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The Ancient Pompeiians Still Speak: The AD 79 Vesuvius Eruption and Its Catastrophic Sequence Told by Its Victims

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Abstract

This study re-examines the circumstances of the death of the inhabitants of Pompeii during the A.D. 79 eruption of Vesuvius, considering both archaeological discoveries and stratigraphic analyses. Several evidences indicate that a substantial number of roofs and buildings withstood for many hours after the eruption began, allowing residents to shelter indoors. Subsequently, intense earthquakes triggered widespread structural collapse. We infer that many individuals likely died when they attempted to flee in terror from the seismic tremors that occurred during the eruption.

Our investigation aims to define the stratigraphic position of many victims even when it is not documented by archaeological descriptions. This allows us to trace the time of death and its coincidence with the phases of the eruption, and therefore to understand when Pompeiians attempted to save themselves. For this purpose, the necessary constraints to obtain a cast are investigated through historical documentation, recent archaeological reports, and direct observations.

Excavation works related to restoration (ongoing for over two centuries), vegetation removal, and modern activities complicate the volcanological record. Despite this, the surviving structures and volcanic products, with the location of victims allow a more nuanced understanding of how and when many Pompeiians died. These findings highlight the crucial role of syn-eruptive seismicity in the deadly dynamics of the disaster, as well as the chances of survival that might exist with today's knowledge.

Keywords: Vesuvius; Pompeii; Eruption of A.D. 79; Explosive; Casts

1. Introduction

The eruption of Vesuvius in A.D. 79 has been studied by numerous authors (Lirer et al., 1973; Sigurdsson et al., 1985; Carey and Sigurdsson, 1987; Cioni et al., 1992; Gurioli et al., 2007; Scandone et al., 2019; Scarpati et al., 2020). It was an explosive event that struck a densely populated area and caused severe losses of property and human life. There are few cases in the world of eruptions that have buried entire cities and for which we have, from such a distant time, such extensive testimony, including the written account of an eyewitness, Pliny the Younger.

The main phases of the eruption were summarized by different authors (Lirer et al., 1973; Sigurdsson et al., 1982; Sigurdsson et al., 1985; Carey and Sigurdsson, 1987; Cioni et al., 1992). Here we follow the nomenclature of Cioni et al. (1992) (Fig. 1):

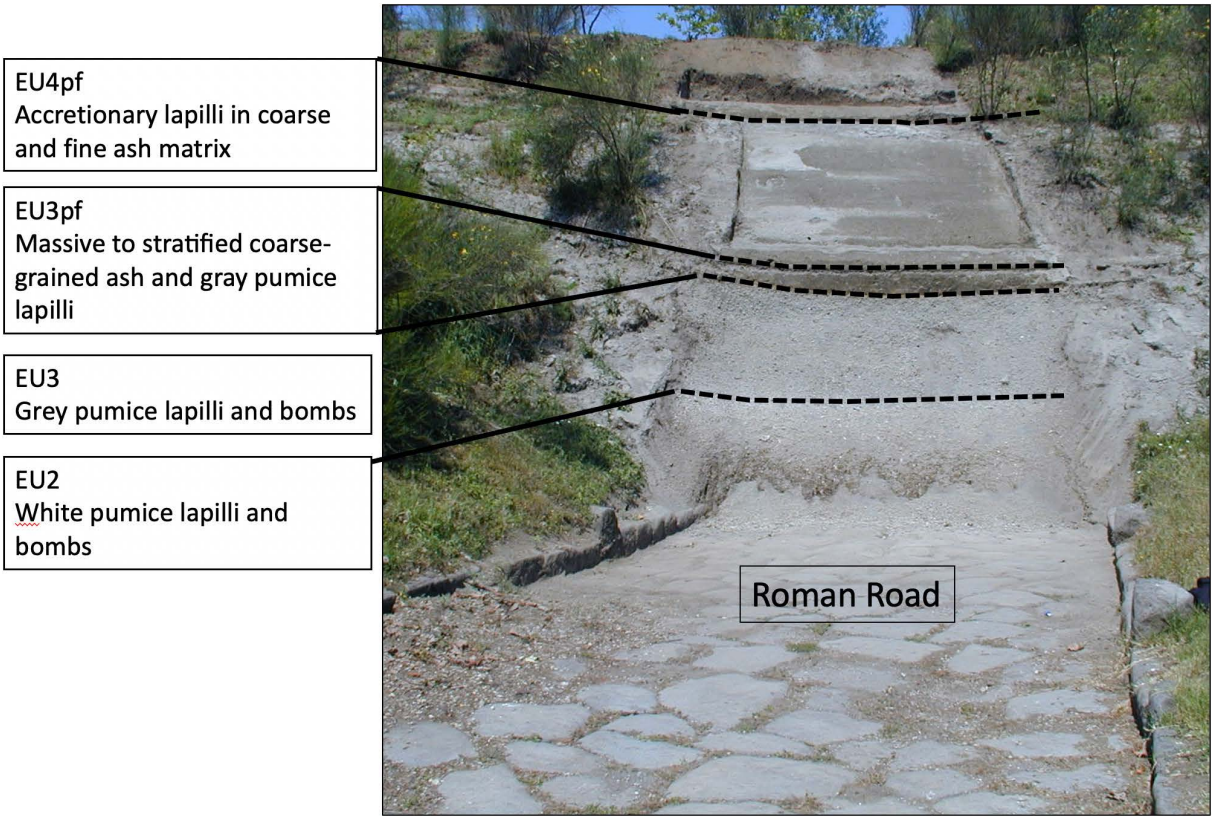

Figure 1. A.D. 79 deposits at Pompeii, Nola Gate, according to the nomenclature of Cioni et al. (1992).

- Plinian eruption column.
  The eruption column (the volcanological term that pays homage to Pliny the Younger) exceeded 30 km in height, dispersing toward the southeast. Pumice fell on Pompeii for at least 12-20 hours, forming a layer about 3 m thick (units EU2-EU3 of Cioni et al., 1992), while Herculaneum, located in a different position relative to the volcano, was spared.
- Intra-Plinian eruption column collapses.
  These collapses gave rise to numerous pyroclastic density currents (PDCs) that initially affected only Herculaneum and subsequently also reached Pompeii (Sigurdsson et al., 1985) (unit EU3pfi of Cioni et al., 1992).
- Caldera-forming phase.
  This phase involved total column collapse and widespread diffusion of PDCs (Sigurdsson et al., 1985; Cioni et al., 1992; Doronzo et al., 2022) (units EU3pf, EU4pf, and subsequent units EU7-EU8 of Cioni et al., 1992).

We will never know exactly how many people managed to save themselves in Pompeii before or during the eruption. In observed eruptions, the number of victims during pumice fall has always been lower – about 4% (Tanguy et al., 1998) – than the number believed to have perished in Pompeii during the initial phase of the eruption (EU2-EU3 of Cioni et al., 1992), which has been estimated at more than 37% (De Carolis et al., 1998; De Carolis and Patricelli, 2003, 2013; Luongo et al., 2003). However, some details concerning the victims found inside or near the city during excavations allow us to hypothesize how many people were still alive many hours after the eruption began and were able to move in such a difficult environment.

The aim of this paper is to understand the timing of death of the Pompeiians based on their stratigraphic position, without investigating (or only briefly hinting at) the causes of death – such as asphyxia due to fine ash dispersed in

the air, high temperature, or traumatic impacts – which have already been discussed extensively by many authors (Kent et al., 1981; Baxter, 1990; Baxter et al., 1998; Giacomelli et al., 2003; Luongo et al., 2003; Cioni et al., 2004; Zanella et al., 2007; Mastrolorenzo et al., 2010; Caricchi et al., 2014; Giordano et al., 2018; Petrone et al., 2020; Pensa et al., 2023).

The discovery of most victims occurred before modern stratigraphic survey methods were adopted. As a consequence, our investigation is mostly based on a re-analysis of evidence collected during early excavations, using field notes by the first excavation directors from the second half of the eighteenth century onward (e.g., Alcubierre, La Vega, Weber) (Fiorelli, 1860; Dyer, 1868; Notizie degli scavi di Antichità; Gell and Gandy, 1821, 1852; Pagano, 1997). For more recent excavations, we have used photographic records collected in the pompeiiinpictures.com database, as well as excavation notes by archaeologists (Auricchio, 2001; Amoretti et al., 2021; Amoretti et al., 2023b). Some observations have also been drawn from historical photographs available on open.pompeiisites.org. Whenever possible, we conducted direct field investigations on site.

2. Syn-eruptive earthquakes

Many observed explosive eruptions, as well as deposits from others that occurred in the past, indicate a frequent pattern like that of Pompeii: an initial phase with a sustained eruptive column, followed by intraplinian pyroclastic flows (Walker, 1981). This sequence of events is attributed to a rapid increase in the emission rate of volcanic material, which prevents the formation of a sustained eruptive column. As a result, the column collapses and flows down the slopes of the volcano. This transition is often accompanied by the collapse of deeper rock layers, sometimes involving aquifers destabilized by the evacuation of large volumes of magma in a short time (Scandone and Malone, 1985; Scandone and Giacomelli, 2001).

The strongest seismic shocks occur during phases of high magma drainage, before and during chamber collapse (Scandone and Malone, 1985; Scandone et al., 2007), and mark the transition from one eruption style to another. During the A.D. 79 eruption, the shocks were particularly violent. In Misenum (about 30 km from Vesuvius), Pliny felt and described strong shocks, suggesting that they may have been even more intense and destructive closer to the volcano, especially in Pompeii. He wrote that the ground in Misenum began to shake – causing panic – already during the night between the first and second day of the eruption, when the pumice fall had not yet definitively ceased:

"There had been noticed for many days before a trembling of the earth, which did not alarm us much, as this is quite an ordinary occurrence in Campania; but it was so particularly violent that night that it not only shook but actually overturned, as it would seem, everything about us (…) The buildings all around us tottered, and though we stood upon open ground, yet as the place was narrow and confined, there was no remaining without imminent danger: we therefore resolved to quit the town" (Pliny the Younger, second letter to Tacitus).

