdom in the classic sense of the word. But that doesn't diminish the site's value, they add.

"No research has been done by professional archaeologists on the effects of the Tambora eruption as far as I am aware," notes National University of Singapore archaeologist John Miksic in an e-mail. "So this is a useful contribution."

Tambora's effects were far-reaching. The 1815 eruption released 100 cubic kilometers of magma and left a caldera nearly five miles wide and 1,250 feet deep. (By comparison, Mt. St. Helens ejected about half a cubic kilometer of magma

during its 1980 eruption.) The original summit of the 37-mile-wide mountain reached nearly 14,000 feet; after the eruption, the mountain stood just over 9,000 feet tall.



← 'I had to come back here ... [this civilization] could be the Pompeii of the East.' - Haraldur Sigurdsson, University of Rhode Island volcanologist, on returning to Mt. Tambora in 2004. PHOTO COURTESY OF THE UNIVERSITY OF RHODE ISLAND

Ultimately, Mt. Tambora's eruption killed 117,000 people, either directly, through the surge of pyroclastic material down the slopes and the fallout that collapsed houses on nearby islands, or indirectly, through famine after the fallout buried fields and fouled water supplies.

Tambora's reach was global. It vaulted 400 million tons of sulfur dioxide high into the stratosphere, where it was carried around the world. The compound formed sulfate aerosols, which reflect sunlight back into space. The next year, 1816, would become known as the "the year without summer." The unusually cool climate led to crop failures and famine worldwide.

Sigurdsson, a native of Iceland, has a longstanding interest in the impact of volcanoes on culture. He has worked at Pompeii and Herculaneum in Italy (both buried in 79 AD when Mt. Vesuvius erupted), as well as at the site of the 1982 eruption of El Chichon in Mexico. Tambora's remoteness and the scant scientific record of such an important eruption proved an irresistible lure.

Sigurdsson says he made his first trip to the island in 1986 with a colleague to begin seeking answers to some of the fundamental geological questions about the event. Historical records indicated that the town of Tambora was near where the two scientists were working. At the time it existed, the area was known for its horses, honey, sandalwood, and sappan-wood, which was used to make red dye.

Sigurdsson returned to the island in 2000 to continue his work. There, one of his guides described a gully where people had been finding pottery shards, bones, and bits of bronze. It lay some 16 miles west of the volcano's caldera.

On the last day of the trip, with a boat scheduled to pick the team up the next morning, he and his colleagues set out to find the gully. "It was 5 p.m., and we had to do a 'death march' to get there before dark," he says. What he saw was enough, he says, "to convince me that I had to come back here, that this was a very promising place."

Excavations during a return trip in 2004 yielded the carbonized remains of house beams and the foundation stones around which they collapsed. Scientists also found iron, bronze, and ceramic artifacts, as well as other evidence of human habitation.

Despite the tropical setting, "it didn't rain a drop during the time we were there," says Lewis Abrams, a University of North Carolina geophysicist who worked with Sigurdsson that year, adding that the lack of rain was vital in allowing the team to excavate the house's remains from the gully bed.

Sigurdsson says he hopes to return next year with his team to map the area more fully with ground-penetrating radar, magnetometers, and other remote-sensing tools. Then, he says, he hopes professional archaeologists will pick up the baton,

relegating him to more of a supporting role in setting the geophysical context for the area.

Indeed, the work "presents a wonderful opportunity," notes University of Hawaii's Miriam Stark, a professor who specializes in Southeast Asian archaeology. "We need more professional and systematic archaeological work done on the European period across Southeast Asia."

# Indonesian volcano arc



# Mt. Rainier



***Mt. Rainier, often said to be the most dangerous volcano in the World***

From <http://vulcan.wr.usgs.gov/Volcanoes/PacificNW/AGU-T106/rainier.html>

***Excerpt from:***

***Swanson, Cameron, Evarts, Pringle, and Vance, 1989, IGC Field Trip T106: Cenozoic Volcanism in the Cascade Range and Columbia Plateau, Southern Washington and Northernmost Oregon: American Geophysical Union Field Trip Guidebook T106, p.21-24.***

**Mount Rainier**

**Mount Rainier, highest (4,392 meters (14,410 feet)) and third-most voluminous volcano in the Cascades after Mounts Shasta and Adams, dominates the Seattle-**



Tacoma area, where more than 1.5 million know it fondly as *The Mountain*. The Mountain is, however, the most dangerous volcano in the range, owing to the large population and to the huge area and volume ( $92 \times 10^6$  cubic meters and  $4.4 \times 10^9$  cubic meters, respectively of ice and snow on its flanks that could theoretically melt to generate debris flows during cataclysmic eruptions. In addition, sector collapses of clay-rich, hydrothermally altered debris have generated at least three huge ( $>2 \times 10^8$  cubic meters) debris flows in the last 5000 years. Yet surprisingly little is known of Mount Rainier's eruptive history, composition, or age. For example, probably fewer than two dozen chemical analyses of Rainier's products have been published. Probably the dominantly nonexplosive nature of past eruptions and the challenging logistics of studying the cone contribute to the relatively limited knowledge. Outstanding work, however, has been completed on its fragmental deposits, and most of what is known about the volcano derives from this work.

### Underpinnings

Mount Rainier is underlain by middle Tertiary volcanic rocks of the Ohanapecosh, Stevens Ridge, and Fives Peaks Formations (Fiske et.al., 1963; Vance et al., 1987), described elsewhere in this guide. These rocks were gently warped along a northwest-trending system of folds and intruded by the Tatoosh pluton, chiefly granodiorite and quartz monzonite. The main body of the Tatoosh is 17.5-14.1 million years, but dikes, sills, and various volcanic deposits interpreted as forerunners to the emplacement of the pluton to its final level are as old as 26 million years, judging from U-Pb dating of zircons (Mattinson, 1977). Fiske, et.al. (1963) interpreted the Tatoosh to have "broken through to the surface" several times, giving rise to eruptions such as that which created The Palisades, a 250-meter-high cliff of 25-million-years-ago silicic welded tuff 5 kilometers northeast of Yakima Park (Mattinson, 1977).

### Forerunner to Mount Rainier

No evidence has been found for magmatism near Mount Rainier between about 14 and 3 million years. The Lily Creek Formation, a thick sequence of debris flows and related volcanic deposits (Crandell, 1963a), crops out just west of the volcano and was hypothesized by Fiske et.al. (1963) to have been erupted from the Tatoosh. However, Mattinson (1977) dated the Lily Creek as no older than 2.9 million years and therefore agreed with Crandell (1963a) that it likely was formed during the earliest activity of Mount Rainier or from a center that just preceded the cone. Stratigraphic relations with glacial deposits suggest that Lily Creek volcanism began before 0.84 million years (Easterbrook, et.al., 1981; Smith, 1987). Hornblende occurs in juvenile clasts of the Lily Creek but not in rocks from Mount Rainier (Fiske, et.al., 1983). No chemical analyses have been published for the Lily Creek.

### The Main Cone

Mount Rainier was built on a rugged surface with more than 700 meters of relief eroded mainly into the Tatoosh pluton and the Stevens Ridge Formation. Early andesite flows from the volcano, undated but presumably several hundred thousand years old, were channeled along deep canyons, some of which were oblique to the present radial drainage pattern. The eruptions were apparently

frequent, because in places one flow rests on the undissected surface of its predecessor. Laharic deposits and till locally occur between the early flows. Eventually the flows stacked up to form a mound near the main vent that became the foundation of the present cone.

Most of Mount Rainier's cone was built by hundreds of thin lava flows interbedded with breccia and minor tephra. The flows are rarely more than 15 meters thick high on the cone, where they drained down the steep slopes. They thicken near the base, and flows more than 60 meters thick occur on the apron around the cone. Some flows entered canyons radial to the volcano. Much breccia on the cone was probably derived from moving flows, but some probably reflects explosions and lahars. Radial dikes are prominent in places; possibly they fed some of the flows. The flows and dikes are petrographically uniform two-pyroxene andesite; the few chemical analyses available are medium-K silicic andesite, with three analyses marginally dacitic. The flows and breccia eventually built a cone standing 2,100-2,400 meters above its surroundings before the end of the latest major glaciation about 10 thousand years ago.

A thick pumice layer northeast, east, and southeast of the volcano may have been erupted from Mount Rainier between 70 and 30 thousand years ago. Estimates from limited outcrops suggest it is an order of magnitude more voluminous than any of the volcano's Holocene tephra layers.

Two late Pleistocene vents, Echo Rock and Observation Rock, erupted olivine-phyric basaltic andesite near the northwest base of the cone after Mount Rainier was almost fully grown. The basaltic andesite is more mafic than the cone-building flows.

Smith (1987) estimates that about 270 cubic kilometers of lava was erupted from Mount Rainier in the last 1 million years.

#### **Postglacial Eruptive History**

Eleven tephra layers record evidence of Holocene explosive volcanism at Mount Rainier (Mullineaux, 1974). Eight of the tephra layers fell between 6500 and 4000 carbon-14 years B.P (before present). Only one tephra-producing eruption, between about 1820 and 1854 A.D., is known from the last 2,200 years; it was very small and left a scanty deposit that could easily be overlooked if it were older. Chemical analyses indicate that layer D is basaltic andesite and layers L and C are silicic andesite.

The tephra layers rich in lithic fragments are probably products of phreatic or phreatomagmatic eruptions. Layer F contains 5 to 25% clay-sized material, as much as 80 percent of which locally consists of clay minerals, chiefly montmorillonite, that was derived from altered rocks within Mount Rainier. Layer F and the Osceola debris flow have similar clay contents and ages, and are likely correlative. However, layer F has not been found on the Osceola and so could be slightly older.

**Layer C, the most widespread and voluminous of the Mount Rainier tephras, covers the east half of the National Park with 2-30 centimeters of lapilli, block, and bombs. Overall it is the coarsest of the tephras, with 25-30-centimeter bombs 8 kilometers from the summit. A block-and-ash flow in the South Puyallup valley west of the volcano contains blocks emplaced above the Curie isotherm and charcoal dated at 2350 +/- 250 carbon-14 years. Its age and lithologic similarity suggest correlation with layer C.**

**Isopachs and isopleths for layer C indicate an origin at the summit of Mount Rainier, yet the layer does not occur on snow-free parts of Columbia crest cone, a young andesite cone standing 250 meters above the former summit of the volcano. Columbia Crest cone is therefore younger than about 2200 years. Crandell (1971) found numerous lahars and flood deposits in valleys surrounding the mountain that postdate layer C but predate layer Wn (1480 A.D.) from Mount St. Helens; some of the flowage deposits have carbon-14 ages older than 1000 years B.P. The eruptions that formed Columbia Crest cone likely produced some of those deposits. If so, the layer-C explosions might have initiated activity that formed Columbia Crest, and the cone would be about 2000 years old.**

**Crandell (1971) identified more than 55 lahars and debris flows of Holocene age from Mount Rainier. At least some were probably associated with eruptions, most notably the Paradise lahar (possibly associated with tephra layers A, L, or D) and the Osceola debris flow (layer F). The Osceola is described in the road log for Mount Rainier (see *below*). In general, Crandell (1971) associates lahars that lack much clay at Mount Rainier with magmatic eruptions, and those that contain much clay with phreatic or phreatomagmatic eruptions or with collapses of the hydrothermally altered edifice. Glacier-outburst floods from Little Tahoma Glacier, typically in late afternoon of warm days or after heavy rain, repeatedly scoured Tahoma Creek in the late 1960's and the middle and late 1980's. Outburst floods frequently modified many other drainages, most notably Kautz Creek and Nisqually River, during historical time.**

**About 20 small earthquakes occur yearly at Mount Rainier, more than at other composite cones in the Cascades except Mount St. Helens (Malone and Swanson, 1986). Trilateration and tilt networks established in 1982 indicate no definite deformation. Seven significant thermal areas above 3350 m on the volcano, including one at the summit, reflect "a narrow, central hydrothermal system ... forming steam-heated snowmelt at the summit craters and localized leakage of steam-heated fluids within 2 kilometers of the summit" (Frank, 1985).**

## Unit 10



***Supervolcano*** is a television docufiction film that was released by the BBC on April 10, 2005 and that appeared on Discovery Channel. It is centered on the speculated and potential eruption of the volcanic caldera of Yellowstone National Park. Its tagline is "Scientists know it as the deadliest volcano on Earth. You know it...as Yellowstone."

