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Responses to, and the short and long-term impacts of, the 1957/1958 Capelinhos volcanic eruption and associated earthquake activity on Faial, Azores.

1. Introduction

Although the eruption of Surtsey in Iceland gave its name to a particular style of hydrovolcanic activity, the 1957 to 1958 eruption of Capelinhos in the Azores (Fig 1) is not only an earlier but also arguably a better example of this type of volcanism. The eruption was meticulously recorded at the time (Machado, 1958a, 1958b, 1959a; Castello Branco et al., 1959; Machado et al., 1959a, 1962; Zbyszewski and Veiga Ferreira, 1959; Zbyszewski, 1960), and subsequent analysis of its well-exposed proximal and distal sub-aerial deposits has allowed mechanisms of eruption, transport and emplacement to be analysed (e.g. Waters and Fisher, 1971; Cole et al., 1996; 2001).

Despite the fact that the Capelinhos eruption and associated earthquake activity are well known events, their impacts on the people resident on Faial Island have not been studied in detail. This is an unfortunate omission because the ways in which catastrophic events are handled by a society has a major bearing on present-day disaster planning, not only in the Azores, but also more generally in hazard exposed island communities (Pelling and Uitto, 2001; Anon, 2005a, 2005b; Mercer et al., 2007).

At the time of the emergency the system of government in Portugal was known as the *Estado Novo* (i.e. New State). This regime ruled Portugal for over forty years, being

initiated in 1928 and continued until it was overthrown by the *Portuguese Revolution* of 1974. Ruling from 1928 to 1968, the Head of Government and effective dictator of Portugal was António de Oliveira Salazar (1889-1970) and, although sometimes equated with superficially similar fascist governments in Italy and Spain, the *Estado Novo*, differed from these regimes in several important respects¹. The principal features of the regime were that:

- a. power was maintained by Salazar's skillful "juggling of the interests of the army, the urban middle class, the monarchists and the church, (the great ideals being) patriotism, paternalism and prudence" (Birmingham, 1993 pp. 159);
- b. it provided a market economy that was subject to state control;
- c. it emphasised strict limits over government expenditure, including that spent on education², sought a balanced budget and eschewed overseas borrowing;
- d. in 1933 the government adopted a constitution that was anti-parliamentary and placed power in the hands of the executive and
- e. involved strict centralized control over the activities of the civil service and the press (Anon, 1956; Baklanoff, 1992; Anderson, 2000).

Salazar assumed direct responsibility for the Azores through his personal selection of military commanders and civil governors (Guill, 1993).

Whereas academic study of and publishing about pure and applied volcanological and seismic aspects of the 1957-58 eruption and 1958 earthquake was encouraged and even financially supported by the government through its agencies and involved both Portuguese and foreign scholars³, at the time of the emergency and until recently there have been virtually no in-depth studies of the impacts of and government responses to the

emergency. Evaluative and potentially critical studies of policy were not welcomed by the government.

Although academic study of policy was not encouraged, in common with other European authoritarian regimes the government of the time possessed a highly efficient bureaucracy and detailed accounts of government responses to the volcanic eruption and earthquake have been preserved in the archives. This information may be found either in government reports (e.g. Junta-Geral Horta, 1958a; 1958b) and other qualitative archival sources (Araújo, 2007), or in statistical form and which relate to the demographic, economic and social impacts of the volcanic and seismic events of 1957 and 1958 (e.g. SREA, 2003; SREA, 2007). Regarding the former, many records about the relationship between the central government in Lisbon and the Governor in Horta, the capital and principal settlement of Faial⁴ (Fig. 1), have recently been edited and published (Araújo, 2007). Covering the years 1831-1975, for 1957/8 these documents include memoranda, unpublished reports and, especially useful for the present study, personal correspondence and telegrams between the Civil Governor, Dr António Freitas Pimentel (see section 5.2), and the central government. The fiftieth anniversary of the eruption and earthquake saw the publication of several commemorative volumes of which two are particularly valuable: *Vulcão dos Capelinhos Memórias 1957-2007* (Memories of Capelinhos Volcano 1957-2007) (Forjaz, 2007a) and *Capelinhos, A Volcano of Synergies* (Goulart, 2008). The former work not only republishes many often obscure articles and reports on the eruption, but also includes chapters which focus on how officials managed emergency responses, and brings together the memories of people affected by the volcanic eruption and earthquake. *Capelinhos, A Volcano of Synergies* concentrates on families of the

Azorean diaspora who emigrated from Faial to America in the immediate aftermath of the emergency. As in *Vulcão dos Capelinhos Memórias*, so in *A Volcano of Synergies* first-hand testimonies from some of those affected by the eruption and earthquake are presented.

Essential though these studies are for understanding disaster management and human responses during and after the emergency, in the present study several previously unused and/or underused sources are additionally employed. These include: foreign newspapers and news magazines of record; and archival sources which are and are not included in Araújo's (2007) compilation. In 1960 a comprehensive land use survey of Faial was undertaken by the Oxford Women's Expedition (Callender and Henshall, 1968)⁵. This meticulous and impressive 1: 25,000 scale survey contains much valuable information on both the extent of, and ways in which land was affected by, volcanic products and the recovery that had taken place in the two years that elapsed between the end of the emergency in October 1958 the date of the field survey in 1960. In addition the memoir that accompanies the land use map provides many near contemporary comments on the demography, economy, society and culture of Faial. Finally, the authors carried out in-depth interviews with nine people who were selected because they were either involved in initiating emergency responses and/or were directly affected by the catastrophe.

In this paper we seek critically to evaluate the responses of the authorities to the Capelinhos volcanic eruption and associated earthquakes, and draw out lessons that these events may hold for future emergency planning.

2. Volcanic and Seismic Activity

The Capelinhos eruption is the second of two historic basaltic eruptions to have affected Faial. The first was the 1672-73 Cabeço do Fogo eruption that occurred on the fissure system which extends west northwest from the central caldera (Coutinho et al., 2008). Three people were killed apparently overwhelmed by lava when they went to view the eruption (Machado, 1959b). Lava from this eruption reached the north and south coasts isolating the western end of the island. In addition to volcanism, Faial is seismically active and significant earthquakes have frequently occurred (Table 1). The most recent event in 1998 led to eight deaths, 150 people were injured and 1,500 were made homeless (Senos et al., 1998; Coutinho et al., 2008).

The Capelinhos eruption began 1.2 km off the northwestern tip of the island on September 27 1957 (Machado, 1958a). As the eruption developed new cones formed progressively to the east, and in November an isthmus formed linking the new volcano to Faial. The history of the eruption is summarised in Table 2. The Capelinhos eruption is a classic example of a hydromagmatic event of a *Surtseyan* type. Hydromagmatic explosivity leads to a high degree of comminution generating large volumes of fine ash which is distributed downwind. In October and December 1957 there were heavy falls of ash on the western part of Faial. Capelo *freguesia* was particularly badly affected, most of its agricultural land being covered (Callender and Henshall, 1968) and villages were evacuated (see sections 4 and 5 and Anon, 1957d). Relatively cool and wet pyroclastic surges were formed and these were largely restricted to within 1 km of the active cone (Fig. 2) but, at times when the active cone built up so excluding sea water from the vent, *Surtseyan* activity was replaced by magmatic activity, which was characterized by

Hawaiian type fountaining and *Strombolian* style minor explosive activity together with the eruption of lava flows. During the course of the eruption there was repeated switching between hydromagmatic and magmatic activity (Cole et al., 2001).

The third phase of Surtseyan activity finished by the beginning of May 1958 and activity was now predominantly of a magmatic style. Though eruptive activity was entering its final stage, on the night of Monday May 12 through to Wednesday May 14 the island was struck by over 400 earthquakes. Intensities reached values of X on the *Modified Mercalli Scale* on the night of May 12 (Machado, 1959a) and much damage was caused in Praia do Norte (Fig 3). On May 14 a small explosion occurred in the floor of the caldera (Machado, 1959a) and there were concerns that this might be a precursor to a major explosive eruption in the centre of the island (Anon, 1958d). From this time, both volcanic activity at Capelinhos and seismicity declined and the eruption ended on October 24 (Table 2).

