ELSEVIER

Journal of Historical Geography 33 (2007) 168–196

JOURNAL OF HISTORICAL GEOGRAPHY

www.elsevier.com/locate/jhg

Responses of the Anglo-American military authorities to the eruption of Vesuvius, March 1944

David K. Chester [a,*], Angus M. Duncan [b], Philip Wetton [c] and Roswitha Wetton [c]

[a] *Department of Geography, University of Liverpool, Roxby Building, Liverpool, L69 3BX, UK*
[b] *Research Directorate, University of Luton, 2 Adelaide Street, Luton, LU1 5DU, UK*
[c] *Aller's End, East Kennett, Wiltshire, SN8 4EY, UK*

Abstract

Vesuvius, which last erupted in 1944, is one of the world's most perilous volcanoes and around 600,000 people live on its flanks. In March 1944 the Anglo-American Allies had still to complete their conquest of southern Italy from the Axis forces and, although in control of Naples and the region of Vesuvius, civil administration had only recently been established. Economically the region was severely depressed and much of its population was destitute. Notwithstanding these difficulties, a fine volcanological description of the March 1944 eruption was produced by Professor Giuseppe Imbò, Director of the *Reale Osservatorio Vesuviana*. In contrast, although some valuable accounts were published at the time and subsequently, the management of the emergency by members of the Allied Control Commission was neither comprehensively described nor evaluated. In this paper a day-by-day – at critical stages an hour-by-hour – chronology of the effects of the 1944 eruption on the local population and the role of the military authorities in responding to it, is presented, based primarily on archival research, together with written and oral testimony from British and American personnel directly involved. Material has also been compiled from newsreel films and previously unused, in some cases unpublished, archival photography. Meteorological data-bases have been interrogated to provide information on the effects of weather conditions on plume directions and tephra deposition. Finally, using

* Corresponding author.
E-mail address: jg54@liv.ac.uk

0305-7488/$ - see front matter
doi:10.1016/j.jhg.2006.02.001

all these sources plus information collected from local authorities (*comuni*) in the areas affected by the eruption, we describe and discuss recovery and reconstruction following the eruption and the dangers faced by the population today. We conclude that, despite all the problems of wartime, management of the emergency by the Allied Control Commission was both impressive at the time and holds important lessons about the manner in which eruptions may be handled in the future.

Keywords: Italy; Vesuvius; 1944 Eruption; Hazards; Second World War

Introduction

Mount Vesuvius in southern Italy is one of the world's most dangerous volcanoes, with around 600,000 people living on its flanks and an estimated 3 million within range of a future eruption.[1] Observations of Vesuvius by literate observers stretch back to the classical era and two letters written in AD 79 by Pliny the Younger to Tacitus are the first reliable accounts of an eruption and the destruction it wrought on the surrounding countryside, Pompeii and Herculaneum being but two of the many settlements affected.[2] Vesuvius is one of the cradles of volcanology, as increasingly detailed study over the centuries has not only advanced knowledge of this particular volcano, but also the science of volcanology more generally.[3]

The March 1944 eruption was the latest, but probably not the last, eruption of Vesuvius. In spite of its relatively recent date, the responses of the population and the authorities to the eruption have neither been fully recorded nor have they been properly evaluated. March 1944 marked the climax of the campaign by the Anglo-American Allies to capture southern Italy from the Axis forces. Italian science and social science were in a parlous state due to the exigencies of war, and civil administration had only recently been re-established. Conditions across southern Italy were grim. There was a severe lack of food and this was exacerbated by problems of disease, wartime destruction, dislocation and lawlessness. Yet in spite of these problems, we will argue that the management of the emergency by the allied authorities was impressive at the time and also holds important lessons about the manner in which similar eruptions may be handled in the future.

Notwithstanding the problems faced by scientists observing the eruption, detailed volcanological descriptions of events in March 1944 were made at the time and published over the

[1] C. Kilburn and B. McGuire, *Italian Volcanoes*, Harpenden, 2001, 23; D.K. Chester, C.J.L. Dibben and A.M. Duncan, Volcanic hazard assessment in western Europe, *Journal of Volcanology and Geothermal Research* 115 (2002) 423–426.

[2] H. Sigurdsson, S. Carey, W. Cornell and T. Pescatore, The eruption of Vesuvius in AD 79, *National Geographic Research* 1 (1985) 332–387.

[3] J.E. Guest, P. Cole, A.M. Duncan and D.K. Chester, *Volcanoes of Southern Italy*, London, 2003, 10–19, 36–38.

following decade.[4] It is upon these that all subsequent summaries are based,[5] though our archival research adds further details. For many years and apart from reports in newspapers of record such as the *London Times*, *Manchester Guardian* and the *New York Times*, the only reliable account of the effects of the eruption was contained in a document entitled, *Final Report on the Vesuvius Emergency Operation*. This report was published privately by Lt. Col. J. Leslie Kincaid, who managed the eruption on behalf of the Allied Control Commission (A.C.C.), and was written by two British army officers, H. Bentley and J.W. Gregory.[6] Although distributed to some of the allied personnel involved in the operation, today copies are only available from some copyright libraries and national archives in the U.S.A., the U.K. and Italy. Adopting the perspective of the A.C.C., Bentley and Gregory provide a day-by-day account of allied operations, together with a few photographs and lists of many of the military personnel involved. In 1994, Angelo Pesce and Giuseppe Rolandi, respectively, an historian and a volcanologist, published *Vesuvio 1944: L' ultima eruzione*.[7] This incorporated Bentley and Gregory's research and made excellent use of photographic evidence, especially that supplied to the authors by the Imperial War Museum in the U.K. and the U.S. Air Force Photographic Collection. In addition, Pesce and Rolandi conducted interviews with a number of local people affected by the eruption and accessed some additional Italian source material.

In the present paper we have taken the research further and are now in a position to provide a day-by-day, at critical stages an hour-by-hour, account of the effects of the 1944 eruption on the local population and the role of the military authorities in responding to it. We base our account

[4] G. Imbò, L'attivita' eruttiva vesuviana e relative osservazioni nel corso dell'intervallo interuttivo 1906–1944 ed in particolare del parossismo del marzo 1944, *Annali Osservatorio Vesuviano* 5, serie volume unico (1949) 185–380; G. Imbò, Sismicità del parossismo vesuviano del marzo 1944, *Annali Osservatorio Vesuviano* 6, serie 1 (1955) 59–268; A. Parascandola, L'eruzione vesuviana del marzo 1944, i prodotti piroclastici, *Rendiconti dell' Accademia delle Scienze Fisiche Matematiche di Napoli* serie 4, 13 (1945) 285–305; A. Parascandola, Lo stato attuale del Vesuvio, *Bollettino Società Geologica Italiana* 70 (1951) 513–522; A. Parascandola, I Minerali Vesuvio nella eruzione del marzo 1944 e quelli formati durante L' Attuale periodo di riposo, *Bollettino Società Geologica Italiana* 70 (1951) 523–526; A. Parascandola, Contributo alla mineralogia Flegrea, *Bollettino Società Geologica Italiana* 70 (1951) 527–532.

[5] D. Dolfi and R. Trigia, The role of water in the 1944 eruption of Vesuvius, *Contributions to Mineralogy and Petrology* 67 (1978) 297–304; R. Santacroce, *Somma Vesuvius*, Roma (Consiglio Nazionale delle Ricerche, Progetto finalizzato 'Geodinamica' monografie, Vol. 8, Quaderni de 'La Ricerca scientifica' finali, Vol. 114), 1987; E. Abatino, *Vesuvio: A Volcano and its History*, Napoli, 1989; E. Cubellis and G. Luongo, L' eruzione del marzo 1944, in: G. Luongo (Ed.), *Mons Vesuvius: Sfide e catastrofi tra aura e scienza*, Napoli, 1997, 273–294; A. Nazzaro, *Il Vesuvio: storia erruttiva e teorie vulcanologiche*, Napoli, 1997; P. Marianelli, N. Metrich and A. Sbrana, Shallow and deep reservoirs involved in magma supply of the 1944 eruption of Vesuvius, *Bulletin of Volcanology* 61 (1999) 48–63; Kilburn and McGuire, *Italian Volcanoes* (note 1); A. Scarth and J-C. Tanguy, *Volcanoes of Europe*, Harpenden, 2001; Guest, Cole, Duncan and Chester, *Volcanoes of Southern Italy* (note 3); P. Fulignati, P. Marianelli, N. Metrich, R. Santacroce and A. Sbrana, Towards a reconstruction of the magmatic feeding system of the 1944 eruption of Mt. Vesuvius, *Journal of Volcanology and Geothermal Research* 133 (2004) 13–22; D. Minghelli, Marzo 1944, il risveglio del Vesuvio, *Plinius* (Periodico di Informazione del Parco Nazionale del Vesuvio) 17 (2004) 4–7; S. Carlino and G. Luongo, *Due giorni al Vesuvio: Guida Vulcanologia del Parco Nazionale del Vesuvio*, San Sebastiano, 2005.

[6] H. Bentley and J.R. Gregory, *Final Report on the Vesuvius Emergency Operation*, Headquarters Naples Province (Allied Control Commission), 1944.

[7] A. Pesce and G. Rolandi, *Vesuvio 1944: L' ultima eruzione*, S. Sebastiano al Vesuvio (Private Publication), 1994 (first edition) and 2000 (second edition).

on the abundant documentary evidence contained in official archives in the U.S.A. and the U.K., the oral and written testimony of surviving service personnel directly involved in the operation, information available from newsreel films and previously unused archive still photography and field data collected from the local authorities (*comuni*) affected by the eruption. In *comuni* we were able to collect oral testimony from local people who had been affected by the eruption. Eyewitnesses were identified either by the *Sindaco* (mayor) or by senior staff members, and their recollections and opinions are used in the present account. Meteorological data-bases have also been interrogated to provide an insight into the influence of weather conditions on plume directions and tephra deposition. Using these sources a description of reconstruction both during the allied occupation and subsequently is presented for the first time. Finally, we consider the implications of the 1944 eruption within the context of current emergency planning within this overcrowded region.

Vesuvius

Historic activity of Vesuvius was signalled by the plinian eruption of AD 79.[8] Before this eruption Vesuvius was not generally recognised as an active volcano, though scholars including Strabo recognised a volcanic origin on the basis of the mountain's morphology.[9] The AD 79 eruption was the most explosive eruption of Vesuvius to have occurred in historical times.[10] After AD 79 there are few records of activity until AD 472, the date of the next plinian eruption[11] but – by using documents and archaeomagnetic dating – Principe et al. have produced a chronology of eruptions from AD 79 to 1631.[12] In the period up to the so called *Pollena* eruption in AD 472, there was a major eruption in AD 203 and a number of minor events, but there is no evidence of lava being erupted from locations outside the Monte Somma caldera (Figs. 1 and 2). From AD 787 a new style of activity began with mixed explosive and effusive eruptions, and a number of

[8] A *plinian* eruption represents a sustained explosive event that may continue for several days, but is usually much shorter. The eruption column may rise as high as 50 km and reach the stratosphere. Plinian eruptions normally deposit pumice and ash and, when columns collapse, hot destructive pyroclastic flows may be generated. Plinian eruptions are named after Pliny the Younger, who first described such an eruption at Vesuvius in AD 79. A plinian eruption has a magnitude (mass of erupted material) of 10^{11}–10^{12} kg and an intensity of 10^{6}–10^{8} kg s^{-1} (based on: R. Cione, P. Marianelli, R. Santacroce and A. Sbrana, Plinian and subplinian eruptions, in: H. Sigurdsson, B. Houghton, S. McNutt, H. Rymer and J. Stix (Eds), *Encyclopedia of Volcanoes*, San Diego, 2000, 477–494).