### Plot

The film begins with a group of hooded people in caribou parkas riding through the snow on snowmobiles. Arriving at a nearly buried building, inside they find a video recorded journal of a man

who appears to be dying. The man in the video reports that the Yellowstone caldera eruption has affected nearly everything in the United States, burying much of the country under several feet of volcanic ash.

The film then goes back to five years before the incident, where tourists are seen viewing Old Faithful and exploring the hydrovolcanic features of the Yellowstone National Park. Inside the visitor's centre, the same man from the video journal, Rick Lieberman, a USGS scientist in charge of the Yellowstone Volcano Observatory (Y.V.O), is seen presenting to a crowd on Yellowstone's seismic activity. He states during the presentation, using a fictional holographic projector known as *Virgil*, that Yellowstone is on the verge of an eruption, though neither major nor hazardous.

Later throughout the film, more and more signs of seismic activity occur, all indicating towards the imminent eruption of Yellowstone (such as geyser explosions, earthquakes, tsunamis and Old Faithful going silent), though Rick



and most of his colleagues try not to cause public panic by saying that these seismic activities do not necessarily indicate an imminent volcanic eruption. However, media speculation raises public alarm, helped in part by Rick Lieberman's brother-in-law, who is selling a book on supervolcanoes called 'Super Bangs'. As seismic activity increases, a leaked government e-mail acknowledging a possible eruption causes widespread panic.

Rick's team is caught by surprise while researching at the USGS field office next to Yellowstone when the volcano violently erupts, spewing tonnes of rock and pyroclastic material into the sky. Two of his colleagues, Nancy and Matt, are killed as a result of attempting to outrun the pyroclastic flow, and only an injured Jock survives the eruption, escaping via helicopter. Rick is away at a conference and is caught in the ash cloud as he returns.

Tension begins to rise at the Federal Emergency Management Agency (F.E.M.A.) as more and more vents open above the underlying magma chamber throughout the week-long eruption. On Day Three the ash destroys the second Y.V.O. base in Bozeman, killing another colleague, Dave. People are literally being drowned in the volcanic ash and the death toll rises to hundreds of thousands. Slowly, thermal images begin to reveal a contour of the new caldera produced by the vents and authorities begin to realise the seriousness of this problem. Very soon, the authorities become desperate, trying to find a way to save the trapped Americans in the central and western half of the country. At F.E.M.A. Jock raises tension by saying that even after 2,500 cubic km of magma had come out, that it could still go on because Yellowstone has a maximum capacity of 25,000 cubic kilometers, ten times the amount already ejected. And Rick, while in contact with F.E.M.A., mentions that the entire caldera could explode after the collapse. Luckily, things take a better turn just as all hope is nearly lost: the caldera collapses upon itself, indicating the decrease in pressure within the magma chamber, and it doesn't explode.

As it turns out, the film ends with three-quarters of the United States covered in nearly one centimeter of volcanic ash on average as a looming cloud of suspended, lighter ash gets carried over the globe, engulfing the northern hemisphere of Earth, and as a result, plunging it into a volcanic winter.

The film ends the same way it started, only this time, the man is revealed to be Rick, shown with his brother-in-law and a US Marine. He later flies in a helicopter

back to Yellowstone to see what has happened to the volcano that he has been studying all his life. What he sees is a frozen landscape resembling Antarctica, where no vegetation or animals are visible; but he optimistically says that although it is the ending of much life, life would also begin as a result of this event.

Finally, the last scene shows the camera panning out from the area where Yellowstone erupted in a series of satellite images, eventually showing the cataclysmically large resulting landform caldera relative to the size of the United States.

## Truth, fiction and everything in between at Yellowstone

Jake Lowenstern

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When I was asked to take over as scientist-in-charge of the Yellowstone Volcano Observatory (YVO) in 2002, I was unaware that soon I would be responding to a rapidly growing urban legend (or perhaps a rural one in this case). Just Google for the words “Yellowstone” and “Doomsday,” and you’ll find hundreds of entries from scores of Web sites warning that the world is about to end at the hands of America’s first national park and largest restless caldera.

*In the BBC-Discovery Channel docudrama Supervolcano, Yellowstone*

*volcano erupts violently, sending hundreds of cubic miles’ worth of debris into the atmosphere and creating plumes of ash and debris that race at hundreds of miles an hour.*

*Although this type of eruption has happened*

*in the geologic past, scientists say an eruption of that magnitude is unlikely to happen anytime soon. Courtesy of*

*DiscoverCommunications*



Of course, the Yellowstone caldera is a volcano, and it almost certainly will erupt again someday. It’s possible, though unlikely, that future eruptions could reach

the magnitude of Yellowstone's three largest explosive eruptions, 2.1 million, 1.3 million and 640,000 years ago. Smaller eruptions, however, are far more likely, and no eruption seems imminent on the timescale that most people truly care about — their lifetime or perhaps even the next few hundred or thousands of years.

These realities, however, do not always make it into the coverage we see in TV documentaries, on the Internet or in the popular press. Sometimes, the media bends the realities to make for better entertainment rather than better science, as evidenced by my experiences over the past three years evaluating everything from fictional movies about Yellowstone to dispelling myths on Internet chat rooms.

## **What actually is happening**

So, why all the attention on Yellowstone volcano now? Although scientists first recognized Yellowstone's history of repeated titanic eruptions back in the 1960s, the general public became aware of them only during the past five years or so. The upsurge in interest can be tied partly to the release of an episode of the BBC-produced *Horizon* in 2000, which addressed volcanic eruptions at Yellowstone and was frequently replayed in the United Kingdom and in North America on the Discovery Channel.

Around the same time, the U.S. Geological Survey (USGS) signed a memorandum of understanding with the University of Utah and Yellowstone National Park to create YVO. The idea was to formalize what had been an unofficial observatory for many years and create a stronger framework for monitoring and research. A few years later, in late 2002, a number of geological factors contributed to ramping up public interest in Yellowstone and its volcanic potential.

First, surface waves from the magnitude-7.9 Denali, Alaska, earthquake triggered about 400 small temblors within the park, 3,100 kilometers (about 1,900 miles) distant from the epicenter. Next, Steamboat Geyser, Yellowstone's tallest and most unpredictable geyser, erupted in March 2003 and again in April and October. A new and vigorously steaming 75-meter (245-foot) line of steam vents erupted within sight of the Norris-Mammoth Road. A trail in the Norris Geyser Basin was closed because of increased steaming and resulting elevated ground temperatures. Our coordinating scientist Robert B. Smith of the University of Utah spearheaded a seismic and GPS-based experiment trying to understand the nature of the changes to hydrothermal features at Norris.

At the same time, new USGS mapping of thermal features on the floor of Yellowstone Lake resulted in a flurry of articles on Yellowstone's potential for hydrothermal explosions — events in which geothermal groundwater is flashed to steam, hurling rocks substantial distances and forming craters. These articles reasonably highlighted the active thermal features beneath the lake and the importance of hydrothermal explosions, but they also incorrectly implied that active “bulges” were rapidly forming beneath the lake, that they were ready to explode, and that they could cause volcanism in their wake.

## Eruption on the small screen

With all this attention on Yellowstone late in 2003, BBC Science decided to produce a two-hour “docudrama” on the volcano and its potential for widespread devastation. Entitled *Supervolcano*, it chronicles a near-future cataclysm modeled after the Huckleberry Ridge eruption 2.1 million years ago, which vented more than 2,500 cubic kilometers of volcanic debris (enough to bury the state of Texas 12 feet deep). The BBC movie cost approximately \$5.5 million to make and was co-produced with Discovery Channel, NHK and several other global television interests. It premiered in the United Kingdom in March and in the United States in April.



*Jake Lowenstern, real-life scientist-in-charge of Yellowstone Volcano Observatory (YVO), collects geothermal gas in the field. In the docudrama *Supervolcano*, Michael Riley plays the scientist-in-charge of YVO (Rick Lieberman), and he consulted with Lowenstern on everything from dress code to pronunciation of geologic terms in preparation for his role.*

← *Image courtesy of Fraser Goff, USGS.*

Scientists from USGS, Yellowstone National Park, the University of Utah and elsewhere in academia were visited by the film’s producer and writer, prior to filming. They asked us countless questions during script development, including the following: How do you monitor the volcano? What phenomena imply an eruption? Who is responsible for what tasks? What do you do in the field? Where do you stay? How do you get around? Later, we reviewed a draft script for the drama and provided them with our comments and critiques. Michael Riley, the actor playing the YVO scientist-in-charge, phoned me twice, and we had lengthy conversations about topics ranging from “my typical day” to dress code to the proper pronunciation of place names and geological jargon.

In the end, the BBC Science team did an impressive job of addressing the sorts of scientific issues we would grapple with during the start of an eruption. The drama unfolds as a true scientific thriller, both gripping and fact-filled. The characters, though based only loosely on real people, had motivations and interests similar to mine and those of my colleagues. Although we strongly would have preferred



portrayal of the effects of a small eruption, their intent was always to provide a worst-case scenario, and the final product did that very well.

Surprisingly, our experience with two documentary film programs was somewhat more negative. Both BBC and the National Geographic Channel requested our assistance on documentaries that would explore the effects of “supereruptions.” The BBC program followed its showing of *Supervolcano*, while the National Geographic program was for its series *Naked Science*. My naïve assumption was that the filmmakers would interview their subjects and then synthesize the results of what they had learned. In both cases, though, we felt as if our roles had been scripted beforehand and that the filmmakers relentlessly pursued several key quotes that fit neatly within their desired narrative.

We were never given the opportunity to critique the *Naked Science* program, and the final product was highly sensationalized. The BBC did allow us to view an early version of their documentary, one which we felt was highly misleading about actual geologic hazards and risks at Yellowstone National Park. Their revised program, entitled *The Truth About Yellowstone*, was broadcast in the United Kingdom and elsewhere overseas. Although it was much better than the earlier draft, it tended to focus more on corroborating *Supervolcano* than on providing an unbiased assessment of current events and likely volcanic scenarios. Discovery Channel opted to replace *The Truth About Yellowstone* with its own documentary hosted by Tom Brokaw. Overall, that documentary was balanced, providing both the science and the sensational with appropriate perspective.