On the same night, at Stabiae (about 16 km from Vesuvius as the crow flies), the pumice continued to fall, and people tied pillows to their heads for protection while trying to save themselves by reaching the beach (Pliny the Younger letter).

Volcanological considerations, geophysical observations, and epigraphic documents from several locations in Campania (Nola, Sorrento, Naples, Salerno) reporting damage and repairs following the A.D. 79 eruption (Fig. 2), together with Pliny the Younger's testimony and cracks observed in buildings, form a body of evidence indicating that strong earthquakes occurred during the eruption and that they had a significant role in people's behavior.

A map of isoseismal lines – representing not a single shock, but the cumulative effects of syn-eruptive seismicity – has been produced (Fig. 3) (Scandone et al., 2019). According to this reconstruction, Pompeii falls within the isoseismal area of intensity X, sufficient to severely damage structures already weakened by the accumulation of pumice.

Although this topic has never been directly addressed, some previous works refer to damage attributable to earthquakes that occurred during the eruption. For example, plaster debris found on the ground at the Villa of the Papyri in Herculaneum (Cioni et al., 2000). A wall collapsed above a victim lying on a thin ash – flow layer covering the pumice fall – thus coinciding with the transition from a sustained eruptive column to the pyroclastic flow phase – appears in archaeological excavation photographs from Pompeii's Suburban Baths (Capurso, 2021; Capurso and Masseroli, 2021).

Recently, new archaeological excavations have also supported this hypothesis (Sparice et al., 2024).

Figure 2. Epigraph of the reconstruction of a clock destroyed by the AD 79 earthquakes, ordered by Emperor Titus (Museo Correale di Terranova, Sorrento). Note that all the epigraphs pertaining the AD 79 eruption reference is made to the "earthquakes" (plural) whereas those of AD 62 are referred as "earthquake" (singular).

EMP(ERATOR) TITUS CAESAR,[DIVI]/SON OF VESPIAN, VESPASIANUS/(…) HOROLOGI[UM WITH ITS] ORNAMENTS EARTHQUAKES [COLLAPSE RESTORED]

Below, the bilingual Greek Latin inscription in the entrance hall of the Casa dell'Annunziata in Naples refers to the reconstruction of the baths and gymnasium by Titus Vespasian following the AD 79 earthquakes.

[IMPERATOR] TITUS CAESAR,/[SON OF THE DEIFIED VESPASIAN, (…) RESTORED [THE BUILDINGS] THAT HAD COLLAPSED UNDER THE EARTHQUAKES

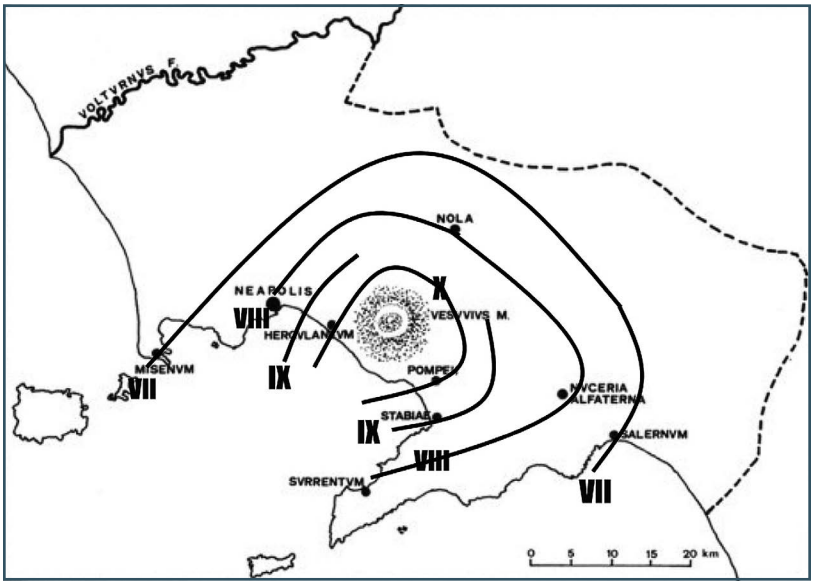

Figure 3. Seismic intensity map (from Scandone et al., 2019).

3. Structural behaviour of buildings during the eruption

We identify the buildings using the system introduced by Fiorelli (1860) for organizing Pompeii's topography by insulae, regiones, and street numbers, which is still in use today. The buildings mentioned in the text are shown on the map (Fig. 4).

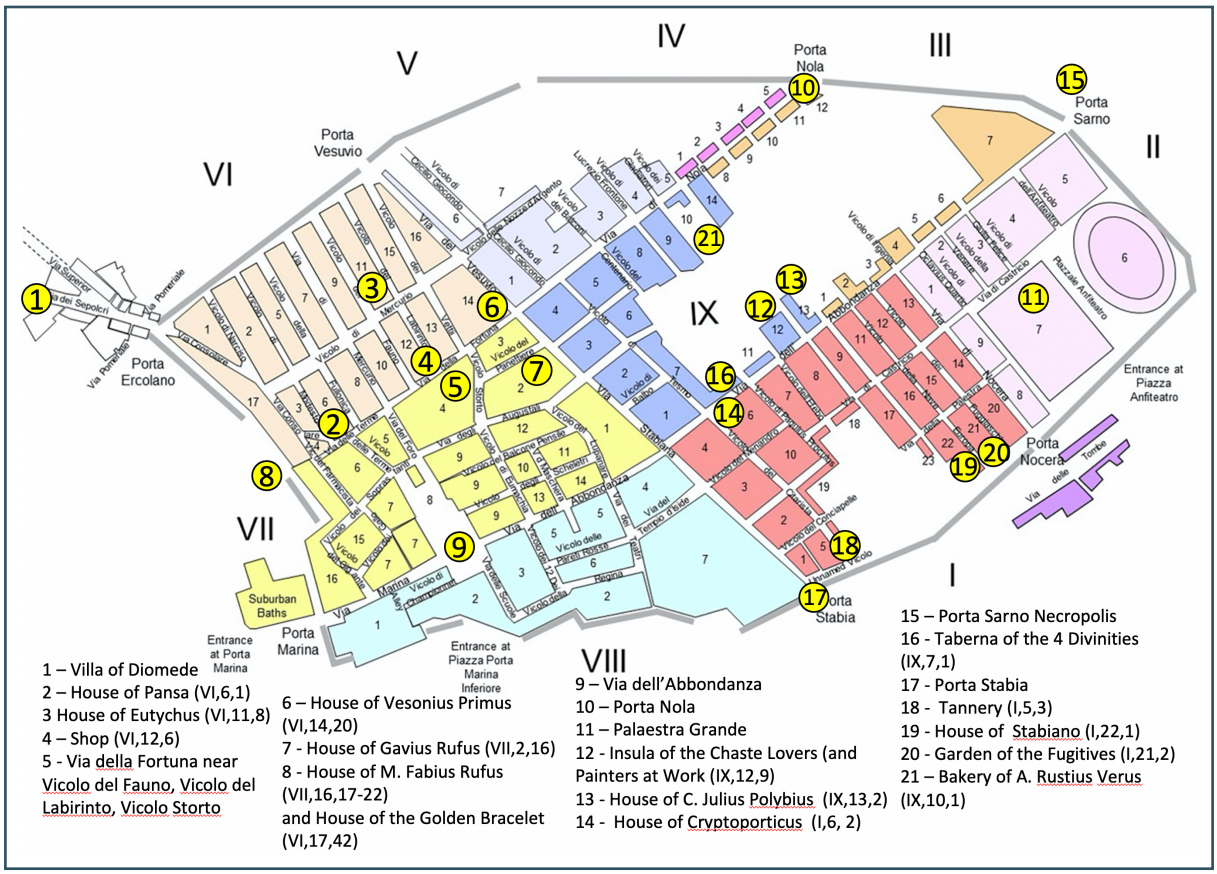

Figure 4. Map of the Regio, Insulae and names of the streets of Pompeii with the houses mentioned in the text.

From the notes of early excavators, it can be deduced that many structures resisted for a long time during the pumice fall. A report from 1853 noted in the peristyle of the Casa di Sirico (VII,1,25-46/7) "several roofs, the most intact discovered so far in Pompeii. These roofs no longer exist" (Breton, 1870). The same information was reported by the English press, accompanied by drawings: "for the first time, we have a complete roof of a house formed of square tiles, about twelve inches by twelve, with coping tiles running between them" (The Illustrated London News, 30 April 1853).

In the early 1900s, along Via dell'Abbondanza (buildings IX,11,3-4 and IX,7,1-2), "a roof was found with its tiles still in place at the time of excavation," and nearby "a canopy was found lying intact in its original location" (Spinazzola, 1953). These structures faced the street, and the one above the Taberna of the Four Divinities (IX,7,1), although "shattered in each of its tiles and imbrices, was nonetheless found in situ, because during the catastrophe it was able to rest on the lapilli that had accumulated in the street, rising to just beneath it" (Notizie degli scavi di Antichità, 1912).

A façade (IX,12,7) along Via dell'Abbondanza preserved "the corner of a balcony projecting over the street, with the west wall intact up to 2 m high and a cocciopesto floor extending 1.30 m" (Notizie degli scavi di Antichità, 1912).

The resistant buildings constituted a real trap for the Pompeiians. The latrine adjacent to the Large Palaestra, where 18 people had taken refuge, was found intact: "its (roof) slope facing the pomerium had withstood the pumice fall, but the accumulation of lapilli had blocked every possible exit through doors and windows (...). With the fall of ash, carried everywhere by gusts of wind and slowly raising the floor level inside the latrine, death by asphyxiation

eventually overtook them as well" (Notizie degli scavi di Antichità, 1939). The building remained standing almost to its full height, nearly reaching the post-eruption agricultural surface. It lay so close to the surface that four late-period burials were found above the roof tiles (Stefani, 2010).