3. Pre-disaster vulnerability

Every natural disaster involves an interaction between an extreme event and a vulnerable human population. Moreover, it is well known from societies around the world that the conditions which exist when disaster strikes may play a vital role, not only in affecting the character of responses, but also in shaping the path to recovery (Wisner et al., 2004, pp.1-16). In common with other island communities, one aspect of pre-existing vulnerability is isolation, with Faial lying in the middle of the Atlantic Ocean and at the time having only seaborne links to metropolitan Portugal and other islands within the archipelago, although the United States Air Force base at Lajes on Terceira island (Fig.1),

the international airport on Santa Maria Island (Fig. 1) and Faial's excellent telecommunications were all to assume positive roles in the emergency⁶. Ministers, officials and scientists were able to fly from Lisbon to Santa Maria and take the relatively short ferry crossing to Faial, emigrants utilized the international airport to fly to North America and aircraft from the US base at Lajes flew numerous aerial reconnaissance sorties. Faial is also vulnerable because of its small size (173 km²) and there is limited scope for intra-island evacuation in the event of a major emergency (see section 5.2).

A second area of pre-existing vulnerability is related to the susceptibility of the island's building stock to seismic events. Despite the history of damaging earthquakes and the poor performance of traditional rubble-stone constructed single-story rural domestic dwellings and more substantial buildings in towns and villages of a similar type, by 1958 virtually nothing had been done to improve the situation. In 1955 a symposium was held to mark the 200th anniversary of the Lisbon earthquake (Ordem dos Engenheiros, 1955) and concluded that buildings in Portugal were highly vulnerable to losses during earthquakes and that a new building code was urgently required. A new code was introduced three years later which was both too late to have had any impact on hazard losses on Faial during the seismic emergency and was generally agreed to have been ineffective (Azevedo et. al, 2009, pp. 561-562). In-depth study of building vulnerability in the Azores has had to wait until more recent times (Pomonis, et al., 1999; Costa, 2002; Murphy-Corella, 2009 and see section 7) and the passage of the 1983 Portuguese seismic building code (RSA, 1983), though this code has not been without its critics (Azevedo et. al, 2009, pp. 562).

The principal features of the island's vulnerability were expressed, however, in its economy and demography. For the people of Portugal in general and Faial and the Azores more particularly, the decade of the 1950s was one in which life for the vast majority of the population was precarious. At the time the economy of Portugal was comparable to that found in other semi-industrialised nations of southern Europe and Latin America with: per capita incomes below \$300 (US); low labour productivity; a predominance of unskilled, often illiterate workers; a large proportion of the labour force employed in agriculture and other primary activities; and technological backwardness (Baklanoff, 1992). In addition the Portuguese government policies of a balanced budget with limited investment and a desire not to be in the thrall of foreign creditors meant that rates of growth in *Gross Domestic Product (GDP)* were low in comparison with other western European countries, averaging *c.*1% per annum between 1934 and 1947 and just over 2% between 1948 and 1958 (Lains, 2003). In the early 1950s the government became alarmed that, as a result of low rates of emigration, living standards in Portugal were hardly rising because of a swelling population (Anon, 1956), and in the *Plano de Fomento 1953-1958* (i.e. Formation Plan) a programme was introduced which involved the investment *c.*17% of *GDP* each year at 1950 values with an orientation towards infrastructure (Neves, 1994). Although this raised growth rates in *GDP* to over 4%, by 1957 little of this wealth had trickled down to the Azores which remained a poor and peripheral region within Portugal (Lains, 2003).

In 1957 Faial was as it had been for hundreds of years an island dominated by the production of primary products both for subsistence and export. First settled in 1466, the land was quickly cleared of its indigenous vegetation, settlers cultivated vegetables and

fruits and the island became known as the 'garden of Portugal', attracting in the period up to the nineteenth century immigrants from both mainland Portugal and Flanders (Costa, 2008a). Especially around Horta, production was geared to victualing ships and American whalers. In the nineteenth century the economy had to change because of the advent of steam ships and refrigeration, and the island developed an agricultural sector that remained largely unchanged at the time of the eruption. Marine provisioning declined and the economy became more closely tied to that of mainland Portugal, with a landuse pattern evolving from one dominated by fruit and vegetable growing to a predominance of pasture and the cultivation of fodder crops. Exports of live cattle, tinned butter and cheese became the staples of agricultural production and cereals - especially maize and to a lesser extent wheat - were grown for local commercial consumption and/or for subsistence, with the former being sown as both a food and a fodder crop. Fishing and whaling were also important activities. As Figure 4 shows, at the time of the emergency landuse was largely controlled by altitude and distance from Horta with cropping being concentrated below 300m, where climatic conditions are sub-tropical, and on the eastern side of the island. Grazing reached to more than 650m in height when not constrained by high slope angles and/or bare rock outcrops, though very high pastures often remained unused. A large area of scrub vegetation to the west of caldera (Fig. 4) comprised both the lavas erupted during the 1672/3 eruptions (Forjaz, 2008) and land with soils too poor or degraded to support anything but very low intensity pastoralism (Callender and Henshall, 1968, pp. 6, 13-14).

At the time of the 1950 census population numbered nearly 24,000 with a density of *c.* 143 persons per km² (SREA, 2007), the highest total in the twentieth century.

Although emigration to Brazil may be traced back to the seventeenth century, mass migration dates from the middle of nineteenth century and acted as a ‘safety-valve’ whereby population pressure was relieved by emigration first to Brazil and later to the USA (Ávila and Mendonça, 2008a). In 1866 population of Faial stood at an all time high of 25,839, falling to 18, 917 in 1920 (SREA, 2007), thereafter it increased due to immigration restrictions imposed in the aftermath of the First World War by the Brazilian and American governments. By the 1950s it was estimated that there were some 250,000 people of Azorean origin living in the USA, who were concentrated in New England and California, whereas at that time the population of the Azores was *c.*337,000 (Callender and Henshall, 1968, pp. 19). Although some limited emigration to Canada occurred after 1953 and small numbers still joined their compatriots in the USA, the end of significant out-migration resulted in an excess of labour and widespread rural poverty in Faial (Ávila and Mendonça, 2008b). Indeed the uncontrolled increase in population was widely viewed as the island’s principal economic problem at the time of the eruption (Forjaz, 2007c). In the 1950s agriculture employed two thirds of the employed population and was characterised by many semi-subsistence farmers who often owned as few as 4-5 head of cattle and frequently cultivated fields of less than 1 hectare in area. In most years there were only *c.*90 days of farm work and, hence, unemployment and mass underemployment were endemic on the island (Callender and Henshall, 1968, pp. 21).

The Azores is often described as a land of peasant farmers who own and cultivate their land (Dervenn, 1956, pp. 18), but this is not the case on Faial. At the time of the eruption one proprietor owned a large proportion of the land and owner-occupiers only just outnumbered tenant farmers (Callender and Henshall, 1968, pp. 20). A third of the

agricultural workforce was over 50 years of age and a mere fifth under 30 (Sousa, 1957) and, despite being dominated by agriculture, the island still had to import significant quantities of foodstuffs especially wheat. In 1957 the only other occupations of significance were fishing (both full and part time), whaling, administration and telecommunications. In 1900 300 expatriates from the UK, USA, France and Germany were employed by companies whose transatlantic cables came ashore at Horta, but by the 1950s this had fallen to just 12 from the UK and USA, with the remainder of the labour being locally recruited (Anon, 1945; Callender and Henshall, 1968).

4. The human impact

The impact of the volcanic eruption and earthquake on the people of Faial is summarized in Table 3. Several features require emphasis. The effects of the emergency for a small island community were severe and for those living in the western *freguesias* of Capelo and Praia de Norte, devastating. By October 1958 in the vicinity of village Norte Pequeno (Fig. 1) farming had virtually ceased, Capelo *freguesia* had only 123 farm animals (excluding poultry) and Praia do Norte just 242 animals, of which all but three were cattle. Most farmers were forced either to sell their livestock, or send them to Pico Island (Fig.1) and/or to mainland Portugal (Rosa and Pereira, 2008, pp. 58).

It is difficult to estimate the maximum extent of the area sterilized by ash, since light coverings were quickly removed by rainfall and at the time different authors used varying minimum depths of ash cover in their calculations. According to Eng. Agr. Garcia of the Technical Mission (Table 3 and Fig. 4) the maximum area covered was 4,652 hectares, *c.* 28% of the area of the island (da Cunha, 1962), but a figure of 2,350 hectares covered by ash to a depth of 5cm or greater (*c.* 14% of Faial) is quoted by

Campos et al. (1960, see also Rosa and Pereira, 2008). Rainfall was ten times heavier than normal in the last three months of 1957 cleansing many pasture lands. For areas formerly in crop this allowed the authorities to clear the land and plant leguminous plants, but further falls of ash from the middle of December covered more land including some that had been previously cleared (Calendar and Henshall, 1968, pp.16). As part of the programme of technical aid to the Azores (Table 3 and Campos et. al., 1960), much attention was paid to land reclamation. Initially in December 1957 this merely involved cutting through the ash, combining it with soil and sowing new crops in the mixture, but later more detailed research was commissioned on the maximum proportion of ash within soils that crops could tolerate. This proportion varied with different plants and overall Garcia (1959) found that when ash accounted for more than 20% of the soil then cropping was rarely satisfactory, although a second study put the figure as low as 10% (Garcia et al., 1960).