## Explosions in the newspaper

“Under Pressure? Yellowstone may be getting ready to erupt, scientists say.” This alarming headline grabbed many readers’ attention in Longmont, Colo., in December 2003. Actually, the associated article in the local paper, the *Times-Call*, was quite good and with the exception of the headline, made no mention of any scientists who thought Yellowstone might be getting ready to erupt. I’ve since learned that headline writers don’t always worry too much about matching headlines to storylines. They can creatively embellish the fundamental science without any serious consequences, at least to themselves.

And that was true to a limited degree for the wide range of coverage Yellowstone has received in recent years in the *New York Times*, the *Los Angeles Times* and CBS News, among many, many others. Coordinating scientists Robert Smith, Henry Heasler (the park geologist) and I have done interviews for scores of newspapers and magazines (including *Geotimes*), as well as television and radio news stories, some of which were accurate and reasonable, whereas others were sensationalized and twisted.

Generally, the most carefully researched articles about volcanism at Yellowstone were penned by writers from the local newspapers in Billings, Mont., Jackson, Wyo., and other nearby towns. This paralleled my experience at Mount St. Helens in October 2004, where the local writers were more likely to take the time to get the story right.

When confronted with a litany of potential eruption scenarios, local reporters covering Mount St. Helens thoroughly educated themselves about the volcano, its history and the techniques used to monitor volcanic activity. They did not want to overstate the danger once they understood that a relatively nonhazardous effusive eruption was underway.

Similarly, at Yellowstone, local reporters were typically careful, whereas those sitting at a greater distance from the park often viewed the story as ripe for “titillation.” I don’t think it’s a coincidence that so much of the hyperbolic press on the Yellowstone volcano comes from the United Kingdom. In reading many of the U.K. news articles, I cannot but sense an unstated glee as the author recounts the future doom headed for their brethren “across the pond.”

### **Cataclysms on the Internet**

Not surprisingly, the Internet is the biggest source of misinformation about Yellowstone’s volcanic past and present. By mid-2003, Internet news magazines and chat rooms had exploded with speculation and fabrications about current events at Yellowstone. One online report was cobbled together “from a series of articles, emails and official information.” It included nuggets such as “The [Yellowstone] Lake is now closed to the public. It is filled with dead fish floating everywhere. The same is true of the Yellowstone River and most of the other streams in the Park.” Later in the same report came the following: “The movement of magma has been detected just three-tenths of a mile below the bulging surface of the ground in Yellowstone raising concerns that this super volcano may erupt soon.”



*The Norris Geyser Basin in Yellowstone National Park, shown steaming here in August 2003, is home to many hydrothermal features, which are fueled by an enormous magma chamber seated below much of the*

*park.*

*Image courtesy of Jim Peaco/NPS.*

Needless to say, these statements were not true, and someone did not do a very thorough job of fact checking the story — but that did not stop dispersal of these misleading reports all over the Internet. Similarly, an online Web forum reported

that USGS had secretly sent 200 geologists into Yellowstone to study “the situation.” I can only dream that USGS had such resources!

Most of these articles referred to generic “scientists” who were worried about one thing or concerned about another. None of these people were ever mentioned by name, and I certainly have not met any of these generic scientists — but they sure did seem worried. As a result of these stories, enthusiasts flocked to our real-time data on seismicity, ground deformation and stream flow, looking for any anomaly that might foreshadow an approaching eruption and devastation. Their musings provided fascinating, but unsettling, reading for YVO scientists. Wind, trucks and snowmobiles were interpreted as tremors, swarms and other signs of instability.

Although the denizens of these chat rooms may have had scant geological education, they were passionate. One online forum sent us a series of penetrating questions about how we monitor Yellowstone. Smith, Heasler and I responded, knowing that our words would be posted on their Web site. Although we were unsure whether answering was a good idea, in the end, we responded as forthrightly as possible. While answering their questions, we admitted that our monitoring system could not predict certain kinds of events (for example, localized steam or hydro-thermal explosions), that we do not monitor gas flux or composition in real time, and that there are many topics that earth scientists still do not understand.

Our letter was painstakingly analyzed by many in their group, some of whom still accused us of obfuscation and evasion. We soon noted, however, a significant curtailment in their concern — messages to their Yellowstone chat room slowed to a near halt. Overall, I think we gave them what they needed, and we turned a few skeptics into grudging admirers.

## **Observations and lessons learned**

My experiences over the past few years have necessarily caused me to reflect on the public face of science, scientific information and scientists themselves. Prior to my role at YVO, I’d worked as a full-time researcher on the geochemistry of magmas and their related hydrothermal systems. I recognized that although my research was relevant to volcanology and economic geology, it explored subjects too arcane to be of much interest to the public. My focus was toward other scientists, and when reporters did venture near my door, I was challenged to convey properly the significance of my work while keeping things simple, technically accurate and appropriately reflective of work done by others.

So it came as a bit of a shock when regardless of anything I’d actually done as a research scientist, I was now solidly in the role as the point person for a whole host of critical questions. Will it erupt? Why not? When? How do we know?

It's been a fascinating transition — one that was not necessarily desired, but that has taught me useful lessons in communicating technical information to a public that truly cares about what scientists say and how we say it. These lessons hold true for people dealing with media in any profession, not just the earth sciences.

The first lesson is not to talk about a sensitive subject unless you've thought about it before, talked about it with others and gotten some feedback. Fortunately at YVO, we have three coordinating scientists with varied expertise and different home institutions, so we have natural checks and balances when we communicate to the public. We've learned that it's critical to keep things as simple as possible. If you're trying to answer a question, do not give an answer that will spark two more questions. And while there may be 10 different possible ways to answer a technical question, there's always one that is a bit more direct and more intuitively satisfying, and that's the one you should use.

Second, tell the truth and admit when you don't know something. If you tell the truth as you see it, many will still call you a baldfaced liar. If you choose to hide anything, they'll know you are one.

And last, don't confuse enthusiasm with good outreach: It may work for high school kids but it won't work with the *New York Times* or nightly news hours. When we get too casual or enthusiastic, our words come back to haunt us. Our excitement about understanding earthquakes, volcanoes, hurricanes and floods can be misinterpreted. Reporters may confuse our reconstruction of past events with a prediction of future events. Ultimately, the latter holds their interest.

In the end, the reporters and filmmakers have the final say. They write the articles and scripts, they choose the quotes and sound bites, and they have the attention of the public. When they work hard to get the facts correct, it pays off. The *Supervolcano* drama was successful in large part because it was authentic, making the plot more gripping and the whole experience more educational. When the science is ignored, or misunderstood, everyone loses. The challenge for us scientists is to relay both the details and the context of our work, so that society understands that science is ultimately a human endeavor — sometimes uncertain, often complex, but always exciting.

### ***What is a supervolcano?***

From the U.S. Geological Survey (USGS) Yellowstone Volcano Observatory Web site:

“The term ‘supervolcano’ implies an eruption of magnitude 8 on the Volcano Explosivity Index, meaning that more than 1,000 cubic kilometers (250 cubic miles) of magma (partially molten rock) are erupted. The most recent such event on Earth occurred 74,000 years ago at the Toba Caldera in Sumatra, Indonesia.”

Examples of volcanoes that have produced exceedingly voluminous eruptions and formed large calderas in the past 2 million years include



Yellowstone, Long Valley in eastern California, Toba in Indonesia, and Taupo in New Zealand. Other supervolcanoes would likely include the large caldera volcanoes of Japan, Indonesia, and South America, among others, according to USGS.

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Mr. Lowenstern is scientist-in-charge for the Yellowstone Volcano Observatory and is based at the U.S. Geological Survey (USGS) in Menlo Park, Calif. The observatory is a partnership between Yellowstone National Park, USGS and its Volcano Hazards Program, and the University of Utah, which operates the earthquake and ground-deformation monitoring networks.

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Yellowstone

Volcano Yellowstone Volcano Observatory

# ***Yellowstone Scientists answer questions about the Supervolcano documentary***

***The docudrama Supervolcano dramatically explores the impact of a large caldera-forming eruption at Yellowstone. The scale of the portrayed eruption is similar to the eruption of the Huckleberry Ridge Tuff at Yellowstone 2.1 million years ago. The movie is realistic insofar as depicting what could happen if an eruption of this magnitude were to occur again. Although the drama is set in the future, it does an acceptable job of addressing some of the issues scientists would grapple with if Yellowstone showed signs of an impending eruption. The questions and answers below shed light on issues related to volcanism at Yellowstone.***

**QUESTION: What is the chance of another catastrophic volcanic eruption at Yellowstone?**

**ANSWER: Although it is possible, scientists are not convinced that there will ever be another catastrophic eruption at Yellowstone. Given Yellowstone's past history, the yearly probability of another caldera—forming eruption could be calculated as 1 in 730,000 or 0.00014%. However, this number is based simply on averaging the two intervals between the three major past eruptions at Yellowstone — this is hardly enough to make a critical judgement. This probability is roughly similar to that of a large (1 kilometer) asteroid hitting the Earth. Moreover, catastrophic geologic events are neither regular nor predictable.**

**QUESTION: What is a "supervolcano"?**

**ANSWER: The term "supervolcano" implies an eruption of magnitude 8 on the Volcano Explosivity Index, meaning that more than 1,000 cubic kilometers (240 cubic miles) of magma (partially molten rock) are erupted. The most recent such event on Earth occurred 74,000 years ago at the Toba Caldera in Sumatra, Indonesia.**

**QUESTION: What would happen if a "supervolcano" eruption occurred again at Yellowstone?**

**ANSWER: Such a giant eruption would have regional effects such as falling ash and short-term (years to decades) changes to global climate. The surrounding states of Montana, Idaho, and Wyoming would be affected, as well as other places in the United States and the world. Such eruptions usually form calderas, broad volcanic depressions created as the ground surface collapses as a result of withdrawal of partially molten rock (magma) below. Fortunately, the chances of this sort of eruption at Yellowstone are exceedingly small in the next few thousands of years.**

**QUESTION: Is Yellowstone monitored for volcanic activity?**

**ANSWER: Yes. The Yellowstone Volcano Observatory (YVO), a partnership between the United States Geological Survey (USGS), Yellowstone National Park, and the University of Utah, closely monitors volcanic activity at Yellowstone. The YVO website (<http://volcanoes.usgs.gov/yvo>) features real-time data for earthquakes, ground deformation, streamflow, and selected stream temperatures. In addition, YVO scientists collaborate with scientists from around the world to study the Yellowstone volcano.**

**QUESTION: Do scientists know if a catastrophic eruption is currently imminent at Yellowstone?**

**ANSWER:** There is no evidence that a catastrophic eruption at Yellowstone is imminent, and such events are unlikely to occur in the next few centuries. Scientists have also found no indication of an imminent smaller eruption of lava.

**QUESTION:** How far in advance could scientists predict an eruption of the Yellowstone volcano?

**ANSWER:** The science of forecasting a volcanic eruption has significantly advanced over the past 25 years. Most scientists think that the buildup preceding a catastrophic eruption would be detectable for weeks and perhaps months to years. Precursors to volcanic eruptions include strong earthquake swarms and rapid ground deformation and typically take place days to weeks before an actual eruption. Scientists at the Yellowstone Volcano Observatory (YVO) closely monitor the Yellowstone region for such precursors. They expect that the buildup to larger eruptions would include intense precursory activity (far exceeding background levels) at multiple spots within the Yellowstone volcano. As at many caldera systems around the world, small earthquakes, ground uplift and subsidence, and gas releases at Yellowstone are commonplace events and do not reflect impending eruptions.

