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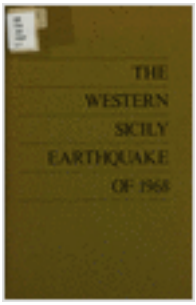

Western Sicily Earthquake of 1968 (1969)

Pages
79

Size
5 x 8

ISBN
0309339081

Haas, J. Eugene; Committee on Earthquake Engineering Research; Division of Engineering; National Research Council; National Academy of Engineering

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THE WESTERN SICILY EARTHQUAKE OF 1968

A Report Prepared
by

J. Eugene Haas, Professor of Sociology, and
Robert S. Ayre, Professor and Chairman of Civil Engineering
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Division of Engineering - National Research Council
National Academy of Engineering

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Published by the National Academy of Sciences
for the
National Academy of Engineering
Washington, D. C.
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This is a report of work under
Contract No. NSF C310, Task Order 115
between the National Science
Foundation and the National
Academy of Engineering

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INTRODUCTION

Location

The map in Figure 1 shows the island of Sicily (a governmental region of Italy, with the regional capital at Palermo), the three affected western provinces - Palermo, Trápani and Agrigento - and their capital cities of the same names, and the various towns of principal interest to us. The cities of Messina, Catania, and Syracuse on the east coast have also been shown, but they were not affected by the western earthquakes of 1968. Many separate governmental units and sources of authority were involved in the reaction to the earthquakes, including the national government of Italy, the regional government of Sicily, three provincial governments (the common point of the provinces lying near the center of greatest damage), and the many town governments. The population figures for the provinces (source: 1961 official government census) are: Palermo Province, 1,117,500; Trápani Province, 430,711; Agrigento Province, 494,891. Small fractions of these populations lived in or near the seriously damaged towns. The island of Sicily is only slightly larger in area than the state of Vermont.

History

One of the major earthquake disasters of this century occurred in Messina at a distance of less than 250 kilometers from the region of damage of the January 1968 quakes. Sicily and the mainland of Italy, particularly the south, have been known for many years to be seismically active. The region lies in one of the major earthquake belts of the world. Furthermore, the high density of population and the crudeness of much of the old masonry building construction, coupled with seismic activity, make the region prone to earthquake-induced disaster. Western Sicily, at least in recent times, had escaped earthquake disaster. While there were regulations governing earthquake-resistant construction in eastern Sicily it had generally been felt that they were not necessary in western Sicily and none were in effect (Earthquake, 1963). Even if there had been such regulations in force they would have

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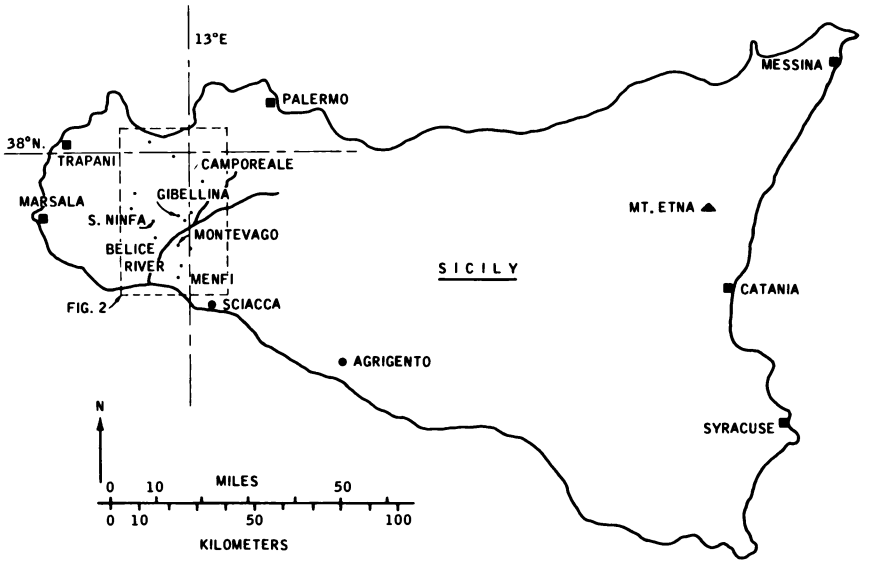

Figure 1. Map of Sicily showing the damaged towns visited (Vita, Salemi, Santa Ninfa, Partanna, Montevago, Santa Margherita di Belice, Gibellina, Salaparuta, Poggioreale, and Camporeale), the capitals of the affected provinces (Palermo, Trapani, and Agrigento), and some other cities. The rectangular area, surrounded by a dashed line, is shown in greater detail in Figure 2.

had no effect on the old masonry construction in which so much of the destruction, injury, and death occurred. The damage was reminiscent of that which has occurred in other locations in the vicinity of the Mediterranean, for example, in Greece, (Ambrasey, 1967) and Turkey, (Pinar, 1956; Ambraseys and Zatopek, 1968, 1969; Wallace, 1968).

Goethe, in the years 1786-1788, made an extensive tour through Italy. In the spring of 1787 he spent considerable time in Messina, which had been destroyed by an earthquake in 1783. In his published record of the visit he describes vividly the devastation of the city, some of the types of

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construction, the temporary housing, and the reaction of the people. Change a few details of time and place, and the description could apply as well to western Sicily nearly two hundred years later. The following quotations have been taken from a translation (1968) of Goethe's book:

> "..... we got a terrifying picture of a devastated city. For a good quarter of an hour we rode on our mules through ruin after ruin till we came to our inn. This was the only house which had been rebuilt, and from its upper floor we looked out over a wasteland of jagged ruins.....
>
> "..... After the enormous disaster in which twelve thousand people were killed, there were no houses left in Messina for the remaining thirty thousand. Most of the buildings had collapsed and the cracked walls of the rest made them unsafe. So a barrack town was hastily erected in a large meadow north of the city.....Only a few of the larger buildings have entrances which can be closed, and even these rarely are, because those who live in them spend most of their time out of doors. They have been living under these conditions for three years now, and this life in shacks, huts and tents, even, has had a definite influence on their characters. The horror of that tremendous event, the fear of its repetition, drive them to take their delight in the pleasures of the moment. The dread of a new catastrophe was revived about three weeks ago...when a noticeable tremor shook the grounds. We were shown a little church which was crowded with people at the time. A number of them, it is said, have not yet recovered from the shock.
>
> .....
>
> "We entered the hut (one of the barracks), which was built and roofed with planks.....The timberwork was visible and a green curtain separated off the front part, which had no

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> flooring but seemed to have been beaten flat like a threshing floor. A few chairs and tables were the only furniture, and the only light came through chance chinks in the boards.....
>
> .....
>
> "There can be no more dreary sight in the world than the so-called Palazzata, a crescent of palazzi which encloses about a mile of the harbour waterfront. Originally they were all four-storey stone buildings. Several facades are still intact up to the coping; in other cases one, two or three floors have collapsed, so that this string of once splendid palazzi now looks revoltingly gap-toothed and pierced with holes, for the blue sky looks through nearly all the windows. The rooms inside are all in ruins.
>
> "There is a reason for this. The grandiose project was begun by the rich. The less well-to-do wished their houses to look as impressive from the street, so they concealed their old houses, which were built of rubble cemented with lime, behind new facades of quarried stone blocks. Such structures were unsafe in any case, and when there was an earthquake, they were bound to collapse.....
>
> "That it was shoddy building, due to the lack of decent stone in the neighborhood, which was the main reason for the almost total destruction of the city, is confirmed by the fact that the few buildings which were solidly constructed survived. The Jesuit college and church, which were built of quarried stone, are still intact....."

It is also of interest to refer to the extensive accounts by Freeman (1932) of earthquake damage in Italy. With reference to an earthquake disaster in 1915 on the mainland he writes of "wretchedly weak walls, built of rounded stone laid in weak mortar, and with weak girders for the support of heavy roofs." These same words can be

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applied to describe many of the old buildings in west central Sicily. Other publications which are pertinent are those by Ambraseys (1965), Cavallo and Penta (1965), Minami (1965), and Sheehy (1966).

Summary of the 1968 Disaster in Sicily

The Sicilian earthquakes of 1968 were relatively modest for disaster-inducing earthquakes, the magnitudes ranging from 4.1 to 5.4. There were many of them, however, at least seventeen separate occurrences in this range of magnitude being recorded in twenty-three days. Perhaps it was the number of occurrences in a relatively short length of time, as much as their magnitudes, that resulted in the great human disaster. Rescue workers came in rather quickly after the first few earthquakes (the afternoon and evening of January 14 and the early morning of January 15), but they were frequently caught in the further collapse of the buildings brought on by later quakes. Furthermore, the repetition of the earthquakes at relatively short intervals of time had a strong psychological effect on the inhabitants akin to repeated physical torture. No sooner had the people partially forgotten their fears after one earthquake than another occurred. The effect was terrifying to a great many persons. There is good evidence to indicate that this was so even in the city of Palermo which is located a considerable distance from the center of activity.

At least four other factors also contributed to the disaster. One was the unusually severe winter weather and the lack of safe shelter; another was the superstition, poverty, and generally low level of education found among the villagers of interior Sicily; a third was the frequent lack of effective town government and adequate services even in the best of times, and a fourth was the lack of advance planning.

Disaster - A Dynamic Phenomenon

The earthquake itself is not the disaster. It is the adverse consequence to the human community that is the disaster (injury and death of human beings; disruption of family and community life; impairment of business, agriculture, and other gainful activity; destruction and loss of buildings, crops, farm animals, and other forms of

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wealth). It is a dynamic phenomenon which takes place in a short period of time and which has far-reaching effects in time.

The human community is a highly nonlinear system of interacting components (human beings, their property and organizational subsystems related to wealth, education, survival, government, and so on). This system responds dynamically to a disturbance which upsets its equilibrium. It has properties akin (in time response) to the mass, elasticity, plasticity, and energy dissipation of inert physical systems. The duration of a single earthquake, however, is very short and the earthquake acts on the community system essentially as an impulse. If this impulse is repeated before the system has returned to equilibrium, especially if it is repeated many times, the system may react in a highly adverse way and may show characteristics of instability.

The earthquake is a triggering device which sets off a chain of events, including vibratory response and possible collapse of buildings (shelter), the destruction or disruption of accustomed service facilities (communications, electric power supply, water supply, transportation, food and health services, etc.), and the reactions of human beings to these events and to each others' reactions. The extent to which the human community and its activities are disrupted in the dynamic response to the disturbance, or succession of disturbances, is the measure of the disaster. The disaster may be measured in numbers of deaths and injuries, the dollar values of property and business losses, the length of time for recovery, or a combination of these. Human disaster is a very complicated psychological, social, economic, political, and physical phenomenon regardless of whether it is triggered by natural causes, e.g., an earthquake, or by human causes, e.g., war.

The extent of the disaster is distinctly human-related, depending on the presence of wealth and the type of property or business activity in which wealth is vested, the vulnerability of buildings and other physical systems to damage or destruction, the presence of effective disaster-control plans, and the presence of responsible, efficient, well-organized government at all levels which may respond effectively to emergency.

