

*Pozzuoli: la città che trema*  
*Mario Sirpettino*  
*1971*

Franco di Mauro Editore

Diary of events, abridged and translated by

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Potographs courtesy of Lux in Fabula

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Warnings and Alerts during Volcanic Emergencies:  
Scientific Practice Informed by Community Experience

## Diary of upheaval

*February 1970.* The ground is no longer sinking at two or three millimetres a year<sup>1</sup>, but is now rising out of the sea. A small beach has appeared on the coast in front of the Serapeo, where only a few years ago the sea was more than a metre deep. Signs of uplift can also be seen along the coastline near La Pietra. No-one can deny the uplift any more. Scientists say this is dangerous.

Mayor Angelo Nino Gentile has gone to Rome to discuss the danger to buildings. The previous known uplift occurred before the eruption of Monte Nuovo in 1538. He is reassured that the movements have been under observation for some time. Even so, no seismometer is in place.

*22 February.* The Minister for Public Works confirms the official view of the uplift. Prof. Giuseppe Imbò, Director of the Institute of Terrestrial Physics at the University of Naples [and Director of the Vesuvius Observatory] adds that "we are measuring as precisely as possible the rates of uplift and their variation from place to place."

*25 February.* The first families are evacuated from old buildings in via Giovanni De Fraja (in the centre of Rione Terra). In an interview for *Il Mattino*, the mayor announces that buildings showing cracks are being instrumented to monitor their movements. The buildings include the town hall, schools, churches and private homes. Repeated mention of 29 September 1538 is doing nothing to allay fears. In only one night, a volcano grew where the village of Tripergola had been. And the ground had been rising and shaken by earthquakes<sup>2</sup> since 1511.

*26 February.* Sensational headlines are appearing everywhere. The evacuation of Rione Terra has been ordered. The coast along the port has risen 1.2 m and it is increasingly difficult for boats to dock in the shallow water.

Tide gauges and seismometers are being installed in Pozzuoli. Scientists and public officials announce there is no cause for alarm. No-one is listening.

*27 February.* The hospital "Santa Maria delle Grazie", the Istituto Magistrale "Virgilio", the Capitaneria del Porto and a building in via Pergolesi have been evacuated.

Two evacuation plans are being prepared: Plan A is restricted to the lower part of Pozzuoli; Plan B involves the whole town (with more than 60,000 people in the town centre). The aim is to use military transports to move everyone "in just six hours" to the railway stations of Villa Literno and Napoli-Campi Flegrei, from where they can be moved inland.

Reports continue to arrive about cracks in buildings and roads. Prof. Imbò confirms that the situation is "completely under control".

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<sup>1</sup> The average rate of subsidence at Pozzuoli had been about 1.5-2.0 centimetres a year since Campi Flegrei's last eruption in 1538 (Bellucci et al., 2006. *Geol. Soc. Spec. Pub.* 269, 141-157).

<sup>2</sup> Uplift is now considered to have begun at least 100 years before the 1538 eruption (Bellucci et al., 2006. *ibid*; Di Vito et al., 2016. *Sci. Rep.* 6. doi: 10.1038/srep32245).

28 February. The population is asked to keep calm as the pace of evacuation is increased. Renowned scientists have been called in from abroad to evaluate the situation. Alarming rumours are spreading, mostly unfounded. The possibility of an eruption is openly discussed. Scientific opinion is that “an eventual eruption can probably be predicted days or months beforehand – certainly with enough time to complete the evacuation.”

01 March. According to *Il Mattino*, Pozzuoli is built on a very porous layer of rock, full of liquid [water], that is underlain by calcareous rock. The water is being heated by very hot gas rising through a fracture [in the calcareous rock]. The heated water is expanding and causing the uplift. An oceanographic ship is heading to Pozzuoli from Montecarlo.

02 March. The port area at Pozzuoli is confirmed as the epicentre of the uplift. All the old buildings in the town are being assessed (and there are lots of them!). Some earthquakes have been recorded.

The decision is taken to evacuate Rione Terra. About 5,000-6,000 people live in its unhealthy conditions. The civil defence is mobilised. The population is afraid. “If they are sending us away, it must mean something serious is about to happen.”

The exodus begins. This is how a town dies. The evacuees are scattered. Many are sent to the psychiatric hospital at Miano<sup>3</sup>.

“We may as well dissolve the town council; soon there won’t be any town to administrate.”

Headlines around the world declare a catastrophe is in the making: “the town that has disappeared”; “a volcano will replace Pozzuoli”; “an eruption is imminent”, and so on.



Evacuation from Pozzuoli in 1970. Cars in the left photo line the approach to Rione Terra; the building with two windows facing left was damaged by the uplift and later demolished. (Courtesy of Lux in Fabula.)

<sup>3</sup> The hospital was newly built, but not yet in use.

03 March. Panic is spreading like an oil stain. People are leaving not just from Rione Terra, but from the whole town. 30,000-40,000 people are on the move. We have suffered an "earthquake of fear".

05 March. The scientific committee, chaired by the CNR's<sup>4</sup> Prof. Caglioti, excludes the possibility of a sudden disaster. Integrated measurements will be conducted on the ground, in the air and at sea and co-ordinated by Prof. Imbò . They will consist of:

1. Surveys onland and offshore to identify changes in temperature caused by the movement of magma at depths of 3 km. The surveys will combine geothermometry, magnetics and infrared measurements.
2. Structural surveys and direct sampling of the sea floor across the Bay of Pozzuoli.
3. Analysis of gas and thermal waters sampled onland and offshore.
4. Integration of measurements with seismic data from existing networks.