**QUESTION:** Can you release some of the pressure at Yellowstone by drilling into the volcano?

**ANSWER:** No. Scientists agree that drilling into a volcano would be of questionable usefulness. Notwithstanding the enormous expense and technological difficulties in drilling through hot, mushy rock, drilling is unlikely to have much effect. At near magmatic temperatures and pressures, any hole would rapidly become sealed by minerals crystallizing from the natural fluids that are present at those depths.

**QUESTION:** Could the Yellowstone volcano have an eruption that is not catastrophic?

**ANSWER:** Yes. Over the past 640,000 years since the last giant eruption at Yellowstone, approximately 80 relatively nonexplosive eruptions have occurred and produced primarily lava flows. This would be the most likely kind of future eruption. If such an event were to occur today, there would be much disruption of activities in Yellowstone National Park, but in all likelihood few lives would be threatened. The most recent volcanic eruption at Yellowstone, a lava flow on the Pitchstone Plateau, occurred 70,000 years ago.

**QUESTION:** Because Yellowstone is so geologically active, are there other potential geologic hazards in Yellowstone?

**ANSWER:** The heat and geologic forces fueling the massive Yellowstone volcano affect the park in many ways. Yellowstone's many geysers, hot springs, steam vents, and mudpots are evidence of the heat and geologic forces. These hydrothermal (hot water) features are mostly benign, but can rarely be the sites of violent steam explosions and pose a hydrothermal hazard. Earthquakes, another

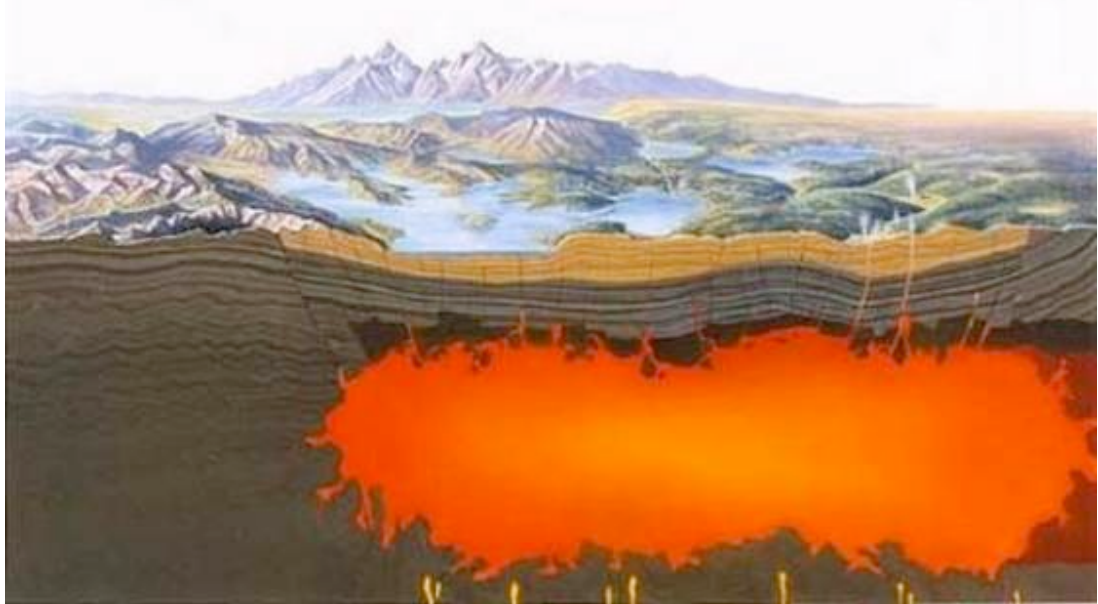
**example of active geologic forces, are quite common in Yellowstone, with 1,000 to 3,000 occurring annually. Most of these are quite small, although significant earthquakes have shaken Yellowstone, such as the 1959 magnitude 7.5 Hebgen Lake quake, the largest historical earthquake in the intermountain region, and the 1975 magnitude 6.1 quake near Norris Geyser Basin. The many earthquakes and steam explosions in the past 10,000 years at Yellowstone have not led to volcanic eruptions.**



# Yellowstone's killer hazard: Earthquakes, not eruptions

Becky Oskin -- LiveScience

<http://www.livescience.com/40738-yellowstone-earthquake-hazard-eruptions.html>



*National Park Service*

***Yellowstone is an active volcano. Surface features such as geysers and hot springs are direct results of the region's underlying volcanism.***

**DENVER — A super-volcano blasting Yellowstone National Park to smithereens may capture the imagination, but the region's real risk comes from earthquakes, researchers reported at the Geological Society of America's annual meeting.**

**"The pervasive hazard in Yellowstone is earthquakes," said Robert Smith, a seismologist at the University of Utah. "They are the killer events."**

**Smith and his collaborators analyzed 4,520 earthquakes in and around Yellowstone that struck between 1985 and 2013. Their goal: Create the best picture ever of the magma chamber hidden beneath the park's colorful hot springs and spectacular geysers. A side benefit was a better view of the seismic risk from nearby faults. [SEE Infographic: Geology of Yellowstone -- FOLLOWING]**

**Constant trembling One of these faults triggered the most destructive earthquake ever recorded in the Rocky Mountains — the deadly magnitude 7.3 Hebgen Lake quake in 1959. The epicenter was about 15 miles (24 kilometers) north of West Yellowstone.**

**Smith said the probability of another magnitude 7 or larger earthquake on one of the major faults near Yellowstone is 0.125 percent. The number reflects the chance an earthquake will occur in any given year, based on past records.**

**The annual probability of a Yellowstone supereruption is a much smaller 0.00014 percent, Smith said.**

**Yellowstone National Park is cradled inside a gentle depression created by a giant volcanic eruption 640,000 years ago. The ground collapsed, leaving a bowl-shaped caldera. It was the third in a series of massive eruptions, the first of which exploded 2.1 million years ago.**

**A mantle plume (also called a hotspot) feeds Yellowstone's supereruptions. Hotspots are massive rising blobs of hot rock from Earth's mantle, the layer beneath the crust. As the planet's tectonic plates trundle over hotspots, the plumes punch through the crust, forming volcanic chains like Hawaii or the Idaho's Snake River Plain and Yellowstone.**

**In the millennia since the last massive volcanic blowout, magma has again built up beneath Yellowstone. The park trembles constantly with tiny earthquakes as gas and hot fluids course through underground fractures, escaping from the molten rock below.**

**Beneath Yellowstone Led by graduate student Jamie Farrell, the University of Utah group used these tremors like a CT scan, building a precise image of the underground magma reservoir.**

**However, Yellowstone's magma chamber isn't just a giant pool of molten rock. What's called a partial melt — small interconnected zones of magma filling fractures and small spaces — fills 6 to 7 percent of the crust beneath Yellowstone, Smith said. "The Yellowstone crustal reservoir is 250 percent larger than previously imaged," Smith said.**

**The actual volume of molten magma is between 200 to 600 cubic km (50 to 145 cubic miles), he said.**

**The reservoir is shaped like a dog's knobby chew toy, with one end about 9 miles (15 km) below the center of Yellowstone National Park, and the other rising to the northeast, about 3 miles (5 km) below the surface.**

**The shallow end extends 12 miles (20 km) northeast of the caldera rim created 640,000 years ago, Smith said. That distance matches the total tectonic drift of the North American plate over the Yellowstone mantle plume since that time, he said.**

***Email Becky Oskin or follow her @beckyoskin. Follow us @OAPlanet, Facebook and Google+. Original article on LiveScience's OurAmazingPlanet.***

***Infographic:*** (See <http://www.livescience.com/29720-yellowstone-national-park-old-faithful-super-volcano.html> for color images.)

Yellowstone National Park may be one of the nation's most well known landmarks and is one of the most visited national parks in the country. The unique geology of the park is part of what makes it such a big draw for tourists; in particular, the many hot springs and geysers that dot the park are the most famous features of Yellowstone.

# The Geology of Yellowstone

Yellowstone National Park covers 3,472 square miles (8,987 sq. km) of mountains, lakes and canyons. The area contains an estimated 10,000 geothermal features (hot springs and geysers), half of the total in the entire world. The Yellowstone Caldera is an active supervolcano that erupted in the past and will do so again, possibly covering up to half the United States in volcanic ash.