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In the interior of western Sicily the wealth in and around the villages is small, is chiefly in the form of dwellings, farm animals and farm operation, and is especially vulnerable to any disruption of family or community life. There were no anti-earthquake regulations in the building codes and the old buildings in the villages and farms were readily subject to collapse. There were generally no disaster-control plans of any sort, and there was evidence in many cases of lack of efficient government at all levels for effective response to emergency. Hence, a series of relatively modest earthquakes resulted in great disaster. The occurrence of a series of earthquakes, rather closely spaced in time, was a geological phenomenon, but the resulting heightened effect of disaster was a distinctly human-related phenomenon. It was similar in some respects to the effect on a physical system of a succession of impulses timed so as to result in an additive response.

It does not seem unduly farfetched to think of a human community, in its response to dynamic input, as a second-order system described by the system of coupled nonlinear equations,

$$[M] \{\ddot{y}\} + [D] \{\dot{y}\} + [R] \{y\} = \{F\}$$

where $\{y\}$ is the response vector; $[M]$, $[D]$ and $[R]$ are matrices of "mass," "energy dissipation" and "restoration" properties, with M, D and R being not constants but functions of response, time, and space; and $\{F\}$ is the excitation vector, a function of time and space. The general model implied by this system of equations may be a reasonable one, but we do not know how to make the detailed transfer from the prototype to the model.

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STRUCTURAL DAMAGE AND SURFACE PHENOMENA

The map in Figure 2 shows the towns visited in the region of earthquake damage. Among those subjected to greatest damage were Gibellina, Salaparuta, Poggioreale, Santa Ninfa, Partanna, Montevago, and Santa Margherita di Belice, contained in an area largely tributary to the Belice River. Within this area near a bridge over the Belice, displacements in bridges and the presence of sand boils were observed.

The photographs which have no source indicated in their captions were taken by one of the authors on February 8, twenty-five days after the start, on the 14th, of the January series of earthquakes and thirteen days after the end of that series. Much of the clearing of streets and other early clean-up work had by then been done, but no significant repairs were in evidence. This group of photographs includes examples of building damage ranging from collapse to apparently minor damage, and examples of bridges, road surfaces, and sand boils.

All other photographs were either purchased from news photographers or obtained through the courtesy of the magazine Epoca (1968), as indicated in the captions. These photographs, with one obvious exception antedating the earthquakes, were taken shortly after the start of the series of earthquakes, and are a better record of the actual conditions before a significant amount of clean-up work had been done. They were taken presumably on January 15 and 16 or soon thereafter. Those obtained from Epoca appeared in the January 28, 1968 issue of that magazine.

Building Damage

The photographs (Figures 3 to 23) show old and new construction of a wide variety. They have been arranged to show examples from towns suffering moderate damage (Vita and Salemi), towns which generally experienced very great damage (Santa Margherita di Belice and Montevago), and towns which were virtually destroyed (Salaparuta and Gibellina). The damage within some towns varied

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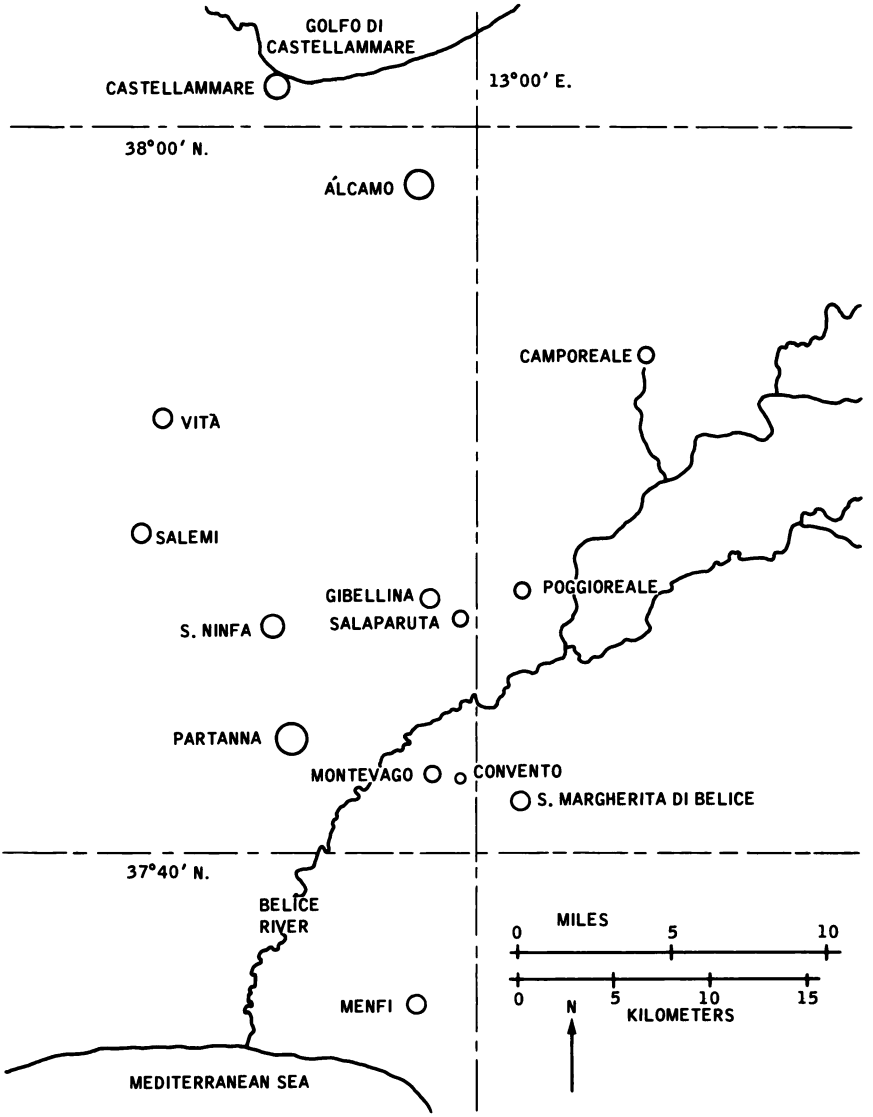

Figure 2. Map of the damaged area. Only the towns visited or referred to in the report are shown.

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tremendously. Even within towns suffering very extensive damage, for example, Santa Margherita di Belice, some structures appeared not to have been seriously harmed.

Limited explanations are given in the captions to supplement the following general comments:

Buildings of modern type consisting of reasonably well-designed and constructed reinforced concrete frames and floor systems, with masonry filler walls, withstood the earthquakes satisfactorily or without very serious damage (Figures 5, 8, 9, 10). They would, however, be improved by increased attention to the effects of lateral loads.

Bearing-wall buildings of one to a few stories, constructed of cut-stone or concrete blocks assembled with mortar of reasonably good quality, and with reinforced concrete floor slabs, withstood the earthquakes much better than the older form of bearing-wall construction, but the damage experienced by these structures varied greatly, probably due to wide variations in quality of workmanship and materials as much as to variations in foundation conditions and other causes (Figures 13, 14, 15, and 17).

The old traditional form of bearing-wall buildings---consisting of very heavy coarse irregular masonry assembled with weak mortar, arched ceiling or floor construction, and heavy tile roof coverings supported on flimsy wood-pole rafters---are death traps of the worst possible variety. In some villages construction of this type collapsed in utter shambles of stone rubble, plaster, roof tile, and poles, reminding one of scenes of destruction caused by saturation bombing or heavy artillery fire. It is a wonder that anyone housed in such buildings escaped alive. (Figures 11, 12, 18, 19, 21, 22, 23)

The old, massive, ornamental church construction is particularly vulnerable and is a potential death trap. (Figures 3, 7, 16, 20). If large numbers of people had fled to the churches at the start of the earthquakes, and remained there, the death toll would have been much greater.

There is evidence that differences in building-foundation conditions and in the geology within the affected region resulted in very significant differences in building

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damage but the authors do not have sufficient information to elaborate on this.

It is evident that the conclusion reached by Goethe (1968) nearly two centuries ago regarding Sicilian building construction is still quite appropriate: "... it was shoddy building ... which was the main reason for the ... destruction ..., ... the few buildings which were solidly constructed survived." Today he would include modern, well-designed and well-constructed reinforced concrete buildings among those which survived. The problem, of course, is not simply one of building construction and materials; it is more basically a problem of education, tradition, economic conditions, and lack of proper governmental control.

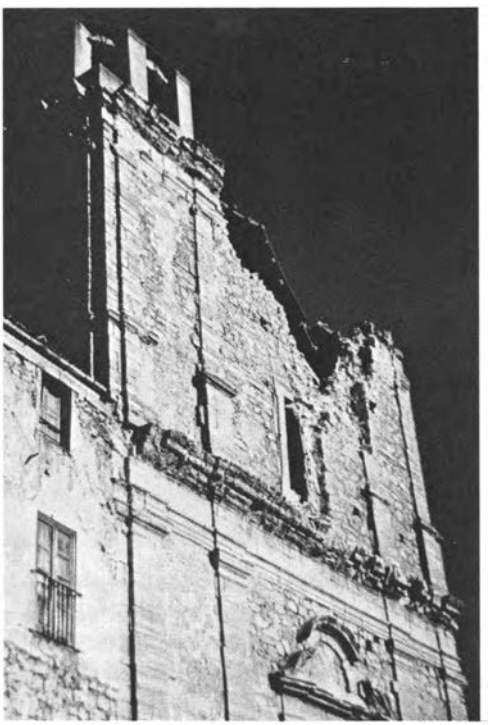

Figure 3. Vita. Church facade, showing fallen roof, wall and masonry ornamentation.

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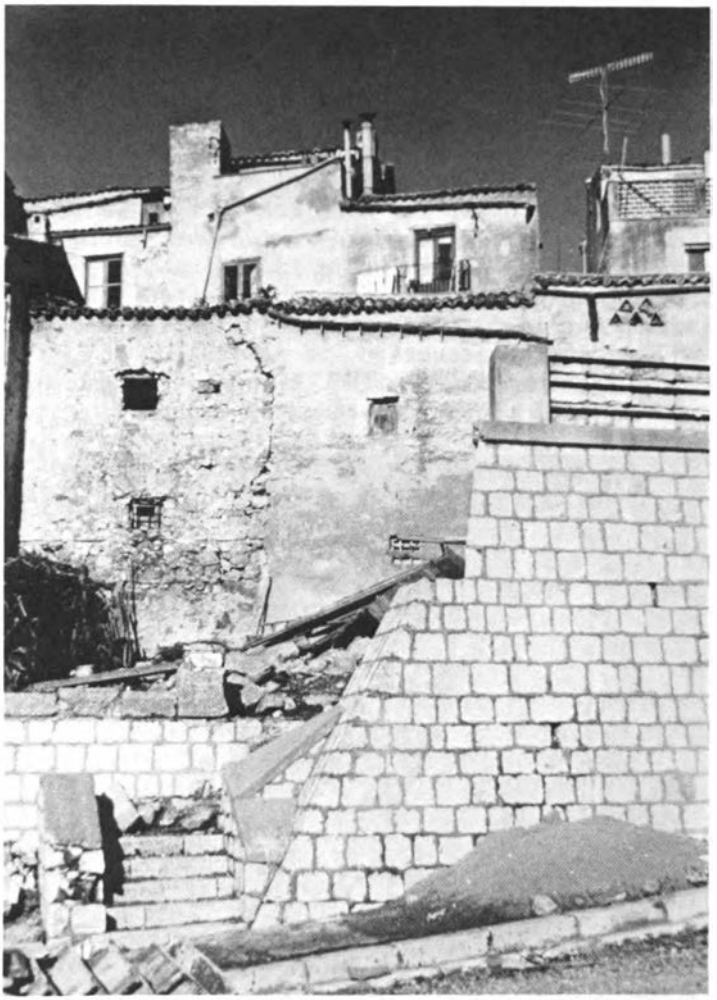

Figure 4. Vita. Showing old and new construction of local stone. The new wall in the foreground appeared to have been well constructed. The old walls are of very coarse, crude masonry with ineffective mortar.