In spite of the severe problems encountered in reclamation considerable progress was made in the two years following the eruption, but as late as 1960 c.4.5% of the total land area of Faial was still ash affected to some degree (Callender and Henshall, 1968, pp. 16-18). Not surprisingly given these figures, the effects on cultivation were as severe as those affecting the pastoral sector. For example, before the eruption Capelo *freguesia* had 768 hectares of cropland and 140 hectares of vineyards and even in 1960 the area under crop and vine was only 40% of its pre-eruption total (Callender and Henshall, 1968, pp. 17), through a combination of inundation by ash and lower population pressure due to emigration.

It is not easy to be precise about the number of people who either lost their homes and/or were forced to evacuate, since many people moved on their own initiative using their own resources and are effectively lost from the official record (Neves, 2008). Other people may also have moved for a short time from an area that was initially threatened, yet in the event were never badly affected by ash fall. The whaling settlement of Porto Comprido (Figs. 2, 5 and 6) was abandoned. In December 1957 Governor Pimentel estimated that 1,500 people had been evacuated due to the eruption (Pimentel, 1957d - see Table 3). More precise figures record 1,712 evacuees, with 1,412 going to Horta and 300 to Praia do Norte (Lobão, 2008, pp. 48), data which in all probability include temporary migrants because post-eruption enquiries by Campos et al. (1960) conclude that 164 families were badly affected, with some 680 individuals being involved. The May 12-13 1958 earthquake was more severe in its impact, with the villages of Praia do Norte, Ribeira do Cabo being destroyed and the smaller settlements of Areeiro, Cruzeiro (near Capelo) and Espalhafatos, being badly affected (Fig. 3). Some 1,037 homes were lost or severely damaged and 3,023 people were displaced (Lobão, 2008, pp. 50; Rosa and Pereira, 2008).

5. The emergency response

During the latter half of nineteenth and early twentieth centuries in *economically more developed countries (EMDCs)*, a common feature of hazard responses was that the State became progressively more involved in managing disaster-related emergencies. In contrast, the traditional involuntary pattern of ‘loss bearing’ by individuals, families and/or isolated communities, which has been termed the ‘pre-industrial’ response by

Gilbert White (White, 1973), became progressively less important (Chester, 2005a, pp. 415-416). In the relative poor states of Southern Europe, though not in Portugal (see section 5.2), this transition generally occurred later than was the case in Northern European countries and North America, and in Southern Italy and Sicily, for instance, comprehensive State involvement in disaster recovery may be dated to 1928, when the government acted in a positive and comprehensive manner when faced with the major flank eruption of Mt. Etna which destroyed the large agricultural village of Mascali (Duncan et al., 1976; Chester et al., 1999).

5.1 Traditional Responses

Two typical features were evident in the Faial emergency. The first involves the individual and family actions taken over evacuation and re-housing that have already been noted, whilst a second relates to explanations of losses using religious frames of reference. Religious explanations of disaster transcend traditions of faith, place culture and levels of economic development (Chester et al., 2008), but are nonetheless particularly important features of pre-industrial societies, being especially prominent in counties with a southern European, or southern European influenced, ethos of popular Catholicism (Chester and Duncan, 2009). In writing about what he terms *Açorianidade* (i.e. Azoreanness), Heraldo da Silva points out how people in the Azores routinely turn to God in their everyday lives, invoking the help of the saints, the Madonna and especially the Holy Spirit (Silva, 2008a), the veneration of whom was probably introduced by Queen Isabel in the 13th century (Guill, 1993; Leal, 1994; Mendes, 2001). Throughout the emergency there were numerous examples of: prayers being offered; processions of

sacred objects and votive images being held; intercessions for safe deliverance being made and special Eucharistic services with an accent on safe deliverance being performed (Lobão, 2008; Rosa and Pereira, 2008).

In countries with a popular Catholic ethos, people frequently adopt what has been termed ‘parallel practice’ (Chester, 2005b; Chester et al., 2008), by holding concurrently two sets of apparently incompatible beliefs⁷. Hence despite possessing beliefs suggestive of a divine element in - even responsibility for - disaster losses, there is no evidence that people resisted government relief efforts, which were positively and universally embraced. It is clear that some people were pleased to avail themselves of the opportunity to confess their sins when faced with the prospect of possible death (Garcia, 2008), especially when inchoate notions of divine responsibility was given official sanction by being endorsed by the clergy, but such interpretations were widely resisted by the people. For instance in May 1958 when the village of Praia do Norte village was destroyed the parish priest - Padre Henrique Pinheiro Escobar - absolved the people’s sins *en masse*, an action that was not only theologically problematic but also caused widespread panic (Neves, 2008). Later a sermon preached by the Bishop of Angra, arguing that the earthquake and volcanic eruption represented divine punishment for individual human sinfulness, caused considerable dissent with some of the congregation spontaneously walking out of church (Fraião, 2005).

5.2 State-Sponsored Responses

In spite of its relative poverty compared to its Southern European neighbours, Portugal stands out as having a much longer established and more effective tradition of

State involvement in handling disaster-related emergencies. Recovery following the 1755 Lisbon earthquake, for example, was organized by the King's Chief Minister, the Marquês de Pombal, and was one of the first examples anywhere in the world of an all embracing planned response to a major natural disaster (Chester, 2008). Indeed it has been argued that in terms of the State involvement, this was the world's first 'modern' disaster (Dynes, 2005), and similar comprehensiveness has been noted following subsequent disasters in Portugal, such as the Lower Tagus Valley (or Benavente) earthquake in 1909 (Anon, 1909). There was nothing particularly original, therefore, about the State involvement that occurred during and following the 1957/58 Faial emergency, what is remarkable is both its financial generosity and its logistical/administrative effectiveness.

In the context of Faial's economy at the time the monetary cost of the 1957/58 emergency was not only severe, but in the context of the generally parsimonious character of the *Estado Novo*, the response of the government was generous. With much of the fixed capital, especially housing, in western Faial being either destroyed or so badly damaged as to be uninhabitable and much of the crop and pasture land covered by ash, the value of lost assets and production was serious and was estimated by Cunha (1959) at c.830, 000 US dollars⁸ for lost agricultural output, to which reconstruction costs of over 776,000 US dollars should be added (Anon, 1958d). The *Junta Nacional de Productos Pecuários* (National Council for Cattle Production) donated over 12,000 US dollars for agricultural development (Rosa and Pereira, 2008, pp. 62)⁸, known charitable donations amounted to 171, 153 US dollars⁸ and there was expenditure involved in the technical mission; over 2,000 US dollars according to Campos et al. (1960). Many other indirect costs were hidden and unqualified

and included, *inter alia*: loss of taxation receipts; loss of income due to economic dislocation; the cost of monies paid to residents to clear roads and roofs (Fig. 2); the value of tractors supplied free of charge by the *Serviços Agrícolas*; the value of charitable donations in kind and the extra costs falling on the budgets of the *concelho* and the Governor. Also unquantified are the costs borne by individuals and families in addition to those met by the State. These not only include some of the costs of evacuation, but house reconstruction was also known to have been in part or fully funded by families in many instances (Lobão, 2008, pp. 49). The cost of daily food relief was *c.* 700 US dollars per day (Rosa and Pereira, 2008, pp. 59)⁸, but there is no indication in the archives over how long this initiative lasted. If it lasted 9 months, which is probably an underestimate given the loss of productive land and how long it took to recover, then an additional cost of nearly 200,000 US dollars should be added. Adding all the quantifiable costs, produces a figure of nearly 2,000,000 US dollars (*c.* 15, 300,000 US dollars at 2008 values)⁸. To put this into context, the represents a subsidy of *c.* 970 US dollars per head for the residents of Praia do Norte and Capelo (*c.* 84 US dollars per head for the inhabitants of Faial as a whole), at a time when male agricultural labour rates averaged 70 US cents per day and female rates less than half this amount (Callender and Henshall, 1968, pp. 21; Scofield, 1958).