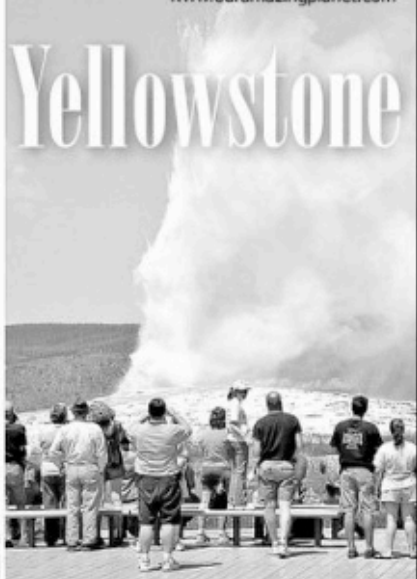
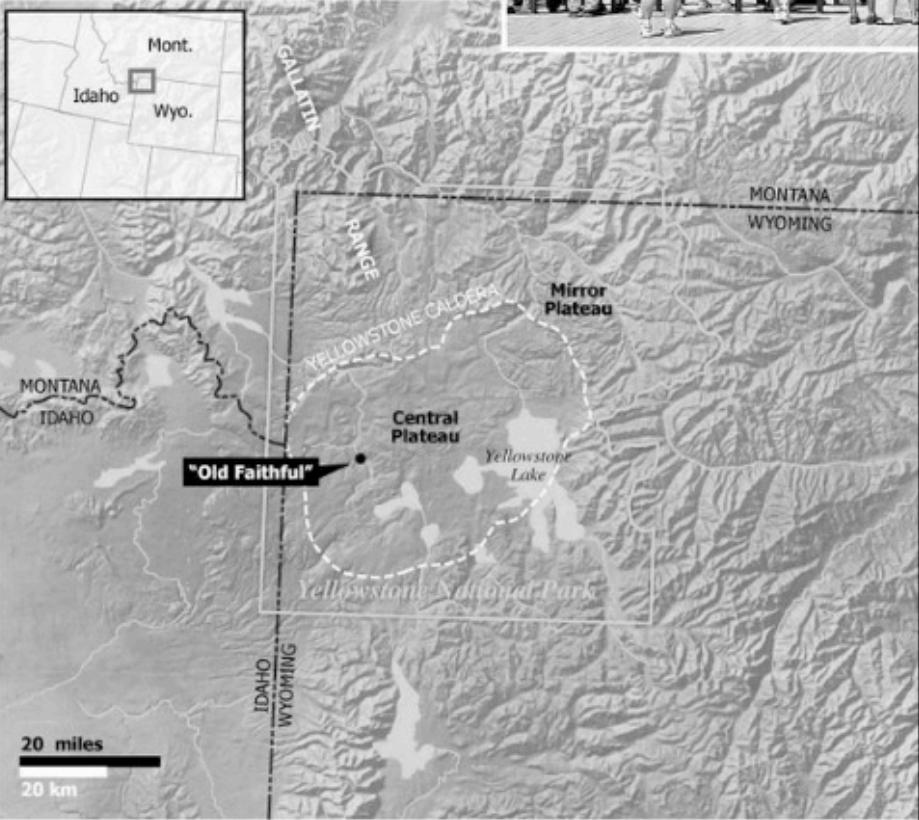
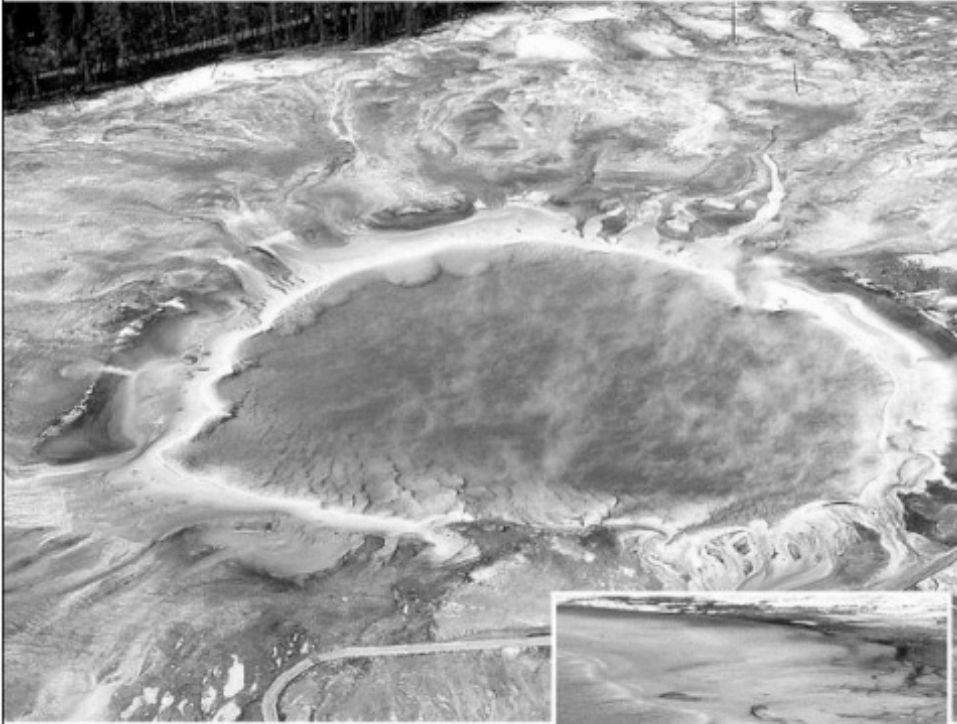


PHOTO: OBSERVERS WATCH "OLD FAITHFUL" ERUPT (DREAMSTIME)





## Hot Water, Mud and Color

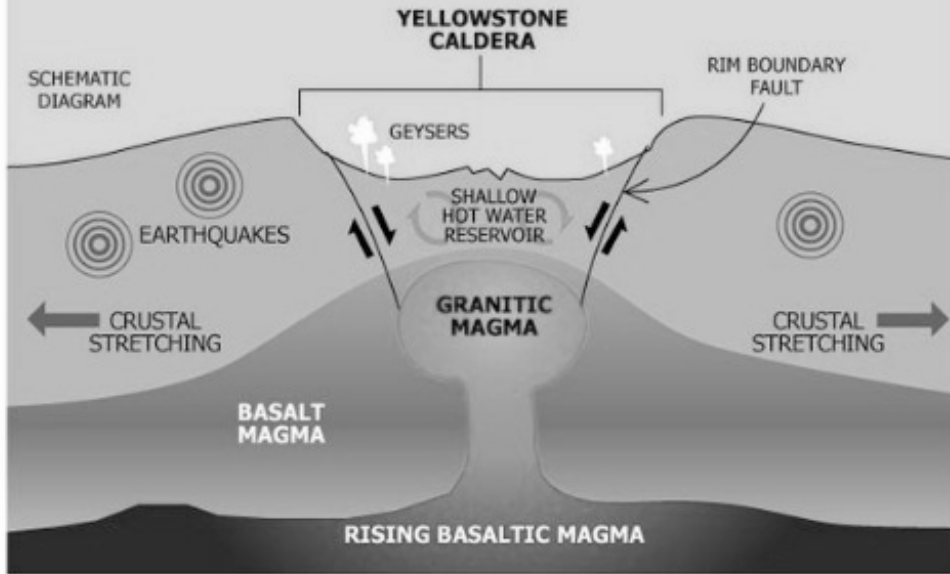


The Grand Prismatic Spring is the largest hot spring in the United States and the third largest in the world. The vivid colors around the rim are due to bacterial mats that thrive in the mineral-rich water. Photos: National Park Service, Al Mebane



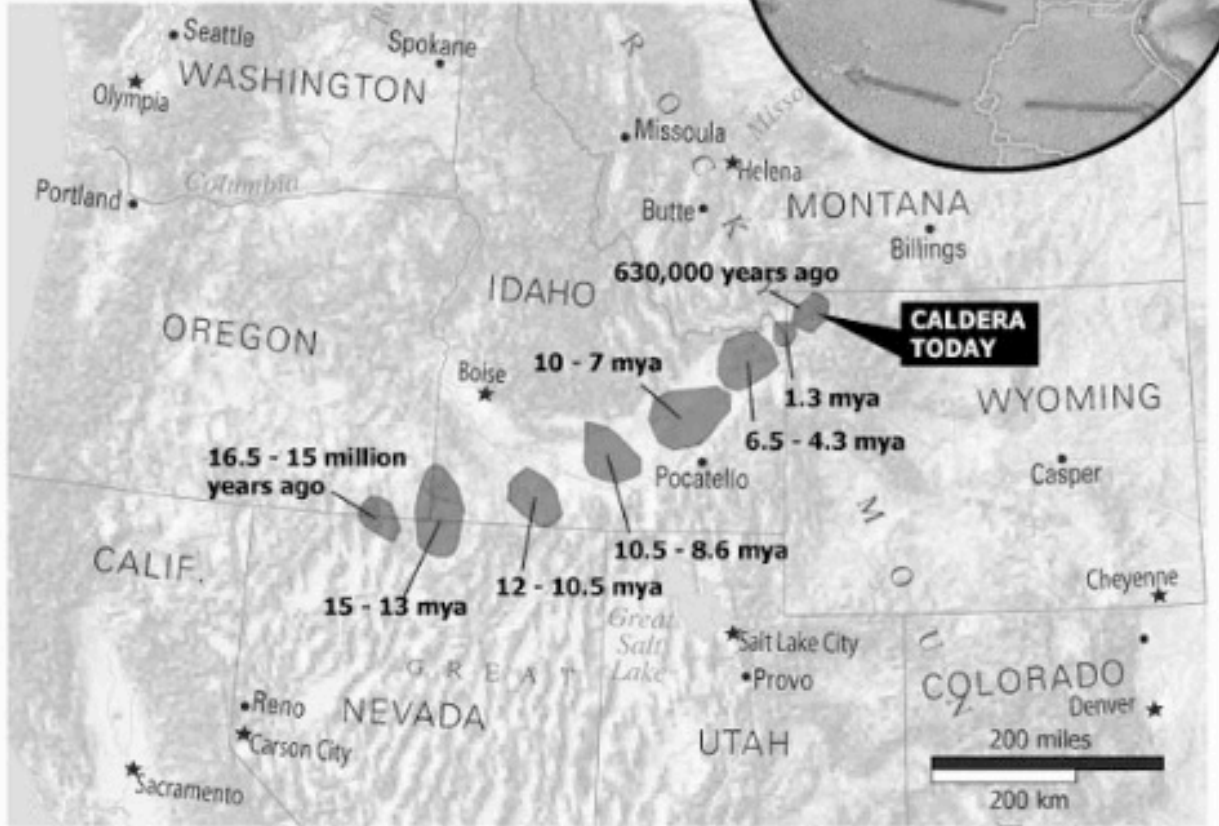
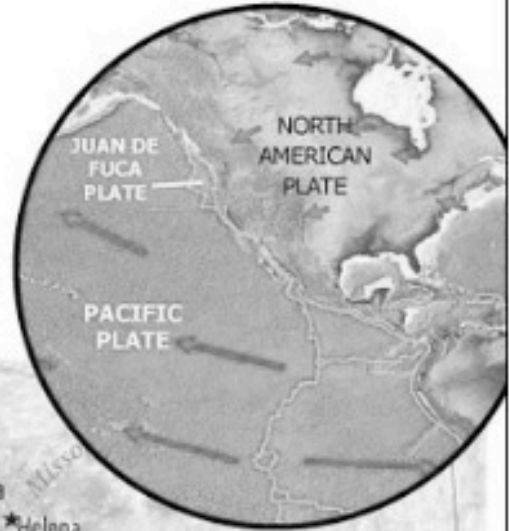
## Molten Rock and Superheated Water

This cross-section shows that the area sits on a "hot spot" where molten rock from deep within the Earth wells up near to the surface. The pressure causes the rock to stretch, which results in earthquakes. Water in the form of rain, snow and ice melting off of nearby mountains trickles through the porous rock. Eventually the cool water reaches a layer of hot brine heated by the magma. The water becomes superheated to 400 degrees Fahrenheit (204 degrees Celsius) but remains liquid due to the pressure.

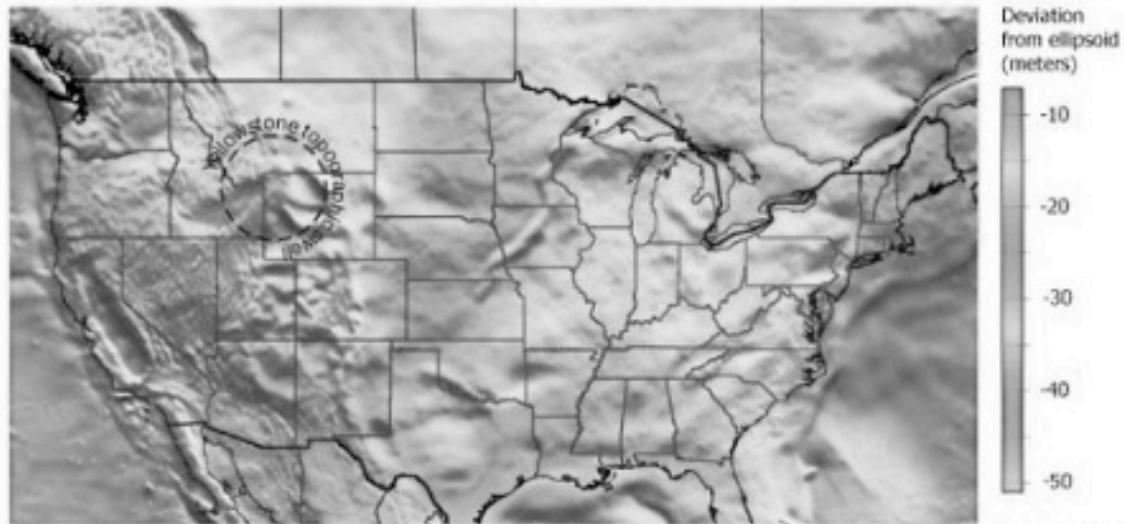


## Plates in Motion

The crust of the Earth is broken up into large tectonic plates, which move slowly against, over and under one another. The North American plate moves steadily to the southwest, carrying the landscape over the magma hot spot. On a map this looks as though the hot spot were migrating eastward.