[9] R. Scandone, L. Giacomelli and P. Gasparini, Mount Vesuvius: 2000 years of volcanological observations, *Journal of Volcanology and Geothermal Research* 58 (1993) 5–25.

[10] Guest, Cole, Duncan and Chester, *Volcanoes of Southern Italy* (note 3).

[11] G. Rolandi, R. Munno and R.I. Postiglioni, The A.D. 472 eruption of the Somma volcano, *Journal of Volcanology and Geothermal Research* 129 (2004) 291–319.

[12] C. Principe, J-C. Tanguy, S. Arrighi, A. Paiotti, M. Le Goff and U. Zoppi, Chronology of Vesuvius' activity from A.D. 79 to 1631 based on archeomagnetism of lavas and historical sources, *Bulletin of Volcanology* 66 (2004) 703–724.

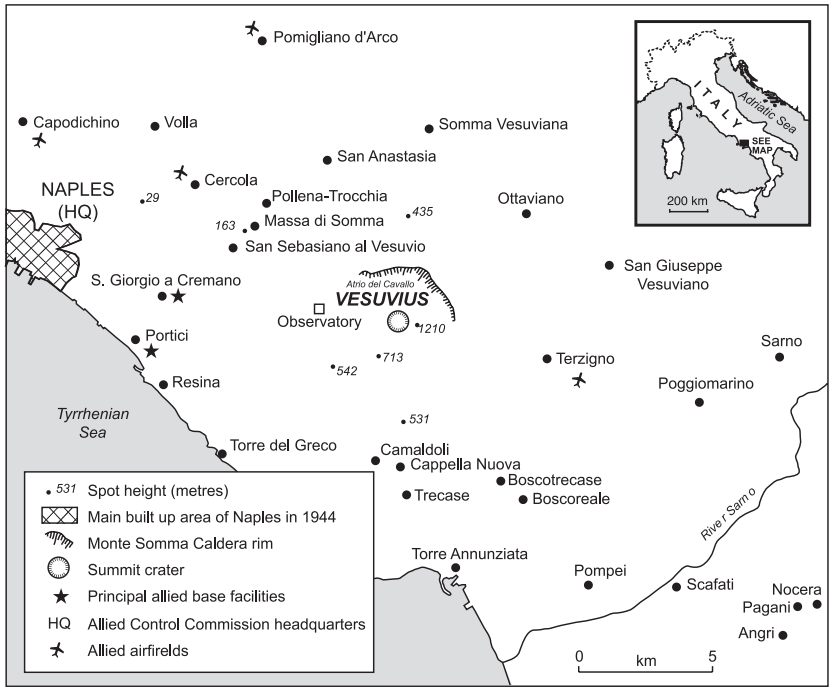

Fig. 1. The location of Vesuvius in relation to the principal allied bases in March 1944.

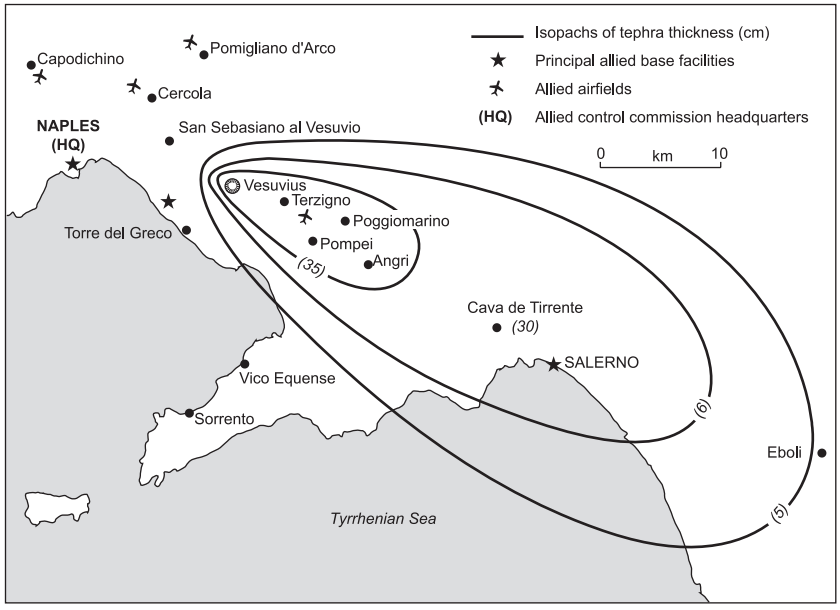

Fig. 2. Tephra fall during the eruption (based on: R. Scandone, F. Iannone, G. Mastrolorenzo, Stima dei Parametri Dinamici dell'eruzione dell 1944 del Vesuvio, *Bolletino Gruppo Nazionale di Vulcanologia* 2 (1986) 487–512).

lava flows were produced that flowed to the coast. Many of these lava flows were erupted from vents on the flanks of the volcano. This phase of activity ended with the 1139 eruption, after which there was a period of quiescence until the large sub-plinian eruption in 1631.[13] Once again it is apparent that before the 1631 eruption people had forgotten that Vesuvius was an active volcano. Around 4000 people were killed in ignorance of the dangers they faced.[14]

The 1631 eruption was followed by a well documented phase of almost continuous activity that ended in 1944. This persistent activity took place at the summit crater and mostly entailed strombolian activity.[15] Eruptions that did occur involved lava either flowing over the crater or being erupted from fractures on the upper flanks of the volcano. Sometimes these eruptions were accompanied by explosions and fire fountains of lava. Brief repose periods (2–6 years) interrupted the persistent activity and, indeed, 18 cycles of activity may be recognised; ranging from 2 to 32 years.[16] Cycles tended to terminate with what are somewhat confusingly termed *final eruptions*. Typically these final eruptions displayed a pattern, beginning with effusive activity and the outpouring of lava over the course of a few days. As the effusive activity waned, explosions at the summit increased and generated high eruption columns – typically 5–15 km height – together with fire fountains. Towards the end of this paroxysmal phase there was often evidence of phreatomagmatic activity, with water–magma interactions producing wet ash and pisolites.[17] The explosive phase often led to collapse of part of the summit cone. Final eruptions of this type occurred in 1737, 1794, 1822, 1872, 1906, 1929, and 1944.

The 1944 eruption

Following the final eruption of 1906, there was a period of repose which lasted until 1913. In the period 1913–1944 there was persistent activity with lava filling in the 1906 eruption crater. This was punctuated by eruptions in which lava, occasionally accompanied by moderate explosive activity, was erupted on the upper flanks of the volcano (as in June 1929). By March 1944 the crater was full of lava and a small cone had been formed. On 13 March this conelet collapsed blocking the throat of the crater. Though there were no overt signs of activity, the staff of the

[13] Scandone, Giacomelli and Gasparini, Mount Vesuvius (note 9). A *sub-plinian* event is a smaller version of a plinian eruption (see note 8), with a magnitude (mass of erupted material) of approx. 10^{11} kg and an intensity of approx. 10^6 kg s^{-1} (Cione, Marianelli, Santacroce and Sbrana, Plinian and subplinian eruptions (note 8)).

[14] M. Rosi, C. Principe and R. Vecci, The 1631 Vesuvius eruption. A reconstruction based on historical and stratigraphical data, *Journal of Volcanology and Geothermal Research* 58 (1993) 151–182.

[15] *Strombolian* activity comprises discrete explosive blasts that eject basaltic fragments a few tens to hundreds of metres into the air. No high eruption column is produced (see P. Francis and C. Oppenheimer, *Volcanoes*, Oxford, 2005, 117).

[16] Scandone, Giacomelli and Gasparini, Mount Vesuvius (note 9); Guest, Cole, Duncan and Chester, *Volcanoes of Southern Italy* (note 3).

[17] A *phreatomagmatic* eruption is an explosive volcanic event produced by the interaction of magma with ground or shallow surface water (G. Heiken and K. Wohletz, *Volcanic Ash*, Los Angeles, 1985, 5). *Pisolites* (accretionary lapilli) 'are spherical or nearly spherical masses of indurated ash, ranging from a few millimetres to several centimetres in diameter. These form as moist aggregates of ash in eruption clouds and can result from…rain falling through an eruption cloud' (Guest, Cole, Duncan and Chester, *Volcanoes of Southern Italy* (note 3), 247).

Volcano Observatory were concerned.[18] In the week preceding the eruption the lack of a plume from the volcano was noted as unusual by the Royal Air Force (R.A.F.) and this may have been related to collapse debris blocking the crater.[19]

The fact that anything is known in detail about the 1944 eruption is due in no small measure to the diligence and devotion to science of one man, Professor Giuseppe Imbò, at the time Director of the then *Reale Osservatorio Vesuviana*.[20] Founded in 1841 the *Osservatorio Vesuviana* is the oldest scientific institution in the world devoted to the study of volcanoes, yet in early 1944 the effectiveness of the observatory was severely compromised. Early in March Professor Imbò had no transport, no photographic film or even alcohol to prevent his seismological charts from smudging.[21] Most of the observatory had been requisitioned by meteorology staff of the United States Army Air Force (U.S.A.A.F.) and all monitoring equipment – including a single seismograph – was relegated to a basement room which Imbò shared with his wife, an assistant and a telegraph operator.[22] Shortly after the start of the eruption the military personnel were evacuated and it was only with considerable difficulty and delay that Imbò acquired the most basic facilities and equipment with which to monitor and record the eruption.[23]

From the time of the earliest reports on its physical characteristics, volcanologists have divided the 1944 eruption into a number of stages with most authors recognizing four distinct phases, summarised here and described in detail in Appendix 1.[24]

[18] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6), 5.

[19] Anon, Report on Eruption of Vesuvius, March 1944: Effect in Respect of Certain Royal Air Force Units, and Action Taken by Royal Air Force, Manuscript, Department of Research and Information Service, Royal Air Force Museum, Hendon, 1944.

[20] By 1944 Giuseppe Imbò (1899–1980) had spent more than twenty years researching volcanoes and had been Director of the Observatory since 1935. He had studied Vesuvius since 1922. The 1944 eruption represented the climax of an already distinguished scientific career. See Anon, Vesuvius: eruption of the world's most famous volcano competes for attention with the war in Italy, *Life Magazine* (17 April 1944) 96; R. Scandone, Giuseppe Imbò: volcanologist in difficult times, *Volcano News* 15 (1983); R. Schick, Giuseppe Imbò and his contribution to volcano seismology, *Annali di Geofisica* 42, 3 (1999) 591–596.

[21] Anon, Vesuvius (note 20).

[22] W. Hoffer, *Volcano: The Search for Vesuvius*, New York, 1982; Cubellis and Luongo, L' eruzione del marzo 1944 (note 5).