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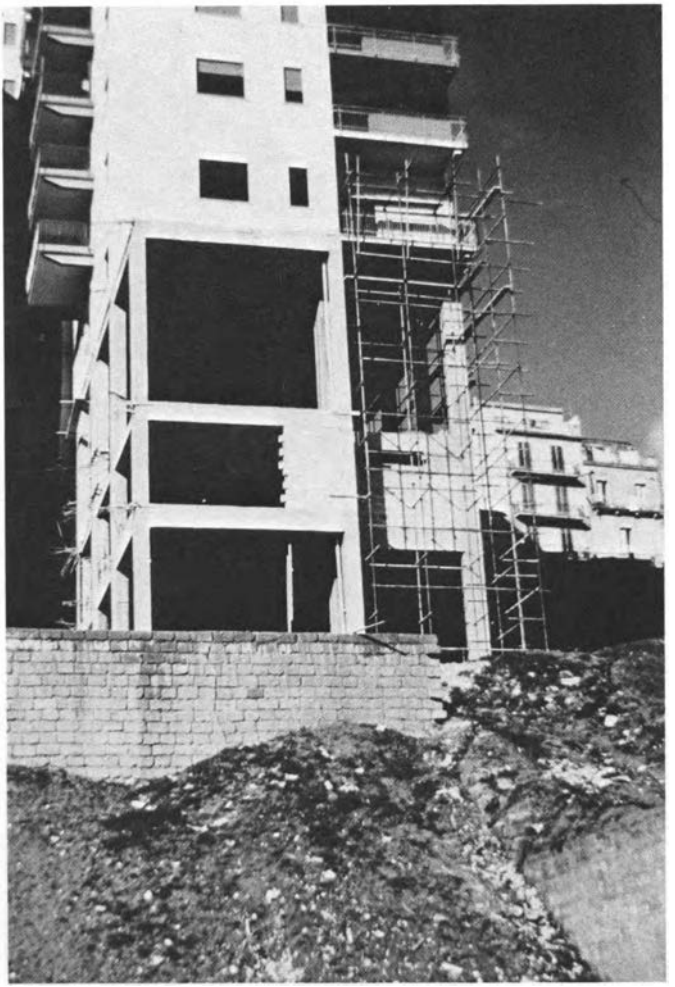

Figure 5. Salemi. Part of multistory, reinforced-concrete frame apartment building nearing completion. There were no outward signs of significant damage visible from the distance at which the picture was taken.

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Figure 6. Santa Margherita di Belice. Before the earthquake; the "Leopard's Palace," which was featured in the novel, The Leopard, by Giuseppe di Lampedusa; an example of early masonry construction for the very wealthy. (Source: "Scafidi" photographic agency, Palermo.)

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Figure 7. Santa Margherita di Belice. After the earthquake; the "Leopard's Palace" and adjoining church (compare Figure 6). The clock and parapet wall on the palace have fallen, but the facade still stands. The church is in complete ruins. (Source: "Scafidi" photographic agency, Palermo.)

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Figure 8. Santa Margherita di Belice. Modern apartment construction of a few stories height; reinforced-concrete frame and slab, with masonry filler walls. Note cracks between frame and filler wall in first story.

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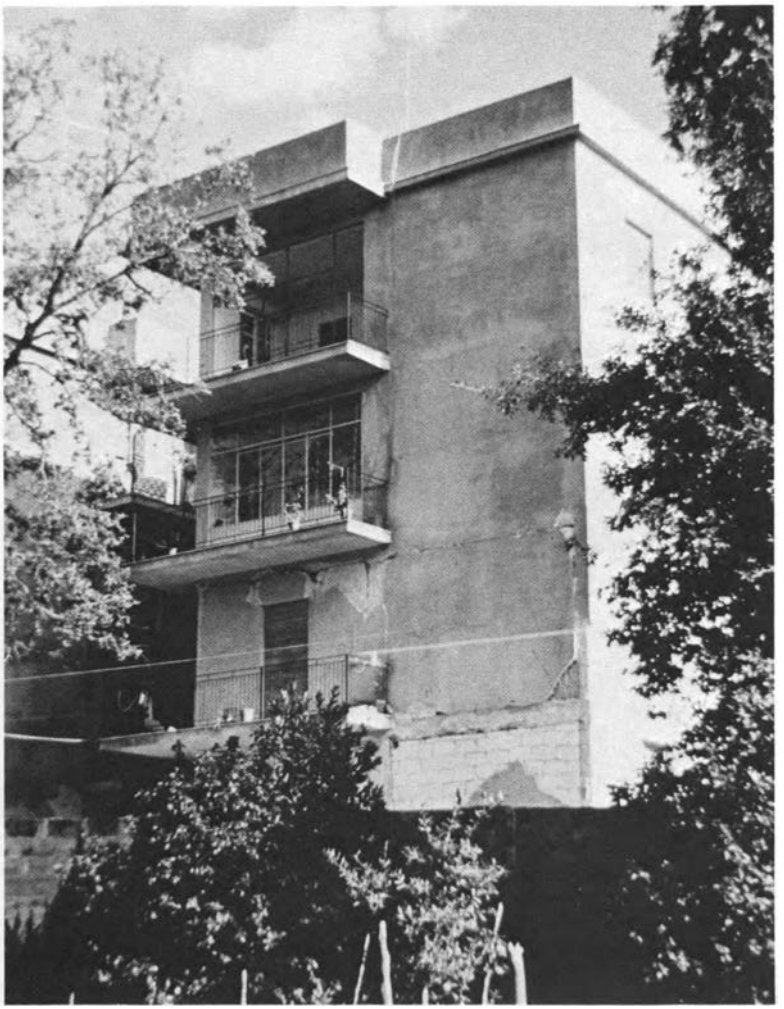

Figure 9. Santa Margherita di Belice. Rear view of a wing of the building shown in Figure 8. Note cracks between frame and filler wall and around lintel; fallen external plaster. The building apparently is repairable.

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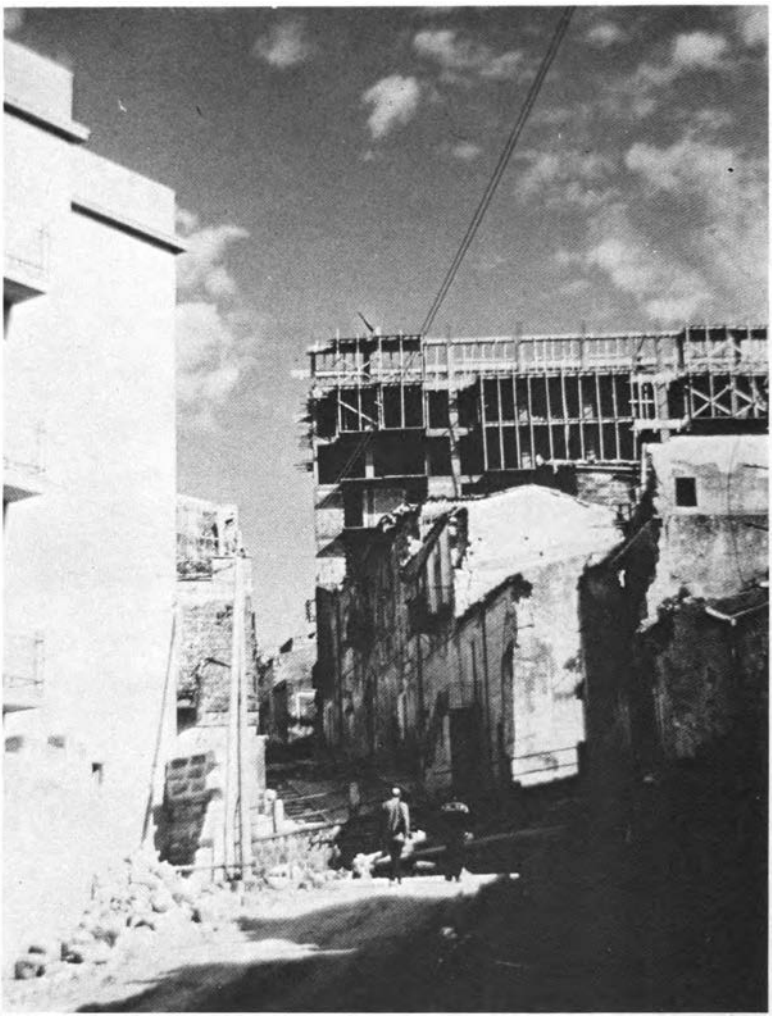

Figure 10. Santa Margherita di Belice. Corner of building at left is a portion of building shown in Figures 8 and 9. Building under construction in the distance is an eight-story, reinforced-concrete frame and slab structure with hollow tile filler walls. It showed (from a distance) no signs of serious damage. The other buildings in the picture were generally of old rough masonry construction and were very seriously damaged.

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Figure 11. Montevago. At least two forms of construction are visible: an old rough masonry with pole-supported tile roofs, and a newer cut-stone masonry with reinforced-concrete floors and roofs. The newer form seems to have fared somewhat better; nevertheless, the destruction in this view is almost complete. (Photograph courtesy of "Mondadori Epoca," Milan; photographers, "De Biasi - Del Grande - Lotti - Cioni.")

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Figure 12. Montevago. Older type of construction; rough masonry with pole-supported tile roofs.

Figure 13. Montevago. Newer construction with cut-stone masonry, concrete lintels, and reinforced-concrete floor slabs.

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Figure 14. Outskirts of Montevago. Masonry and reinforced-concrete slab construction. No apparent great damage.