The logistical support for the people badly affected by the emergency, and the administrative and scientific structures that were put into place in order to deal with its consequences, are listed in Table 3. One feature to emerge from the table is the high level of competence shown by many officials from central and local government who were responsible for delivering the government response. Both contemporary accounts and subsequent reviews and interviews (Campos et al. 1960; Forjaz, 2007a-2007h; Lobão,

2008) praise the actions of: the Minister of Public Works – Eng. Arantes e Oliveira (e.g. Forjaz, 2007c.); Eng. (later Professor Doutor) Frederico Machado (*Director das Obras Públicas* - Director of Public Works for the district), who carried out much of the volcanological and geological observations; Professor Orlando Ribeiro and Dr Castello Branco, respectively heads of the technical and geological missions; Eng. Viriato Campos (head of the Minister of the Interior’s evacuation committee); Sr. Rodrigues Pinelo (head of road construction) and Sr. Tomás Pacheco (lighthouse keeper), who stayed at his post in Capelinhos and made many valuable observations. One feature that emerges from the accounts was the widespread praise paid to the Civil Governor, Dr António de Freitas Pimentel⁹ which dwarfed the tributes received by other officials. For many people at the time Pimentel’s leadership was viewed as heroic, and in June 1958 the governor was awarded a Gold Medal (*Oficial da Ordem Military de Cristo*) (Lobao, 2008, pp 52). One month later a large number of people who had been affected by the volcanic eruption and earthquake approached Pimentel’s residence in Horta spontaneously expressing their gratitude and bringing gifts of flowers (Anon 1958i).

It is difficult accurately to evaluate Pimentel’s leadership because many contemporary accounts so laud his actions that they verge on the hagiographic (Lobão, 2008, pp. 46, 51), none more so than certain reports in Portuguese newspapers which were strongly influenced by government¹⁰. Using more dispassionate accounts of the emergency, both Portuguese and foreign, it is possible to produce a more balanced assessment of the governor’s role, but this still paints a picture of highly successful leadership of an extremely taxing emergency operation. It is clear from Table 3 that Pimentel’s successful leadership was evident from the first days of the emergency (in late

September and early October 1957) to its conclusion, when the village of Praia do Norte was re-opened in 1961. Highlights included:

- a. the initial mobilization and co-ordination of civil, military and political bodies, and the encouragement of central government involvement which culminated in the establishment of the technical and geological missions (October to December 1957);
- b. urging the government in Lisbon to send a mission to aid evacuation in December 1957;
- c. following the advice of Eng. Frederico Machado and Dr Manuel Linhares de Andrade (*Presidente da Junta Geral* the official in charge of public works), in co-ordinating the evacuation of the earthquake damaged settlements in May 1958; and
- d. together with ministers in Lisbon, guiding the reconstruction of earthquake damaged settlements especially Praia do Norte.

Three aspects of Governor Pimentel's management of the emergency are particularly noteworthy. The first relates to his communication skills. Faial is a small island and the governor exploited this to adopt a 'hands on' style of management, being present on site during the most threatening times, not only organizing the response but also showing solidarity with the people and calming their fears (see Table 3 – Forjaz, 2007g). In addition to making extensive use of the local press and wall posters (Anon, 1958b), the fact that the governor was present on the spot was particularly important in a society where illiteracy rates were high and, even amongst those who could read, the vast majority had received only an elementary education (Rosa and Pereira, 2008, pp. 56). The governor's action in donating 300 litres of milk per day from his personal resources was also a gesture which emphasized his care and concern for those affected by the

emergency, so further consolidating confidence in his leadership (Rosa and Pereira, 2008, pp. 62).

A second aspect of leadership relates to the governor's foresight. From the beginning of the emergency Pimentel was aware that the emergency could become much worse and he drew up appropriate contingency plans. In October 1957 his initial evacuation orders erred on the side of caution, later he constantly lobbied central government for both short and long-term aid perceiving correctly that recovery would take many years and, following the earthquake in May 1958, Governor Pimentel joined other officials, government ministers and scientists in planning for the eventuality that a major caldera eruption might occur which would require evacuation of people from Faial by ship (Table 3). They were concerned that refugees would not be able to be accommodated within Faial and all the boats and ships on Faial, Pico and São Jorge Islands (Fig.1) were mobilized, together with two frigates, two patrol ships, a tug from the Netherlands and several merchant ships. Plans envisaged the initial evacuation of the elderly, women and children, but in the event these plans were not required, though the patrol ship *Santo Antão* brought tents and blankets for the homeless (Rosa and Pereira, 2008, pp. 60).

Probably Governor Pimentel's most important insight was that the eruption and earthquake now meant that the island would be even less able to support its population than was the case before the emergency, since productive land had been lost, housing destroyed and the economy disrupted. It is reported that before the end of the emergency Pimentel was already lobbying legislators in the USA, both directly and through the émigré community in New England and California, to pass legislation allowing

immigration from Faial (Lobão, 2008, pp. 46). Emigration as a long-term response to the eruption is discussed more fully in section 6.

The third aspect of leadership shown by Governor Pimentel, perhaps the most important, is his understanding of how successfully to put pressure on central government. As already discussed, the regime at the time was one in which the provision of funds and assistance depended on relationships with people in central government and in this respect the Governor showed finely-honed political skills. Governor Pimentel was able to use his personal friendship with the Minister of Public Works, Eng. Eduardo Arantes e Oliveira, and good relationships with other ministers successfully to lobby for assistance in both cash and kind (Forjaz, 2007c. - see Table 3). Part of the reason for Salazar's longevity was that he continually renewed his cabinets and in the 1950s several members were relatively young technocrats (Lewis, 2002). Arantes e Oliveira (born 1907) being a qualified Civil Engineer. The minister supported Governor Pimentel by visiting the island in May 1958 and announced a comprehensive reconstruction plan (*Plano de Recuperação Económica e Reconstrução da Ilha do Faial*). In turn Arantes e Oliveira was well regarded by and was able to influence Salazar and his Ministers of the Interior, Education and Agriculture (Forjaz, 2007e), all of whom provided assistance.

As the archives make clear (Araújo, 2007), the governor also knew how to exert influence on an extremely bureaucratic government machine and at critical times Pimentel exchanged messages with the authorities in Lisbon on a daily or more frequent basis, usually giving thanks for what had been provided, passing on detailed factual information about the progress of the emergency and making reasoned pleas for assistance. As discussed in section 1, all major items of government expenditure had to

be personally approved by António de Oliveira Salazar and it is reported that on one occasion when Pimentel met the minister he reminded the dictator that he was the only governor in Portugal who had increased the size of his territory due to the additional of new land formed from erupted products. The normally reserved Salazar laughed at this news and signed the papers authorizing further financial assistance (Forjaz, 2007e).

6. The aftermath of the emergency

On October 24 1958 the eruption ended (Table 2) but, as discussed in section 5., much of the financial and other aid continued and many measures that would only bear fruit in the future had already been put in place. In addition to plans to rebuild Praia do Norte and other settlements, these initiatives included: a comprehensive recovery and reconstruction plan, *Plano de Recuperação Económica e Reconstrução da Ilha do Faial*, (Anon, 1958d); and grants from the Ministry of Education (Table 3). Government supported research into economic rehabilitation (Cunha, 1959, 1962) and, more particularly, soil science/agricultural recovery also continued apace (e.g. Garcia et al., 1960; Garcia, 1964), with the joint Central Government and *Junta-Geral do Distrito*⁴ initiatives being especially noteworthy. These included plans to conserve land covered by ash until it could be returned to its owners, to assist in land preparation before planting and to provide grants for machinery, technical assistance and seeds (Campos et al., 1960).

The principal issue in the aftermath of the emergency was, however, demographic, because the loss of so much productive land meant that the long-term problem of excess population in relation to employment opportunities, particularly in the agricultural sector, was exacerbated. With characteristic perspicacity this problem was first recognized by

Governor Pimentel before the emergency ended and on May 26 and reflecting the policy of the *Estado Novo* he encouraged some of the displaced families to emigrate to Angola within the Portuguese overseas empire (Anon, 1958e), while at the end of the month he held talks with the United States Consul from Ponta Delgada when the latter paid a visit to Faial. Later, following lobbying by Americans of Azorean ancestry particularly in New England, a bill was sponsored by Senator (later President) John F. Kennedy of Massachusetts and Senator John O. Pastore of Rhode Island, which subsequently became the *Azorean Refugee Act* of 1958. This legislation allowed 1,500 families affected by the eruption and earthquake to enter the United States, in addition to those allowed entry under the strict quotas established by the *Immigration and Naturalization Act* of 1952. Under the Refugee Act migrants needed a minimal education, no criminal record, a successful medical examination and a sponsor in the United States who was prepared to take financial responsibility for the first five years of an immigrant's life in America (Rogers, 2007, pp. 91; da Silva, 2008b). On December 26 the first evacuees left Faial aboard the ship *Carvalho Araújo* bound for Santa Maria for onward transit by aircraft to the United States. In 1960 an additional 500 visas were made available to victims - or *sinistrados* - of the earthquake and eruption (Lobão, 2008, pp.46-47)¹¹. In 1965 the *Hart-Celler Act* ended the system of immigration quotas and further liberalized immigration policy (Marcos, 2008, pp. 109), so enabling an estimated 40% of Faial economically active population to leave the island in the aftermath of the emergency (Anon, 2001), the majority of whom migrated to the United States though a smaller number went to Canada. Attempts by the central government further to encourage emigration to Portugal's African colonies were singularly unsuccessful, with only 210 people (25 families) taking up this option (Lobão, 2008).