[23] Medical alcohol to fix images on the seismographical charts and a single eight frame roll of film were eventually supplied by the American forces, the latter through the offices of Professor Antonio Parascandola of the University of Naples and the Royal Mineralogical Museum (Anon, Vesuvius (note 20); Abatino, *Vesuvio* (note 5)). Parascandola was later to play an important role in recording many features of the eruption. Staff Sergeant Fred Drake *United Sates Army Air Force* (U.S.A.A.F.) – senior Non-Commissioned Officer (N.C.O.) stationed at the observatory – initially acted as Imbò's driver, but eventually a car was provided by the allies (Hoffer, *Volcano* (note 22)).

[24] Imbò, L'attivita' eruttiva vesuviana (note 4); Imbò, Sismicità del parossismo vesuviano (note 4); Parascandola, L'eruzione vesuviana del marzo 1944 (note 4); Marianelli, Metrich and Sbrana, Shallow and deep reservoirs (note 5); Guest, Cole, Duncan and Chester, *Volcanoes of Southern Italy* (note 3).

Phase 1 – lava effusion from 18 March to 21 March

The eruption started at 16.30 h on 18 March, when lava spilled over the crater rim and headed towards San Sebastiano.[25] Lava also flowed south towards Cappella Nuova, near to Torre del Greco (Fig. 1).[26] Initially the flows travelled at around 300 m h^{-1}, but as they advanced they slowed to about 100 m h^{-1}. The southern flow, which was perceived to be a threat to Torre del Greco, did not extend beyond 3 km. The northern flow entered a valley called the *Atrio del Cavallo*. It then flowed through a notch in the caldera wall, entered a second valley and headed towards the towns of San Sebastiano, Massa di Somma and Cercola. The lava flow reached San Sebastiano at 03.00 h on 21 March and began slowly to engulf the town, the bridge between San Sebastiano and Massa being carried away at 03.30 h. At 13.00 h the lava spreading through San Sebastiano and Massa was travelling at between 50 and 100 m h^{-1}. Though the activity during this first phase was predominantly effusive, strombolian activity also generated tephra. On 19 March observers could not access the southern lava flow by vehicle from the observatory because of the thickness of tephra in this sector (see Appendix 1).[27]

Phase 2 – vigorous fire fountain events from late afternoon 21 March to 22 March

In the late afternoon (17.00 h) on the 21 March, a fire fountain began in the main crater. It is likely that this generated a convective column and a report from the Royal Air Force (R.A.F.) refers to it reaching a height of around 7000 m at 17.30 h.[28] In total there were eight episodes of fire fountaining that had a duration of between 18 and 40 min.[29] These fountains generated tephra which were deposited principally on the south and east sectors of the mountain. On the morning of 22 March the weather was poor,[30] but Professor Imbò climbed the volcano to observe the lava and, though the flows were still moving, increased activity from the summit crater suggested that the eruption was progressing to an explosive stage and that effusive activity was likely to decline. The northern lava flow approaching Cercola slowed and came to a standstill on the afternoon of the 22 March, but the southern flow was still active and perceived to be threatening Camaldoli near to Torre del Greco (Figs. 1 and 2). The final fire fountain at 07.30 h on the 22 March was the most impressive and reached a height of 1000 m.[31] An American airman describes black blocks up to the size of footballs dropping on the airfield at Terzigno.[32]

[25] Anon, Report on Eruption of Vesuvius, March 1944 (note 19).
[26] See also Pesce and Rolandi, *Vesuvio 1944* (note 7).
[27] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6).
[28] Anon, Report on Eruption of Vesuvius, March 1944 (note 19).
[29] Imbò, L'attivita' eruttiva vesuviana (note 4); Scandone, Giacomelli and Gasparini, Mount Vesuvius (note 9).
[30] *Surface Weather Charts Naples March, 1944*, information extracted from U.S.A.A.F. charts supplied by Air Force (A.F.), Weather Technical Library, Asheville North Carolina, 1944.
[31] Marianelli, Metrich and Sbrana, Shallow and deep reservoirs (note 5).
[32] McRae, Sergeant, *Vesuvius and the 340th*, Maxwell Air Force Base, Alabama (Air Historical Research Agency Archive), 1944.

Phase 3 – more sustained explosive activity which began during 22 March and continued to 23 March

This explosive phase is considered to have involved a mixture of magmatic and phreatomagmatic activity and was accompanied by seismicity. During the evening of 22 March there was vigorous explosive activity and a large eruptive column developed which was accompanied by an electrical storm and seismic activity. The seismicity triggered landslides on the flanks of the cone of Vesuvius and tephra, mainly from Phase 2, in places overlain by lava flows, and pre-1944 materials failed and generated avalanches.[33] These avalanches were restricted to the upper slopes of the volcano or within the Monte Somma caldera and the longest flow travelled 1.3 km (Fig. 2). The main issue was now tephra and not lava. Though there was light tephra fall in Portici on the west flank, winds deposited lapilli and ash along a dispersal axis to the south-east; Terzigno, San Giuseppe and Poggiomarino being particularly badly affected (Fig. 2). There was around 15 cm of tephra on the Naples/Pompeii highway between Torre del Greco and Salerno and ash was deposited as far away as Albania, some 500 km distant. At the time this *autostrada* was the only road of this quality within southern Italy[34] and was used extensively during the emergency operation. The tephra from this phase caused widespread disruption and almost all the fatalities attributed to the eruption (Fig. 3). It is clear from contemporary photographs, that the column partially collapsed on several occasions and produced small pyroclastic flows which, because of their size and location, caused no damage.[35]

Phase 4 – activity declined to intermittent vulcanian explosions (23–30 March)

Activity waned during this phase with the eruptive vent becoming periodically blocked by wall collapses that were cleared by vulcanian explosions. Activity became increasingly restricted to the crater area and the eruption ended on 30 March.

In total some $35–40 \times 10^6$ m^3 of magma (dense rock equivalent D.R.E.) had been erupted, in less than 12 days.[36]

Socio-economic, political and military contexts

In order to understand the nature and success of the responses of the authorities to events of March 1944, it is necessary briefly to examine conditions in the region in the months leading up to the eruption and the administrative structures that had been put in place by the Allies. Following Mussolini's

[33] R.W. Hazlett, D. Buesch, J.L. Anderson, R. Elan and R. Scandone, Geology, failure conditions and implications of seismogenic avalanches of the 1944 eruption at Vesuvius, Italy, *Journal of Volcanology and Geothermal Research* 47 (1999) 249–264.

[34] British Admiralty, *Italy*, London, Geographical Handbook, Naval Intelligence Division, Vol. 3, 1944.

[35] Guest, Cole, Duncan and Chester, *Volcanoes of Southern Italy* (note 3).

[36] Kilburn and McGuire, *Italian Volcanoes* (note 1).

Fig. 3. The eruptive plume during Phase 3 of the eruption viewed from Massa di Somma (United States United States National Archive and Records Administration image 111SC 189374).

Fig. 4. The military situation in southern Italy: September 1943–March 1944 (based on information and maps in: K.V. Smith, *Naples-Foggia – Brief Histories of the U.S. Army in World War*, Vol. 8, Washington, DC (Center of Military History), 1992.

removal from power by King Vittorio Emanuele III on 26 July 1943 and his replacement by Marshall Badoglio,[37] mainland Italy was invaded by the Allies in September 1943.[38] The British Eighth Army under General Sir Bernard Montgomery crossed the Straits of Messina on 3 September and on 8 September there was a formal announcement of Italian surrender. On 9 September the United States Fifth Army under General Mark Clark landed at Salerno (Fig. 4) and the two armies met on 17 September. Despite a major German counterattack aimed at the Salerno beachhead, the armies slowly advanced up the Italian peninsula and on 1 October soldiers of the British King's Dragoon Guards entered Naples,[39]

[37] P. Badoglio, *Italy in the Second World War*, Oxford, 1948; H.L. Coles and A.K. Weinberg, *Civilian Affairs: Soldiers Become Governors, United States Army in World War II Special Study*, Washington, DC, 1992.

[38] Hoffer, *Volcano* (note 22).

[39] Bishop M. Mann, personal communication, 14 March 2005; M. Mann, *The Regimental History of the 1st The Queen's Dragoon Guards*, Norwich, 1993.

followed by the more substantial forces of the United States 82 Airborne Division who assumed responsibility for the immediate policing and the rehabilitation of the city.[40]

Conditions in Naples and its surrounding region were daunting for the Allies. Not only had the city been extensively bombed by the allied air forces, but – sparing only churches and monasteries – German sappers had also mined and destroyed a large proportion of the remaining buildings. Roads, railways, water, sewage and electricity supplies were severely disrupted in a highly effective scorched earth policy. Starvation threatened in the early weeks of allied occupation and there was serious concern about possible outbreaks of infectious diseases, especially typhoid, dysentery and typhus.[41] Nearly 800,000 Neapolitans depended upon the Allies for survival, a situation that was to continue for some months.[42]

In the event, between October 1943 and March 1944 conditions did improve. Within two weeks most districts had some form of albeit rudimentary water supply, severe downpours towards the end of October flushed out the sewage system and there was only one major outbreak of infectious disease involving just 13 cases of typhus.[43] Electricity supplies were slowly restored. Although food remained in short supply and people suffered to the point of malnutrition for the first three months of occupation, requisitioning and distribution of horded supplies, together with imports from North Africa and the Middle East meant that there were only a limited number of cases of starvation.[44] One well-documented survival strategy was the development of a notorious black market often under the control of organised crime syndicates.[45] At the time it was estimated by one well-placed writer that around one-third of all allied supplies and much war *matériel* eventually found its way on to the black market.[46]

Although many contemporary and later writers have viewed southern Italian society as being particularly backward, even degenerate, in recent years this image has been challenged. The historian John Dickie argues that, following Italian unification in 1860, 'the concept of the South was (re-invented) and a massive accretion of real and symbolic problems rapidly began to shape that concept as a national concern.'[47] Dickie and others have demonstrated that views that appear in

[40] K.V. Smith, *Naples-Foggia: Brief Histories of the U.S. Army in World War*, Vol. 8, Washington, DC, 1992.

[41] C.R.S. Harris, *Allied Military Administration of Italy*, London, 1957.

[42] N. Lewis, *Jackdaw Cake: An Autobiography*, London, 1985; Smith, *Naples-Foggia* (note 40).

[43] An excellent account of the ways in which the allied authorities dealt with public health issues, not only in the weeks following occupation but also subsequently, may be found in Harris, *Allied Military Administration of Italy* (note 41), appendix 4, 419–428. The fact that priority was given to health issues was in large measure due to the influence of the distinguished American physician and soldier Brig. Gen. Edgar Erskine Hume, who headed the military government of Naples immediately following the city's surrender (E. O'Rear, *Edgar Erskine Hume*, Washington, DC, – http:www.arlingtoncemetery.net/eehume.htm – last accessed 03 October 2003).Venereal diseases of various kinds were endemic and affected both the civilian population and the allied forces (H. Macmillan, *War Diaries: Politics and War in the Mediterranean January 1943–May 1944*, London, 1984, 354).

[44] Harris, *Allied Military Administration of Italy* (note 41), 88.