Prof. Imbò explained the new programme in an interview with *Lo Specchio* on 8<sup>th</sup> March [sic].

"The probable cause of the uplift is an intrusion of magma at shallow depth. Such a circumstance had not previously been anticipated. Now, however, the evolution of the upheaval can be followed by analysing data from seismometers, gravimeters, tide gauges and geothermometers... Several years ago, I proposed that a permanent geophysical monitoring station should be established in the Phlegraean area, because it is an active volcano, but the request was not supported."

Interviewer: "Would a permanent station have been able to monitor the day-to-day evolution of the phenomenon?"

"Yes, that's correct. From the terrible seismicity that shook the Phlegraean basin on 29 September 1538 to the end of 1968, the bradiseism had continued at about 13 mm a year<sup>5</sup>; at the start of February this year, our measurements showed an uplift of about 80 cm. We have no information about what happened between the end of 1968 and the beginning of February 1970, because we did not have the necessary equipment. We would not be in this position if a geophysical station had been operating."

Tax payments are suspended. About 30 families refuse to leave Rione Terra. The President of the Republic<sup>6</sup> has opened the villa Rosebery at Posillipo [in Naples] to some of the evicted families.

Author and journalist Giovanni Artieri writes in *Il Tempo* on 4<sup>th</sup> March:

"I confess that I can't feel sorry about the geological events at Pozzuoli and Campi Flegrei. Perhaps it's because I'm a Neapolitan and Phlegraean myself that I have the innately fatalistic view of someone who has grown up in the mouth of a volcano. Volcanoes, eruptions, glowing lava flows, the infernal puffs and boiling of Solfatara - for we Phlegraeans, these are spectacles and not reasons to be afraid... It is normal for a region that moves like the breasts of a sleeping woman. Ups and downs have been continuing for hundreds of centuries - movements measured in millimetres and centimetres, scientists tell us..."

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<sup>4</sup> The CNR is Italy's National Science Research Council.

<sup>5</sup> See Footnote 1.

<sup>6</sup> Giuseppe Saragat, President 1964-1971.

The Phlegraean people, like those on Etna, have learned to fear institutions, but they are not scared by the untamed forces of Nature. The sea, earth, volcanoes - even earthquakes - are friends of Southern Italians. Shelter from the earth, food from the sea and wine from the land all stir a loyalty not given to others... It is completely understandable that the fishers of sea and tillers of the soil have greater faith in the workings of God than a man from Rome in his sky-blue limousine..."

*06 March.* Stories spread of dead fish being seen in a bubbling sea. It is nothing new: just like Solfatara, the fumaroles in the Gulf of Pozzuoli have always been there.

In an interview with *France Soir*, Prof. Haroun Tazieff, who has been invited to advise the CNR, raises the question of whether the uplift is localised or affects a larger area, especially under the sea.

The seismologist Bendandi, from Florence, says that Vesuvius regulates the stability of the Phlegraean area. All is well as long as Vesuvius remains quiet for only short intervals. But when it has been quiet for a long time - as is the case today - its internal equilibrium is disrupted and can have unexpected results.

There is talk of a spent volcano under the sea. Rumours abound, out of control.

*08 March.* Prof. Izumi Yokoyama has visited Pozzuoli. He is a geophysicist from the University of Hokkaido in Japan. He is surrounded by journalists, photographers and residents, all anxious for his opinion. The events at Pozzuoli are making the television news around the world - the United States, France, Great Britain, Switzerland, Germany, Japan and more.

*09 March.* The town is virtually deserted, especially the centre. A levelling survey shows that the rate of movement has slowed down. This is reassuring. Pozzuoli is out of immediate danger. Roman statues from the Serapeo are being transferred to the National Museum of Archaeology in Naples. Earthquakes are recorded by the seismometer at the bishop's residence in Rione Terra.

*10 March.* The town's economy has collapsed. Shop fronts remain shuttered. Studies of the sea floor continue. More seismometers have been installed and register small tremors. The evacuation continues.

Prof. Yokoyama reports that "although there is no immediate cause for concern, monitoring must continue as a precautionary measure."

Tazieff declares that "The bradysesim at Pozzuoli is not a prelude to an eruption. The vibrations being recorded are normal for a volcanic area. There are no warning signs yet. So no earthquake, no submarine volcanoes, no eruption."

The atmosphere is calmer. There is talk of exaggerated alarm.

*18 March.* Warning sirens are installed, just in case. Conflicting interpretations are offered to explain the bradysesim.

*21 March.* People are returning, but the economy is still on its knees.

*27 March.* In *Le Monde*, Tazieff writes that the events at Pozzouli have not yet finished. Understanding what is happening has been hindered by a lack of monitoring. Monitoring must continue even in volcanic areas that appear to be quiet, because it reveals the normal levels of small earthquakes that cause the so-called background noise... The idea of a submarine volcano was absurd - as was the evacuation of Rione Terra... I was told on 18<sup>th</sup> March that the evacuation was not prompted by concern for a submarine eruption, but to prevent people from being buried by the collapse of old buildings should the bradyseism become stronger.

The idea is floated of drilling into the volcano to let gases escape.

*February 1971.* A year has passed. The economy has collapsed, but people are determined to bring the town back to life. It mustn't ever happen again. Only a small upset may still bring back the fear.

They say that the earth has always danced here, but that the music changes tone. For us, the bradyseism was deafening.

London, October 2018.