It is extremely difficult to be precise about how many people left Faial under the legislation and how many left later, because the 1958 Act also applied to Dutch immigrants from Indonesia who were included in the bill to ensure a broad consensus in the United States Congress and its rapid passage, but figures range from 3,761 under the 1958 Act according to Callender and Henshall (1968), 3,811 under the same legislation but also including some Canadian migrants (Costa, 1998), c.5000 under the 1958 and 1960 Acts combined (Marcos, 2008) and a more precise figure of 5,164 emigrants between 1959 and 1960 (Ávila and Mendonça, 2008b). A detailed study by Costa (1998), of early migrants makes use of official statistics including passport records (*Livros de Registo de Passaportes*) and confirms that, whereas the three *freguesias* comprising Horta⁴ lost 14% of their population, comparative figures for more rural areas some of which were relatively unaffected by the emergency (Fig. 1), were usually much higher (e.g. Capelo - 41%, Cedros - 25%; Pedro Miguel - 21%, Ribeirinha - 21%, Salão - 20% and Castelo Branco - 18%), though redevelopment of Praia do Norte kept the figure for this *freguesia* down to 14%. These data and others, which show that 16% of total emigrants did not even reside within the District of Horta⁴ and were unaffected by the emergency, is strongly suggestive that many emigrants were non- *sinistrados*: economic migrants who made use of the legislation to re-settle in the USA. A breakdown of the data from Faial by age and occupation shows that: 95% of migrants were either agriculturalists or had no occupation; and that the majority comprised whole families.

Governor Pimentel's period in office ended in 1973, just one year before the *Portuguese Revolution*, allowing him plenty of time to supervise the reconstruction programme. In addition to the policy measures already outlined, the governor also made use

of the publicity Faial had received and his political skills successfully to lobby for further inward investment from central government which took the form of an airport opened in 1971, paved roads, a plan for re-forestation, agricultural co-operatives and improved hospital services (Forjaz, 2007c).

What could not be predicted at the time was the unexpected outcome of emigration policy. Whereas the aim of post-emergency emigration policy was well-founded and intended to bring population and employment into equilibrium by reducing excess labour and so increasing wage rates, for reasons largely beyond the control of either Governor Pimentel or central government emigration was much greater than had been planned and had severe negative consequences, not only for Faial, but also for the Azores more generally. Exodus under the 1958 and 1960 acts acted as a trigger, which when combined with the stimulus provided by the *Hart-Celler Act*, the limited employment opportunities in the Azores and a desire of young men to avoid military conscription, encouraged large-scale out-migration to occur throughout the archipelago. Between 1966 and 1980, c.80, 000 Azoreans emigrated to America (Ávila and Mendonça, 2008b; Marcos, 2008), and by the time of the 1991 census the population of Faial had fallen to just 14, 920, only 62% of its 1950 total. Despite some recovery in the two years following the emergency, by 1991 the population of Capelo (427), Praia do Norte (249) and other *freguesias* in the west of the island had suffered catastrophic demographic collapse, with these two villages losing c.50% of their 1950 population totals (SREA, 2007). Following initial emigration under the 1958 and 1960 acts of a cohort comprising mostly rural labourers, small-scale farmers and their families, there was a marked decrease in land under the plough and an increase in pastoralism which required fewer labourers and produced higher profits for landowners. As

Ávila and Mendonça (2008b, pp. 68-9) have shown, this in turn freed up even more labour which under the *Hart-Celler* Act was now able to emigrate leading to still further declines in subsistence agriculture so increasing food imports and, since it was mostly the young who left, the residual population became progressively more aged. Those who remained were often forced to rely on remittances from younger family members who were now resident abroad. Demographically and economically the fortunes of Faial only improved from the time of the *Portuguese Revolution* in 1974¹².

The vast majority of migrants joined existing communities either in California (Chapin, 1989) - especially in and around San Jose, or on the East coast - where the principal communities are located in Massachusetts, Rhode Island, New Jersey, New York, Connecticut and Florida (de Sá, 2008a). The largest number of post-Capelinhos immigrants went either to New Bedford and Fall River in Massachusetts or to California (de Sá, 2008b). In comparison with some other evacuations from small islands following earthquakes and volcanic eruptions, the most notable being Tristan da Cunha in the Atlantic in 1961 where all but four individuals chose to return to the island some years later (Blair, 1964; Chester, 1993, pp. 235), the post-Capelinhos migrations to America formed stable communities in USA. In the early days the majority of migrants were either too poor to be able to afford a return fare home or had no inclination to do so, but more recently many erstwhile emigrants have returned for visits and some retired people have re-settled on Faial.

Within the context of being a generally successful migrant community, the Faial diaspora has not been without its difficulties. On both the east and west coasts of the USA, virtually all the new arrivals initially entered the lowest stratum of the labour

market usually working in unskilled industrial occupations, though some arriving in California worked on the land (Ávila and Mendonça, 2008). Culturally immigrants continued to express their Azorean identity by maintaining, *inter alia*: strong links within the expatriate community; contacts with family in Faial and practice of a Roman Catholic faith that was grounded in Azorean festivals and processions, in particular those associated with the *Império* (i.e. The Holy Spirit) (Silva, 2008a). Emigrants from the Azores and from Portugal more generally did not fare as well in the USA as many people including Governor Pimentel expected. Although there are many exceptions amongst individuals, their children and grandchildren, studies which have been carried out suggest that even half a century later Americans of Portuguese ancestry, including many within the post-Capelinhos cohort, are still over-concentrated within unskilled occupations (Almeida, 2008). For example de Sá (2008a) points out that graduates comprise 24% of the American population, yet only 19% amongst people of Portuguese origin, while in a study of employment at Brown University on Rhode Island some 90% of employees of Portuguese origin are to be found in manual grades. In a highly detailed study of migrants who entered the United States during Salazar's rule, including those from Faial, Miguel Moniz (2008) points out that the vast majority only possessed an elementary education, usually lacked even basic English language skills and often came from 'small socially conservative and deeply religious villages' (Moniz, 2008, pp. 125). The support newly arrived migrants received from the established Azorean community in the USA, though very welcome at the time, in the long term served to inhibit integration, while the educational opportunities of children were commonly stifled by the need to enter the

workforce as early as possible to support family incomes and remittance payments and/or provide labour for family businesses.

Moniz (2008) also points out that a small number of migrants were deported to the Azores because of felonies related to illegal drugs and that alcoholism was a particular problem within the Azorean community. In a study of the mental wellbeing carried out amongst Azoreans in Cambridge Massachusetts, it was noted that people from isolated rural backgrounds found it difficult to come to terms with life in the urban USA, that many, especially amongst those who arrived in the early 1960s, felt a sense of failure often having to live with what they described as *agonies*. This phenomenon is, not only an ‘anxiety disorder’, but is also a far more complex psychiatric condition in which people dealt with their distress using a mixture of conventional medicine, mainstream spiritual healing within the Christian tradition and by using the services of less conventional traditional healers (James, 2002; Morrison and James, 2009). A much milder longing for homeland, for which Portuguese has the word *saudade*, has long been a feature of expatriate Azorean communities including those displaced by the emergency of the late 1950s (Callender and Henshall, 1968, p. 19).

7. Conclusion: The policy implications of the 1957/8 emergency

As argued in section 6, responsibility for the unplanned and unexpected impact of the *Hart-Celler Act* on the demography of the Azores generally and particularly on Faial cannot be placed at the door of Governor Pimentel, though the policies of the *Estado Novo* over the lack of economic opportunities outside traditional economic sectors and military conscription undoubtedly played their part. In spite of some negative comments

from one of our interviewees over what was perceived to be the slow response of the Portuguese government in providing financial aid, which contrasted with that given by the USA government, its agencies and the Azorean expatriate community (Garcia, 2007), this is a minority position. The overall impression gained both from our respondents and from contemporary source materials is of a difficult emergency handled extremely well by the authorities, and of a successful recovery from it. Although it is impossible to say with any certainty what might have happened in any historical context, it is arguable that the disaster caused a focusing of resources and political interest on Faial with the people adversely affected doing better economically than they would have done if the eruption and earthquake had never occurred.