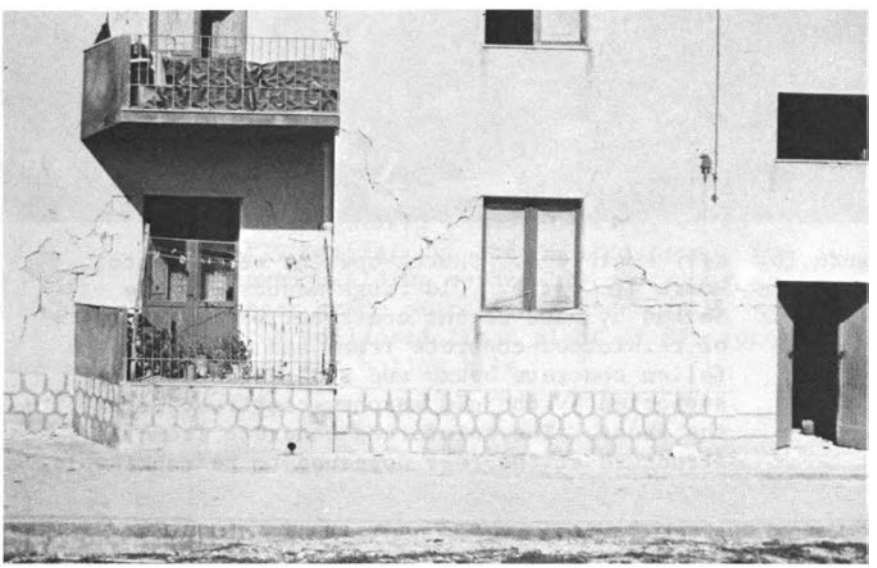

Figure 15. Outskirts of Montevago. Classic diagonal cracks in masonry walls. Considerable damage, although the building appeared to be repairable.

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Figure 16. Near Montevago. Church-convent at Convento Madre di Grázie. Old rough-masonry facade backed by more recent construction consisting of reinforced-concrete frame and masonry. The fallen concrete beams and slab evidently were supported by the old masonry construction at the front. The reinforced-concrete frame structure at the rear appeared to be repairable.

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Figure 17. Poggioreale. Complete collapse of a building alongside another, still standing, of apparently similar age and construction. The collapsed building apparently contained a very poor grade of reinforced concrete. Note the collapsed floor slabs of reinforced concrete and hollow tile.

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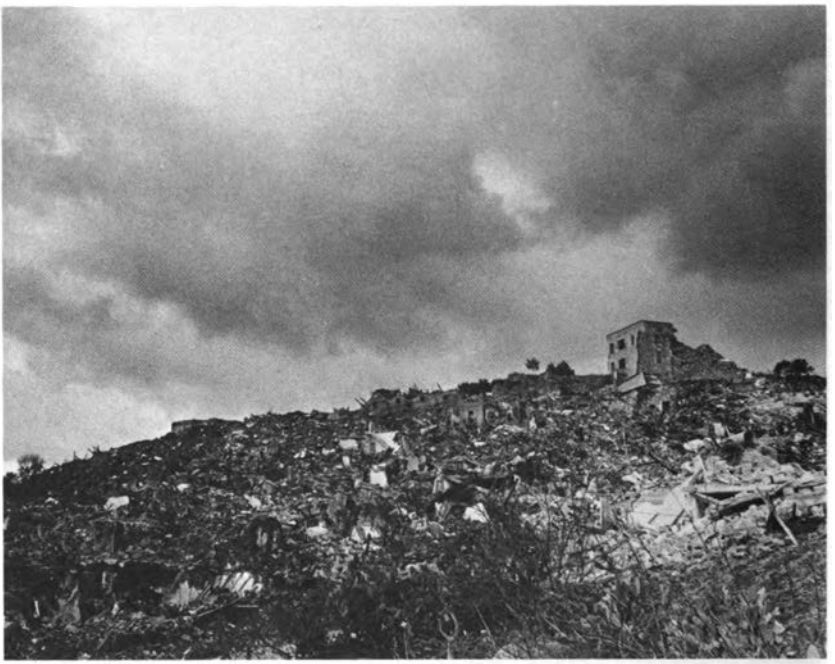

Figure 18. Salaparuta. Complete destruction. The town appeared almost to have rolled down the hill. (Photograph courtesy of "Mondadori Epoca," Milan; photographers, "De Biasi - Del Grande - Lotti - Cioni.")

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Figure 19. Gibellina. Complete destruction. The construction appears to have been somewhat more substantial than that in Salaparuta, but no less subject to damage. (Photograph courtesy of "Mondadori Epoca," Milan; photographers, "De Biasi - Del Grande - Lotti - Cioni.")

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Figure 20. Collapsed church, an example of many. Consider the death toll if the churches had been filled. (Photograph courtesy of "Mondadori Epoca," Milan; photographers, "De Biasi - Del Grande - Lotti - Cioni.")

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Figure 21. Collapsed houses, showing detail of some of the old forms of coarse masonry construction and building materials. (Photograph courtesy of "Mondadori Epoca," Milan; photographers, "De Biasi - Del Grande - Lotti - Cioni.")

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Figure 22. Collapsed building, showing the very heavy but weak masonry, heavily plastered and filled above the arch construction, the stones joined by very poor mortar. (Photograph courtesy of "Mondadori Epoca," Milan; photographers, "De Biasi - Del Grande - Lotti - Cioni.")

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Figure 23. A dining room. Some pictures on the wall and dishes in the cabinets were displaced, but the television set, the cabinets themselves, and other furnishings do not appear to have been harmed. The exterior heavy masonry wall, however, and evidently part of the roof have completely collapsed. (Photograph courtesy of "Mondadori Epoca," Milan; photographers, "De Biasi - Del Grande - Lotti - Cioni.")

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Bridges and Roads

Old masonry arch bridges seemed to fare much better than old buildings (Figures 24 and 25). The damage to bridges was perhaps as much due to inadequate maintenance as to any other cause. A reinforced concrete tied-arch bridge showed no outward signs of serious structural damage due to the earthquakes (Figure 26). There was evidence of movement of at least one of the piers of this bridge, however (Figure 27).

The damage to roads was relatively minor and, as observed by the authors, occurred on filled ground (Figures 28 and 29).

Sand Boils

Along the Belice River near the bridge shown in Figure 26, an area of sand boils was found (Figures 27, 30, 31, and 32). They were not large but their formation was very distinct.

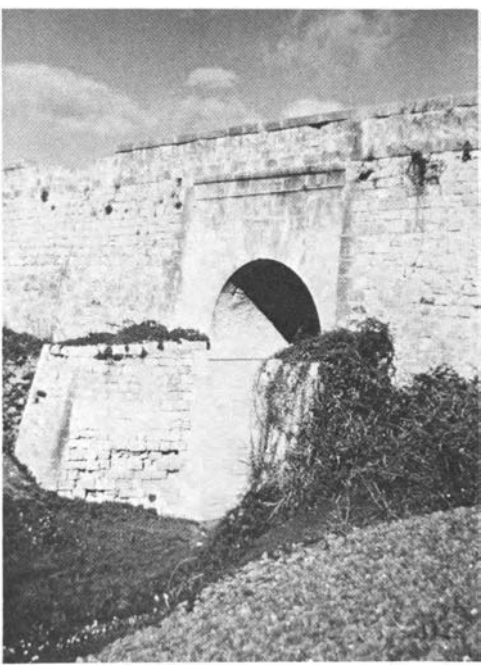

Figure 24. Near Salemi. Old highway bridge. No outward signs of great damage, but we were told that the bridge was to be removed and replaced by a culvert and fill.

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Figure 25. Old, abandoned railroad bridge over the Belice River about 2 kilometers upstream (east) of the highway bridge shown in Figure 26. Cut-stone masonry barrel arch with filled roadbed. Photograph taken from north bank, looking at west side of bridge. Note failure in third arch. This failure was obviously old, but there was evidence of further very recent collapse, and portions of the parapet or guard walls had very recently fallen to the east. There was easily visible evidence of a horizontal transverse relative displacement in the bridge, equal to a small fraction of a meter, in a vertical plane through the third arch. No evidence could be found that this was a new displacement, however. No cracks or sandboil areas were observed along the stream near the bridge.

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Figure 26. Highway bridge over the Belice River on road between Santa Margherita di Belice and Salaparuta. Reinforced-concrete tied-arch and suspenders; resting on cut-stone masonry abutment piers; span about 40 meters. The bridge suffered no apparent serious damage, and was in regular use by moderately heavy truck traffic. (View of west side of bridge).

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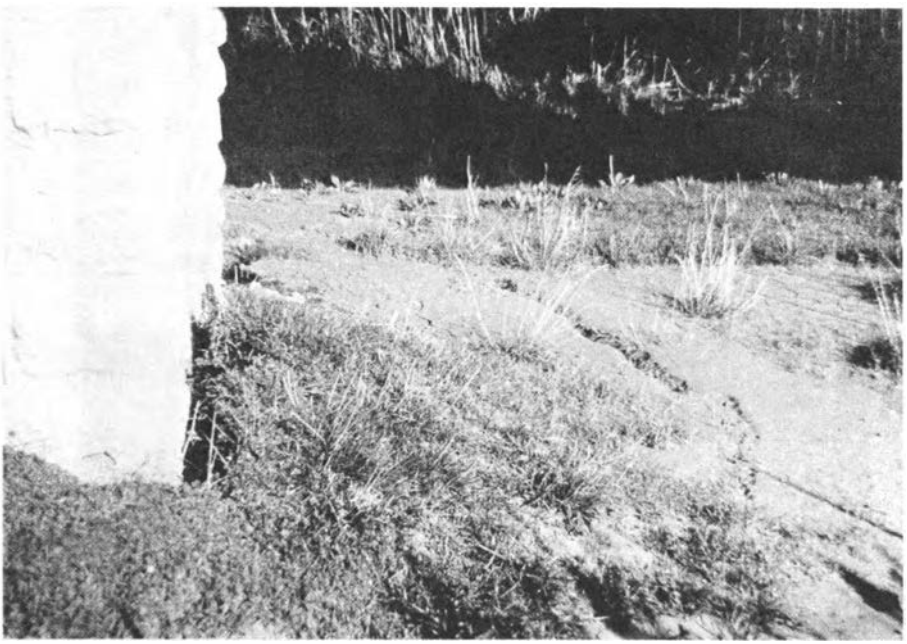

Figure 27. North abutment pier and stream bank under bridge shown in Figure 26. Note fresh fine material brought to surface through sand boil crack at right. At the left, between the bridge pier and the ground, is a deep, crack-like opening, about 10 centimeters wide at the surface, extending across the full width of the pier. The vertical plane of the opening is perpendicular to the longitudinal axis of the bridge. The opening gives the observer the impression that the bridge rocked back and forth horizontally along its longitudinal axis (roughly north-south). There was no visible significant damage to the pier.

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Figure 28. Road between Salemi and Montevago. Masonry guard walls on filled road shoulder shifted or overturned; cracks in road surface.