[45] A diary kept by Norman Lewis, a British soldier in the Intelligence Corp (N. Lewis, *Naples' 44: An Intelligence Officer in the Italian Labyrinth*, London, 1978) and a novel, *The Gallery*, by the American author John Horne Burns (J.H. Burns, *The Gallery*, London, 1948) provide vivid snapshots of the shortages, corruption and black market activities that dominated Neapolitan life in late 1943 and 1944.

[46] Lewis, *Jackdaw Cake* (note 42).

[47] J. Dickie, *Darkest Italy: The Nation and Stereotypes of the Mezzogiorno*, London, 1999, 143.

the literature are often shaped by those of ruling northern elites and involve sometimes exaggerated – indeed manufactured – perceptions of the South as being a morally simple region that is ravaged by organised crime. In addition the region is perceived as being persistently mal-administered and resistant to all forms of modernity, as alien or 'other', even being described in some contexts as 'Arabic'.[48] However, as far as the Allies were concerned, southern Italy was not a uniquely difficult area to administer and there were few incidents of civil unrest during this period. In contrast, there are many accounts of the local people being able to innovate, adapt and survive.[49]

Although by March 1944 mass starvation had been averted, the Allies had additional problems with which to contend. Military advance to the north was temporarily halted, especially at the German stronghold of Monte Cassino. The costly engagements known as the First and Second Battles of Monte Cassino (21 January 1944 to 12 February 1944 and 16 February 1944 to 18 February 1944) had produced a large number of casualties and many of the wounded were evacuated to hospitals in Naples and other settlements of the region.[50] The bridgehead established by the seaborne invasion at Anzio (Fig. 4), that began on 24 January, was also only just holding. As well as battle casualties, civilian refugees were migrating in large numbers from battle fronts to the comparative safety of Naples and the settlements on the flanks of Vesuvius.[51] The Third Battle of Monte Cassino started on 15 March, just three days before the eruption, and lasted until 25 March. The Monte Cassino stronghold was eventually captured on 19 May and the final breakout from the Anzio bridgehead only occurred on 24 May.[52]

For some months military administration of southern Italy was extremely complex and several bodies with ill-defined powers and jurisdictions vied with each other in trying to provide effective government. Until January 1944 military administration of southern Italy involved three bodies. The A.C.C. was directly responsible to the Supreme Military Commander and was effective from November 1943, having superseded the Allied Military Mission that had been established in September to negotiate an armistice with Marshall Badoglio. The A.C.C. was responsible for affecting the eventual transfer of allied-occupied territory to Italian control and in the meantime concerned itself with day-to-day administration. Government functions were also exercised by the Allied Military Government (A.M.G.), which functioned in the more stable pacified areas to south of Campania, while in late 1943/early 1944 the Headquarters of Allied Military Government-Allied Central Mediterranean Force (A.M.G.-A.C.M.F.) operated in the combat zones to the north of Naples.[53] To add to the confusion the British Prime Minister, Winston Churchill, and the President of the United States, Franklin D. Roosevelt, had personal representatives in southern Italy. Churchill's Minister Resident in the Mediterranean was the distinguished

[48] Dickie, *Darkest Italy*, 146 (note 47).
[49] Lewis, *Naples'44* (note 45); Lewis, *Jackdaw Cake* (note 42).
[50] E. Griffin, Friend's reminiscences, *Newsletter of the Society of Friends of the National Army Museum* 14, 3 (2003) 6–7.
[51] Griffin, Friend's reminiscences (note 50); Harris, *Allied Military Administration of Italy* (note 41).
[52] C.D. Laurie, *Anzio: Brief Histories of the U.S. Army in World War*, Vol. 9, Washington, DC, 1992.
[53] Lewis, *Jackdaw Cake* (note 42); *Records of the Allied Commission (AFHQ) 1942–1948*, Washington, DC, 2004 (National Archives ref: 331.30 – http://archives.gov/research_room/federal_records_guide/ww2_allied_occupation_headquarters_rg331.html#top – last accessed 15 July 2005).

Fig. 5. Lt. Col. (later Brig. Gen.) James Leslie Kincaid in 1939. Reproduced with permission of the Syracuse University Archives.

parliamentarian, Harold Macmillan, who later served as British Prime Minister between 1957 and 1964, whilst Roosevelt was represented by a senior diplomat, Robert D. Murphy.

By early 1944 it was clear that simplification was required.[54] On 24 January the system was streamlined and all administrative functions were assumed by the Allied Control Commission (A.C.C.), though the war leaders' personal representatives were left in place. Although under the notional leadership of General Sir Harold Alexander (Supreme Allied Commander in Italy), Lt. Gen. Sir Noel Mason-Macfarlane was Chief Commissioner of the A.C.C.; effectively its Chief Executive.[55] The A.C.C. was divided into regions, which were themselves sub-divided into provinces. In March 1944 the Commissioner of Region III (Campania) was Lt. Col. Charles Poletti,[56] and the Commissioner of the Naples Province, which included Vesuvius, was Lt. Col. Kincaid (Fig. 5). Lt. Col. Kincaid's role as leader of the emergency response was to prove pivotal, not least because of his combination of legal, military and administrative skills.[57]

A frequent complaint made by American officers and civilian officials was that the British were over-represented in the higher echelons of the chain of command, this situation causing some friction and resentment on the part of well qualified military and civilian personnel from the United States.[58] Although both Alexander and Mason-MacFarlane were British, the emergency response to the eruption was firmly under American control, Poletti, Kincaid and virtually all their key subordinates being members of the American forces. For instance, Major Harry G. Herschenson (1899–1981) was deputy

[54] Harris, *Allied Military Administration of Italy* (note 41), 92.

[55] Although he was the officer in overall command, Alexander (1891–1969) took no part in the Vesuvius emergency (N. Nicolson, *Alex: The Life of Field Marshall Earl Alexander of Tunis*, London, 1973). Mason-Macfarlane (1889–1953) was a skilled linguist, widely acknowledged to have been an excellent administrator (E. Butler, *Mason-Mac: The Life of Lieutenant General Sir Noel Mason-Macfarlane*, London, 1972).

[56] Poletti (1903–2002) was a lawyer, who served as Lieutenant Governor of New York (1939–1942) and Governor in 1942, and he was a somewhat controversial appointment as Commissioner of Region III (Macmillan, *War Diaries* (note 43), 352–353; Lewis, *Jackdaw Cake* (note 42); Information file on Harry G. Hershenson, Paul V. Galvin Library Archives, Illinois Institute of Technology, 2004).

[57] Kincaid (1884–1973), was a wealthy business executive, who had served with distinction in the First World War and attended the Army School of Military Government in Charlottesville, Virginia, prior to service in Italy: see E.F. Ziemke, *The U.S. Army in the Occupation of Germany, 1944–1946*, Washington, DC, 1975; Information file on James Leslie Kincaid, Syracuse University (Archives and Records Management), 2004; Information file on James Leslie Kincaid, Saratoga Springs, New York State Military Museum and Veterans Research Center, 2004.

[58] Coles and Weinberg, *Civilian Affairs* (note 37).

Provincial Commissioner and at the time of eruption in charge of the City of Naples. He acted as deputy to Col. Kincaid.[59] During the emergency Col. Kincaid used the entire staff of the A.C.C. Provincial Headquarters. In addition 89 British and American officers were loaned to his command and Col. Kincaid draws attention to the contributions of 65 by name, together with 45 non-commissioned officers and 11 United States Red Cross Nurses.[60] The only senior British officer involved was Group Captain Stuart D. Culley (1895–1975), who was Officer Commanding the R.A.F. Base at Portici (Fig. 1).[61]

In fact inter-allied tensions were not a feature of Col. Kincaid's command and, following the emergency, Kincaid was of the opinion that the success of operation was in no small measure due to the good working relationships that had been established between representatives of the armed forces of the two nations.[62] As subsequent discussion will demonstrate, Col. Kincaid was extremely modest in the assessment of his own role and that of his senior subordinates, who brought to the emergency operation much valuable experience and executive skill. There was also the frequent criticism that far too many personnel were involved in the administration of that part of Italy then in allied hands.[63] In fact once the eruption began the availability of a ready supply of non-combatant military personnel and their associated transport was essential, this being acknowledged after the eruption as a further reason for the success of the operation.[64]

The day-by-by response

Appendix 1, which describes the responses of the allied authorities to the eruption in detail, raises a number of wider issues. The first concerns the veracity of some of the material conveyed in press reports at the time, some of which has entered the academic literature as established fact. It is often stated, for example, that two children were killed by a steam blast – usually in San Sebastiano but sometimes in Massa di Somma – after lava entered a well,[65] yet checks carried out in these *comuni* and discussion with Dott. Angelo Pesce provide no evidence to support these accounts.[66] Interviews with witnesses of the eruption in Pollena-Trocchia revealed that two boys were, however, asphyxiated trying to empty a well near Ercolano and this may be the basis of the story.[67]

[59] Hershenson was a successful lawyer and later a judge, who (like Kincaid) attended the Army School of Military Government and was initially placed in charge of the city of Nola in southern Italy. He was one of the few Jewish officers to be decorated by the Pope (Information file on Harry G. Hershenson, Archives Illinois Institute of Technology, Paul V. Galvin Library, 2004).

[60] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6).

[61] Anon, *Who Was Who 1971–80*, Vol. 8, London, 1981.

[62] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6), 26–28.

[63] It was estimated that some 1400 officers and a total of 4000 other personnel were involved. Macmillan wryly notes that only 500 British officials were required to administer the whole of India at the time (Macmillan, *War Diaries* (note 43)).

[64] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6), 1–28.

[65] Hoffer, *Volcano* (note 22), 32–33; Cubellis and Luongo, L' eruzione del marzo 1944 (note 5), 279; Kilburn and McGuire, *Italian Volcanoes* (note 1).

[66] A. Pesce, personal communication, 10 September 2004.

[67] Interview with Dott. Antonio de Falco, Sindaco of Pollena Trocchia, interview conducted 15 September 2004. As on many volcanoes, it is well known that CO_2 seeps through the flanks of Vesuvius and accumulates in basements, wells and excavations, posing an asphyxiation hazard.