One negative feature often noted in the recovery phase following a disaster is a lack of overall leadership which results in spatial variation in the effectiveness of the measures put into place. Following the 1944 eruption of Vesuvius, for example, only one local authority (i.e. *comune*) had a single mayor (i.e. *sindaco*) in office throughout the recovery phase and it is notable today that San Sebastiano has a higher quality urban fabric and infrastructure than any other affected settlement (Chester et al., 2007). As mentioned in section 6, the governor served until 1973 and provided strong and sustained overall direction of the recovery programme and it could be argued that the success of responses to the 1957/8 eruption and earthquake, reflected in some measure the fact that Governor Pimentel possessed the advantages of longevity in office, a close personal connection with the island and its people and good relationships with the government in Lisbon all of which would be difficult to replicate under any political system. The *Estado Novo* came to an end with the *Portuguese Revolution* of April 25 1974 and it is

interesting to ask whether the powers of centralized direction so successfully deployed, would be available to today's hazard managers who have to operate within a democratic context.

The indications are that a future emergency would be well handled. In a democracy as opposed to a totalitarian state, politicians have to react to the wishes of an electorate. What is more, the period since the 1974 revolution has been one in which there have been major increases in living standards throughout Portugal and a concomitant inflation of the expectations people have of government. Today administratively responsibility for civil protection in the Azores operates as a cascade. Minor and localized problems are dealt with within individual *freguesias* and larger-scale problems are successively the responsibility of: the *concelho*; the Azores Autonomous Region and a minister within the national government. A repetition of a 1957/8 scale disaster would be under the control of the General responsible for Civil Protection who is located on Terceira Island (Fig. 1), and who would be able to exercise powers very similar to those so successfully employed by Governor Pimentel. Whereas in 1957/8 decision makers had to react to events, and in this respect were fortunate that the decisions they took were correct, today's hazard managers would enjoy the benefits of far more comprehensive hazard assessment and logistical plans, many of which are already in place (Oliveira et al., 2008a, 2008b).

In 1998 Faial was struck by a major earthquake with a maximum intensity of VIII, which killed 8 people, injured 150 and made 1,500 homeless (Table 1). It affected the whole island but caused widespread destruction in the *freguesias* of Salão, Ribeirinha, Flamengos and Pedro Miguel (Fig. 1). This event showed that the system of civil

protection in the Azores worked well (Oliveira et al., 2008b). Orderly evacuation took place, temporary accommodation was provided and generous financial support was made available following the disaster both for those directly affected by it and for the island as a whole. According to Melo (2008, p. 679-681) public investment on housing alone amounted to 245 million Euros (*c.*360 million US dollars), with a further 16 million Euros (*c.* 24 million US dollars) being spent on temporary pre-fabricated dwellings and *c.*42 million Euros (*c.*62 million US dollars) on the repair, reconstruction and/or rehabilitation of the health, education, communications and industrial infrastructure. Encouraging inward investment was also part of post-disaster policy and the number of companies in Faial grew from 292 in 1998 to 414 in 2002, with construction companies alone increasing from 30 to 50 in the two years following the disaster, effectively mopping up any excess and displaced labour (Luis and Ferreira, 2008). The 1998 earthquake also highlighted that the traditional building stock of the Azores, which was so badly affected in 1958 (section 3), remains highly vulnerable.

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Table and Figure Captions

Table 1: List of the principal felt earthquakes on Faial (based on information in: Coutinho et al., 2008 pp. 9-11 and Senos et al., 1998).

Table 2: Summary of the chronology of the 1957/1958 eruptions and seismic activity on Faial Island. Based on information in: Anon (1958a); Castello Branco et al. (1959); Cole et al. (1996, 2001); Machado (1958a, 1958b, 1959a); Zbyszewski, and Veiga Ferreira (1959); Zbyszewski (1960); Machado et al. (1962) and Scarth and Tanguy (2001).

Table 3: Summary of the impacts of the Capelinhos eruption and earthquake on the people of Faial, and the responses of the authorities to the emergency.

Figure 1. Location map showing Faial before the eruption (based on Anon 1945 and other sources).

Figure 2. Map of Capelinhos volcano during and after the 1957/1958 eruption (modified after from Cole et al. 2001, pp. 205, Fig. 2).

Figure 3. Isoseismal lines showing the maximum earthquake intensity during the night of the May 13 to 14 1958 (based on Machado 1958, Fig. 6 and is reproduced with permission of the journal *Atlantida*). Intensity values are mapped according to the Modified Mercalli Scale, which is closely related to both the Medvedev-Sponheuer-Kárnik (i.e. MSK) scale and the more recent European Macroseismic Scale 1998 (i.e. EMS-98). A maximum intensity of X roughly equates to a Richter Magnitude (M_L) *c.* 7-7.6.

Figure 4. The landuse of Faial in 1960. The area in the west that was covered by volcanic products was formerly dominated by cattle rearing, maize production and some of the best vineyards on the islands (simplified after Callender and Henshall, 1968, endpaper and other sources).

Figures 5. View from Porto Comprido looking north to the lighthouse (authors' photograph).

Figure 6. Abandoned houses at Porto Comprido (authors' photograph).

Figure 7. A contemporary photograph showing earthquake damage (photograph reproduced by courtesy of Dr. Luis Decq Mota).

Table 1

Event	Description
May 24 1614	Felt earthquakes from April 9 and significant seismic event occurred on Terceira Island on May 24.
June 9 to 4 July 1647	Earthquakes were felt on June 9, 29 and July 4.
April 12 to April 23 1672	Seismic shaking was frequent and intense.
April 5 1690	A strong earthquake.
July 9 1757	Earthquakes were felt on S. Jorge island (Fajã dos Vimes), where 128 people were killed. Damage was noted in Piedade (Pico Island) and Terceira Island.
December 24 1759 to May 8 1760	Felt earthquakes. A strong earthquake occurred on December 24 and another 'extraordinary one' at 21.00 h on January 4.

June 24 1800	A strong earthquake that caused destruction on Terceira Island.
February 26 1801	A strong earthquake occurred at 15:30 h on Terceira.
May 1 1808	A strong earthquake at 11.30 h (A volcanic eruption on S. Jorge, Island)
September 26 1862 to February 9 1863	A prolonged crisis with violent shaking between October 8 and 13, and on February 9 1863.
May 3 1871	Intense ground shaking at 5.30 h.
May 3 1872	Strong ground shaking felt at 02.15 h and at 02.18 on S. Jorge Island.
July 1 1890	At 06.45 h, or 08.30 h, a strong earthquake was felt and caused damage.
December 1892? to February 1894	A drawn out seismic crisis, (starting in April 1892) with major events occurring on May 12, July 2 and September 16.
April 30 1896	Three earthquakes, one of which was very strong.
April 8 1898	Strong earthquake at 07.00 h.
May 8 1915	A strong earthquake.
December 21 1917	A strong earthquake at 17.00 h.
March 16 1920	A strong earthquake was felt at 05.15 h. Fallen walls and the opening of cracks in houses were noted.
February 9 1924	A strong earthquake occurred at 01.15 h and damage was caused to churches in the Conceição area in Horta and in the village of Flamengos.
September 1926	A seismic crisis. Violent earthquakes occurred on April 4 (Intensity VIII) and on August 31 (Intensity X). Much damage was caused in: Horta; Flamengos; Praia do Almojarife; Pedro Miguel; Ribeirinha; Salão and Feteira. 8 people were killed, more than 100 were injured and there were 4,138 cases of houses being destroyed and rendered uninhabitable.
May 12 1946	A strong earthquake was felt in Capelo (Intensity VII).
May 12 and 13 1958	Violent earthquakes (Intensity X). Extensive and severe destruction in: Praia do Norte; Ribeira Funda and Espalhafatos. 508 houses were damaged and 273 were destroyed.
December 1973	Seismic crisis on Pico and Faial, centred on

November 1992 to May 1993 1998	<p>Horta and Flamengos (Intensity VII). Damage to houses and slope failures occurred along the coast and on the inner-slope of the caldeira.</p> <p>Seismic crisis. More than 100 earthquakes. Prolonged seismic crisis. A violent earthquake occurred on July 9, with more than 400 earthquakes occurring in October. 8 people died, 150 people were injured and more than 1,500 people were made homeless.</p>
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Table 2