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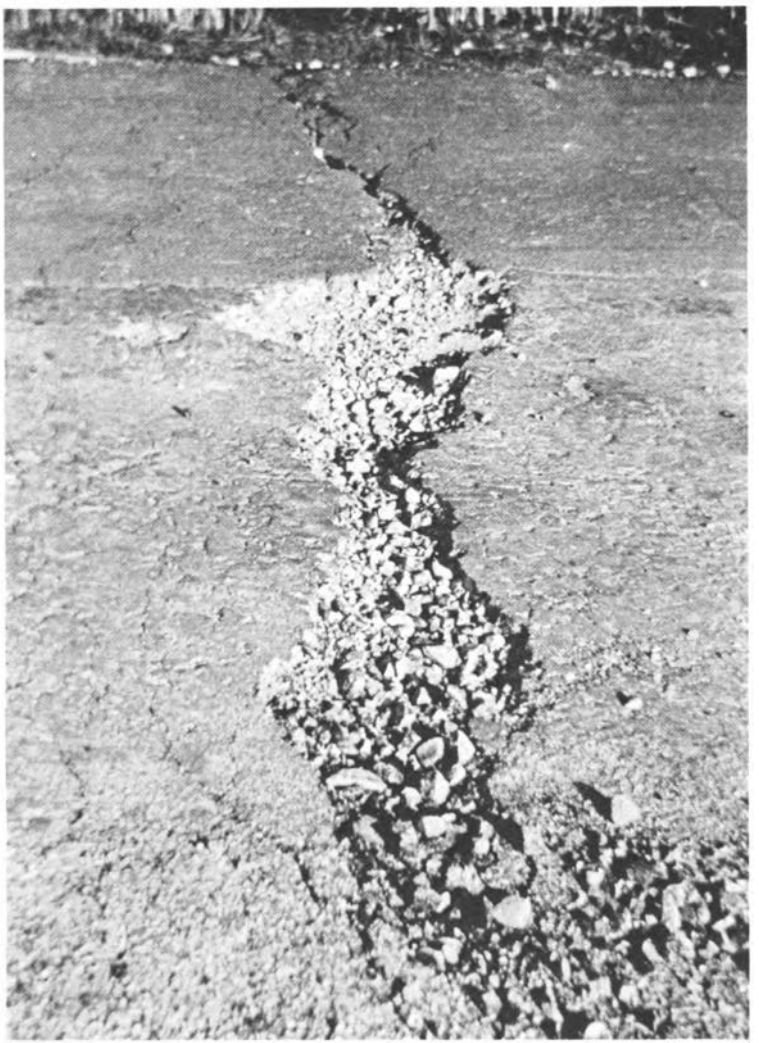

Figure 29. Crack across paved road surface on north fill approach near bridge shown in Figure 26. The vertical plane of the crack is approximately perpendicular to the longitudinal axis of the bridge.

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Figure 30. Sandboil area on the north bank of the Belice River, west of the bridge shown in Figure 26. The line of the sandboils is approximately east-west.

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Figure 31. Detail of the sandboils shown in Figure 30. Note pen for scale.

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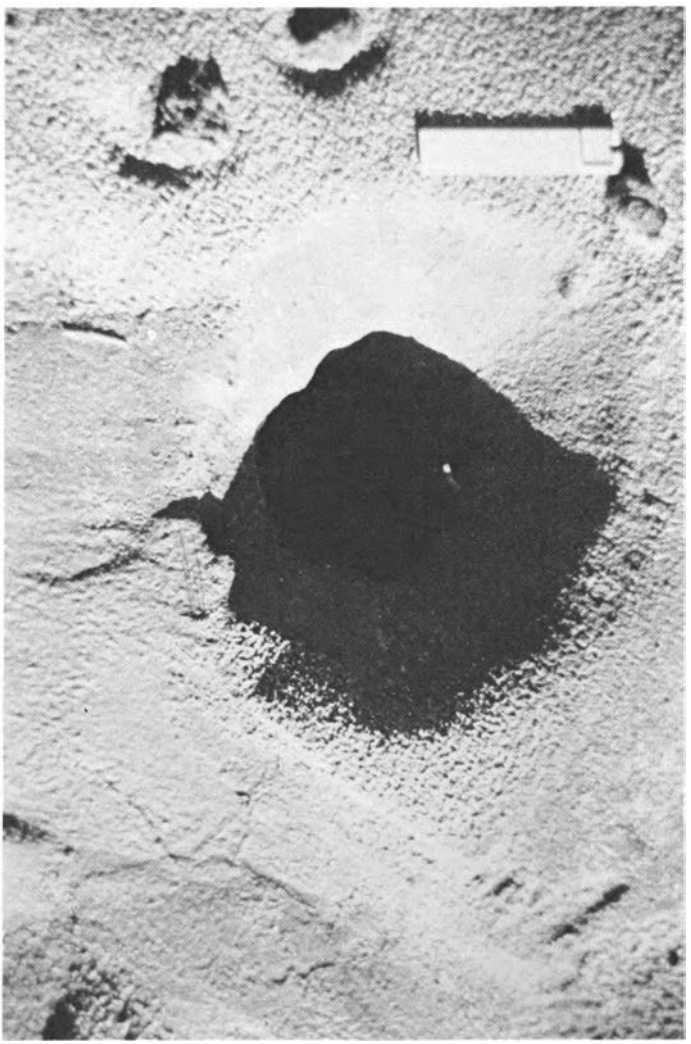

Figure 32. Close-up of a sandboil. Note small slide-rule for scale.

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SOCIO-ECONOMIC-POLITICAL ASPECTS

Health and Mortality

Deaths and Injuries: There were 260 known deaths directly attributable to the three most destructive earthquakes. Approximately ten of these occurred when searchers were working in or near previously damaged structures. The difficulty of the rescue work is indicated by the scene in Figure 33. During the early weeks, determining the number of dead was exceedingly difficult because thousands of refugees fled the area, many leaving Sicily entirely. Figure 34 shows a group of refugees near Poggioreale.

Some bodies were not recovered until February 25, one month after the final major shocks. There was an occasional shortage of coffins in the hardest-hit villages. This shortage and rubble-blocked roads delayed burial in one town for more than four days. According to news reports some persons were found alive in the rubble six days after the January 15 earthquake. A team of French specialists with specialized sensing equipment came to the area to assist in the search for buried victims, but according to reports their efforts were not particularly successful.

The best estimate is that more than 600 persons were injured. In many instances record-keeping with regard to injuries seems to have been nonexistent or ineffective. This is not surprising under the conditions prevailing. In Agrigento Province many persons were treated at the scene and released. Others who should have gone to hospitals refused to go out of fear that further temblors might cause buildings to collapse on them. Police reported that they had a continual problem keeping people out of their damaged homes where the risk of injury was high.

Hospitals: There were no hospitals in any of the towns sustaining significant damage. The majority of the injured were taken by helicopter, ambulance, and public bus to hospitals or field hospitals at larger coastal towns. Blocked roads due to landslide and rubble were partly responsible for delays in getting patients to hospitals. In

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Figure 33. Rescue workers in Gibellina. Compare with Figure 19. Imagine the great difficulty of conducting rescue work in the situation shown. (Source of photograph: "Scafidi" photographic agency, Palermo.)

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Figure 34. Refugees near Poggioreale. (Source of photograph: "Publifoto" photographic agency, Palermo.)

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at least two cases hospital space and beds were not sufficient for the large numbers of injured arriving for treatment. There was a severe shortage of blood plasma for several days. After the January 25 quake the hospital at Sciacca had to be completely evacuated.

Medical Personnel: Prior to the earthquakes each of the affected villages normally had a physician paid from public funds, who was responsible for medical care for the poor. Each also had a sanitarian. In most but not all cases these persons stayed in the vicinity and assisted in coping with medical and public health problems. There were no physicians in private practice. One local physician was killed in the first earthquake.

The speed with which outside medical help arrived varied from a few hours to two days. In one province the number of medical personnel and medical supplies was adequate but coordination was lacking. Officials attributed the lack of coordination to the absence of any previously developed emergency medical-care plan. In another province, despite a subterfuge, the evidence suggests that an outline of such a plan was drawn up after the earthquake because no plan had been in existence before.

Volunteer Medical Services: The Italian Red Cross and medical and nursing personnel from nearby towns responded promptly in most cases. A rescue group is shown at work in Figure 35. To our knowledge no religious groups provided medical assistance. The provision of medical care was greatly enhanced by personnel and supplies on board ships from several nations that happened to be anchored in local harbors. One medical team flew in from Israel. Another team whose members had worked together following the Viaont dam disaster assisted in Montevago. The British Navy supplied the largest single share of foreign medical assistance. After three or four days most foreign medical personnel withdrew from the disaster area and personnel from the Italian Army or Navy established clinics or small field hospitals at the refugee camps. One month after the initial disaster the medical care at the tent camps appeared to range from excellent to marginal. As is usual in such disasters, after the first two weeks there was an overabundance of contributed medical supplies. Sorting and labeling of these supplies continued to be a problem.

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Figure 35. Rescue workers. Masks were sometimes worn because of the sulfurous odors reported in some areas or possibly as a protection against diseases which could be transmitted through the respiratory tract. (Source of photograph: "Scafidi" photographic agency, Palermo.)

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Communicable Diseases: Extensive efforts were made within the first week to provide inoculations for typhoid, paratyphoid, and diphtheria for all persons remaining in the most heavily devastated areas. The number of known cases of these diseases did not increase. Much publicity was given to a so-called meningitis epidemic. The 96 recorded cases did vastly exceed the number recorded for the same period the year before, but medical authorities tended to discount any direct connection between the disaster-produced conditions and the increase in recorded cases. Apparently there was widespread fear of contracting the disease, especially in Palermo, and as a consequence the demand for sulfa frequently exhausted the supply. In Italy the drug may be purchased without a prescription and pharmacies were besieged with long lines of would-be purchasers as late as mid-February. Police were sent to control the crowds outside the pharmacies in numerous instances. Medical personnel also distributed sulfa tablets to children and young adults in some refugee camps.

Respiratory Infections: There were numerous cases of respiratory infections due to the cold weather and exposure. There were many reports of severe shortages of clothing and blankets even after the first week. As late as February 7 we observed one camp at which refugees were still sleeping on straw-covered ground in unheated, severely crowded tents. Although housing was by then available in some of the nearby cities, hundreds of peasants refused evacuation because of fear and ignorance. Respiratory infections continued to be a problem.

Domestic Animals: Medical and veterinary officers feared an outbreak of hoof-and-mouth disease but it was at least ten days before action was taken to round up stray animals and vaccinate them. There were no reported cases of the disease. Starving stray dogs were in abundance, so authorities, fearing rabies, started a program of collecting and destroying them. Veterinary officers, firemen, and forestry officials worked together putting lime on hundreds of decaying animals, many of which had been trapped in the rubble.

Sanitation and Water Supply: The tent camps were plagued with sanitation problems for at least one month. Most camps had no latrines of any kind for five to seven

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days. The refugee population ranged in size from 1,000 to 4,000 per camp. Latrines consisted of trenches under platforms with skeleton structures covered with burlap. Camp officials complained that many refugees failed to use the latrines even when they did become available.

At the camps in the devastated area potable water was absent or in very short supply for five to ten days, after which above-ground water lines were completed. Bathing facilities of even the most rudimentary sort were still largely absent in mid-February.

Special Financial Benefits, Exemptions and Reimbursements: The "Earthquake Omnibus Act," which became law on March 2, 1968, provided the following:

1) Death benefits for surviving relatives: one million lire for the first family member killed and one-half million lire for each additional member.

2) For all persons permanently or temporarily disabled and unable to work: regular workman's compensation payments normally provided for work-related disablement.

3) Workers who were prior residents of the officially designated disaster areas would be exempt from payment of national health-insurance contributions for the remainder of 1968.

4) The national government would provide reimbursement for disaster-related medical costs to hospitals, including tuberculosis and psychiatric hospitals, and to the provincial offices for extraordinary sanitation costs.

Provision of Food, Clothing, and Shelter

An estimated 60,000 to 80,000 persons were made homeless by the quakes. A February 6th government estimate indicated that more than 19,000 dwelling units were destroyed or severely damaged.