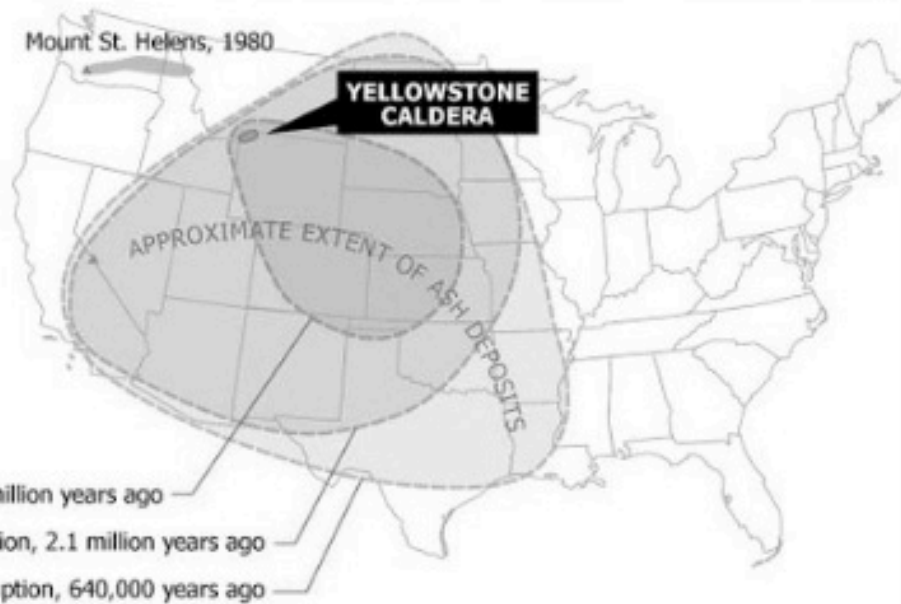


## The Yellowstone Supervolcano: Ticking Time Bomb



MAP SHOWS DEVIATION FROM THE "GEOID," OR THE MATHEMATICALLY IDEALIZED SURFACE OF THE EARTH. THE YELLOWSTONE AREA IS A SWELLING 300 MI (500 KM) ACROSS. SOURCE: JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH

Geologists predict that eventually Yellowstone will erupt into a supervolcano that could blanket half the United States in volcanic ash 3 feet (1 meter) deep. Geological evidence shows that similar eruptions have happened several times in the past.



SOURCE: UNITED STATES GEOLOGICAL SURVEY; NATIONAL PARK SERVICE; JOURNAL OF VOLCANOLOGY AND GEOTHERMAL RESEARCH; EARTH AND PLANETARY SCIENCE LETTERS

KARL TATE, OurAmazingPlanet.com



10 December 2013 --

<http://www.bbc.co.uk/news/science-environment-25312674>

# Yellowstone supervolcano 'even more colossal'



By **Rebecca Morelle** -- Science reporter, BBC World Service



***Hot springs are surface evidence of the huge magma chamber that sits beneath Yellowstone***

The supervolcano that lies beneath Yellowstone National Park in the US is far larger than was previously thought, scientists report.

A study shows that the magma chamber is about 2.5 times bigger than earlier estimates suggested. A team found the cavern stretches for more than 90km (55 miles) and contains 200-600 cubic km of molten rock.

The findings are being presented at the [American Geophysical Union Fall Meeting](#) in San Francisco. Prof Bob Smith, from the University of Utah, said: "We've been

working there for a long time, and we've always thought it would be bigger... but this finding is astounding."

If the Yellowstone supervolcano were to blow today, the consequences would be catastrophic. The last major eruption, which occurred 640,000 years ago, sent ash across the whole of North America, affecting the planet's climate.

Now researchers believe they have a better idea of what lies beneath the ground. The team used a network of seismometers that were situated around the park to map the magma chamber. Dr Jamie Farrell, from the University of Utah, explained: "We record earthquakes in and around Yellowstone, and we measure the seismic waves as they travel through the ground. "The waves travel slower through hot and partially molten material... with this, we can measure what's beneath."

The team found that the magma chamber was colossal. Reaching depths of between 2km and 15km (1 to 9 miles), the cavern was about 90km (55 miles) long and 30km (20 miles) wide. It pushed further into the north east of the park than other studies had previously shown, holding a mixture of solid and molten rock. "To our knowledge there has been nothing mapped of that size before," added Dr Farrell.

The researchers are using the findings to better assess the threat that the volatile giant poses. "Yes, it is a much larger system... but I don't think it makes the Yellowstone hazard greater," explained Prof Bob Smith. "But what it does tell us is more about the area to the north east of the caldera." He added that researchers were unsure when the supervolcano would blow again.

Some believe a massive eruption is overdue, estimating that Yellowstone's volcano goes off every 700,000 years or so. But Prof Smith said more data was needed, because there had only been three major eruptions so far. These happened 2.1 million years ago, 1.3 million years ago and 640,000 years ago. "You can only use the time between eruptions (to work out the frequency), so in a sense you only have two numbers to get to that 700,000 year figure," he explained. "How many people would buy something on the stock market on two days of stock data."

In another study presented at the AGU Fall Meeting, researchers have been looking at other, more ancient volcanic eruptions that happened along the same stretch of continental plate that Yellowstone's supervolcano sits on. Dr Marc Reichow, from the University of Leicester, said: "We looked at a time window of between 12.5 to 8 million years ago. We wanted to know how to identify these eruptions and find out how frequently they happened."

The team found there were fewer volcanic events during this period than had been estimated, but these eruptions were far larger than was previously thought. Dr Reichow added: "If you look at older volcanoes, it helps to understand what

Yellowstone is likely to do.

## ***Neogene Snake River Plain-Yellowstone Volcanic Province***

*by Paul Link, Idaho State University*

*From*

[http://geology.isu.edu/Digital\\_Geology\\_Idaho/Module15/mod15.htm](http://geology.isu.edu/Digital_Geology_Idaho/Module15/mod15.htm)

Geology of the Snake River Plain

Geologic History of the Snake River Plain

PDF Slideshows: [Snake River Plain](#) and

[SRP Topographic Development](#) by Paul Link

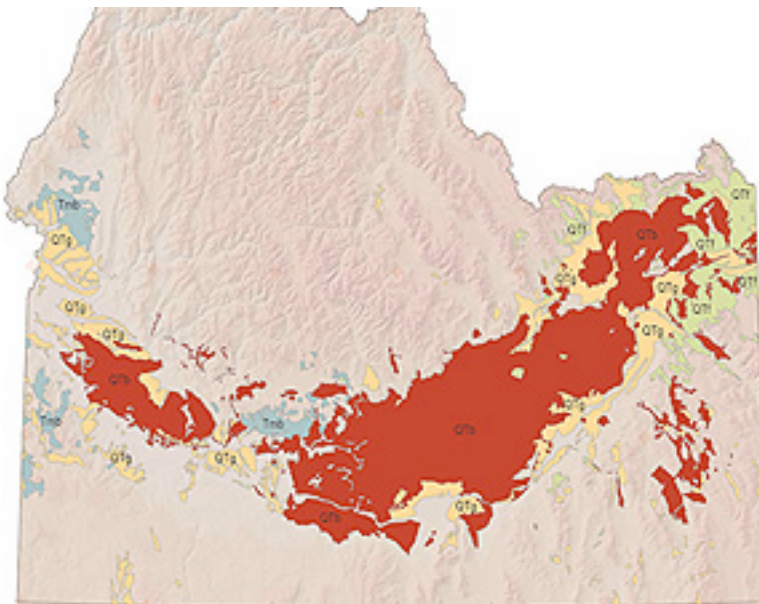
and [SRP-Yellowstone Volcanism](#) by Scott Hughes



Flythroughs: [Snake River 1](#) , [Snake River 2](#) [Snake River 3](#)

### **Neogene Snake River Plain**

The Snake River Plain is a broad arcuate topographic depression that extends across southern Idaho (figure 1 to the right; click on image for a larger image or [click here for PDF version](#).) The western Snake River Plain sits in a fault-bounded graben while the eastern Snake River Plain (ESRP) is a large structural downwarp that formed due to the weight of the overlying volcanic rocks. The Owyhee Plateau is genetically related to the Snake River Plain, although it has remained a highland region. The map below shows the geography of the Snake River Plain and surrounding areas.



*<-- Figure 1. Geology of the Snake River Plain*

Current studies suggest that the Snake River Plain resulted from the passage of the North American Plate over a stationary mantle plume or “hotspot” that is currently located beneath Yellowstone National Park (Figure 2) or what is often referred to as the Yellowstone Caldera or Yellowstone Plateau. The North American plate migrates at a rate of



approximately 4.5 mm/year over the "hotspot". (Rodgers et al., 1990, Pierce and Morgan, 1992).