Events	Description
First phase of <i>Surtseyan</i> activity	<p>Sept. 6 - 27, <i>c.</i>200 felt earthquakes with an increasing frequency over time.</p> <p>At 08.00 h on Sept. 27 the sea began to boil and an eruption occurred from vents <i>c.</i>400m west of Ilhéus dos Capelinhos, in seawater and with a depth of <i>c.</i>80m (Figs. 1 and 2). The eruption consisted of hydrovolcanic (i.e. <i>Surtseyan</i>) activity with explosive interactions between the magma. Clouds of white steam were generated.</p> <p>In October much of the island was affected by lapilli and ashfall and, by the time this activity ceased on October 29, a substantial tuff cone had been constructed. Thin ashfall was noted on Pico and São Jorge islands (Fig. 1)</p> <p>By November 1, the cone had partially collapsed and had been heavily eroded by the sea. All that remained was a shoal of material around the</p>

	western end of the Capelo peninsula (Fig. 1)
Second phase of <i>Surtseyan</i> activity	<p>On Nov. 4 and 5 a small cone was constructed which was subsequently destroyed by the sea.</p> <p>Eruptions resumed on Nov. 7, from a vent <i>c.</i> 100m to the east of the initial eruption site (Fig. 1) and quickly constructed a new tuff cone. By Thursday Nov. 12, windblown ash had built an isthmus that jointed the new volcanic cone to Faial.</p> <p>In early Dec. the eruption began to wane and this second cone began to slump into the sea.</p> <p>On Dec. 10-11 - 10.5 cm of ash was deposited overnight in the Castel Branco region (Fig. 1).</p> <p>Effusive activity began at 22.30 on Dec. 16, with lava fountaining and <i>Strombolian</i> explosions.</p> <p>On Dec 19 <i>Surtseyan</i> activity recommenced.</p> <p>Activity ceased on Dec 29 and partial cone collapse occurred.</p>
Third phase of <i>Surtseyan</i> activity	<p>In January <i>Surtseyan</i> activity gradually increased in intensity and continued throughout the first four months of 1958. Sufficient lava was erupted to form an apron around the tuff cone that, not only reduced marine erosion, but also kept sea water from penetrating the vent, so inhibiting the volume and frequency of the <i>Surtseyan</i> events.</p> <p>On Feb. 9-10 - 1.55m of tephra was deposited in one night at the lighthouse. Ashfall affected the entire island. On March 23-24 1.9 m of ashfall at the lighthouse. By March 31 ash had covered most of the Capelo peninsula with ash.</p> <p>On April 20 simultaneous magmatic and <i>Surtseyan</i> activity. April 23 - Strong effusive eruptive activity, lava was erupted to the south west and violent magmatic activity occurred. By the beginning of May <i>Surtseyan</i> activity declined.</p>
Seismic Crisis	<p>Over 450 earthquakes occurred between Monday May 12 and Wednesday May 14. Intensities reached X on the <i>Modified Mercalli Scale</i> on the night of May 12-13, had a focal depth of <i>c.</i> 1 km and caused extensive damage. Many large cracks in the ground (Fraga, 2008). The epicentres of the earthquakes occurred below the caldera located in the centre of the island (Fig. 3). Lower intensity earthquakes (<i>c.</i> 130 in number) continued until the end of June.</p> <p>May 14. A small explosion followed by fumarolic activity occurred in the floor of the central caldera. At Capelinhos magmatic activity built a basaltic spatter cone to a height of <i>c.</i> 75m before the end of May. Activity continued</p>

until Friday October 24 when the eruption ended.

Table 3

Events	Human Impacts and Responses
Phase 1 - <i>Surtseyan</i> activity. September 16 to November 7	<p>September 16-27. Many earthquakes caused concern, but produced no damage (Anon, 1957a). Much evidence of prayer and more frequent church attendance was noted (Anon, 1957b).</p> <p>September 27. Whalers and their families abandoned Porto Comprido whaling station (Lobão, 2008). Before the eruption there over 100 whalers were employed and operated an estimated 18-19 boats (Garcia, 2005). Interview with Sr. Manuel Vargas Garcia – Technical Officer to the <i>Junta Geral de Distrito Autónomo</i>. December 15, 2005.</p> <p>October 1. The lighthouse (Fig. 2) was abandoned (Anon, 1957c) and fishermen had to leave the area because of the toxicity of the water (Cunha, 1959).</p> <p>On October 7. The Governor called a meeting of all civil, political</p>

and military organizations.

October 6-7. Change of wind from SE to NE and most of the island suffered ash fall. Governor Pimentel mobilised medical aid and transport and was advised by Professor Orlando Ribeiro (of the technical mission) to evacuate the affected area. Governor Pimentel consulted the President of the *Câmara* of Horta *concelho* (Dr. Sebastião Goulart i.e. chairman of the county council) and c.1,500 people were evacuated from Canto do Capelo and Norte Pequeno *freguesias*, by the *bomberios* (e.g. fire fighters) and the *Legião Portuguesa*.¹³

Some people were evacuated to relatives' homes in other parts of Faial (Garcia, 2005). Rainfall, ash and high winds impeded the evacuation and people were transported by trucks, cars and ambulances. Ash fall caused roofs to collapse. Most people were accommodated in Praia do Norte (Fig. 1) and food was supplied to the victims (Pimentel, 1957a). The authorities restricted access to the area affected (Anon, 1957d, 1957e).

October 5 to December 30. A technical mission was sent from the Ministry of Public Works in Lisbon to Faial, headed by Professor Orlando Ribeiro, who arrived in Horta aboard the warship *S. Tomé* (Campos et al., 1960; Labão, 2008). It was concerned with: geology and meteorology; the provision of finance; evacuation assistance; authorization of public works and, from Oct. 31, the removal of ash from roofs and roads, and the planting of land affected by ash fall. The mission proposed that:-

- a. Public works should provide 2-3 years of employment for the people affected by the eruption.
- b. The agricultural service (*Direcção - Geral dos Serviços Agrícolas*) should investigate how the land covered by ash could be brought back into production.
- c. Land taxes for the *freguesia* of Capelo should be suspended.
- d. Research should be carried out on a scheme of agricultural development to provide the island with greater long-term economic security
- e. Aid from State should be forthcoming to repair housing, roads and the lighthouse.
- f. The terms of loans advanced for the purchase of livestock should be eased.

October 20. A specialized geological mission arrived on Faial led by Dr Castello Branco. During the eruption members of the Ministry of Education gave up their time to observe the eruption (Forjaz, 2007f) Around this time, three committees were formed to deal with: Transport; Assistance (i.e. food and lodging) and Animal

 Assistance/Veterinary Care (Lobão, 2008)

October 28. So far 150 families had been evacuated and Governor Pimentel writes to the Minister of the Interior that he is seeking accommodation in unoccupied houses, 150 men and some women have been found work and total evacuees now total *c.* 1,700. Many animals – mostly cattle – have been removed from the area affected. Men were paid *c.* 70 cents (US) per day to clear roads (Scofield, 1958) and woman *c.* 30 cents to clear roofs (Fraião, 2005). He intercedes with the government for taxes to be suspended in Capelo *freguesia* (Pimentel, 1957b). Council workers, fire fighters and a small number of soldiers assisted the evacuees and photographs show that a variety of vehicles were used (Rosa and Pereira, 2008)

Phase 2 - *Surtseyan* activity. November until the middle of December

December 16. Torrential rain causes damage to houses and wet ash causes roof failure, further evacuation is required and the Governor reports in a telegram to the Minister of the Interior that the people of Capelo (Fig. 1) now feel threatened (Pimentel, 1957c). In reply to this telegram the Minister of the Interior formed a committee, headed by Engineer Viriato Campos, to assist the local authorities with evacuation and the committee left for the Azores by air to Santa Maria Island (Ministry of the Interior, 1957).

December 17. Azorean and Portuguese expatriates in California donate *c.* \$800 (US) to provide Christmas presents to the victims of the eruption. In his reply the Governor notes that many people have been found work, and that food, clothes and toys have been distributed (Anon, 1957f). The clothing was stored in and distributed from Horta and some of it was, reportedly in poor condition (Garcia, 2005).

Phase 3 – *Surtseyan* activity.

December 29 (1957) to May 12 (1958)

December 30. The technical mission leaves Faial for Lisbon. By this time the *freguesia* of Capelo has been reduced ‘to ash and sand’ and those who are too old and/or cannot work receive an allowance of food (Pimentel, 1957d). The ration comprised two loaves of bread, *c.* 1 litre of milk, some cheese and vegetables (Scofield, 1958, pp. 753).