The Villages: With only a few exceptions the typical pattern in the villages was as follows:

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1) There was no significant aid to refugees, not even food, for the first two to three days. Food and clothing were not generally adequate for five to seven days.

2) In the majority of camps there were no tents for the first four to five days. Tents remained in short supply for several months. The typical tent for at least the first month had a straw floor, no heat, no electricity, an inadequate number of beds, and no partitions of any kind for privacy. Nighttime temperatures were often in the 30's (Fahrenheit).

3) Although there was much publicity about how prefabricated family units and barracks would be erected quickly, by mid-April 15,000 persons were still living in tents and another estimated 5,000 living in shacks put up along city sidewalks and in village squares. Much of the camp housing consisted of large wooden sheds and metal hothouses without internal partitions. From 250 to 500 persons lived in each structure. Two examples of temporary housing are shown in Figures 36 and 37. In January, 1969, a full year after the quakes, the New York Times reported that 3,600 emergency living units were still to be built! Many of the barracks still had no heat.

4) Inspection of dwellings to ascertain if they were habitable started about ten days after the initial earthquake and in most villages wasn't completed until sometime in March.

5) Efforts to transfer children to more adequate housing were notably unsuccessful. Parents were fearful of losing their children and the matter became an issue between left-wing organizations and the Catholic Church.

6) Official government statistics show that 9,294 more persons left Sicily for northern Italy and foreign countries during the February-June period in 1968 than during the same period in 1967. During the first month they were given free

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Figure 36. Temporary metal prefabricated housing being erected for family groups. (Source of photograph: "Scafidi" photographic agency, Palermo.)

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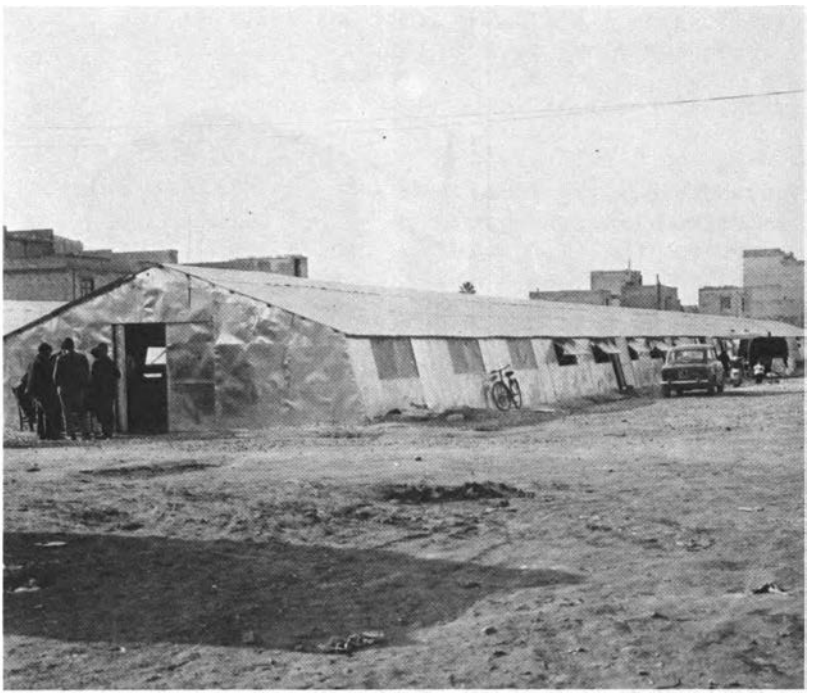

Figure 37. A large metal shed erected in Menfi to house several hundred refugees. (Source of photograph: "Publifoto" photographic agency, Palermo.)

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transportation to any point in Italy outside of Sicily. Later they were encouraged to return and many thousands did so, ending up in the tent camps.

Palermo: Palermo had its own unique housing problem. Approximately 125,000 persons had been living in slum housing. To relieve this problem 2,500 public housing units had been completed by 1966 but had never been allocated. Following the first quake, frightened slum dwellers, fearing that their old buildings would collapse, broke into the new housing units and occupied them, refusing to leave even though water, gas, and electricity were not turned on. The stalemate continued for months. Other slum dwellers went to nearby refugee camps for an extended period of time.

The Refugee Camps: The delays and shortages in the refugee camps seem to have stemmed from a number of conditions:

1) The poverty-stricken villages had no economic resources upon which to draw in such an emergency. Town councils could not make emergency purchases of supplies from nearby warehouses. They had no money and the warehouses were nonexistent or limited in supply.

2) At the provincial governmental level there were no meaningful plans for meeting such an emergency. Here, too, economic resources were somewhat limited with the possible exception of Palermo.

3) The Italian Civil Protection Agency did have stockpiles of food, clothing and bedding but there were too few for the need and these were located too far away for quick use in the disaster area.

4) For the first few days the national government insisted that no aid was needed from foreign countries. This probably accounted for some of the delay in the arrival of tents.

5) When reports persisted during the first week that the government was doing very little to help the victims, hundreds and perhaps thousands of individual citizens and small groups drove into the

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damaged area with what resources they could collect and deliver. At most camps or would-be camps they found little or no leadership, indigenous or otherwise. Distribution of supplies was often haphazard. General chaos was the order of the day. Santa Ninfa and Montevago were partial exceptions to this situation.

6) What we would call an "earthquake omnibus act" was not finally approved by the national government until March 5. Until that time no one knew the nature and extent of government compensation and hence planning and decisive action were not taken.

7) Indications are that in southern Italy generally, and especially in Sicily, there is a very small middle class and few professionals or others who have managerial skills. Such skills are critical for organizing huge refugee populations, procuring and distributing the necessary supplies, and for directing the transition from emergency housing to relatively permanent housing.

Economic Aspects

The Belice Valley and adjoining areas are characterized by rolling hills and depleted land farmed without powered equipment in very small parcels. Commercial fertilizer and modern farming practices are almost unknown. The more able and energetic young people migrate continuously to more prosperous areas of Italy and to foreign countries. Mean per capita annual income is $480, one-fourth that of the Milan area.

The rural peasant (contadino) tends to live in small towns, going out to work on the land with a single horse or mule. He usually owns his "fazzoletto" (handerchief) of land. For the most part it is a hand-to-mouth existence.

While the magnitude of the earthquakes was not great (up to 5.4 on the Richter scale) the damage was very extensive. In addition to the loss of human life and the injuries there was damage or destruction of buildings, roads, bridges, water and sewer facilities, and electric and telephone systems. Farm animals were killed, injured,

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and lost. In some cases farm land was made useless due to landslides and debris.

The affected villages had almost no economic reserves of any type. High unemployment and underemployment are traditional there. Perhaps as many as one fourth of the affected population left Sicily during the first few weeks. While that emigration relieved somewhat the total need for immediate relief measures, it also had a disorganizing effect on the local economic structure. Knowledgeable informants reported that a disproportionately large number of the emigrants were young men.

The Earthquake Omnibus Act: Valid estimates of the total damage in monetary terms are always very difficult to get following any large-scale disaster. In this case, as in the 1964 Alaska earthquake, various agencies reported markedly different figures. To complicate matters further, in the Sicilian case there were widespread demands that governmental support for reconstruction be combined with extensive development programs for most of western Sicily including metropolitan Palermo. In October and November of 1967, there were minor earthquakes in the Medrodi mountains southwest of Messina. The "earthquake omnibus act," which became effective on March 5, 1968, included this region also as part of the official disaster areas. The best data available suggest that total national and regional authorizations for emergency relief and reconstruction efforts amounted to approximately $370 million, with an additional $230 million for long-range development. Most of the funds for reconstruction were to be spent over a period of five to seven years.

In the United States, with few exceptions, federal funds may be used only to replace or repair damaged public property. Persons suffering private losses are often eligible for special low-interest, long-term loans but not direct government grants. In the case of the Sicilian earthquakes the government made the decision to finance restoration of all losses, public and private. With some minor exceptions the "omnibus act" authorized outright grants to cover all significant losses directly attributable to the earthquakes. For residential structures, shifting maximum amounts were established based on the number of persons in the family. For nonresidential buildings the

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government would pay 90 percent of replacement. Favorable long-term loans were made available to pay the additional costs of restoration or replacement of all structures. The legislation also included provisions for deferred payment of personal and property taxes and mortgage and other debt payments. All new buildings and those requiring extensive repairs would be exempt from property taxes for twenty-five years. All new and rebuilt businesses in the disaster area would be exempt from income tax for ten years. Governmental and quasi-governmental agencies at all levels would be reimbursed for extraordinary expenses resulting from their disaster-related operations. Regional and local governmental units would receive reimbursement for any short-fall in tax revenues. Even debris-clearance costs were covered.

It is difficult for us to determine whether the amount appropriated for the various emergency and reconstruction efforts was adequate or not, but the legislation certainly was comprehensive in scope as contrasted to the standards used in our society. In 1964 it was four and one-half months after the Alaska earthquake when the United States Congress passed the Alaska Omnibus Act. It took the Italian Parliament only about six weeks to pass similar legislation. Emergency relief, repair, and reconstruction are taking much longer in Sicily than they took in Alaska, however. One reason for the difference seems to be that in the United States there was an experienced federal agency, the Office of Emergency Preparedness, which began operations promptly under the provisions of our previously developed national disaster law (PL-875). It had a large contingency fund available at all times. In addition, within a week President Johnson took the unprecedented step of establishing a special federal commission, headed by a widely respected United States Senator, which was specifically given the responsibility for ensuring rapid action and coordination among all federal agencies.

Summary of Conditions Approximately One Year after the Earthquakes: From the very first days in Italy, speed and decisive action have been notably absent in relief and reconstruction efforts. We cannot document the reasons for this response. Charges of "bureaucratic inefficiency," bribery, and profiteering have been rampant in Sicily. The facts of the matter are considerably less obvious. One full year after the earthquakes, hundreds of families were still

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living in tent camps. Several thousand prefabricated housing units for which money had been appropriated still had not been completed and allocated (The New York Times reported the number as 3,600, while L'Ora, a Palermo newspaper, used the figure of 5,912).

In most of the barracks towns, small business operators had no buildings in which to conduct business. In about one half of the towns public utilities were yet to be completed. More than a thousand families were living in other parts of Sicily because there was not even temporary housing available for them in their home areas. Only about one third of the refugee families had received their $320 grant authorized by the government. No construction had begun on permanent housing. Compare this with Goethe's similar observations on conditions in Messina in 1787 (Goethe, 1968).

Only twenty-four animal shelters had been built, and they were small. There were almost no sheds to protect feed, equipment and tools from the rain. Speculators had purchased perhaps as many as half of the farm animals which were found and claimed after the earthquakes.

Agricultural production, the only significant source of income for the area, had declined sharply.

Basic Community Services

Communications: There was extensive damage over the entire affected area. In the provincial capitals of Palermo and Agrigento following the January 15, 16 earthquakes the telephone systems were so overloaded that they were almost useless for 24 to 48 hours. This problem was further complicated by some desertion of duty of telephone company personnel in Palermo and sporadic strikes of personnel in Rome.