In more recent excavations, the roof of the portico of the House of the Painters at Work (IX,12,9), was found intact. Archaeological documentation (Varone, 2007) reports that "the tile grid rested, at the time of the excavation, solely on lapilli that had entirely filled the garden and portico arms during the eruption, up to roof level." Moreover, "the portico columns (…) were all extracted from the lapilli, showing varying degrees of damage at their tops (visible at open.pompeiisites.org; House of the Chaste Lovers record), and the capitals were generally shattered." One might infer that the roof remained intact due to its steep slope, which allowed pumice to slide off; however, the extensive damage to the capitals suggests earthquake-induced failure after the pumice fall had already partially buried the building.

The portico roof of Villa San Marco at Stabiae was found "between pyroclastic flow and lapilli" (Catoni and Rescigno, 2023). The figure accompanying the paper shows fractured but still aligned tiles resting on, or partially embedded in, the underlying pumice, with some tiles encased in overlying ash. The authors report that the roof withstood "the initial fall of white lapilli, which opened the first breaches in the tile covering. In the advanced phase of the lapilli fall (grey lapilli), larger sections of roof collapsed. (…) It may have been during this phase that a group of people arrived in the area," whose remains were discovered during the 2006 excavation expansion. Furthermore, "seismic tremors accompanied the accumulation of eruptive deposits, causing the detachment of plaster and stucco" (Catoni and Rescigno, 2023).

Even in this case, the roof was not seriously damaged during the white pumice phase; its collapse occurred only in coincidence with the subsequent fall of grey pumice. In areas closer to the volcano, grey pumice is interbedded with ash layers from pyroclastic density currents (EU3pfi), indicating a partially collapsing eruption column phase. At Stabiae, which lies farther from the volcano, the succession of volcanic products is less detailed than in the more proximal areas; nevertheless, the complete collapse of the roof, which occurred after the white pumice fall, can be attributed to earthquakes accompanying and following the pyroclastic flows interbedded with grey pumice. At that time, Pliny the Elder was forced to flee from the villa at Stabiae, as reported by his nephew Pliny the Younger:

"They consulted together whether it would be most prudent to trust to the houses, which now rocked from side to side with frequent and violent concussions as though shaken from their very foundations; or fly to the open fields, where the calcined stones and cinders, though light indeed, yet fell in large showers, and threatened destruction. In this choice of danger, they resolved for the fields." (Pliny the Younger, first letter to Tacitus).

In several cases, even the collapse of internal walls of buildings can be attributed to earthquakes occurred during or towards the end of the gray pumice phase (EU3). Excavation reports from the Insula of the Chaste Lovers, in the sector known as the House of the Painters at Work (IX,12,9), revealed a wall with clear syn-eruptive seismic damage (Amoretti et al., 2023). Archaeologists noted that the volcanic material inside the rooms consisted of a thin layer of grey pumice – the final product of the Plinian phase – and an ash-flow layer that entered through doors and windows after the wall had collapsed. Crumbled plaster fragments mixed with the volcanic material indicate that the walls shook during the eruption, as does the geometry of the fracture that caused the partial overturning of the wall. There is no evidence of roof collapse, likely because it withstood the Plinian pumice load (Sparice et al., 2024).

A similar situation occurs in a nearby context (Bakery of Aulus Rustius Verus; IX,10,1), where two victims were discovered lying on a few centimetres of ash and directly covered by a series of wall blocks (Zuchtriegel et al., 2024).

In the same House of the Painters at Work (IX,12,9), a toppled wall was found some years ago and it was recently removed during excavation expansion. It was a large wall with a grated window that collapsed onto thin ash-flow layers (EU3pf of Cioni et al., 1992), interbedded with grey pumice (Fig. 5).

Figure 5. Insula of the Chaste Lovers. Upper-floor wall, with a window and iron grille, collapsed above EU3pf. The arrow indicates the main flow direction.

It appears at the same stratigraphic level – and therefore to have fallen at the same time – as the bodies of many victims (Scandone et al., 2019) (Fig. 6).

Figure 6. The casts of the victims in the House Stabiana (I,22,1) in the same stratigraphic position as the toppled wall of Fig. 5.

A similar example of seismically induced failure occurs in the nearby upper storey of the House of the Second Colonnaded Cenacle (IX,12,4), within the Insula of the Chaste Lovers (Fig. 7), where a wall collapsed onto the floor before volcanic products had entered the building interior. Prior to archaeological excavation, the area appeared

to be almost filled with volcanic material (Bravaccio, 2024), but between the two rooms the breach left at the top by the collapsed wall remains visible, confirming that the overturning occurred earlier. The opposite wall – more exposed to pyroclastic flow impact – remained intact (Fig. 8).

Figure 7. Wall collapsed onto the floor (below) in the House of the Second Colonnaded Cenacle. The red plaster and light-colored baseboard, like those still upright, correspond to the interior face of the wall.

The available documentation leads to an important conclusion: various roofs and walls withstood the fallout phase and the load of pumice, allowing people to remain indoors. The buildings' initial resistance misled many people. As noted by Pliny the Younger, at Stabiae the escape was forced when the earthquakes intensified, as occurred in Misenum and in Pompeii.

It is reasonable to assume that the inhabitants of Pompeii, entirely unaware of what was unfolding, sought shelter inside buildings at the onset of the eruption, when the event may have seemed – or was hoped to be – relatively harmless and short-lived. Many porticoes and basements, especially those with vaulted structures, withstood the eruption for several hours, if not until its very end. It is likely that many roof and wall collapses, which occurred toward the end or shortly after the pumice fall, can be attributed to the earthquake swarm.

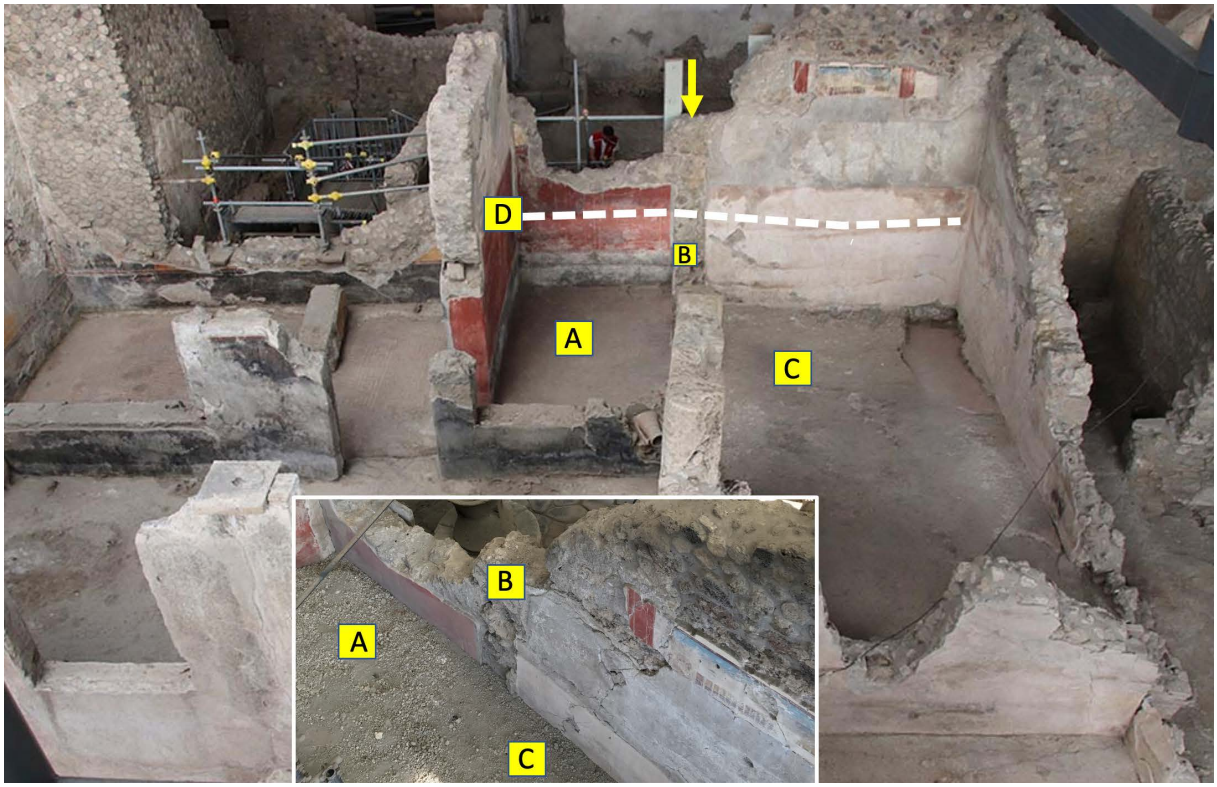

Figure 8. House of the Second Colonnaded Cenacle. Wall (B) fell from room A into room C. In the inset, the same rooms before the removal of the volcanic products (level indicated by the dashed white line). It is evident that wall B had already collapsed.

3.1 Damages from earthquakes and collapse timing

In previously excavated buildings, it is difficult to distinguish syn-eruptive earthquake damage from that produced by earlier events, such as the A.D. 62 earthquake, or by later impacts related to reconstruction activities, the bombing that occurred in 1943, or more recent seismic events, such as the 1980 Irpinia earthquake. However, some damage can be attributed to the seismic shaking of A.D. 79 through dated illustrations or photographs, which allow other causes to be ruled out.