Seismic Crisis

Monday May 12 to Friday October 24

May 12 – 13. During the night an earthquake destroyed the villages of Praia do Norte, Ribeira do Cabo and partly destroyed the smaller settlements of Areeiro, Cruzeiro (near Capelo) and Espalhafatos (Fig. 3). Governor Pimentel, following the recommendation of Eng. Frederico Machado, ordered an immediate evacuation. Later the Governor, together with Dr. Linhares de Andrade (*Presidente da Junta Geral* i.e. chairman of the council) and Eng. Frederico Machado (*Director das Obras Públicas* i.e. Director of Public Works), visited the caldera and found that gases were being emitted and feared a major eruption. The local press and wall posters were used to reassure the people (Anon, 1958b), and Governor Pimentel and Eng. Machado ordered the evacuation of the population of Capelo and Praia do Norte. Some 500 homes had been destroyed (Anon, 1958c; Anon,

2008b).

May 15. The Minister of Public Works Eng. Arantes e Oliveira, arrived in Horta, to examine the situation. He: announced a comprehensive recovery and reconstruction plan (*Plano de Recuperação Económica e Reconstrução da Ilha do Faial*); ordered that ships should be made available should rapid evacuation of the island be required and announced that the Under-Secretary of National Education (*Subsecretário Educação Nacional*), Sr. Rebelo de Sousa would be providing grants.

May 26. Governor Pimentel and the *Junta Geral* discussed a plan to assist farming and the Governor encouraged families to emigrate to Angola (Anon, 1958e).

End of May. The US Consul visited the Azores to discuss immigration into the USA (Anon, 1958f).

June 1. USA forwarded 30,000 US Dollars worth of food aid. It is provided by a charity CARE (Cooperative (for) American Remittances To Everywhere) (Anon, 1958d; 1958g).

August 18 – Crops sown after the initial eruption were covered once more by ashes (Anon, 1958h).

Phase 5 After October
1958

A delegation from the Portuguese community in California visited Faial and donated 140,364 US Dollars (Lobão, 2008, pp. 52).

40% of economically active population emigrated from Faial following the eruption (Anon, 2001). *c.* 5,000 people left the District of Horta under the Azorean Refugee Acts of 1958 and 1960, most of whom lived on Faial. In 1965 a new immigration law abolished the quota system, and between 1966 and 1980 *c.* 80,000 Azoreans emigrated to America, the majority going to the USA (Chapin, 1989; Ávila and Mendonça, 2008a).

By 1960 people had started to return to the villages of Capêlo and Norte Pequeno and began to replant their fields with maize. The plants rarely reached a height of 0.3 m, but provided some fodder (Callender and Henshall, 1968, pp. 18). Reconstruction of Praia do Norte began in 1960 (Labão, 2008), which was closed by the authorities between 1958 and 1961 (Neves, 2008).

¹ A detailed discussion of the policies and characteristics of the *Estado Novo* is beyond the scope of the present paper, but further information may be found in: Gallagher (1981); Wheeler (1981); Guill (1993); Baklanoff (1992); Birmingham (1993); Pinto (1995); Anderson (2000); Lewis (2002); Cairo (2006).

² Even as late as the 1950, the majority of Portuguese only received an elementary education (Moniz, 2008, p. 123).

³ Foreign scientists included: the eminent French volcanologist Haroun Tazieff; and from the USA members of the Lamont (now Lomont-Doherty) Geological Observatory at Columbia University, New York and the Cranbook Institute of Science in Michigan. The emergency was also reported by *Paris Match*, *National Geographic*, *The Times (London)* and the *New York Times*.

⁴ In Portugal local government comprises the *concelho* (i.e. county) and the *freguesia* (i.e. parish). Faial is a single *concelho* administered from Horta, which is divided into 13 *freguesias*: Capelo; Castelo Branco; Cedros; Feteira; Flamengos; Angústias; Conceição; Matriz; Pedro Miguel; Praia do Almoxarife; Praia do Norte; Ribeirinha and Salão. Angústias; Conceição and Matriz are the *freguesias* which constitute Horta and are often combined for statistical purposes. The location of the *freguesias* is shown in Figure 1. In Portugal, the principal settlement (*povoação sede de freguesia*) usually gives the *freguesia* its name. In 1957 the Governor of the District of Horta administered Faial, Pico, Flores and Corvo Islands (Fig. 1).

⁵ The expedition comprised six female students from the University of Oxford, of whom all but one were graduates. The excursion was known as the ‘Oxford Women’s Expedition to the Azores’, because at the time women were not eligible to be members of the Expedition Society and the word ‘university’ could not be used in the title of the Survey (Momsen, 2008; Tomblin, 2008).

⁶ The Azores were important in the early stages of transatlantic aviation. In the late 1930s, Pan-American Clippers (using Boeing 314 seaplanes) called at Horta, a service which after the Second World War was rendered obsolete by the availability of long-distance, land-based piston-engined aircraft. At the time of the emergency these called at Santa Maria airport to refuel. The base at Lajes (originally known as Lagens), was built in the Second World War by Royal Air Force, following an agreement between the UK and Portugal. At the time of emergency it was mostly used by the United States and Portuguese Air Forces (Guill, 1993). Since the 19th century, Faial had been an important centre for transatlantic telegraph and telephone cables (Callender and Henshall, 1968, p. 19).

⁷ Believing in two mutually incompatible explanations, or holding one view yet acting contrary to it, is termed *parallel practice* or sometimes *cognitive dissonance* in hazard studies. In psychology and religious studies *cognitive dissonance* has a more restrictive definition (Carroll 1990, pp. 123-4) and for this reason *parallel practice* is used in the present paper.

⁸ Figures are converted from *Escudos* to US dollars using the conversion: 1 US dollar = 29 Escudos. Cunha (1960) estimates that agricultural losses were 24,000 Contos (1 Conto=1,000 Escudos) = c.830,000 US dollars.

Anon (1958d) costs the reconstruction plan at 22,500 Contos = 776,000 US dollars. The *Junta Nacional de Produetos Pecuários* (National Council for Cattle Production) donated 350,000 *Escudos* = c.12, 000 US dollars for agricultural development (Rosa and Pereira, 2008, pp. 6).

Charitable donations:-

- i. From expatriates in the USA 30, 000 US dollars (Anon, 1958d, 1958g).
- ii. From expatriates in the USA for Christmas presents 789 US dollars (Anon, 1957f).
- iii. From a delegation from the Portuguese community in California 140, 364 US dollars (Lobão, 2008, pp. 52).

Sub-total - charitable donations 171, 153 US dollars.

Cost of food aid = 20, 000 *Escudos* per day (c. 700 US dollars) for nine months = c.200, 000 US dollars (Rosa and Pereira, 2008, pp. 59).

1957 dollars values expressed in 2008 money terms are approximate and subject to many caveats. In this paper, it is assumed that 1 US dollar in 1957 is worth 7.65 US dollars in 2008 (Anon, 2008a).

⁹ When the eruption began in September 1957, Dr Pimentel had been in post as Governor of the District of Horta (see footnote 4) since 1953, having been born on Flores Island in 1901. Trained in Lisbon, where he made good contact with the government, Pimentel had previously earned his living as a medical practitioner (Forjaz, 2007c).

¹⁰ Lobão (2008, pp. 51) quotes one newspaper report. ‘Dr Freitas Pimentel...is what we could call, very properly, a governor fit for the circumstances. An exceptionally dynamic person, a much-needed leader and even a person of shocking compassion, truly Christian, who has performed a very important job, justifying the highest gratitude, during a very difficult emergency. No one would have known how to take this ship to a safe harbour like he did. He sees everything, he anticipates everything, he is present everywhere, in a fantastic activity. Here we register our utmost and deepest admiration.’

¹¹ The *Azorean Refugee Act* 1958 is also known as the *Pastore-Kennedy-Walter Act* or just the *Pastore-Kennedy Act* (Public Law 85-892). The act under which an additional 500 visas were issued is the *Azorean Refugee Act* 1960 (Public Law 86-648). The 1960 Act followed a visit by Governor Pimentel to the USA in March 1960. In addition to meeting many *sinistrados*, Pimentel lobbied for the new legislation (Lobão, 2008, pp. 52).

¹² From 1974 the rate of decline in population decreased, and between 1991 and 2001 showed a slight increase. Between 1976 and 1980 policy involved limited investment in infrastructure (e.g. housing and sanitation) and social policy (e.g. education and housing). From 1986 and with the accession of Portugal to the European Communities (later the European Union), much greater investment occurred and between 1980 and 1990 economic growth rates exceeded 3.5% per annum (Ávila and Mendonça, 2008b).

¹³ The *Legião Portuguesa* - Portuguese Legion - was a Salazarist militia created by the government in 1933 following prompting from the political right in order to support the aims and objectives of the *Estado Novo* (Rodrigues, 1997).