There was no reported shortage of repair crews or equipment. Work on emergency repairs was hampered somewhat by impassable roads. After emergency service was set up for refugee camps, for a period of several weeks telephone company personnel were not permitted in the heavily damaged areas to begin comprehensive damage assessment because their work was not considered sufficiently urgent.

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Radio communication as a substitute for the telephone was used only occasionally.

Provincial postal authorities in Trápani invited free use of the system for letters, packages, and telegrams into and out of the disaster area. Alitalia (national air line) offered to transport free audio tapes and recorders to help refugees communicate with friends and relatives.

Electric Power: According to the report of the National Society of Electric Power (ENEL) spokesman in Palermo, high-voltage lines in the disaster area were repaired in 18 to 48 hours. Refugee camps had minimal power in seven to ten days. Some diesel-powered generators were used. Destruction of electric power facilities in the damaged area (not including Palermo) ranged from 50 to 100 percent. There was no significant increase in damage following the January 25th quakes. Much of the damage resulted from the power lines being attached to buildings rather than poles.

It was estimated that it would take two years to restore a permanent electric power system. A major cause of the anticipated delay was the indecision on relocation of the destroyed towns.

One year after the disaster several "prefab" camps still had no electric service and others had only partial or sporadic service.

Water and Sewer Facilities: Water and sewer problems in tent camps have been discussed in the section on Health and Mortality.

In many of the villages water and sewer facilities were considered substandard even before the earthquakes. Damage ranged from extensive to total. Outside of Palermo an earthen-dam reservoir started leaking five million liters per day and was finally drained for repair on February 21, 1968. Repairs on the reservoir were begun in August, 1968, with completion planned by December, 1970.

One year after the disaster the "prefab" camps still had less than complete water and sewer service: in Santa Ninfa one third of the inhabited "prefabs" had no interior water or sanitary facilities; in Gibellina water was

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available only two to three hours per day; in Partanna there were no functioning sanitary services; in Camporeale there was no water in any "prefabs," no bathing facilities of any type, and only two toilets for 350 persons.

Fire Control: There were no significant fire problems in the damaged villages. Fire-service personnel were heavily involved in clearing roads, in search and rescue operations, and in reclaiming personal possessions from the rubble. On January 25 in Montevago several firemen lost their lives when the tremors caused walls to collapse. After that the local firemen refused to search further for personal possessions.

As a safety measure fire-service personnel dynamited the remaining structures in Montevago, Gibellina, and part of Poggioreale.

On January 25th, fire equipment in Palermo was unable to reach a fire due to traffic congestion reportedly produced by the absence of traffic control police. This occurred shortly after the late morning tremors.

Transportation: On the whole, damage to roads and bridges was light. Landslides and rubble from buildings were the chief impediments to road transportation. Blocked roads were a relatively minor problem except in Santa Ninfa.

There are a few rail lines in the immediate disaster area. Damage was light enough for trains to continue to operate.

The harbors and airports at Palermo and Trápani were apparently adequate and heavily used. Helicopters were used locally for several weeks in part because of delays in road traffic over narrow mountainous roads.

For the first three weeks the Ministry of Transport provided free train transportation for refugees wishing to leave Sicily providing applicants could obtain the signature of a local official. On February 10th the Prefect of Palermo province reported that more than 7,000 free tickets had been given.

Schools: School buildings seemed to have fared no better than other structures in the quakes.

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In Palermo all schools were closed following the early morning tremors of Jaunary 15. After examination twelve schools were declared unsafe. All but those twelve reopened on the morning of January 25. At approximately 11:30 a.m. that day another strong earthquake (5.1 on the Richter scale) closed the schools again. The students were dismissed in a hurry and the elementary school children were sent home without being accompanied by an adult, which is a highly unusual circumstance in Palermo. On January 26 a total of 56 schools were declared unsafe. The safe schools did not reopen until February 19. On March 4 the elementary schools were closed by the Mayor of Palermo due to concern about a possible meningitis epidemic.

On January 30 a Palermo newspaper estimated that 250,000 students in western Sicily were out of school due to unsafe buildings or because school buildings were being used for emergency purposes.

Numerous teenage and college students served as volunteers in the early tent-camp operations. The Regional Technical School provided electric pumps and other electrical equipment to the damaged villages. In the Salaparuta and Gibellina area they provided free transportation for the farmers to go to their fields.

The "omnibus act" provided $800,000 for restoration of schools and equipment and an additional $160,000 for related costs such as transportation of students and extracurricular activities.

Resumption of school in the heavily damaged communities varied considerably but for most it came very late. On May 1 Gibellina still had no temporary structure for school use. More than half of the children in Menfi were not in school for the same reason. Sciacca, which was not damaged at all, had very few children in school even in late February due to fear of more earth tremors.

The Ministry of Education decided that students in the disaster areas would not be given grades at the end of the school year but the state examinations were administered on schedule.

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Public Order

Following medium and large earthquakes the news media usually carry reports of panic among the people. The findings of careful studies, however, suggest that this phenomenon is usually very rare in western societies. Part of the contradiction in reports rests on the definition of panic being used. We shall use the term only to refer to spontaneous behavior which is clearly antisocial (harmful to others) in its consequences. Such behaviors as running out of buildings when earth tremors are occurring and refusing to go into buildings of any type for days after tremors have subsided will not be considered panic behavior.

The following types of panic occurred following the January quakes in the city of Palermo:

1) Desertion of duty for extended periods of time. Telephone and electric company employees, traffic police and pharmacists were reported to have abandoned their work for more than a few hours following major tremors. Several days after the initial quakes the mayor of Palermo spoke on the radio, pleading with public service personnel to return to work. It is impossible to ascertain the extent of such desertion of duty.

2) Gross violation of traffic regulations. According to reports there were numerous instances of driving at high speed on sidewalks, driving the wrong way on one-way streets, and extensive ignoring of traffic signals. One major highway just outside Palermo was completely blocked by parked vehicles for several hours, making it impossible for emergency vehicles to use the sole highway in the area. On at least one occasion fire-fighting vehicles could not get to the scene of a fire because of jammed streets.

Other problems of public order were:

1) One-day strikes and organized public protest meetings are not unusual in Italy. They occur mostly in the large cities. In the year following the earthquakes the number of such events increased

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sharply, occurring also in villages. Organized, prolonged fasting also developed.

2) Petty theft of such items as blankets and clothing occurred in the refugee camps during the early weeks.

3) In a few instances a black market in relief supplies reportedly flourished for a time.

4) Speculators took advantage of grief-stricken peasants in purchasing their farm animals for a fraction of their fair market value. This practice continued sporadically for almost a year.

5) Village residents reportedly bribed housing inspectors to mark their houses as uninhabitable in the hope of getting government aid to build a new dwelling.

6) Profiteering in the construction of "prefabs" was widely and persistently reported.

7) Relatives of some governmental officials are said to have received preferential treatment, especially in the allocation of housing and in land transactions.

Finally it should be noted that altruistic and even heroic behaviors were common. Volunteers responded quickly and in large numbers. College students were especially noticeable in this effort. If organizational skills had been more available the outcome would have been markedly different.

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CONCLUSIONS

1. The relatively slow and somewhat disorganized relief effort during the first month following the earthquakes was apparently due in large measure to: A) the absence of similar disaster events among the affected villages in recent decades; B) the very limited supply of material resources available in and near the stricken area; C) the paucity of public and private disaster-relief organiations in Sicily generally; D) the absence of disaster-relief plans in local and provincial governmental organizations; E) the relative scarcity or unavailability of experienced persons with managerial skills living in western Sicily; F) a pattern of red tape and inefficiency in governmental agencies generally; G) the lack of cooperation on the part of refugees. This failure to cooperate apparently resulted from their suspicion of outsiders and from fears based on lack of knowledge about the nature of earthquakes.

2. A single governmental agency with comprehensive authority acting aggressively could have reduced human suffering greatly and restored the affected area to relatively normal functioning in a fraction of the time which actually elapsed.

3. Experienced disaster relief specialists working in teams could have provided invaluable assistance during the first few weeks. Such teams should be both national and multinational in composition. Material contributions from foreign countries should be funneled through such teams.

4. Under most circumstances contributions of medical supplies and clothing should not be transported to a disaster area until they have been sorted and labeled properly.

5. Since the arrival of large numbers of volunteers in a disaster area seems to be inevitable, responsible organizations should have detailed plans and procedures developed in advance for the utilization of their services.

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6. The strengthening of local governmental units generally offers the best prospect for reducing suffering and loss in future disasters.

7. The capacity of much of the old, and some of the more recent construction in the damaged area to resist earthquakes of relatively modest magnitude is very poor. The direct reasons include lack of adequate governmental regulation, lack of skilled workmanship, and, especially in the older buildings, the use of rubble and other coarse forms of masonry, very weak mortar, and poorly supported heavy tile roofs. The more indirect reasons are economic, educational, social, and political.

8. Buildings of reinforced concrete frame and floor-slab construction appeared to have withstood the earthquakes without great damage. Those constructed with cut stone bearing walls and reinforced concrete floor slabs showed wide variation in capacity to withstand the shocks, the great damage to some of these structures probably being due to poor workmanship, inadequate design, and improper use of materials more than to other causes. The old traditional buildings constructed of rubble masonry with very weak mortar and heavy tile roofs on flimsy supports are death traps of the worst sort. Future construction of these should be forbidden. Furthermore, the existing buildings of this type should be condemned and replaced with modern, well-designed earthquake-resistant structures. The latter suggestion would require drastic governmental action and is probably not feasible economically, socially, and politically.

9. Regulations requiring earthquake-resistant construction should be adopted and enforced in all of Sicily.

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ACKNOWLEDGMENTS

The authors are indebted to a great many persons in Sicily for their friendly assistance in gathering the information which has been presented here. Above all we are indebted to Miss Pamela Gardner for her highly capable assistance as interpreter, translator, and guide. Professor Roberto Cassinis and Professor Ruggiero Jappeli, both of the University of Palermo, were very helpful in conducting a tour of the zone of earthquake damage; our thanks go to them. We owe thanks also to Professor Giusseppe Grandori of Milan who took special interest in our visit, but unfortunately we were unable to make contact with him during his trip to Sicily. We are indebted to the magazine Epoca and its publishers for permission to reproduce some of the photographs included in this report. Staff members of the U. S. Department of State and the U. S. Coast and Geodetic Survey in Washington, of the U. S. Embassy in Rome, and of the U. S. Consulate in Palermo gave us valuable assistance. Finally, we are indebted to the National Science Foundation, through the Committee on Earthquake Engineering Research of the National Academy of Engineering, for financial support.

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APPENDIX A

CHRONOLOGY OF EVENTS, PERSONS AND PLACES VISITED

The following account is essentially a diary of events, persons and places visited. Many of the details recorded here are not significant in the drawing of final conclusions. They have been included in order to provide a chronological base for the main part of the report, and for possible later use in follow-up visits to Sicily.

Sun., Mon., Tues., Jan. 14, 15, 16, 1968
The first earthquakes of the series in Sicily occurred; extensive damage was done (See Appendix B).

Fri., Jan. 19
Professor George Housner of California Institute of Technology phoned us to determine if we could visit Sicily in the very near future. We started to make necessary arrangements.