Similar problems concern, *inter alia*, reports of the total number of deaths, proportions of the towns destroyed and the number of people evacuated. Some early reports claim that San Sebastiano was virtually destroyed in 1936,[68] whereas the only major twentieth century hazard losses were occasioned by flooding in 1913 and an earthquake in 1930.[69] In 1929 the outskirts of Terzigno were the only urban areas affected by volcanic activity between 1906 and 1944.[70]

This problem of inaccurate reporting is frequently encountered when reconstructing the effects of and responses to eruptions.[71] By checking these accounts against information supplied by the *comuni* affected, we conclude that 20 people died from tephra-induced roof collapse in the Pagani/Nocera area, to which should be added one death in Terzigno caused by rock impact and possibly one suicide in San Sebastiano of a man who was depressed following the destruction of his home town.[72] There is no reason to doubt the number of evacuees recorded by Bentley and Gregory and listed in Appendix 1, while the same source and Hoffer conclude that two-thirds of housing stock in Massa di Somma and San Sebastiano was either destroyed or rendered uninhabitable.[73]

There is also doubt about the veracity of certain aerial operations that are often reported in the literature on the eruption. Some years later Professor Imbó recalled that in 1940 the British had proposed bombing the crater of Vesuvius in order to induce an eruption to disrupt Axis shipping in the Bay of Naples. In November 1941 he suspected that significant seismic activity had been caused by a bomb dropped into the crater.[74] Despite extensive research in Royal Air Force squadron diaries and British National Archives, the authors have been unable to substantiate these accounts, though unofficial action on an authorised bombing raid cannot be ruled out. Major allied bombing raids on military targets in Naples and on towns on the flanks of Vesuvius, including Pompeii, were carried out in September 1943. Once again there is no evidence that the crater was deliberately bombed.[75] There is also an unconfirmed report that the *Luftwaffe* used the erupting volcano as a navigational aid.[76]

Another point of importance concerns the weather. During 1944 weather data were collected at Capodichino airfield[77] and, during the climax of the eruption on the 21 and 22 March, it is clear that no correlation existed between the wind directions recorded at this near sea-level station (Fig. 6) and those at heights of 2–4 km. It was the latter that caused tephra to be deposited along

[68] *Manchester Guardian* (22 March 1944) 5g.
[69] M. Capasso, Vesuvio, il silenzio del gigante, *Il Denaro* (19 March 2004) 6.
[70] Abatino, *Vesuvio* (note 5).
[71] J-C. Tanguy, C. Ribière, A. Scarth and W.S. Tjetjep, Victims from volcanic eruptions: a revised database, *Bulletin of Volcanology* 60 (1998) 137–144.
[72] Hoffer, *Volcano* (note 22); Interview with Dott. Ing. Nunzio Boccia, *Assessore* of Terzigno, interview conducted 15 September 2004.
[73] Hoffer, *Volcano* (note 22), 35.
[74] Hoffer, *Volcano* (note 22), 177.
[75] K.F. Carter and R. Mueller, *Combat Chronology 1941–1945: U.S. Army in Forces in World War II*, Washington, DC, 1991, 217–225.
[76] Anon, *Vesuvius 1772–Today*, London (United Kingdom, Channel 4 Television) (http:www.channel4.com/history/microsites/P/pompeii02.htm – last accessed 5 January 2005).
[77] *Surface Weather Charts Naples March, 1944* (note 30).

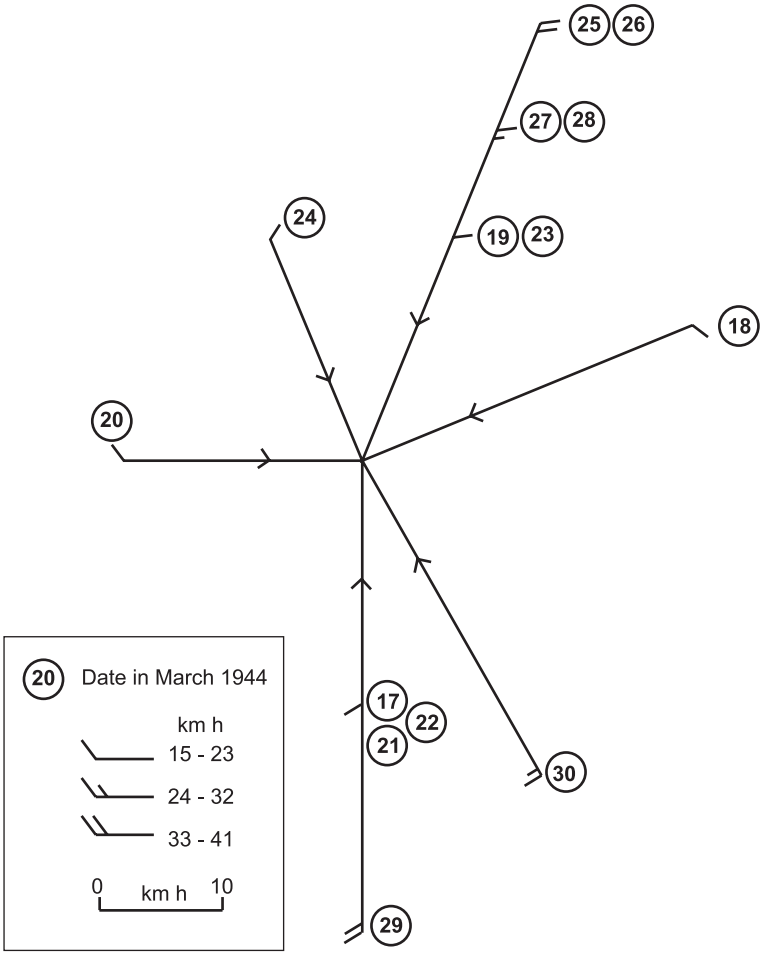

Fig. 6. Wind directions and strengths during the eruption. Based on information in: *Surface Weather Charts Naples March, 1944*. Information extracted from U.S.A.A.F. charts, 1944, supplied by Air Force (A.F.), Weather Technical Library, Asheville, North Carolina.

the south-east to south south-east trending axis of dispersal (Fig. 2). Synoptic charts for the 21 and 22 March show a complex frontal system passing over Vesuvius from the north-west and, although the Capodichino data and those from other stations were used to produce weather forecasts for allied air forces, there is no evidence that such predictions were employed by Col. Kincaid and his staff to identify those sectors which might be affected by tephra. The impression gained from Bentley and Gregory[78] is that officers of the A.C.C. merely reacted to events as they developed. At the very least the A.C.C. could have concluded that surface winds would probably not mirror those at heights of 2–4 km especially under the synoptic conditions at the time. One

[78] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6).

lesson to be drawn from the experience of 1944, therefore, is that meteorological data and weather forecasts are important elements in the management of volcanic eruptions.

The prevailing winds for this part of Italy are from the west, north-west, north and north-east sectors and during the 1944 eruption the principal axis of tephra dispersal (Fig. 2) reflected this. No tephra fell on Naples and relatively little on settlements to the north-west, north and north-east of the summit. Current emergency plans assume that in any future eruption plumes will be similarly wind affected.[79] For highly explosive eruptions, such as the sub-plinian event of 1631 or the plinian eruption of AD 79, this is a reasonable assumption because dispersal of tephra is largely controlled by nearly constant jet streams within the stratosphere.[80] This assumption is not valid, however, for lower magnitude events such as those that occurred in 1944 and 1906, when dispersal was controlled by lower altitude winds confined to the troposphere.[81] There were several days in March 1944 when tephra deposition could have affected the north to north-west sectors if a significant tropospheric plume had been generated. In fact in 1944 the A.C.C. was fortunate that Poggiomarino was the only airfield affected because a conjunction of winds from the south or south-east and a higher plume would have placed the far more important airfields at Pomigliano d' Arco and Capodichino at risk (Fig. 1).

The response of the A.C.C. was even more comprehensive than is implied by both Appendix 1 and many previous accounts. As telegrams filed in the British National Archives make clear, General Mason-Macfarlane not only reported to his superiors on the progress of the eruption and the civil defence measures being put in place[82] but also developed a contingency plan to evacuate civilian refugees to Sicily, mostly by sea, should the eruption have become more severe.[83] Outlined in a telegram from Mason-Macfarlane to Lieutenant General James Gammell – Chief of Staff to the Supreme Allied Commander of the Mediterranean Theatre, Pesce and Rolandi also mention the actual ships that would have been involved.[84] This aspect of the operation would have severely tested allied resources and, fortunately, was not required.

A further point not captured by Appendix 1, concerns the amicable relationships that quickly developed between the A.C.C., local government and the people of the *comuni* affected. Considering that just over five months earlier Italy had been part of the Axis, and that at the start of the

[79] Dipartimento della Protezione Civile, *Pianificazione Nazionale d'Emergenza dell'Area Vesuviana*, Naples (Prefettura di Napoli), 1995; Chester, Dibben and Duncan, Volcanic hazard assessment in western Europe (note 1).

[80] Francis and Oppenheimer, *Volcanoes* (note 15), 174–180.

[81] An interesting discussion of this point is to be found in: F. Barberi, G. Macedonia, M.T. Pareschi and R. Santacroce, Mapping the tephra fallout risk: an example from Vesuvius, Italy, *Nature* 344 (1990) 142–144.

[82] N. Mason-Macfarlane, Telegram 2438 from Chief Commissioner A.C.C. British National Archives Ref: WO 204/2225/121623; N. Mason-Macfarlane, Telegram 2481 from Chief Commissioner A.C.C. British National Archives Ref: WO 204/2225/121623, 1944; N. Mason-Macfarlane, Telegram 2526 from Chief Commissioner A.C.C. British National Archives Ref: WO 204/2225/121623, 1944; N. Mason-Macfarlane, Telegram 2584 from Chief Commissioner A.C.C. British National Archives Ref: WO 204/2225/121623, 1944.

[83] N. Mason-Macfarlane, Telegram 2493 from Chief Commissioner A.C.C. British National Archives Ref: WO 204/2225/121623, 1944; H.M. (Lord) Wilson, Telegram F 22462 from General Wilson to Allied Combined Chiefs of Staff 24 March 44, British National Archives Ref: WO 204/2225/121623, 1944.

[84] Pesce and Rolandi, *Vesuvio* 1944 (note 7), 66–67.

eruption Professor Imbò's research was severely hindered because of a lack of facilities, then the fulsome tributes paid to the A.C.C. and Col. Kincaid following the eruption are eloquent testimony to the manner in which the emergency was handled. Written appreciations were received from Prime Minister Badoglio, the *sindaci* of Cercola, San Sebastiano and San Giuseppe and from local clergy.[85] Several senior officers were also decorated by the Italian, Papal and Neapolitan authorities. Once the eruption had started, relationships with Professor Imbò improved and he was consulted on several occasions by allied officers involved in the emergency.[86]

Contrary to popular opinion, panic and anti-social behaviour including looting do not invariably occur during and following natural disasters.[87] The occurrence of anti-social behaviour often depends upon whether it has been present in a society before disaster strikes.[88] Given the reputation of the region for supposed lawlessness[89] it is notable, that there was no evidence of crime in the villages affected either during the eruption or in its immediate aftermath. Bentley and Gregory[90] report that in 1944 there was no looting, and noted that increased community solidarity and self-help were in evidence. These features, incidentally, also characterised the Friuli and Irpinia earthquakes that occurred, respectively, in 1976 and 1980.[91] The fact that at the time of eruption villages on the slopes of Vesuvius were stable communities, containing a relatively small number of extended families, may be of significance. In 1944 crime in the region was externalised, was associated with organised syndicates and directed towards the looting of and trading in government stores and war *matériel*.[92]

Finally it has become customary in the literature on the management of natural hazards to relate the responses and adjustments made by societies following disasters to their levels of economic development. According to a common model, pre-industrial societies deal with disasters such as eruptions by adapting to nature rather than employing managerial or technological solutions, the latter being more typical of modern or industrial societies.[93] Although

[85] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6). Some copies of Bentley and Gregory do not contain the letters of thanks. These are, however, included as an appendix in the complete edition. A complete edition is available in the British National Archives (WO 220/439 #121623).

[86] Hoffer, *Volcano* (note 22); Griffin, Friend's reminiscences (note 50). It may have been fortuitous that Col. Kincaid had only one conduit of volcanological information. In recent years, there have been many cases where hazard managers have had to deal with conflicting advice. See D.W. Peterson and R.I. Tilling, Interactions between scientists, civil authorities and the public at hazardous volcanoes, in: C.R.J. Kilburn and G. Luongo (Eds), *Active Lavas*, London, 1996, 701–718.