For instance, the two Corinthian pillars of the portal of the House of Pansa (VI,6,1), made of stacked tuff blocks without mortar, display cracks – especially the left one – that are consistent with seismic effects (Fig. 9). The most damaged portion is currently supported by a brick wall added after excavation began in 1810. This support is absent in early nineteenth-century drawings (e.g., Gell and Gandy, 1821) (Fig. 10). Various post-A.D. 62 repairs was recognized inside the building, but not at the portal (Maiuri, 2002). This suggests that the damage was neither caused by the A.D. 62 earthquake and repaired before the A.D. 79 eruption, nor produced by the 1943 bombing, instead pointing to syn-eruptive earthquakes in A.D. 79.

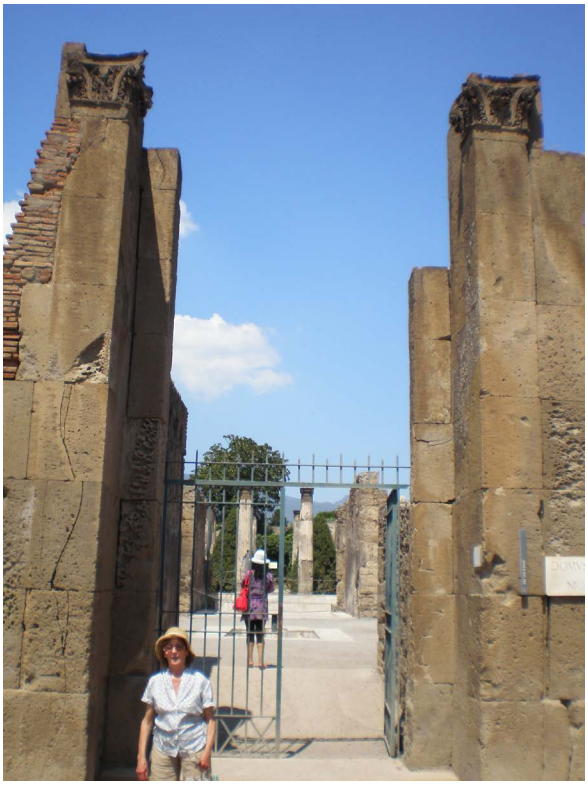

Figure 9. Cracks in the entrance portal of the House of Pansa (VI,6,1). On the left, below the capital, a brick support, built after the time of the excavation, is visible. The missing blocks may be those that fell into the street, shown by W. Gell in his 1921 Pompeiana guide.

Figure 10. Drawing by William Gell in his 1921 Pompeiana guide, showing the absence of the now-reconstructed brick section. There are large blocks on the road.

Similar nearby damage may have the same origin (e.g., VI,12,1; VI,6,4). Pre-1943 photographs of a shop entrance along Via della Fortuna (VI,12,6) already show cracks in tuff blocks, thus excluding bomb damage. In other cases – such as the corner wall between Vicolo della Maschera and Vicolo degli Scheletri – despite visible shifts of large blocks, masonry repairs predating the eruption are also evident (Dessales, 2022) (Figs. 11 and 12).

Figure 11. Tuff blocks with visible fractures in the wall of the shop (VI,12,1), connected to the House of the Faun.

Figure 12. The pillars of the shop at the corner of Via della Fortuna and Vicolo del Labirinto (VI,12,6) show repairs with brick supports, likely due to damage from the AD 62 earthquake, as well as fractures that may have occurred later. However, as shown in historical photographs, these are not attributable to the 1943 bombings.

Even the tombstone of A. Umbricius Scaurus found broken on the ground in the necropolis of Porta Ercolano – may have fallen because of earthquake shocks rather than from the impact of the eruption itself, if the description of its discovery in 1812 is reliable (Kockel, 1983).

The recurrence of cracks still visible in many houses, possibly attributable to syn-eruptive earthquakes of A.D. 79, warrants further study of the distribution and condition of such structures at the time of excavation. Local morphology and the lithological characteristics of foundation soils beneath Pompeii's buildings influenced their seismic response, both in A.D. 79 and during earlier events. The most stable areas are those founded on solid lava bedrock, whereas sloping zones or areas with loose soils amplified seismic shaking (Dessales, 2022; Amato et al., 2022). Regiones VI and VII display extensive post-A.D. 62 renovation activity. Although evidence of earlier reconstruction has been thoroughly studied (Maiuri, 1942; Dessales, 2022), initial observations suggest that A.D. 79 seismic damage may also be more frequent in the same areas (e.g., Regio VI, along Via della Fortuna near its intersections with Vicolo del Fauno, Vicolo del Labirinto, and Vicolo Storto).

In 2024, at the Porta Sarno necropolis (located beyond the Circumvesuviana railway and excavated in 1998), a funerary monument depicting two life-size spouses was uncovered (Alapont et al., 2025). Parts of the monument and its stucco decorations were found collapsed within the pumice. Moreover, a fracture cuts across the monument's flanking walls and the chin of the female figure, coinciding stratigraphically with the base of the pyroclastic ash-flow sequence (EU3pf). Archaeologists report that the monument was standing during the eruption, although they suggest that the damage resulted from pre-eruption earthquakes (Alapont et al., 2025). However, we consider the statue fracture and wall collapse to be indicators of earthquakes that occurred during the transition from a sustained eruptive column to pyroclastic flows in the A.D. 79 eruption.

Each new excavation contributes valuable data to volcanology, while simultaneously highlighting the loss of information caused by missed opportunities in the past (Giacomelli et al., 2021).

In complex urban settings, pyroclastic flows may vary rapidly in temperature, density, and dynamic pressure (Gurioli et al., 2004; Gurioli et al., 2005). The two overturned walls in the Insula of the Chaste Lovers occur in different stratigraphic contexts: one fell onto the first ash layers above the grey pumice, while the other collapsed directly onto the floor and was later buried by pumice and ash. Both collapses may coincide with earthquake shocks that occurred prior to the largest pyroclastic flows (EU4pf). The wall collapsed onto the floor in an empty room was protected by adjacent rooms and was only later reached by the eruption products. No cause other than an earthquake can be identified for this collapse. The other wall overturned for the same reason, but in a less protected room already filled with grey pumice and the ash of the first pyroclastic flow that reached Pompeii.

The heterogeneous impact of volcanic products on Pompeii is evident in the nearby House of Julius Polybius (IX,13,1-3), separated only by a narrow alley from the Insula of the Chaste Lovers, where at least three overturned walls were identified. In contrast, the peristyle wall of the House of Julius Polybius remained intact and preserved evidence of multiple pyroclastic flows overlying the pumice deposit, possibly owing to its orientation or shielding by adjacent structures (Cerulli Irelli, 1981; Jashemski, 2014). Strong variability in both temperature and impact of volcanic products is also evident among the victims themselves (Zanella et al., 2007; Giacomelli, 2022).

Wall collapses not caused by pumice overload occurred when strong earthquakes began, coincident with an increase in magma discharge (Scandone et al., 2019). Additional major damage followed with the larger pyroclastic flows associated with total column collapse and the onset of magma chamber collapse.

4. The Casts

The victims of the eruption were found both inside houses and outdoors (De Carolis et al., 1998; De Carolis and Patricelli, 2003, 2013). In some cases, casts were made of them (De Carolis and Patricelli, 2018; Lazer et al., 2020; Osanna et al., 2021). The method of creating casts by filling with plaster the voids left by decomposed bodies in volcanic deposits was pioneered by the archaeologist Giuseppe Fiorelli in the 19th century (Osanna, 2016).

Ancient excavation notes inform us that some human impressions were preserved in the ash and that the bodies were located above the ancient walking surface, at a height consistent with the thickness of the pumice layer. An old and well-known example – prior to the use of plaster – supports the hypothesis that, to preserve a body's impression, the enclosing ash must be fine and homogeneous, likely deposited by an expanded and granulometric sorted pyroclastic current. Some of the 18 victims found on 12 December 1772 in the Villa of Diomedes left body-shaped impressions ("marks in the soil") in what was described as a "rain of ash mixed with water" (Fiorelli, 1860) resembling

a kind of fine ash slurry that later solidified. This villa lies outside the Herculaneum Gate, where the flows, or their expanded component, arrived before reaching the city walls and entering Pompeii.

The excavation director La Vega wrote: "The flooding of smooth eruptive material – ash fallen after the lapilli – had over time become a very tenacious substance, which had completely enveloped all the bodies… I decided to cut and preserve 16 pieces of these body impressions, among which one showed a woman's breast covered by a garment" (Fiorelli, 1860). The impression of the female torso caused a stir at the Portici Museum, where it slowly crumbled away. The ambassador William Hamilton, a frequent visitor to the excavations and probably present at the time, reported that the torso lay a few feet above the ground, in very fine ash: "in so fine a powder… deposited in a fluent state" (Gell and Gandy, 1821).

It appears also established that, in addition to being enveloped in fine ash, for a perfect negative to form the body must have decomposed slowly enough to allow the surrounding ash to harden around the flesh and clothing. This condition was achieved when the bodies lay above the pumice layer or, at least, were not in direct contact with the ground.

Casts of Pompeian victims found indoors are rare because of the lack of porous material at the base, with a few exceptions – such as the group of three people crouched on a staircase (one still in situ but inaccessible), discovered in November 1961 in the House of Marcus Fabius Rufus (VII,16,17-22), or the four victims found in 1974 under the stairs of the House of the Golden Bracelet (VI,17,42). Unfortunately, documentation suitable for detailed volcanological analysis is limited to a few photographs taken in 1974, before the casts were removed (Mastroroberto, 2003).

4.1 Stratigraphic Observations

There are few cases in which the exact location of the victims' casts at the time of execution is documented, but in three instances it is certain that they lay above a few centimetres of pyroclastic-flow deposits overlying the grey pumice. Thirteen casts from the Garden of the Fugitives (I,21,2) and four from the courtyard of the House of the Cryptoporticus (I,6,2) were photographed before removal. Nine casts from House Stabiana (I,22,1), a property parallel to the Garden of the Fugitives, remain in situ but have long been inaccessible. The stratigraphic position of these casts matches that of the wall believed to have been toppled by earthquake shocks in the Insula of the Chaste Lovers.