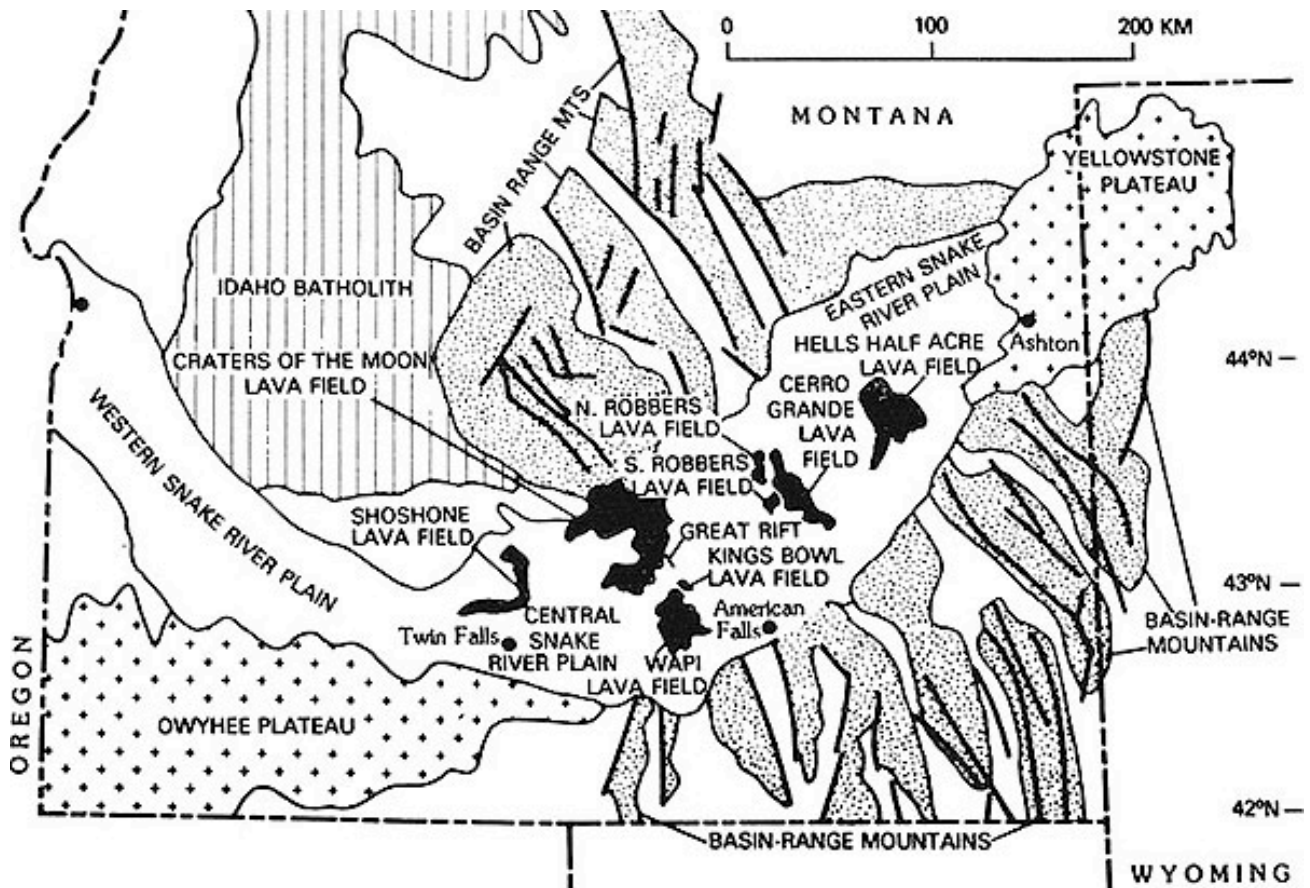
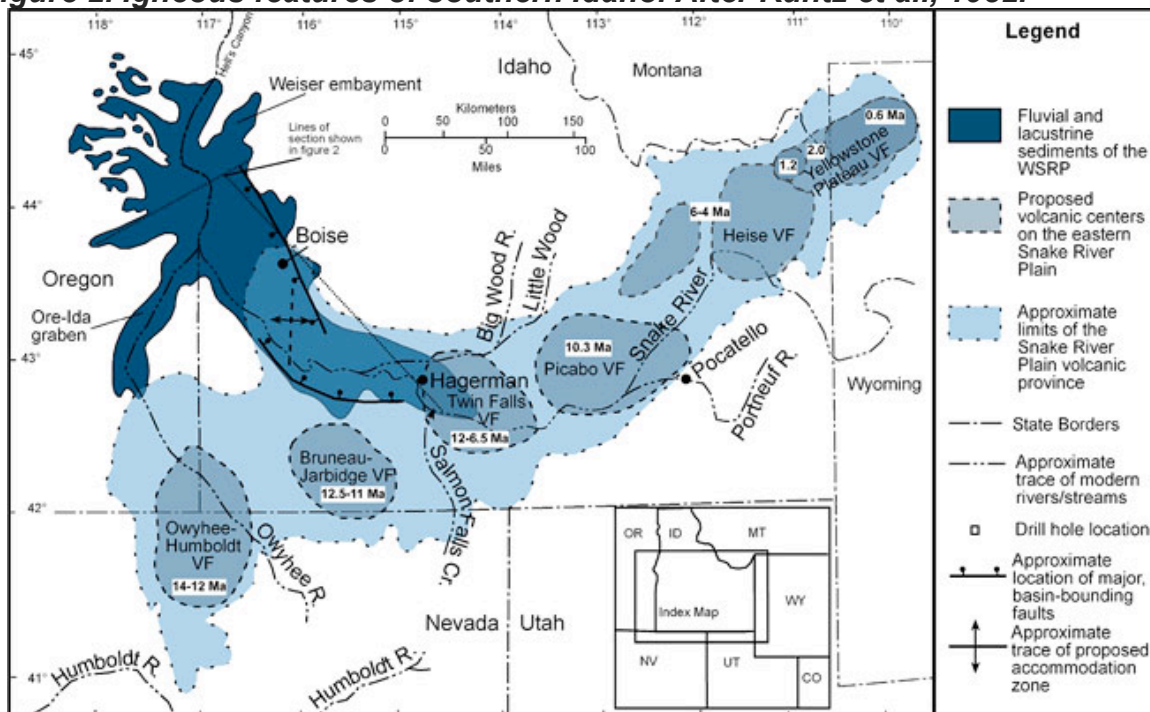


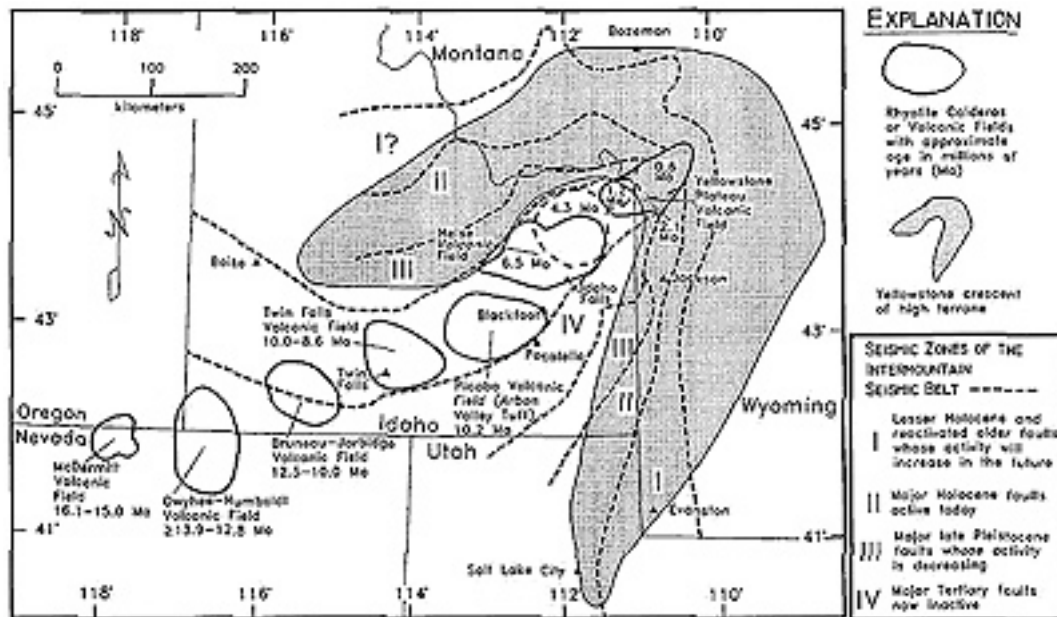
Figure 2. Igneous features of southern Idaho. After Kuntz et al., 1982.





**Figure 3. Map showing the northeastward apparent motion of hotspot migration and the ages of the various calderas. From Link and Phoenix (1996), as simplified from Pierce and Morgan (1992).**

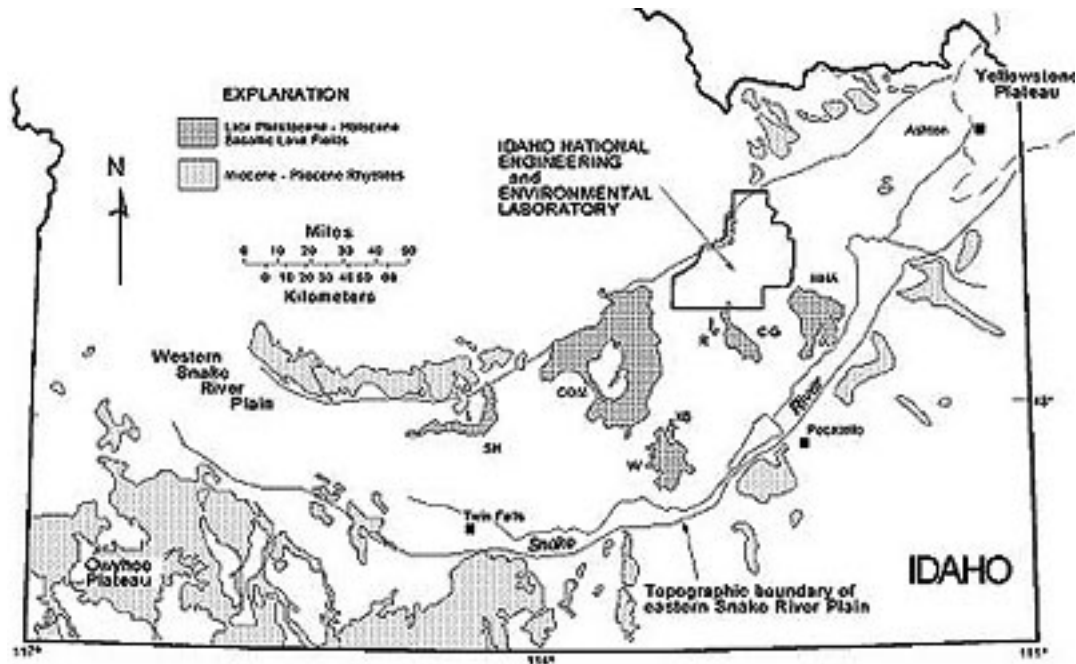
Hotspot volcanism commenced ~17 Ma in northeastern Nevada and continues to the present (Figure 3). Ignimbrites and tuff deposits marginal to the Snake River Plain record the path of the movement. Basaltic lava fields, polygenetic eruptive centers, and rhyolite domes that spatially and temporally overlie Yellowstone Hotspot volcanism comprise the upper 1-2 km of ESRP stratigraphy. Many of the basalts of the ESRP erupted along volcanic rift zones (VRZ) that are oriented parallel to the direction of regional basin and range extension.



**Figure 4: After Pierce and Morgan, 1992.**

Current silicic volcanic activity is centered in the Yellowstone area. Previous silicic volcanic centers produced a topographic bulge that coincided with the continental divide. As the North American plate migrated to the southeast and volcanic activity shifted to new regions, the extinct calderas gradually subsided to their present elevations due to thermal and gravitational effects.

Four zones of seismic activity are associated with the migration of the hotspot (Figure 4 after Pierce and Morgan, 1992). Zone II contains active Holocene faults that are thought to be connected with current volcanic activity of the Yellowstone Hotspot. Zone III contains late Pleistocene faults that are decreasing in activity. Zone IV contains faults that are no longer active. The zones form belts which curve around the hotspot track.