[87] D.E. Wenger, J.D. Dykes and T.D. Sebok, It's a matter of myth: an empirical examination of individual insight into disaster response, *Mass Emergencies* 1 (1975) 33–46.

[88] T.E. Drabek, *Human Systems Responses to Disaster: An Inventory of Sociological Findings*, New York, 1986; C. Dibben and D.K. Chester, Human vulnerability in volcanic environments: the case of Furnas, São Miguel, Azores, *Journal of Volcanology and Geothermal Research* 92 (1999) 133–150.

[89] Chester, Dibben and Duncan, Volcanic hazard assessment in western Europe (note 1).

[90] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6), 25–27.

[91] R. Scandone, personal communication, 15 December 2005.

[92] Lewis, *Jackdaw Cake* (note 42).

[93] G. White, Natural hazards research, in: R.J. Chorley (Ed.), *Directions in Geography*, London, 1973, 193–212; D.K. Chester, A.M. Duncan and J.E. Guest, Responses to eruptions of Etna from the Classical Period to 1900, in: M.S. Balmuth, D.K. Chester and P.A. Johnston (Eds), *Cultural Responses to Volcanic Landscape: The Mediterranean and Beyond*, Boston, 2006, 93–107.

elements of the technological may be seen in the manner in which the authorities responded to the 1906 eruption,[94] the 1944 emergency represented the first – and so far the only – example in which a comprehensive industrial response has been applied to an eruption of Vesuvius. Certain elements of the pre-industrial tradition nevertheless persisted. Some are noted in Appendix 1, such as the help provided by extended families and friends and the local relief committee set up in Pollena-Trocchia to distribute food and issue ration cards, but others are difficult to capture in a summary table and require further discussion.

In 1944, the memory of previous eruptions in 1872, 1906 and 1929 was still alive, and older people had both experience of hazardous events and knowledge about how to cope with them. People knew the importance of not venturing outside their homes without protecting their heads and of clearing tephra off roofs to prevent collapse.[95] This knowledge and understanding shown by the residents, many of whom remembered earlier eruptions, may be another reason why panic did not occur (Appendix 1). With regard to lava specifically, people realised that lives were not threatened by slow moving flows and that there was no need to panic.[96] Parents kept their children away from lavas because they were aware of the dangers of steam blast if flows entered wells and/or underground cisterns.[97] In the areas covered by tephra, traditional Arab-influenced building styles used strong dome-shaped (i.e. cupola) roofs, and these provided some protection against failure under heavy ash loading. This explains why there was limited structural collapse in the *comuni* of Terzigno and Poggiomarino, whereas 20 fatalities from roof collapse occurred in the more rural areas of Pagani/Nocera where the buildings were typically of mud/adobe construction.[98]

In the case of the 1944 eruption, religious responses – specifically, attempts to appease God's supposed wrath and punishment visited on the people of the area – were also evident. Although propitiation is a more prominent feature of hazard response in economically more developed societies than is often admitted by social scientists and civil defence planners,[99] the sheer scale and elaborate character of the religious rituals that were performed in 1944 may be regarded as characteristics of a pre-industrial society. Photographs and newsreels show that large numbers of people of all ages were involved and well attended processions took place in San Giorgio, Ercolano, and Angri – near to Pompei and San Sebastiano.[100] In San Giorgio, a statue of the eponymous saint was processed and in San Sebastiano an image of the Neapolitan saint, San Gennaro, was paraded at the flow front together with one of the Virgin.

[94] C. Comino, *Dies Irae: L' eruzione vesuviana dell'aprile 1906 a Ottaviano e a San Giuseppe Ves.no il progresso, la natura, la catastrophe*, Ottaviano, 2001.

[95] Interview with Gennaro Ambrosio, *Assessore* of San Giuseppe Vesuviano, interview conducted 10 September 2004.

[96] *The Manchester Guardian* (note 68).

[97] Interview with Dott. Gaetano Panico, Vice-Sindaco San Sebastiano, interview conducted 10 September 2004.

[98] Interview with Dott. Roberto Raffaele Giugliano, *Sindaco* of Poggiomarino, interview conducted 10 September 2004.

[99] D.K. Chester, Theology and disaster studies: the need for dialogue, *Journal of Volcanology and Geothermal Research* 146 (2005) 319–328.

[100] *The Manchester Guardian* (23 March 1944) 5f; M. Bracker, 1944, Vesuvius lava flow slackens, *New York Times* (23 March 1944) 6b; Lewis, *Naples' 44* (note 45); P. Simonetti, *Il Vesuvio San Giorgio e le Feste*, Napoli, 1983.

In Naples Cardinal Ascalesi led prayers and in many towns similar services were conducted by parish priests.[101]

Recovery and reconstruction

Except for the northern provinces of Udine and Venezia/Giulia, the A.C.C. ceased to administer Italy on 31 December 1945, with the result that only the initial stages of recovery and reconstruction were under allied control. Even before the end of the eruption measures were put in place to aid recovery. The area to the east and south-east of Vesuvius, that was covered by tephra and named the 'dust bowl' by allied officers, received immediate attention.[102] Photographic evidence shows details of the clean up in San Giuseppe, with military bulldozers being used to clear roads of drifting tephra.[103] Altogether 30 trucks were employed together with several bulldozers and mechanical scrapers. Damage was greatest in Poggiomarino, San Giuseppe and Terzigno where crops were also laid waste by drifts of tephra up to 1.2 m in depth Fig. 7. The A.C.C. estimated that in this sector alone food was required for around 20,000 people and that there was a particular need for green vegetables and animal forage because neither was now available from the local area.[104] Later residents would recall that the effects of the eruption on the towns of the east and south-east were more serious than the privations occasioned by the war.[105] Food had to be transported from Naples using the *autostrada* and was distributed through relief organisations established in each *comune* by Col. Kincaid. In addition to supplying American and British forces it was fortunate that the Allies not only possessed surplus shipping, but had also restored the port of Naples to a capacity which allowed it to cope with the additional burden of importing food on a vast scale.[106]

Another initiative carried out by the A.C.C. in the villages of the east and south-east flanks, was the provision of agricultural experts to advise on land reclamation and re-planting. Seeds and seed potatoes were supplied and the land was restored by deep digging to bring top soil to the surface.[107] In the years that followed it was found that with careful management a fertile soil was produced and within two years normal cropping was resumed.[108] The site of the Poggiomarino airfield was restored to agriculture and is today a highly productive area of irrigated agriculture.[109]

For towns on the north-west flank of the volcano, the A.C.C. efforts were no less impressive. Tents were provided for the homeless and the Italian civilian authorities classified buildings in

[101] *New York Times* (24 March 1944) 5d.
[102] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6), 26.
[103] Pesce and Rolandi, *Vesuvio 1944* (note 7), 182.
[104] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6), 23.
[105] Interview with Gennaro Ambrosio (note 95).
[106] W.S. Churchill, *The Second World War: Closing the Ring*, Vol. 5, London, 1952, 443.
[107] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6), 24.
[108] Interview with Dott. Roberto Raffaele Giugliano (note 98).
[109] Interview with Dott. Ing. Nunzio Boccia (note 72).

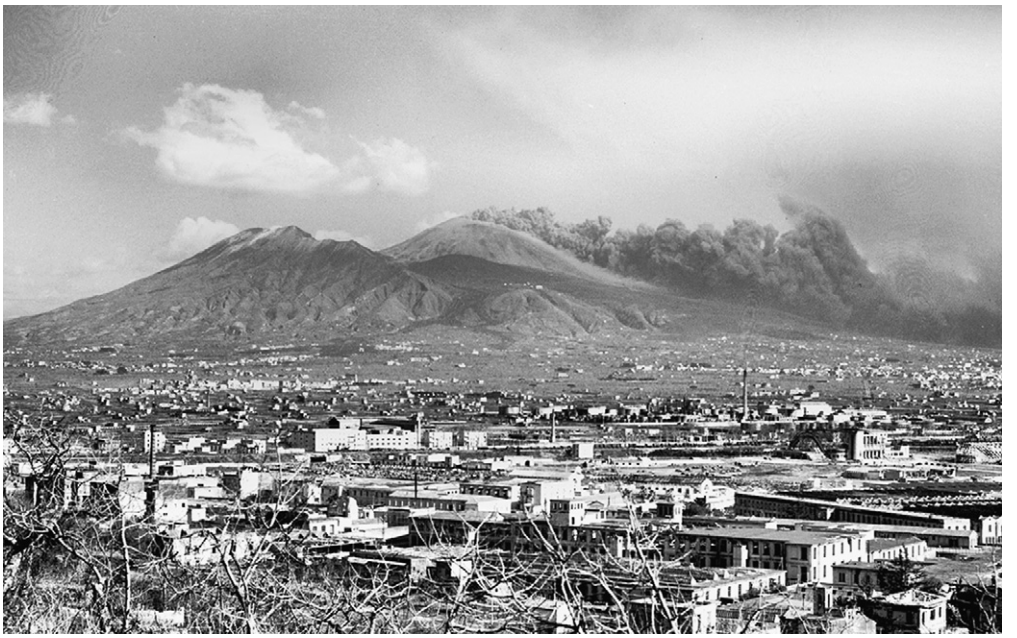

Fig. 7. View from Naples of the plume affecting the *comuni* of Terzigno, Poggiomarino and San Giuseppe (photo ref: mcs 115it). Reproduced by permission of Melvin C. Shaffer Collection, World War II, 1939–1945: Digital Resources from the Library Collections at Southern Methodist University, Government Information Resources, Central University Libraries, Southern Methodist University, Dallas, Texas. http://digitallibrary.smu.edu/.

terms of whether they should be demolished, or repaired and re-occupied.[110] The funicular was not rebuilt and the rack railway was sold by the Thomas Cook Company to Circumvesuviana Railway and re-opened.[111] The towns of the north-west also shared with the other affected settlements generous schemes of financial and medical support and, with regards to the former and from 27 March, Major Rogers (a finance expert) liaised with the *sindaci* of the *comuni* affected to determine the levels of financial aid required. Captain Mackenzie of the A.C.C. led a team who advised on matters concerning sanitation and hygiene.[112]

At the end of March 1944, some 600 people in Massa di Somma were without a roof over their heads, the parish church was destroyed and much land 'sterilized' by lava.[113] Following the eruption of 1872 which almost completely destroyed the town, Massa di Somma was incorporated into

[110] Pesce and Rolandi, *Vesuvio 1944* (note 7), 72.

[111] In 1953 the funicular was replaced by a chair-lift, which now no longer operates. The rack railway proved to be unprofitable and closed in 1955. At present there are plans to restore the funicular as a tourist attraction (Abatino, *Vesuvio* (note 5); R. Owen, Funicular railway on Vesuvius is to rise again from the ashes, *The Times* (23 February 2004).

[112] Bentley and Gregory, *Final Report on the Vesuvius Emergency Operation* (note 6); Pesce and Rolandi, *Vesuvio 1944* (note 7).