Further cases that allow us to recognize the position of the body can be found in descriptions of excavations up to the early 1900s. The first four casts made by Fiorelli on 3 February 1863 were reported as being in an open area (Vicolo degli Scheletri), above the pumice layer (with two cases indicating 2.5 m and the others 5 m above ground level), "overwhelmed by the first pyroclastic cloud" (Fiorelli, 1877; Capurso, Masseroli et al., 2021).

The dog chained at the entrance of the House of Vesonius Primus (VI,14,20) is assumed to have managed to climb up to the pumice layer (García y García, 2006). The cast, obtained in 1873, is one of the most impressive, even though it is the result of assembling several pieces (Lazer, 2009).

Two casts, one male and one female, made on 23 April 1875 near Via Stabiana, were located 4 m above ground level – clearly above the pumice layer (García y García, 2006; Osanna et al., 2021). Likewise, the female cast made on 24 January 1882 near the House of Accetto and Euhodia (VIII,5,39) was about 4 m above the ground (Notizie degli Scavi di Antichità, 1882), as was the one made on 28 December of the same year in the garden of House VIII,6,6 (García y García, 2006; Capurso and Masseroli, 2021).

Two casts were made under the portico of the Palaestra Grande in 1939, a covered but not enclosed space. According to Amedeo Maiuri, who excavated the area, one of them had died "on the portico floor at the first fall of ash," crouched against the wall. Of both individuals, "casts could be made because they lay in the upper ash layer" (Notizie degli Scavi di Antichità, 1939; De Carolis, 2003). In the portico, the abundance of ash – and perhaps some pumice – able to envelop the bodies and isolate them from the ground may have created the necessary conditions for casting. Of the 18 victims found in the nearby latrine of the same Palaestra, only images of the skeletons exist; no casts were made.

Some descriptions require an interpretive effort. The stratigraphic context for the victim from whom the cast was taken on 25 September 1873 is not specified, but the body was found in the garden of the Tannery (I,5,3), an open area where pumice almost certainly fell (Pappalardo, 2001). This cast is among the most complete and detailed made in Pompeii, despite the damage it suffered during the bombing raids of 1943 while housed in the site's Antiquarium (Fig. 13).

Figure 13. Cast of the victim found in the Tannery garden (I,5,3) in 1873.

At the Villa of the Mysteries, in 1909-1910, a victim's "partial imprint of the lower limbs and torso was obtained, because, lying face down in the ash layer 0.60 m above the floor, the collapse of materials from the upper floors had disturbed the stratigraphy" (Maiuri, 1967). In this case, the position of the victim is not clear (perhaps upside down, with the head in the pumice and the body in the ash), but the mention of collapsing materials – although vague – does not exclude earthquake damage.

In excavations carried out between 1907 and 1908 outside the Nola Gate, one victim was reported to lie 3 m above the ground. Two other victims were attempted for casting, but "only the side, shoulder, and arm" of one were successfully cast (Bosso, 2003). Always outside the Nola Gate, fifteen bodies found later in 1976-1978 (De Caro, 1979) were "above two meters of lapilli" (Alapont et al., 2023). From the 1976 excavations, 12 casts survive – not all complete – of bodies "emerging from the hardened ash layer (referred to as tuono)," (Bosso, 2003) a common name given to compacted ash by excavators. For some bodies, it is noted that they were "in the ash layer, 3 meters above the ground." Other indications are less accurate, with generic mentions of "two individuals buried by the pumice fall" and even "in the ash layer" or "buried by lapilli." The inappropriate volcanological term "swept away by lava flow," repeated multiple times (Bosso, 2003), represents a detail that also renders the other indications not completely reliable. It is known that there was no lava emission during the eruption of A.D. 79.

For some victims, it is specified that they were not above, but entirely or partially within the pumice layer (lapilli). Fiorelli already noted that next to the four victims in the Vicolo degli Scheletri there was "a man who had fallen into the lapilli, preserving no imprint of his back or right arm" (Fiorelli, 1877).

Of the seven victims found on 12 March 1868 in the House of Gavius Rufus (VII,2,16), only one incomplete cast was made (García y García, 2006). The body was described as lying "between the lapilli layer and the ash level deposited by the surge, which only partially covered the victim" (Capurso and Masseroli, 2021). Another reference states that "the cast was only partially successful because the cavity had been infiltrated by lapilli, leaving the skull and left leg exposed" (Dwyer, 2010).

In the Caupona of Astylus (III,8,8), on 1 April 1903, two victims were recovered but not cast, even though they were one meter above the floor, because they were immersed in lapilli (Notizie degli Scavi di Antichità, 1905; Luongo et al., 2003).

An expressive image shows the cast made in 1927 in the House of Priest Amandus. It consists only of the head and right shoulder, the victim apparently being half-immersed in pumice – although archaeological reports do not specify this (Notizie degli Scavi di Antichità, 1927; Osanna et al., 2021).

Among the numerous victims found in December 1936 outside the Palaestra Grande (14 outside the first eastern gate, 17 on the west side of the pool, and 4 along the western portico), "14 skeletons (…) were on the first layer of ash (…); only one – a young man – could be partially cast, as his lower limbs were still embedded in the lapilli" (Notizie degli Scavi di Antichità, 1939).

Next to the nine casts made in 1991 in the property of the House Stabiana (I,22,1), there were two other bodies. For one of them, "it was not possible to obtain a cast due to its stratigraphic position in the lapilli layer". (Masseroli, 2021) (Fig. 14). The other one, visible in the excavation next to the casts, is embedded in coarse material, rather than fine ash.

Figure 14. House Stabiana (I.22.2). A skeleton embedded in coarse material not far from the bodies from which the casts were made.

4.2 Interpretation

Evidence from nearly two centuries of excavation strongly supports the conclusion that, for a high-fidelity impression to form, the body must have decomposed slowly enough to allow the encasing ash to harden, preserving the shape of the body. Complete plaster casts require victims to lie incorporated within fine ash that allows cavity preservation. Although the underlying pumice is necessary for slow decomposition, direct contact with lapilli inhibits cast formation. Wherever victims were immersed in pumice, impressions were generally lost.

Based on archaeological descriptions and direct observations, we believe that the presence of a thin, compact layer of ash separating the bodies from the pumice is also critical for producing complete casts of outdoor victims. This layer prevents the liquid plaster, poured into a void parallel to the stratigraphy, from seeping and dispersing into the porous material within the time of plaster injection. This condition allows almost all casts of Pompeii – more than one hundred – to be placed in the same stratigraphic position, even those lacking adequate documentation (for example, the victim in the Tannery Garden (I,5,3)).

Therefore, the necessary conditions of post-mortem decomposition required to obtain the casts lead to an understanding of the stratigraphic context and, consequently, of the dynamics of the eruption at the time of the individual's death.

No casts of the victims exist, even if they were in a condition to be made, until 1863, when Fiorelli first used plaster. For example, in 1835, the skeleton of the servant Eutychus – "who, after having attempted to escape too late, perished in the peristyle (of the House of the Labyrinth, VI,11,9/10), already filled with pumice" – was found. He carried with him some precious objects, his seal, and the house keys. (Della Corte, 1965).

5. The skeletons

With rare exceptions, the skeletons found inside Pompeian buildings have always been removed. Photographs published in archaeological reports mostly show skeletons lying on a thin layer of pyroclastic material (e.g., the

House of Julius Polybius (VI,17,32), the House of V. Popidius (VII,14,9), the House of the Blacksmith (I,10,7), the Central Baths (IX,4,18)), intact unless affected by building collapse – such as in recent finds – or disturbed by earlier or illicit excavations (Fig. 15).

Figure 15. Animal skeletons inside the bakery of the House of Chaste Lovers.

A skeleton was found in 1863 in the House of V. Popidius (VII,14,9), inside a small arched room at the rear of the house, "lying on its back, half-buried in ash." The reason why it had "the frontal bone broken and the left arm detached from the shoulder" (Breton, 1870) is not specified.

The director Antonio Sogliano reported three skeletons in the House of Cinnius Fortunatus (VI,15,22), found on 23 and 26 June 1897 and on 17 June 1899, without further detail other than that they were in a closed room (Notizie degli Scavi di Antichità, 1897, 1899).

Eight skeletons were discovered in 1899 in a room near the secondary entrance of the House of M. Lucretius Fronto (V,4,11) (quoted by pompeiiinpictures.com).

Four skeletons were found on 1 May 1902 in the House of M. Samellius Modestus (V,4,c). The excavation report states that they were found "more than a meter above the floor. Above them was a layer of what our excavators call tuono, a mixture of ash and water that must have flowed over the already half-buried city. (…) Below the skeletons appeared floor fragments and traces of burned beams, beneath which lay the usual layers of ash and lapilli that had filled the lower room. It was impossible, due to the tangle of bodies, the debris among the bones, and the partial calcination of the skeletons, to obtain plaster casts" (Notizie degli Scavi di Antichità, 1902). The collapse of a floor during the later stages of the eruption (with layers of ash and lapilli in the lower room) was interpreted as the result of a fire, but seismic shocks cannot be ruled out.

In the House of the Menander (I,10,4), some skeletons are still preserved in a display case, although poorly reconstructed. Other bones, perhaps deemed unfit for display or difficult to assemble, were found in a pit in the same room as the case (Lazer, 2003, 2009). Three other victims were discovered on 29 April 1931, crouched on the floor of a room with their legs drawn up to their chests, one with his mouth agape. A mattock and a pickaxe (appendix in D'Ambrosio et al., 2003) found near the skeletons may have been used by the victims in an attempt to escape. This led to the assumption that they had remained alive at least for some time, trapped inside due to the accumulation of pumice. These skeletons were removed, but in the excavation photograph the bones appear to emerge from "a layer of lapilli" (Stefani, 2003), though seemingly mixed with abundant ash. In a nearby corridor, another ten victims were found between 30 April and 1 May of the same year, piled on top of one another in less than 4 m^2. The bodies were about 2.5 m above the ground, possibly having fallen from the upper floor, one atop the other, "on the already thick accumulation of lapilli and ash" (Stefani, 2003). Here too, an excavation photograph – although not very clear – shows the skeletons above a layer of pumice and a level of ash. A third group, consisting of two women and a child, was identified on 23-24 March 1932 in a rather unusual position, "just one meter below the current ground level," and even damaged by agricultural work (Maiuri, 1986; Stefani, 2003).