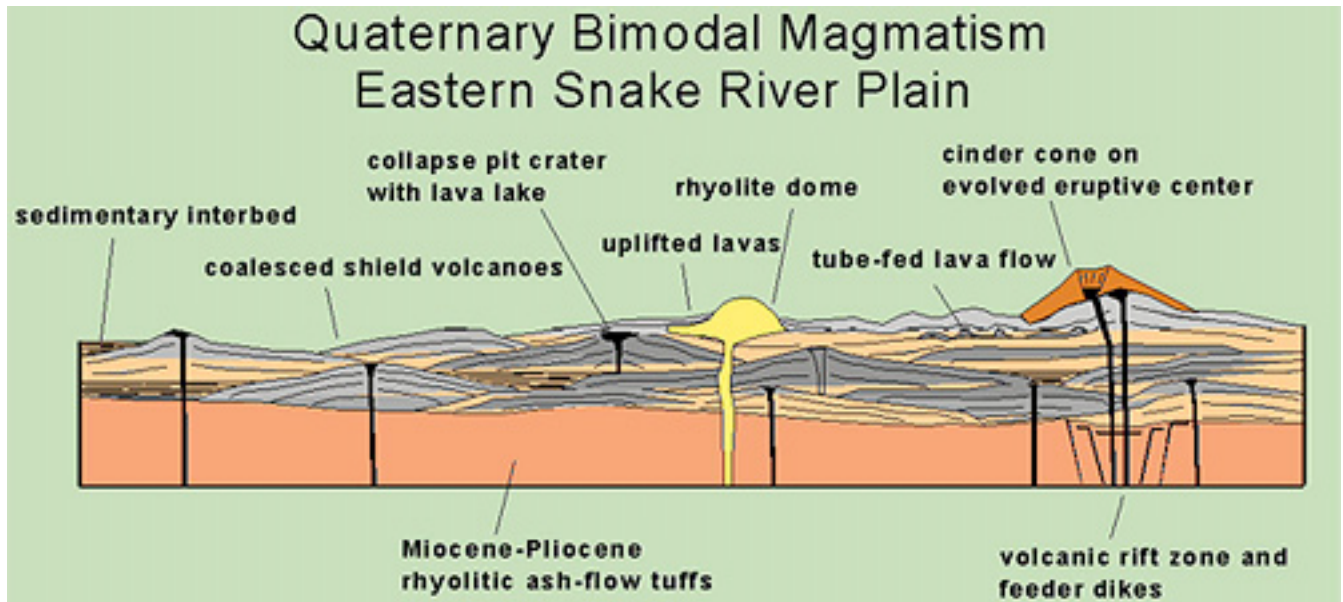


**Figure 5.** Map showing the locations of Late Pleistocene to Holocene basaltic lava flows as well as older rhyolites associated with the Snake River Plain volcanism. Lava field abbreviations: SH= Shoshone, COM= Craters of the moon, W= Wapi, KB= Kings bowl, R= North and South Robbers, CG= Cerro Grande, HHA= Hells Half Acre. Figure from Hughes et al., 1999. [Click on map for enlarged version.](#)

## Geology of the Snake River Plain

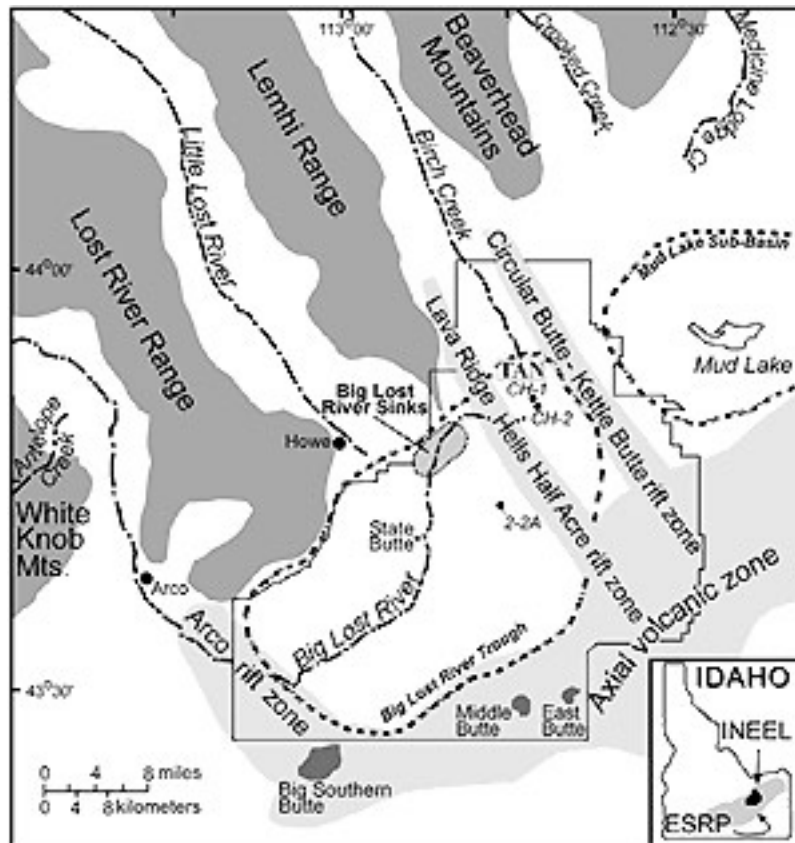
The western and eastern Snake River Plains are topographically continuous and seem similar; however, they are structurally quite different. The western Snake River Plain (WSRP) is a NW trending graben; both the land surface and the rock layers dip towards the axis of the plain (Shervais, et al., 2005; Bonnicksen and Godchaux, 2002). The rocks that occupy the WSRP are rhyolitic tuffs and ash flows of the Idavada Volcanic Group (15 to 11 Ma in age), and fluvial and lacustrine sediments with interbedded basalt flows of the Idaho Group (Pierce and Morgan, 1992; Bonnicksen and Godchaux, 2002). Lake Idaho occupied the WSRP during the Pliocene epoch, as the WSRP subsided and the hotspot continued to the northeast (see Figure 2).

The eastern Snake River Plain is underlain by silicic and mafic volcanic rocks with local interbeds of continental sediments. Quaternary basalt flows cover ~95% of the surface of the ESRP (Kuntz et al., 1992). The Idavada silicic volcanics of the ESRP are lithologically similar to those of the WSRP but are younger in age (10 Ma to 6.2 Ma). The tuffs at Yellowstone (0.6 to 2 Ma) represent the youngest pulse of silicic volcanic activity associated with the hotspot (Pierce and Morgan, 1992).



*Figure 6. Typical cross-section through volcanic rocks on the eastern Snake River Plain. Figure from Hughes et al., 1999.*

There is no evidence of faulting along the margins of the ESRP even though the Basin and Range province borders its northern and southern margins. Basin and Range faults are oriented perpendicular to the axis the eastern Snake River Plain (Rodgers et al., 1990).



*Figure 7. Axis perpendicular to the Snake River Plain from Bestland 1998.*

Basaltic lava flows erupted from northwest-trending volcanic rift zones. Regional extension across the plain allowed for the propagation of mafic dikes from the middle and lower crust. The VRZ's are oriented parallel to Basin and Range extension but they do not appear to connect to Basin and Range faults marginal to the plain (see Figure 7) (Kuntz et al., 1992; Hughes et al., 2002).

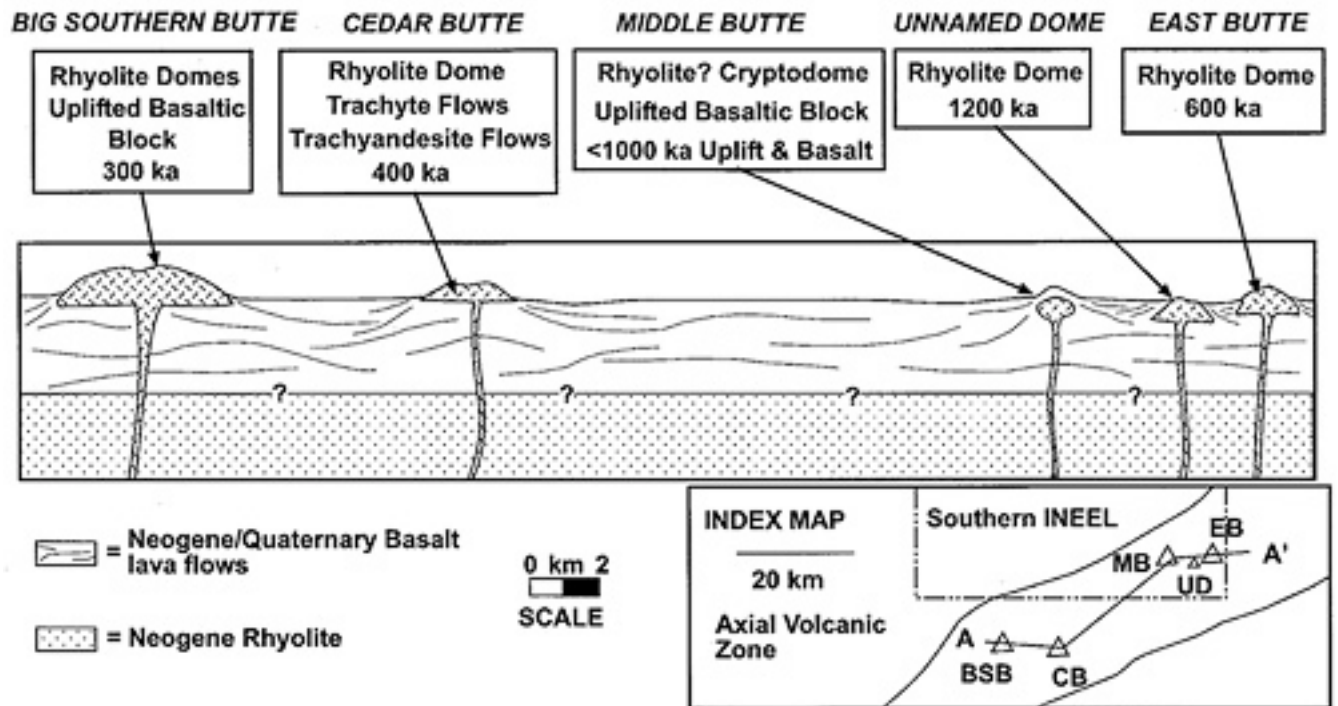


Figure 8. Relative location of the five buttes. From Hughes et al., 1999.

Five major rhyolite domes are present on the ESRP; Big Southern Butte, Cedar Butte, Middle Butte, Unnamed Butte, and East Butte (Figure 8). They are located near the extinct Picabo and Heise volcanic centers but are not directly associated with Yellowstone Hotspot volcanism.

## Evidence for the Geologic History of the Snake River Plain

The hotspot origin model of the Snake River Plain is the commonly accepted model. Pierce and Morgan (1992) suggest three main lines of evidence that support the hotspot model. The first line of evidence is the time transgressive record of silicic volcanism interpreted to be the result of the movement of the North American Plate over a stationary mantle plume. The second line of evidence is the four zones of increasing seismic activity that form the intermountain seismic belt around the current location of hotspot activity.

The third line of evidence is topographic changes resulting from the passage of North America over the hotspot. The land rose due to thermal uplift. As the hotspot migrated to the northeast, the highlands subsided due to cooling of the



underlying crust and crustal loading from the eruption of post-hotspot basalts.

The location of the Continental Divide locally corresponds to the migration of the hotspot. The topographic high produced by the hotspot produced radial drainage systems that flowed away from the volcanic center. In the Miocene epoch, when Snake River Plain volcanism began, the continental divide was located west of its current position and local streams drained toward the Atlantic Ocean; sediments were transported eastward, northward and southward away from the location of the volcanic high.

As the continental divide moved eastward across southern Idaho, rivers south of the Snake River Plain began to flow south and east. Subsidence in the wake of hotspot migration caused a drop in the base level of the Snake River Plain which initiated headward erosion toward the modern Snake River channel. This eventually led to stream capture and the shift of drainage to the Pacific Ocean.

Further Reading -- *plus links in References*  
[Digital Atlas of Idaho: Snake River Plain](#)

[Rocks, Rails, and Trails, p. 21-23 \(Link and Phoenix, 1996\)](#)

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