[113] Interview with Dott. Giovanni di Nicuolo, *Sindaco* of Massa di Somma, interview conducted 14 September 2004.

the *comune* of Cercola and did not achieve independence until 1988.[114] The current *sindaco* is of the opinion that more aid would have been forthcoming from central government if the *comune* had been independent in 1944.[115] Nevertheless and despite a long-running dispute over whether land covered by lava becomes in perpetuity the property of the state, a new church has been built and private individuals have financed much of the reconstruction. Since the middle of the 1950s the population of Massa di Somma has grown rapidly, from around 2000 in 1948 to an estimated 6000 today and the urban area has also grown so that it is now contiguous with surrounding towns including San Sebastiano.[116]

The political context of reconstruction in San Sebastiano has been quite different. An autonomous *comune* in 1944, it did receive limited state aid which paid for some housing. From 1955 to 1970, the *sindaco* was Raffaele Capasso. Such a long tenure of office is most unusual in Italy and allowed continuity to be maintained throughout the period of reconstruction. Re-building was largely inspired by the vision of this enlightened public official, who imposed very high standards on the layout of the town and its landscaping, on methods of reconstruction and on all new development.[117]

A Committee of Reconstruction was formed with Raffaele Capasso as its secretary. Himself socialist, Capasso included people from a wide variety of political and social backgrounds and the committee had considerable success not least in preventing land speculation. It also encouraged people to give their free time to help in the reconstruction of their town.[118] The population, estimated at 1500–1800 in 1944, has risen to just over 10,000 today and San Sebastiano is known as 'little Switzerland', because of the high quality and low-rise character of its urban fabric which is atypical of the region.[119]

The legacy of the 1944 eruption

As argued above, experience of the 1872, 1906 and 1929 eruptions demonstrated to the people what could be expected from an eruption and helped to prevent panic. Earlier eruptions also prepared people psychologically for the dangers they would face. Interviews (carried out in 2004) indicate that the legacy of 1944 is far less benign. It is believed by many residents, for instance, that the 1944 eruption is a 'typical' eruption, and that similar limited damage will be caused next time the volcano erupts.[120] The 1944 eruption was in all probability a *final eruption* that ended the sequence of almost continuous activity since 1631 and it is generally accepted by both Italian volcanologists and civil defence planners that the next eruption will mark the onset of

[114] Interview with Dott. Giusseppe Gallo, *Sindaco* of Cercola, interview conducted 13 September 2004.
[115] Interview with Dott. Giovanni di Nicuolo (note 113).
[116] F. Marciano, A. Casale and F. Cordella, *Massa di Somma. Cenni di storia Civile e Religiosa*, Massa di Somma, 1998.
[117] Interview with Dott. Gaetano Panico (note 97).
[118] Capasso, Vesuvio, il silenzio del gigante (note 69).
[119] Scarpato, Tommasiello and De Luca Picione, *San Sebastiano al Vesuvio* (note 85).
[120] Interview with Dott. Ing. Nunzio Boccia (note 72); Interview with Dott. Giovanni di Nicuolo (note 113).

a new phase of activity and could be relatively violent. The large sub-plinian event that occurred in 1631 is usually accepted as the most likely future scenario.[121] Such an eruption will involve a high eruption column, large-scale tephra deposition, column collapse and the generation of highly dangerous pyroclastic density currents comprising both flows and surges.[122]

Population growth rates in San Sebastiano and Massa di Somma are typical of the region as a whole and, because it is generally assumed that any sub-plinian eruption will be preceded by seismic and other warnings for up to 20 days, it is envisaged that around 700,000 people will have to be evacuated from the so called 'red zone' to other parts of Italy over a 7-day period. This zone also comprises the most highly risk-exposed settlements on the volcano and people will be evacuated from: San Sebastiano to Molise/Abruzzo; Massa di Somma to Umbria; San Giorgio a Cremano to Lazio and Terzigno to Veneto.[123]

The well-established folk memory that people coped very well in 1944 and that damage was limited, combined with a widespread belief in the untrustworthy nature of current political institutions, mean that many people will probably resist orders to evacuate their home towns. In 1944 the Allies were able to operate under *force majeure* to impose their plans on the population. Today Italy is a democracy, but there is an established procedure that allows the Chief Civil Protection Officer to obtain similar powers to those enjoyed by Col. Kincaid.[124] The 1944 emergency demonstrated that Col. Kincaid required large numbers of highly disciplined troops, ready access to resources – both logistical and financial – plus strong political will successfully to manage even the small-scale eruption of 1944. Coping with a larger eruption and a swollen population are but two of the hazards confronting planners today, two other concerns being earthquakes and debris-flows.[125] At the present time there is a policy to reduce the population at risk. A means-tested sum of up to 30,000 Euros (36,000$ U.S.) is payable to families prepared to move to another part of Italy, and it is planned to reduce the population of the 'red zone' by 20% over a period of fifteen years from 2004. It is too early to say whether the plan will be successful.[126]

Notwithstanding the fact that at the height of the eruption weather forecasts could have been used more effectively, the emergency operation was generally well planned and executed by Col.

[121] Barberi, Macedonia, Pareschi and Santacroce, Mapping the tephra fallout risk (note 81); Dipartimento della Protezione Civile, *Pianificazione* (note 79). Recently, however, a view has emerged amongst some Italian volcanologists that this scenario may be too extreme: R. Scandone, personal communication, 9 January 2006; R. Marzocchi, L. Sandri, P. Gasparini, C. Hewhall and E. Boschi, Quantifying probabilities of volcanic events: the example of volcanic hazard at Mount Vesuvius, *Journal of Geophysical Research* 109, B11 (2004), B11201.

[122] Rosi, Principe and Vecci, The 1631 Vesuvius eruption (note 14).

[123] Dipartimento della Protezione Civile, *Pianificazione* (note 79); Anon, *Vesuvia. La scelta possibile*, Napoli, 2003.

[124] After a State of Emergency has been declared by the President of the Council of Ministers, the Chief Civil Protection Officer has the power to order and enforce evacuation (R. Scandone, personal communication (note 121); Servizio Nationale Della Protezione Civile website http://www.protezionecivile.it).

[125] L. Siro and D. Slejko, Different approaches to the seismic hazard of Sannio-Matese (southern Italy), *Natural Hazards* 2 (1989) 329–348; M. Degg and J.C. Doornkamp, *Earthquake Hazard Atlas, 3, Italy*, London, 1991; H. Tiedemann, *Earthquakes and Volcanic Eruptions*, Zurich, 1992, 53; M.T. Pareschi, M. Favalli, F. Giannini, R. Sulpizio, G. Zanchetta and R. Santocroce, May 5, 1998, debris-flows in the circum-Vesuvian area (southern Italy): insight for hazard assessment, *Geology* 28 (2002) 639–642.

[126] Anon, *Vesuvia. La scelta possibile* (note 123).

Kincaid and his staff at the A.C.C. In 1944 the A.C.C. had no background specialist knowledge of volcanoes, no dedicated emergency services and yet moved very quickly to respond to an unfamiliar set of circumstances using the military and civilian resources that they had at their disposal. Col. Kincaid and his team managed to organise, *inter alia*, the efficient evacuation of people and their effects from San Sebastiano and Massa di Somma, they stood ready to abandon Cercola if circumstances warranted it and even developed contingency plans to evacuate people to Sicily should the eruption have taken a more severe course. The A.C.C. managed to maintain good working relationships with Professor Imbò, who supplied specialised information, and the leaders and people of the *comuni* affected. Once the eruption ended, the A.C.C. was also instrumental in spearheading the process of reconstruction by clearing tephra, supplying food water and fodder for livestock; and extending medical and financial aid.

The effectiveness of the response was in part due to two additional factors. First, the eruption only affected spatially limited areas and developed slowly giving the A.C.C. time to react. It was also of limited violence. In this respect Kincaid and his team were highly fortunate, because none of these factors may obtain next time the volcano erupts, when the main issues will be the size of population and area to be evacuated, and the time this will take. Secondly, the officers and enlisted men and women of the A.C.C. were accustomed to operating under wartime conditions, which involved uncertainty, rapidly changing conditions, the ability to improvise, a requirement for decisive action and the need to implement orders in a highly disciplined manner. All these military virtues were capitalised upon by Col. Kincaid and his subordinates.

Appendix 1. Responses to the eruption

Phase of eruption	Responses of the people and the military authorities
Phase 1 effusive activity 16.30 h on 18 March to 17.00 h on the 21 March	**Saturday 18 March** (temperature 18 °C, wind 24–32 km h from the east north-east and cloudy) The night of 18–19 March was clear.[a] Col. Kincaid convened a meeting of his staff in the late afternoon of the 18 March, immediately after the start of the eruption. During most of the operation the Portici to Terzigno and the San Giuseppe to San Giorgio sectors were respectively under the command of Major Jesse Cantor and Lt. Col. Guy Warren. **Sunday 19 March** (temperature 15 °C, wind 15–23 km h from the north north-east. Photographs show clear conditions, with particle-rich plumes during the day). Kincaid ordered Lt. Col. Warren and Capt. Lummus to reconnoitre the area above Torre del Greco and Torre Annunziata and to report on the situation, while a similar mission was undertaken by Kincaid himself accompanied by Lt. Col. Warner. The two colonels ascended the mountain above the level of the observatory in order to observe the southern flow, which they believed was threatening Cercola. At 10.00 h, Kincaid and Warner recorded that the flow was ~150 m wide, 4–5 m thick and had already slowed to ~6 m h. San Sebastiano appeared to be immediately threatened. Warren and Lummus had to abandon their transport because of tephra deposited by winds from the north north-east. Proceeding on foot, they found the southern flow advancing at a rate of about 300 m h. and concluded that, if this rate continued, Torre del Greco would be threatened in under 15 h.

(*continued*)