In the House of Obellius Firmus (IX,14,2-4), seven skeletons were found (Notizie degli Scavi di Antichità, 1911). One, on 23 March 1911, was inside a cubiculum; the other six, between September and October of the same year, were lying on an irregular layer of ash in the house's entrance, blocked because "lapilli had already entered the atrium through the compluvium and had sealed off the exit from the corridor" (Notizie degli Scavi di Antichità, 1911).

In a 1934 photograph, two skeletons found in the triclinium of the House of the Blacksmith (I,10,7) on 6 January 1933 are shown lying down, with their pelvises on the floor and the upper part of their bodies raised to the height of the triclinium couch (Excavation Diary, 6 January 1933; Notizie degli Scavi di Antichità, 1934; Bonifacio, 2003).

Photographs taken during the 1952-1955 excavations in the House of the Upper Floor (I,11,9-15) show a skeleton against the wall of a room, lying on a layer of volcanic material that covers the painted dado of the wall, estimated to be about 50 cm high (Jashemski, 2014).

In addition to those mentioned above, many other skeletons were found almost exclusively in closed spaces (see list in the appendix). Some lay in ash that had entered through every crevice; others were atop layers of ash and pumice; still others lay on the floor inside particularly well-protected rooms. None of them, evidently, were in a condition suitable for making casts.

5.1 Interpretation

Although the above represents only a summary of the victims found at Pompeii, a clear pattern emerges: skeletons belong to people who perished indoors, for whom it is not possible to reliably deduce the exact stratigraphic context and thus the specific phase of the eruption at the time of death. Only for all – or nearly all – outdoor victims we can determine with reasonable accuracy the stage of the eruption during which they died. Anyway, the position of the bodies can testify the situation within the city.

Above all, skeletons provide valuable insight into the behaviours of individuals during the eruption. The most precious things are often near the skeleton, seals, coins, keys or the statuette of the Lares (Della Corte, 1965; D'Ambrosio et al., 2003). In some rooms, the richest furnishings have been sheltered, sometimes a water flask is in one's hands (Auricchio, 2001). Every detail reveals the social status of the individual and his reaction to the sudden disaster.

6. Conclusions: the ancient pompeiians still speak

The victims of the eruption reveal a complex narrative of diverse choices made by individuals and family groups of different social status and age, all subjected to a state of panic and confronted with an unexpected event. Among the victims, two distinct behaviors are evident: those who remained in a closed space and those who, at a certain point, decided to abandon a refuge that appeared safe. Not all inhabitants of Pompeii fled early, perhaps due to physical mobility problems, or because they trusted their shelters and were unwilling to leave their possessions unguarded. This is demonstrated by the number of victims found clutching house keys in their hands (D'Ambrosio et al., 2003).

Individuals sheltering inside houses died either from roof collapse due to pumice loading during the Plinian fall, from earthquake-induced building collapse during the intra-Plinian column-collapse phase (EU3pfi), or possibly from asphyxiation due to inhalation of fine ash (Gurioli et al., 2007).

The casts undoubtedly belong to individuals who died after enduring a relentless hail of pumice throughout almost the entire Plinian phase. While the first intra-Plinian pyroclastic flows reached only Herculaneum, houses in Pompeii began to shake under the effects of earthquake shocks. The Pompeiians were unfamiliar with volcanic eruptions, but they knew earthquakes well – and their consequences – from long experience.

The syn-eruptive seismic shocks simultaneously convinced the boldest or most perceptive Pompeiians to attempt another strategy for survival: fleeing into the open, as also attested by the flight of Pliny the Elder at Stabiae. Several groups of people attempted to escape the city by walking on the layer of ash (EU3pf), which supported their steps better than the pumice into which they sank – as evidenced by bodies found embedded, wholly or partially, in the pumice, in positions that made complete casting impossible. The latter may represent those who perceived, at the first tremors of the earthquake, the gravity of the situation and they tried to escape while pumice was still accumulating.

Defining the conditions necessary to make a complete cast indirectly helps to reconstruct the stratigraphic context for each cast now visible in display cases or placed on the ground. The observation that the pumice layer must have been sealed by a layer of ash, both to allow the Pompeiians to walk and to permit the formation of casts, suggests that the cast corresponds to an individual – adult or child – still alive after the pumice fall and the first PDC entering in Pompeii, therefore many hours after the eruption had begun. The more cases that fall within this framework, the stronger the hypothesis becomes that, with current knowledge, the consequences suffered by the Pompeiians might now be avoided.

The thin ash layers beneath the bodies may correspond to the outermost edge of the first flows that managed to breach the city walls, soon followed by other flows that spread widely over Pompeii and buried the victims. The moment of death would coincide, for almost all the fugitives, with the arrival of the large pyroclastic flow (EU4pf).

The different conditions of the victims, revealed by the casts, provide further data (Gurioli et al., 2005; Gurioli et al., 2007; Giacomelli, 2022). They offer information on the distribution and characteristics of eruptive products. Several bodies appear with clothes and so composed that they seem to be sleeping, suggesting little mechanical impact on victims; others show traces of hair, as if the eruptive products had a negligible temperature. Still others have their faces contorted in spasm or exhibit limb contractions and other symptoms caused by high temperature (Fiorelli, 1877; De Caro, 1979; De Carolis and Patricelli, 2003; García y García, 2006; Mastrolorenzo et al., 2010; Osanna et al., 2021).

The procedure required to make a cast helps to explain these differences and the relative eruptive dynamics. If, to form a cast, the body must be enveloped in fine and homogeneous ash, it means that the pyroclastic flow was a dilute cloud. This also accounts for the variation of energy and temperature, even over short distances, and justifies the victims with preserved hair or fabrics found not far from others showing limb contractions, including the well-known boxer's position (Mastrolorenzo et al., 2010). For example, two casts found close together in the gymnasium are one composite, with the hem of the cloak pulled over the face, the other with the limbs contracted (Maiuri, 1986). Two casts made in April 1875 along the Via Stabiana reproduce a composite female body and a male one with signs of thermal contractions (Lazer et al., 2020; (García y García, 2006).

The place where several casts were made – almost at the edge of the city (Garden of Fugitives and House Stabiana) and beyond the walls (Nola, Stabia and Nocera Gates), in the opposite direction to the volcano – allows us to evaluate the expansion area of the dilute pyroclastic flows.

Despite the absence of outcrops within the city and the loss of stratigraphic information from earlier – and not only earlier – excavations (Giacomelli et al., 2021), the accumulation of numerous clues outlines a scenario of fundamental importance: the possibility of survival in a residential context during a violent explosive eruption, a scenario that could be made even clearer and useful through additional information and continuous updating of data.

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References

Alapont, L., M. Martinón-Torres, M. Osanna, V. Amoretti et al. (2023). The cast of Pompeii: Post depositional methodological insights, PLoS One, 18, 8, e0289378, doi:10.1371/journal.pone.0289378.

Alapont, L., R. Cava, J. A. Llorens, J. J. Ruiz Lopez et al. (2025). A Monumental Tomb with a relief of two spouses in the funerary area of Porta Sarno, E-Journal Scavi di Pompei, 4, 2-23.

Amato, V., M. Covolan, H. Dessales and A. Santoriello (2022). Seismic microzonation of the Pompeii Archaeological Park (Southern Italy): local seismic amplification factors, Geosciences, 12, 7, 275, doi:10.3390/geosciences12070275.

Amoretti, V., A. Martellone, A. Perrotta, C. Scarpati et al. (2021). Nuovi dati stratigrafici, tafonomici e vulcanologici dalla Regio V: il calco mancato dell'Ultimo fuggiasco, M. Osanna, A. Capurso and S. M. Masseroli (Editors), I calchi di Pompei da Giuseppe Fiorelli a oggi, L'Erma di Bretschneider, Rome, 19-28.

Amoretti, V., C. Comegna, S. De Rosa, F. Galadini et al. (2023). Scavo di due vittime dell'eruzione nell'insula dei Casti Amanti. Nuovi dati vulcanologici e sismologici, E-Journal Scavi di Pompei, 1, 1-14.

Amoretti, V., C. Comegna, G. Iovino, A. Russo et al. (2023). Ri-scavare Pompei: nuovi dati interdisciplinari dagli ambienti indagati a fine '800 di Regio IX,1,4, E-Journal Scavi di Pompei, 2, 1-11.

Auricchio, M. O. (2001). La Casa di Giulio Polibio: studi interdisciplinari, Centro Studi Arti Figurative, Pompei, 238.

Baxter, P. J. (1990). Medical effects of volcanic eruptions. I. Main causes of death and injury, Bull. Volcanol., 52, 7, 532-544, doi:10.1007/BF00301534.

Baxter, P. T., A. Neri and M. Todesco (1998). Physical modeling and human survival in pyroclastic flows, Nat. Hazards, 17, 163-176, doi:10.1023/A:1008031004183.

Bonifacio, G. (2003). La Casa del Fabbro, A. D'Ambrosio, P. G. Guzzo and M. Mastroroberto (Editors), Storie da un'eruzione: Pompei, Ercolano, Oplontis, Electa, Milano, 368-376, ISBN:9788837032173.