Mon., Jan. 22
Tentative plans were made to leave Denver on Jan. 30, spend Jan. 31 in Washington, and arrive in Rome on Feb. 1.

Jan. 21, 25, 26
Additional earthquakes occurred in Sicily (Appendix B).

Mon., Jan. 29
Word came from Washington that the Italian government was agreeable to our visit but that it should be delayed.

Fri., Feb. 2
We were notified by Washington that the U. S. Embassy in Rome had cabled approval for us to proceed for a visit to Sicily. We completed arrangements and flew to Washington from Denver.

Sat., Feb. 3
Conferred in Washington with Col. Robert Cliffe of the NAE Committee on Earthquake Engineering Research;

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Mr. Addison Richmond, Jr., of the State Department; and Mr. Leonard Murphy of the Seismological Division, U.S.C., and G. S. Haas talked by telephone with Mr. Stephen Tripp, U. S. Disaster Relief Coordinator, A.I.D., Dept. of State.

Flew to New York and then to Rome.

Sun., Feb. 4

Arrived in Rome. Notified U. S. Embassy of arrival.

Mon., Feb. 5

Conferred at U. S. Embassy with Dr. Walter Ramberg, the Scientific Attache, and Mr. Peter Bridges. Mr. Bridges described his firsthand impressions gained during his visit to the earthquake area on January 16 to 19.

Dr. Ramberg told us that Professor Giusseppe Grandori of Milan, whom we had hoped to meet in Rome, had gone to Sicily. He advised us to fly at once to Palermo and to look for Professor Grandori there.

Flew to Palermo, arriving late in the evening.

Tues., Feb. 6

Telephoned Mr. Joseph Eblan at U. S. Consulate, Palermo, who referred us to Mr. Jack Flatau, economic specialist at the Consulate. Mr. Flatau found that Professor Grandori and Ing. Cipollini of the Ministry of Public Works, Rome, had gone west to Castellammare del Golfo and then apparently south into the earthquake zone.

Professor Ing. Roberto Cassinis, Director of the Institute of Applied Geophysics at University of Palermo, visited us, described his impressions of the earthquakes, loaned us photographs and maps, and invited us to visit his institute. We then went to Professor Cassinis's institute and were given a very detailed firsthand description of the damaged area by Mr. Ignacio Tobacco, from Genoa, a student of Professor Cassinis, who had visited the area on January 18. Arrangements were made with Professor Cassinis to go with him on a tour of the earthquake area on Thursday, Feb. 8.

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Earlier in the day, Haas visited briefly with Dr. Gabriele Morello, an economist to whom we had been referred by Professor Morris Garnsey of the University of Colorado.

During the course of his search for Dr. Morello, Haas met an English school teacher, Miss Pamela Gardner, who spoke fluent Italian and had lived in Palermo for a number of years, and engaged her as interpreter. By the end of the first day in Palermo we had made preliminary contacts, obtained a firsthand survey of locations of special damage, engaged an interpreter, rented an automobile, and made arrangements for the first two field trips.

Wed., Feb. 7

With Miss Gardner as driver and interpreter we drove west to Álcamo, then southeasterly to Camporeale, recording notes along the way regarding damage and refugee housing. At Camporeale we saw the first signs of serious damage within a town, visited the refugee camp, and carried on tape-recorded interviews with town officials, relief workers, refugees, and others. It later became apparent that this was one of our most significant visits. Due to dynamiting in Gibellina we found it necessary to return to Álcamo and take the route through Vita and Salemi to Santa Ninfa, which was seriously damaged. A visit to the refugee camp outside Santa Ninfa revealed that it was far better equipped and managed, and had far better morale, than the camp at Camporeale. At both camps we found a general willingness and eagerness to talk with us. Miss Gardner proved to be highly capable as interpreter and in drawing out the information wanted. It grew dark as we finished the visit and we then returned to Palermo.

Thurs., Feb. 8

On this day we split into two groups, Ayre going with Professors Cassinis and Jappelli of the University of Palermo into and through the zone of greatest damage, and Haas and Miss Gardner making further arrangements in Palermo and visiting the refugee camp at Montevago.

The trip by Ayre, Cassinis and Jappelli (Professor Ing. Ruggiero Jappelli, professor of geotechnics)

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followed the route, described earlier by Mr. Tobacco, through Vita, Salemi, Santa Ninfa, Partanna, across the Belice River, then through Montevago, Santa Margherita di Belice, again across the Belice on a different road, then through Salaparuta (near Gibellina), Poggioreale, and, it now being dark, back to Palermo. The purpose of this trip was chiefly to observe damage. About 40 photographs were taken showing types of construction, damage to a wide variety of structures, minor slides, and sand boils and other minor surface openings along the Belice River. The center of damage appeared to be near Montevago although Gibellina, about 10 kilometers away across the Belice valley, was so nearly completely destroyed that the authorities were dynamiting it, and we were not allowed near it on this trip.

Haas and Miss Gardner tried to visit the Prefect of Palermo Province but without success. They then made arrangements through Mr. Flatau of the U. S. Consulate for an appointment with the Vice-Prefect of Trápani Province on Friday. Other places visited in Palermo during the day included the U. S. Information Service, the offices of the evening newspaper L'Ora where a complete set of copies from Jan. 15 through Feb. 7 was obtained, the official photographer for L'Ora who allowed them to examine about 200 photographs, and the telephone company SIP (without success). The remainder of the day was spent on a trip to the Montevago refugee camp where they interviewed police, relief workers, camp officials and others, and were able to draw comparisons among the three camps (Camporeale, Santa Ninfa, and Montevago) which we visited during the stay in Sicily.

Fri., Feb. 9

On this day we (Ayre, Haas, and Miss Gardner) drove to Trápani at the western tip of Sicily for tape-recorded interviews with the Vice-Prefect, the Head of Emergency Medical Operations, the Chief of the Provincial Medical Office of the Province of Trápani, the director of the national electric utility (ENEL) for Trápani Province, and a junior executive who had been left in charge at the local telephone office. The trip was not especially informative, but it provided a good introduction to provincial organization and bureaucracy.

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Sat., Feb. 10

Ayre spent the morning visiting Professors Jappelli and Cassinis at the University, where he received further information of an engineering nature, and met very briefly with Professor Ruggieri of the faculty of geology and Professor Caronia, dean of the faculty of architecture.

Haas and Miss Gardner interviewed the director of ENEL (electric utility) for all of western Sicily, visited the telephone company but found no officer available, obtained a full set of copies of the morning Sicilian Journal from Jan. 15 through Feb. 7, had a very interesting visit with the official photographers for the Sicilian Journal and obtained some photographs from them, and returned to the official photographers of L'Ora to obtain some photographs.

The afternoon and evening were spent in preparing notes, in reviewing and summarizing the taped interviews, and recording the summaries in English. This part of the work was also carried on in spare moments, during the field trips. The procedure consisted in the play-back of each taped interview, recapitulation by Miss Gardner in English, discussion among the three of us, correction of names and statistics, and finally the recording in English of a summary of each interview. In this way all the translation, discussion of the results of an interview, elimination of unneeded or irrelevant material, and final recording in English of a brief, useful interpretation of an interview were completed with all of us present and before the interview had become "cold" in our memories. The aim was to be able to leave Sicily with all tapes translated, discussed, corrected, summarized, and re-recorded in English ready for transcribing by a stenographer on our return. This was accomplished through the great willingness and ability of Miss Gardner to stick to the job and to be precise in her interpretation. The success of this procedure saved many weeks of what would have been extremely difficult translation and interpretation had they been left for a period after our return.

Sun., Feb. 11

This day was spent in a continuation of the above-

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described procedure until the tapes on hand had been completed. A somewhat similar procedure was carried out in studying the newspapers. Miss Gardner scanned the papers, described the pertinent articles, and then tape-recorded English summaries of the articles which we thought were valuable.

We were finally able to make contact with Professor Grandori. He had returned to Milan and we talked with him by telephone.

Mon., Feb. 12

We visited the offices of the Province of Palermo and were allowed to interview a secondary official in the office of the Prefect, the chief medical officer, the chief veterinarian, and an official in the public works agency. An engineer-manager in the telephone company was also interviewed. The interview tapes were played back, discussed, and summarized in English. In the early evening we drove to the south coast to Agrigento in preparation for the interviews which had previously been arranged for Tuesday with officials of Agrigento Province.

Tues., Feb. 13

The day was spent in interviews with the Prefect, the medical officer, and engineers in the public works agency of the Province of Agrigento. These interviews, especially the one with the Prefect, were more candid and successful than those with some other officials on the previous days. The interview tapes were summarized during the return trip to Palermo in the late afternoon.

Miss Gardner was willing to continue a study of the newspapers and other public sources of information after our departure; we asked her to do this and to report to us from time to time by mail, which she did very faithfully.

Wed., Feb. 14

Haas and Ayre flew to Rome early in the day, reported to Dr. Walter Ramberg and Mr. Robert Gordon at the U. S. Embassy, left for New York, and arrived in Denver late in the evening.

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APPENDIX B

REPORT FROM UNITED STATES COAST AND GEODETIC SURVEY+

NO. 4-68
FEB. 16, 1968

PRELIMINARY DETERMINATION OF EPICENTERS

Jan	H	M	S	Lat	Long	Region	Depth	Mag	SD	N
14	12	28	24*	37.8 N	13.1 E	Sicily	33 R	5.1	1.7	14
14	13	15	41*	37.7 N	13.1 E	Sicily	2	5.0	1.2	17
14	15	48	31.8	37.9 N	13.1 E	Sicily	29	4.7	1.2	32
15	01	33	02.7	37.9 N	13.1 E	Sicily	33 R	5.1	1.3	65
15	02	01	08.5	37.9 N	13.1 E	Sicily	33 R	5.4	1.2	94
15	03	18	40.8	37.9 N	13.1 E	Sicily	33 R	4.6	1.2	22
15	22	19	57*	37.8 N	12.9 E	Sicily	33 R	4.7	0.7	16
15	13	42	95*	37.8 N	12.8 E	Sicily	33 R	5.3	0.8	9
15	18	22	50.1	37.7 N	13.1 E	Sicily	6	4.1	1.2	18
16	13	10	32*	37.8 N	12.9 E	Sicily	33 R	4.6	1.3	10
16	16	42	44.3	37.9 N	13.1 E	Sicily	14	5.1	1.3	71
16	00	54	09*	37.6 N	12.8 E	Sicily	33 R	4.8	1.4	8
21	02	39	05*	38.0 N	13.2 E	Sicily	33 R	4.3	0.7	8
25	09	56	48.7	37.8 N	13.2 E	Sicily	33 R	5.1	1.3	69
25	14	35	33*	37.8 N	12.9 E	Sicily	33 R	4.4	1.4	17
26	08	02	18*	37.7 N	12.8 E	Sicily	31	4.6	0.9	15
Feb										
5	11	17	30*	37.9 N	12.8 E	Sicily	33 R	4.3	1.2	9

+A letter of June 6, 1969, from the U. S. Coast and Geodetic Survey indicated that these "data...are the best available to date."

*These epicenters accurate within 50 kilometers.

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