Phase of eruption	Responses of the people and the military authorities
	Monday 20 March (temperature 15 °C, wind 15–23 km h from the west, low cloud base and intermittent rain) 01.25 Col. Kincaid was informed by telephone that Torre del Greco was threatened and immediately left Naples to meet Lt. Col. Francis. Both officers concluded that there was no immediate danger and Kincaid traveled on to San Sebastiano and Massa di Somma. The large R.A.F. base (57th Base Area), located at Portici was placed on alert.[b] Mobilising his personnel, Col. Kincaid set up a temporary headquarters on an iron bridge that joined San Sebastiano to Massa. The people, who were concerned about the fate of their towns, paraded a statue of San Gennaro, asking for the saint's protection.[c] At 10.30 h Kincaid promised transport to allow the population to be evacuated should the need arise and instructed the *Sindaco* of San Sebastiano to prepare the people for evacuation. Those who had animal transport, were told to make a start by removing their possessions to the homes of friends and family. At 11.00 h, 15 military trucks were on standby and Lt. Col. Warner reported with a detachment of *Carabinieri*. Shortly after evacuation began, when the flow was only 800 m from San Sebastiano, Croup Captain Culley (Officer Commanding the 57th R.A.F. Base Area) used the *autostrada* to provide additional R.A.F. personnel, military police officers and transport, following a request from Captain Carter of the A.C.C.[d] More personnel were supplied by the U.S.A.A.F.[e] Most residents were evacuated to Cercola, San Giorgio and Pollena-Trocchia and the roads were soon filled with refugees, livestock, trucks and carts piled with household furniture and effects. At 21.00 h, Lt. Col. Poletti arrived to discuss the situation with Kincaid and expressed the opinion that the 7000 inhabitants of Cercola were also threatened. Evacuation of Cercola was planned for 06.00 h on the 21 March. **Tuesday 21 March** (temperature 11 °C, 15–23 km h from the south, overcast conditions with intermittent rain and snow at high altitudes) During the night of the 20/21 March Torre del Greco was still considered to be threatened by the southern flow and at 03.00 h the northern flow had reached the built up area of San Sebastaino, which was now fully evacuated. Buildings along the main street were soon engulfed and houses were also being destroyed in the sister town of Massa di Somma. Lava flowed down a valley between the towns and at 03.30 h the iron bridge, which had been Kincaid's forward base, was destroyed. At 06.00 h the evacuation of Cercola began with the lava only ~1.8 km north of the town centre, and was assisted by miliary personnel form the U.S.A. and U.K., together with 60 *Carabinieri*. Over 200 trucks were deployed many from the R.A.F base at Portici. At 11.00 Col. Kincaid set up a second emergency headquarters, this time in the *Municipio* in Cercola. Photographs show the streets thronged with evacuees and attempts being made by Italian officials under A.C.C. supervision to distribute food and other relief suplies. In 1944 Massa di Somma and Cercola were part of the same *comune* and many evacuees from the former sought out friends and families in the latter. Food distribution centres were also set up by the American Red Cross in Pollena-Trocchia and San Giorgio, and in the latter town a local committee issued ration cards. These towns, as well as Volla, were the main destinations for evacuees from San Sebastiano. Some 125 evacuees had to spend the night in the cinema at San Giorgio. At the time the cinema was located in the eighteenth century Villa Vannucchi on the Via Roma. The grounds of the Villa were used by the Allies as a vehicle park.[f] Both the rack railway serving the funicular (cableway) from low levels of the volcano and the funicular itself were cut by the lava.
Phase 2 lava fountain activity – 17.00 h 21 March to 12.00 h on the 22 March	**Wednesday 22 March** (temperature 13 °C, wind 15–23 km h from the south, cloud base 200 m and intermittent rainfall is implied by both the photographic evidence and Sergeant McRae's diary).[g]

(*continued on next page*)

(*continued*)

Phase of eruption	Responses of the people and the military authorities
	Destruction of Massa di Somma and San Sebastiano continued, but new damage was caused on the eastern and south-eastern flanks. Explosive plumes reached 2-4 km in height and were driven by the winds prevailing at these height towards the east and south-east. At the Allied Headquarters in Caserta, Mr Thomas Llewelyn (Llew) Williams of the Royal Signals recalls fine ashes falling across the Italian peninsula as far as the Adriatic (Williams, personal communication, 2004), while at the U.S.A.A.F. airbase at Poggiomarino (sometimes called Pompei or Terzigno), Sergeant McRae[g] of the 340th Bombardment Group, noted in his diary that tephra fall began at 02.00 h with fragments 'as large as golf balls'. Later he noted that tephra completely covered the ground, destroyed tents and tore through the floors, metal, fabric and plexiglass of a large number of B25 Mitchell bomber aircraft. Military personnel had to don steel helmets, while civilians were forced to cover their heads in the best way they could. At noon on the 22 March, the decision was taken to evacuate the base. 88 Mitchells were badly damaged, but there is some doubt about whether or not 14 were eventually repaired.[h] What seems certain is that Poggiomarino airfield was abandoned never to be used again, and the most likely explanation is that spare parts were salvaged from some of the aircraft. The total loss was estimated at around $25 million.[h] The Nazi broadcaster, Axis Sally[i], claimed that the 340th had been removed from the war and was a 'clear sign that God had sided with the Axis'. In fact the re-equipped 340th was in action in just five days.
Phase 3 – a phase of mixed explosions – 12.00 h on the 22 March to 14.00 h on the 23 March.	**Thursday 23 March** (Temperature 9 °C, wind 15–23 km h from the north north-east, 4/10 cloud and dense plume to the south and south-east) By noon on the 23 March the flow, that had caused so much destruction in San Sebastiano and Massa di Somma, came to a halt, one limb terminating 100 m from the cemetery at Cercola, and the other stopping around 1.4 km away from the built up area of Cercola. Destruction in San Sebastiano and Massa di Somma was severe. In addition to the parish church in Massa and many other buildings in both towns, some 600 people were rendered homeless in Massa and 2150 in San Sebastiano. In the afternoon of the 22 March, officers of the A.C.C. considered that the southern flow was threatening the village of Camaldoli and 250 people were evacuated by truck to Castellammare, with almost 500 using their own transport. Officers at the R.A.F. base in Portici continued to be concerned about the southern flow.[b] During the explosive phase of the eruption, Col. Kincaid and his staff became increasingly concerned about the *comuni* of Terzigno, San Giuseppe and Poggiomarino, but transport to this sector of the volcano was almost impossible because of intensity of tephra deposition. Lt. (later Bishop) Michael Mann of the King's Dragoon Guards vividly describes leading troops from the Cassino front to the town of Sarno, south-east of Vesuvius. The ash was so thick and the dust so intense that, even though the squadron was equipped with armoured cars, the re-deployment was only just successful.[j] In a diary kept by an American officer, Captain L. Powers, problems of transport in Pompei and Salerno areas also figure prominently.[k] During the course of the day, Col. Kincaid concluded that Cercola was no longer in danger and gave the population permission to return, assistance with transport being provided by the A.C.C. Kincaid also arranged for the water supply to be restored. Torre del Greco and Camaldoli were also considered to be no longer at risk.

(*continued*)

Phase of eruption	Responses of the people and the military authorities
Phase 4 – a seismic-explosive phase – 14.00 h 23 March, to the 30 March.	**Thursday 23 March** At 14.00 h officers at the R.A.F. base in Portici found the autostrada linking Naples and Pompei was covered by 15 cm of ash between Torre del Greco and Salerno. Later in the day orders were given to maintain and protect supplies of food, water and fuel. On the 23 March, Col. Kincaid had limited personnel available in the areas being affected by tephra fall. For the towns of Boscotrecase, Castellammare, Nocera, Poggiomarino, Pompei, Portici, Resina, Scafati, Terzigno, Torre Annunziata and Torre del Greco there was a total of only 38 officials and 37 soldiers.[l] **Friday 24 March** (temperature 13 °C, wind 15–23 km h from the north north-west, clear weather on the northern flank of the volcano and in Naples). In Cercola life was returning to normal and a few residents also returned to Massa di Somma and San Sebastiano. The A.C.C. supplied drinking water and food. It was considered that the immediate threat posed by the southern flow was over, but the R.A.F. base at Portici was kept on high alert, with officers even considering the possibility of seaborne evacuation if roads became totally impassable.[b] Although vast amounts of tephra were still being erupted, Col. Kincaid concluded that the worst of the eruption was over. The people evacuated from Camaldoli could not, however, immediately return home due to blocked roads. **Saturday 25 March** (temperature 7 °C, wind 33–41 km h from the north north-east, thick clouds) **Sunday 26 March** (temperature 9 °C, wind 33–41 km h from the north north-east, generally clear conditions) **Monday 27 March** (temperature 16 °C, wind 24–32 km h from the north north-east, with overcast conditions. **Tuesday 28 March** (temperature 9 °C, wind 24–32 km h from the north north-east, generally clear but with some haze and dust) **Wednesday 29 March** (temperature 12 °C, wind 33–22 km h from the south, generally clear) **Thursday 30 March** (temperature 11 °C, wind 24–32 km h from the south south-east, overcast with some haze) Although earthquakes continued to affect the area until the 29/30 March and volcanic activity continuing in the crater area, as far as human impact is concerned the emergency response was over by the 28 March. The countryside to the east of the volcano was covered with tephra, causing considerable damage in the *comuni* of Terzigno, San Giueseppe and Poggiomarino. At the time of the eruption, many traditional buildings had domed roofs which proved to have great strength and resistant to failure under tephra loading.[m] The populations of Poggiomarino and Terzigno were also psychologically prepared for the emergency, because the towns had been affected, respectively, by the 1906 and 1929 eruptions. In San Giuseppe, *Assessore* Gennaro Ambrosio remembered that many survived injury by covering their heads. His mother placed a saucepan on his head.

Eruption summary based on: E. Abatino, *Vesuvio: A Volcano and its History*, Napoli, 1989; A. Nazzaro, *Il Vesuvio: storia erruttiva e teorie vulcanologiche*, Napoli, 1997; C. Kilburn and B. McGuire, *Italian Volcanoes*, Harpenden, 2001; A. Scarth and J-C. Tanguy, *Volcanoes of Europe*, Harpenden, 2001; J.E. Guest, P. Cole, A.M. Duncan and D.K. Chester, *Volcanoes of Southern Italy*, London. Information on responses is derived from: H. Bentley and J.W. Gregory, *Final Report on the Vesuvius Emergency Operation*, Headquarters Naples Province (Allied Control Commission 1944), and other references cited in the table. Weather data are from: *Surface Weather Charts Naples March, 1944*. Information extracted from U.S.A.A.F. charts, 1944, supplied by Air Force (A.F.), Weather Technical Library, Asheville, North Carolina. The data are for 12.30 h G.M.T. The data have been extracted from surface charts and are derived from a near ground level station located at Naples (Capodichino airbase – Fig. 1).

[a] According to photographs in: A. Pesce and G. Rolandi, *Vesuvio 1944: L' ultima eruzione*, S. Sebastiano al Vesuvio (Private Publication), 1994.

[b] Anon, *Report on eruption of Vesuvius, March 1944. Effect in respect of certain Royal Air Force Units, and action taken by Royal Air Force*, Department of Research and Information Service, Royal Air Force Museum, Hendon, 1944; N. Lewis, *Naples' 44: An Intelligence Officer in the Italian Labyrinth*, London.

[c] W. Hoffer, *Volcano: The Search for Vesuvius*, New York, 1982, 32–33; Lewis, *Naples' 44*, 105.

[d] Anon, *Report on eruption of Vesuvius, March 1944*.

[e] J.T. Johnson, *Supplementary Comments on History of the 316th Fighter Squadron 1942–1945* (first published 1956). Available http://mywebpages.comcast.net/blueyondur316/JT/JTJTOC.html (last accessed 14 July 2005).

[f] Personal communication. Dott. Ferdinando Riccardi, *Sindaco* of San Giorgio a Cremona, interview conducted 13 September 2004.

[g] McRae, Sergeant, *Vesuvius and the 340th*, Maxwell Air Force Base, Alabama (Air Historical Research Agency Archive), 1944.

[h] Aerofiles, *Italy 74, USAAF 0* – www.aerofiles.com/_noram.html (last accessed 14 July 2004).

[i] 'Axis Sally' was the pseudonym of an American citizen, Mildred Gillars (1900–1988), who broadcast to the allied forces from Berlin. In 1949 she was arraigned for treason and was only released from jail in 1962.

[j] Mann (Bishop Michael), personal communication, 14 March 2004.

[k] P.P. Stramm, My favorite veteran recalls Mount Vesuvius erupting, *Savannah Morning News* (10 November 2003).

[l] Pesce and Rolandi, *Vesuvio 1944*, 70.

[m] Interview with Gennaro Ambrosio, *Assessore* of San Giuseppe Vesuviano, interview conducted 10 September 2004.