Bosso, R. (2003). La Porta Nola, in A. D'Ambrosio, P. G. Guzzo and M. Mastroroberto (Editors), Storie da un'eruzione: Pompei, Ercolano, Oplontis, Electa, Milano, 302-316, ISBN:9788837032173,

Bravaccio, C., C. Comegna, S. De Rosa, G. Gison et al. (2024). Scene di un'infanzia pompeiana. Nuovi scavi nel cortile della Casa del Secondo Cenacolo Colonnato nell'insula dei Casti Amanti, E-Journal Scavi di Pompei, 13, 2-10.

Breton, E. (1870). Pompeia décrite et dessinée, 3rd ed., L. Guérin and Cie, Paris, 536.

Capurso, A. and S. M. Masseroli (2021). Catalogo dei Calchi, M. Osanna, A. Capurso and S. M. Masseroli (Editors), I calchi di Pompei da Giuseppe Fiorelli a oggi, L'Erma di Bretschneider, Rome, 307-557.

Capurso, A. (2021). I calchi delle vittime trovate tra gli anni trenta e sessanta del novecento. L'umana tragedia in quell'immane catastrofe, M. Osanna, A. Capurso and S. M. Masseroli (Editors), I calchi di Pompei da Giuseppe Fiorelli a oggi, L'Erma di Bretschneider, Rome, 67-98.

Carey, S. and H. Sigurdsson (1987). Temporal variations in column height and magma discharge rate during the 79 A.D. eruption of Vesuvius, Geol. Soc. Am. Bull., 99, 2, 303-314, doi:10.1130/0016-7606(1987)99<303:TVICHA>2.0.CO;2.

Caricchi, C., A. Vona, S. Corrado, G. Giordano et al. (2014). AD 79 Vesuvius PDC deposits' temperatures inferred from optical analysis on woods charred in-situ in the Villa dei Papiri at Herculaneum (Italy), J. Volcanol. Geotherm. Res., 289, 14-25, doi:10.1016/j.jvolgeores.2014.10.016.

Catoni, M. L. and C. Rescigno (2023). Stabiae. Scavi a Villa S. Marco, E-Journal Scavi di Pompei, 4, 2-10.

Cerulli Irelli, M. G. (1981). Le case di M. Fabio Rufo e di Giulio Polibio, A. De Franciscis and P. G. Guzzo (Editors), Pompei 1748-1980. I tempi della documentazione, Catalogo della mostra, Roma, 22-33.

Cioni, R., P. Marianelli and A. Sbrana (1992). Dynamics of the AD 79 eruption: Stratigraphic, sedimentological and geochemical data on the successions of the Somma-Vesuvius southern and eastern sectors, Acta Vulcanol., 2, 109-123, https://hdl.handle.net/2158/859543.

Cioni, R., L. Gurioli, A. Sbrana and G. Vougioukalakis (2000). Precursory phenomena and destructive events related to the Late Bronze Age Minoan (Thera, Greece) and AD 79 (Vesuvius, Italy) Plinian eruptions: Inferences from the stratigraphy in the archaeological areas, in W. G. McGuire et al. (Editors), The Archaeology of Geological Catastrophes, Geol. Soc. Spec. Publ., 171, 123-141.

Cioni, R., L. Gurioli, R. Lanza and E. Zanella (2004). Temperatures of the A.D. 79 pyroclastic density current deposits (Vesuvius, Italy), J. Geophys. Res., 109, 2, doi:10.1029/2002JB002251.

D'Ambrosio, A., P. G. Guzzo and M. Mastroroberto (Editors) (2003). Storie da un'eruzione: Pompei, Ercolano, Oplontis, Electa, Milano, ISBN:9788837032173.

D'Ambrosio, A., E. De Carolis and P. G. Guzzo (2003). I contesti di oggetti trovati presso le vittime, in A. D'Ambrosio, P. G. Guzzo and M. Mastroroberto (Editors), Storie da un'eruzione: Pompei, Ercolano, Oplontis, Electa, Milano, ISBN:9788837032173.

D'Ambrosio, A., P. G. Guzzo and M. Mastroroberto (Editors) (2003). Storie da un'eruzione: Pompei, Ercolano, Oplontis, Electa, Milano, ISBN:9788837032173.

De Caro, S. (1979). Scavi nell'area fuori Porta Nola a Pompei, Cronache Pompeiane, 5, 61-101.

De Carolis, E., G. Patricelli and A. Ciarallo (1998). Rinvenimento di corpi umani nell'area urbana di Pompei, RSTPomp, 9, 75-123.

De Carolis, E. and G. Patricelli (2003). Le vittime dell'eruzione, in A. D'Ambrosio, P. G. Guzzo and M. Mastroroberto (Editors), Storie da un'eruzione: Pompei, Ercolano, Oplontis, Electa, Milano, 56-72, ISBN:9788837032173.

De Carolis, E. and G. Patricelli (2013). Rinvenimenti di corpi umani nel suburbio pompeiano e nei siti di Ercolano e Stabia, RSTPomp, 24, 11-32.

De Carolis, E. and D. Patricelli (2018). Impronte Pompeiane, L'Erma di Bretschneider, Roma, 136, ISBN:9788891316011.

Della Corte, M. (1965). Case ed abitanti di Pompei, Faustino Fiorentino, Napoli, 515.

Dessales, H. (2022). Ricostruire dopo un terremoto, Publications du Centre Jean Bérard, Napoli, 331, ISBN:9782380500493.

Doronzo, D. M., M. A. Di Vito, I. Arienzo, M. Bini et al. (2022). The 79 CE eruption of Vesuvius: a lesson from the past and the need of a multidisciplinary approach for developments in volcanology, Earth-Sci. Rev., 231, doi:10.1016/j.earscirev.2022.104072.

Dyer, T. (1868). The Ruins of Pompeii, Bell and Daldy, London, 194.

Dwyer, E. J. (2010). Pompeii's Living Statues: Ancient Roman Lives Stolen from Death, University of Michigan Press, Ann Arbor, 200, ISBN:9780472117277.

Fiorelli, G. (1860). Pompeianarum Antiquitatum Historia, Vol. 1 (1748-1818), Stamperia Reale, Napoli, 800, ISBN:9781018679440 (reprint 2022).

Fiorelli, G. (1877). Guida di Pompei, Tipografia Elzeviriana, Roma, 110.

García y García, L. (2006). Danni di guerra a Pompei. Una dolorosa vicenda quasi dimenticata, L'Erma di Bretschneider, Roma, 228, ISBN:9788882653699, ISSN:1828-1907.

Gell, W. and J. P. Gandy (1821). Pompeiana: The Topography, Edifices and Ornaments of Pompeii, Vol. 1, Rodwell and Martin, London, 275.

Gell, W. and J. P. Gandy (1852). Pompeiana: The Topography, Edifices and Ornaments of Pompeii, Vols. I-II, H. G. Bohn, London, 208 (reprint 2021).

Giacomelli, L., A. Perrotta, R. Scandone and C. Scarpati (2003). The eruption of Vesuvius of 79 AD and its impact on human environment in Pompeii, Episodes, 26, 3, 234-237, doi:10.18814/epiiugs/2003/v26i3/014.

Giacomelli, L., R. Scandone and M. Rosi (2021). The loss of geological memory of past catastrophes: the case of Pompeii, Ann. Geophys., 64, 5, VO547, doi:10.4401/ag-8631.

Giacomelli, L. (2022). I calchi delle vittime di Pompei, Associazione Italiana di Vulcanologia (AIV), https://www.aivulc.it/dettnews-i_calchi_delle_vittime_di_pompei/4_39/it/.

Giordano, G., E. Zanella, M. Trolese, C. Baffioni, A. Vona, C. Caricchi et al., 2018, Thermal interactions of the AD79 Vesuvius pyroclastic density currents and their deposits at Villa dei Papiri (Herculaneum archaeological site, Italy), Earth Plan Sci Let.; 490, 180-192, doi:10.1016/j.epsl.2018.03.023.

Gurioli, L., B. F. Houghton, K. V. Cashman and R. Cioni (2004). Complex changes in eruption dynamics during the 79 AD eruption of Vesuvius, Bull. Volcanol., 67, 2, 144-159, doi:10.1007/s00445-004-0368-4.

Gurioli, L., M. T. Pareschi, E. Zanella, R. Lanza et al. (2005). Interaction of pyroclastic density currents with human settlements: Evidence from ancient Pompeii, Geology, 33, 6, 441-444, doi:10.1130/G21294.1.

Gurioli, L., E. Zanella, M. T. Pareschi and R. Lanza (2007). Influences of urban fabric on pyroclastic density currents at Pompeii: 1) Flow direction and deposition, J. Geophys. Res., 112, B05213, doi:10.1029/2006JB004775.

Jashemski, W. F. (2015). Discovering the Gardens of Pompeii: The Memoirs of a Garden Archaeologist, 1955-2004, CreateSpace Independent Publishing Platform, North Charleston, 342, ISBN:9781505661767.

Lazer, E. (2011). Resurrecting Pompeii, Routledge, London, 404, ISBN:9780415666336.

Lazer, E., K. Welch, D. Vu, M. Vu et al. (2021). Inside the casts of the Pompeian victims: Results from the first season of the Pompeii cast project in 2015, Papers of the British School at Rome, 89, 101-136.

Lirer, L., T. Pescatore, B. Booth and G. P. L. Walker (1973). Two plinian pumice-fall deposits from Somma-Vesuvius, Italy, Geol. Soc. Am. Bull., 84, 3, 759-772, doi:10.1130/0016-7606(1973)84<759:TPPDFS>2.0.CO;2.

Luongo, G., A. Perrotta, C. Scarpati and E. De Carolis et al. (2003). Impact of the AD 79 explosive eruption on Pompeii, II. Causes of death of the inhabitants inferred by stratigraphical and areal distribution of the human corpses, J. Volcanol. Geotherm. Res., 126, 3-4, 169-200, doi:10.1016/S0377-0273(03)00147-1.

Maiuri, A. (2002). L'ultima fase edilizia di Pompei, Associazione Internazionale Amici di Pompei, Napoli, 226, https://www.amicidipompei.com/pubblicazioni/1255001915.pdf.

Maiuri, A. (1967). La Villa dei Misteri, Istituto Poligrafico e Zecca dello Stato, Roma, 212, ISBN:9788824032315.

Maiuri, A. (1989). Pompeii, Old Vicarage Publications, 191, ISBN:9780947818548.

Masseroli, S. M. (2021). I calchi recenti, dagli anni Settanta del Novecento al 2002, una fedele istantanea di una immane tragedia, in M. Osanna, A. Capurso and S. M. Masseroli (Editors), I calchi di Pompei da Giuseppe Fiorelli a oggi, L'Erma di Bretschneider, Roma, 99-115.

Mastrolorenzo, G., P. Petrone, L. Pappalardo and F. M. Guarino (2010). Lethal thermal impact at periphery of pyroclastic surges: Evidences at Pompeii, *PLoS ONE*, 5, 6, e11127, doi:10.1371/journal.pone.0011127

Mastroroberto, M. (2003). La Casa del Bracciale d'Oro, in A. D'Ambrosio, P. G. Guzzo and M. Mastroroberto (Editors), Storie da un'eruzione: Pompei, Ercolano, Oplontis, Electa, Milano, 398-420, ISBN:9788837021252.

Notizie degli Scavi di Antichità, various issues (1882, 1888, 1890, 1897, 1899, 1902, 1905, 1908, 1910, 1911, 1914, 1915, 1934, 1939), https://archive.org.

Kent, D. V., N. D. Opdyke, T. Pescatore and S. R. J. Sparks (1981). Paleomagnetic determination of emplacement temperature of Vesuvius A.D. 79 pyroclastic deposits, Nature, 290, 5806, 393-396, doi:10.1038/290393a0.

Kockel, V. (1983). Die Grabbauten vor dem Herkulaner Tor in Pompeji, Philipp von Zabern, Mainz am Rhein, 212.

Osanna, M. (2016). Rapiti alla morte: i primi calchi delle vittime di Pompei realizzati da Giuseppe Fiorelli, in M. Osanna, R. Cioffi, A. Di Benedetto and L. Gallo (Editors), Pompei e l'Europa. Atti del Convegno, Electa, Milano, 144-161, ISBN:9788891809476.

Osanna, M., A. Capurso and S. M. Masseroli (Editors) (2021). I calchi di Pompei da Giuseppe Fiorelli ad oggi, L'Erma di Bretschneider, Roma, 568, ISSN:2612-4750.

Pagano, M. (1997). I diari di scavo di Pompei, Ercolano e Stabiae di Francesco e Pietro La Vega (1764-1810). Raccolta e studio di documenti inediti, L'Erma di Bretschneider, Roma, 190, ISBN:9788870629678.

Pappalardo, U. (2001). La descrizione di Pompei per Giuseppe Fiorelli (1875), Edizioni Massa, Napoli, 174, ISBN:9788895835071.

Pensa, A., G. Giordano, S. Corrado and P. P. Petrone (2023). A new hazard scenario at Vesuvius: deadly thermal impact of detached ash cloud surges in 79CE at Herculaneum, Scientific Reports, 13, 5622, doi:10.1038/s41598-023-32623-3.

Petrone, P., G. Giordano, E. Vezzoli, A. Pensa et al. (2020). Preservation of neurons in an AD 79 vitrified human brain, PLoS ONE, 15, 10, e0240017, doi:10.1371/journal.pone.0240017.

Scandone, R. and S. D. Malone (1985). Magma supply, magma discharge and readjustment of the feeding system of Mount St Helens during 1980, J. Volcanol. Geotherm. Res., 23, 3-4, 239-262, doi:10.1016/0377-0273(85)90036-8.

Scandone, R., K. Cashman and S. D. Malone (2007). Magma supply, magma ascent and the style of volcanic eruptions, Earth Planet. Sci. Lett., 253, 3-4, 513-529, doi:10.1016/j.epsl.2006.11.016.

Scandone, R. and L. Giacomelli (2001). The slow boiling of magma chambers and the dynamics of explosive eruptions, J. Volcanol. Geotherm. Res., 110, 1, 121-136, doi:10.1016/S0377-0273(01)00217-7.

Scandone, R., L. Giacomelli and M. Rosi (2019). Death, survival and damage during the 79 AD eruption of Vesuvius which destroyed Pompeii and Herculaneum, J-Reading - Journal of Research and Didactics in Geography, 8, 2, 5-30, doi:10.4458/2801-01.

Scarpati, C., A. Perrotta, A. Martellone and M. Osanna (2020). Pompeian hiatuses: new stratigraphic data highlight pauses in the course of the AD 79 eruption at Pompeii, Geological Magazine, 157, 4, 597-602, doi:10.1017/S0016756819001560.

Sigurdsson, H., S. Cashdollar and R. S. J. Sparks (1982). The eruption of Vesuvius in A.D. 79: Reconstruction from historical and volcanological evidence, Am. J. Archaeol., 86, 1, 39-51, doi:10.2307/504292.

Sigurdsson, H., S. Carey, W. Cornell and T. Pescatore (1985). The eruption of Vesuvius in A.D. 79, Natl. Geogr. Res., 1, 3, 332-387.

Sparice, D., V. Amoretti, F. Galadini and M. A. Di Vito et al. (2024). A novel view of the destruction of Pompeii during the 79 CE eruption of Vesuvius (Italy): syn-eruptive earthquakes as an additional cause of building collapse and deaths, Front. Earth Sci., 12, 1386960, doi:10.3389/feart.2024.1386960.

Spinazzola, V. (1953). Pompei, alla luce degli Scavi Nuovi di Via dell'Abbondanza (Anni 1910-1923), Vol. 2, Libreria dello Stato, Roma, 1110.

Stefani, G. (2003). La Casa del Menandro, in Storie da un'eruzione: Pompei, Ercolano, Oplontis, edited by A. D'Ambrosio, P. G. Guzzo and M. Mastroroberto, Electa, Milano, 355-376, ISBN:9788837021252.

Stefani, G. (2010). I calchi. Exhibition at Boscoreale Antiquarium, 5 March-20 December 2010, Soprintendenza Speciale per i Beni Archeologici di Napoli e Pompei, Napoli, 16.

Tanguy, J. C., C. Ribiere, A. Scarth and W. S. Tjetjep (1998). Victims from volcanic eruptions: a revised database, Bull. Volcanol., 60, 2, 137-144, doi:10.1007/s004450050222.

Varone, A. (2007). Ricostruzione del tetto del triportico nella Casa dei Pittori al Lavoro (Regio IX ins. 12), in Pompei, Via dell'Abbondanza. Ricerche, restauri e nuove tecnologie, edited by S. A. Curuni Santopuoli, Electa, Milano, 115-119.

Walker, G. P. L. (1981). Plinian eruptions and their products, Bull. Volcanol., 44, 3, 223-240, doi:10.1007/BF02600561.

Zanella, E., L. Gurioli, M. T. Pareschi and R. Lanza (2007). Influences of urban fabric on pyroclastic density currents at Pompeii (Italy): 2. Temperature of the deposits and hazard implications, J. Geophys. Res., 112, B05213, doi:10.1029/2006JB004775.

Zuchtriegel, G., L. Alesse, V. Amoretti and A. Onesti et al. (2024). Scavando nella notte oscura di Pompei. Il rinvenimento di due vittime nell'ambiente 33 dell'Insula 10, Regio IX, E-Journal Scavi di Pompei, 19, 2-28.

Appendix.

- House of Saturninus (1960), three skeletons inside;
- House of the Garden of Hercules (1953-54), two skeletons in the summer triclinium;
- Caupona of Asylus (April 1, 1903), two skeletons 1 m above the ground, in lapilli;
- House of the Colored Pillars (VII,4,31) (December 27, 1902), one skeleton;
- House with Garden (V,3) (2020), eleven disordered skeletons in a room, disturbed by previous inspections – one had its skull crushed by a tile after death;
- Thermopolium (V,3) (2020), at least two dismembered skeletons, possibly due to ancient looting; House of a Flamen (V,4,3), (1899), one human skeleton and animal bones in the atrium;
- Building VI,15,23 (June 23, 1897), one skeleton in a small space; November 4, 1900, one skeleton in the north wing. On June 8 and 22, 1899, in the oecus, two pairs of skeletons;
- Thermopolium (VI,16,12) (October 2, 1903), one skull without the rest of the skeleton behind the bar;
- House of C. Vettius Firmus (VII,2,23) (August 26, 1904), one skeleton in a cubicolo;
- House of Romulus and Remus (VII,7,10), three human skeletons and one dog in the oecus;
- House of Queen Carolina (VIII,3,14) (1813), "after removing 18 inches (about 50 cm) of material, a skeleton was discovered just barely covered in volcanic debris, located ten feet (3 meters) above the ancient floor. (…) Several skeletons were found outside the doorway, a few feet above the ancient ground; from which it is deduced that they struggled before collapsing" (Gell and Gandy, 1852);
- Bakery of P. Aemilius Gallicus (VIII,6,1), two skeletons of a woman and a child found in March 17, 1882, in a sheltered room, two more skeletons in the same house were found on May 20;
- Gladiators' Barracks (VIII,7,16), an undetermined number of skeletons with iron shackles and four without shackles in a room on the west side;
- House of Marcus Lucretius or the Musicians (IX,3,5) (ca. 1849), one skeleton on the stairs beside the tablinum;
- Central Baths (IX,4,5/18) (2019), skeleton of a child not in primary deposition;
- House of Oppius Gratus (IX,6,5) (1878), skeleton in the triclinium;
- House of the Vintner (IX,9,6) (February 13, 1888), one skeleton in the garden;
- House of Casellius Marcellus (IX,2,26) (November 18 and 20, 1869), nine skeletons.

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