Natural Hazard Research

DISASTER PREPAREDNESS AND THE 1984 EARTHQUAKES IN CENTRAL ITALY

David Alexander
Department of Geology and Geography
University of Massachusetts, Amherst

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SUMMARY

This report describes the effects of earthquakes in the central Italian regions of Umbria (April 29, 1984, magnitude R 4.8) and Abruzzo (May 7 and 11, 1984, magnitudes R 5.2 and R 5.0, respectively). The relief effort that followed these events is evaluated in the light of changing disaster mitigation policies and bureaucratic reorganization in Italy. The evaluation covers logistics, legal problems, financial provisions, scientific endeavors, the role of macroseismic survey, medical organization, evacuation, and public perception of earthquakes.

A permanent structure for emergency management and scientific coordination emerged belatedly in Italy with the creation in 1982 of a Ministry for Civil Protection, but many dilemmas remain. These include the level of state indemnity for private losses, the content of the national macroseismic questionnaire, and the degree of autonomy to be given to regional, provincial and local levels of government when formulating emergency plans. The 1984 disasters illustrate that considerable spatial variation exists among the responses of individual Italian municipalities to seismic catastrophe.

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David Alexander

PREFACE

This paper is one in a series on research in progress in the field of human adjustments to natural hazards. It is intended that these papers be used as working documents by those directly involved in hazard research, and as information papers by the larger circle of interested persons. The series was started with funds from the National Science Foundation to the University of Colorado and Clark University, but it is now on a self-supporting basis. Authorship of the papers is not necessarily confined to those working at these institutions.

Further information about the research program is available from the following:

William E. Riebsame
Institute of Behavioral Science #6
University of Colorado
Boulder, Colorado 80309

Robert W. Kates
Graduate School of Geography
Clark University
Worcester, Massachusetts 01610

Ian Burton
Institute for Environmental Studies
University of Toronto
Toronto, Canada M5S 1A4

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Prodigies, Monsters, and Other Extravagances,
All Produced by Earthquakes

D. Marcello Bonito, Naples, 1691 (title of a book)

It is characteristic of earthquake defense in Italy that the attention given to this problem by the scientific and technical world has so far only been manifest in any significant way after destructive seismic events.

It is also worth noting that efforts have almost always been limited to therapeutic actions, while there has been a lack of organic analysis of the actions required to stop the disasters from repeating themselves; in other word, to avoid the catastrophic consequences of earthquakes in terms of lives lost and damage caused. This stems from the fact that the link between earthquakes and the use of the land has never been taken into serious consideration in Italy, and, instead, earthquakes have been considered as a natural catastrophe that necessarily governs to some extent the human condition itself.

Only recently has the conviction begun to diffuse that this logic must be overturned and one must necessarily abandon the notion of earthquakes as natural catastrophes (and thus as accidental events not to be included in preparatory action) and assume instead the idea that both the tremors and their effects are an integral component of social life, and thus a social problem to be researched.

Consiglio Nazionale delle Ricerche, 1981b

The experience of recent years has demonstrated, apart from a commendable grasp of the problems on the part of functionaries, professionals, and university workers, an unfortunate lack of professionalism in the specific sectors of applied research, including traits of falsification or dangerously concealed improvisation (whether by design of default). One must state that it is frankly better to be without microzonation or seismic laws and norms than to have the wrong results, perhaps at high cost.

Consiglio Nazionale delle Ricerche, 1981a

INTRODUCTION

On Sunday, April 29, 1984, an earthquake of magnitude R 4.8 occurred in the vicinity of Urbino and Gubbio, central Italy. The tremors affected 39 communities: 41 people were injured and 6,081 were evacuated from their damaged homes. On Monday, May 7, a magnitude R 5.2 earthquake occurred in the Val Comino, Abruzzo Region (also in central Italy) and was follwed on Friday, May 11, by a further tremor of magnitude R 5.0 in the nearby Val Sangro. Three people died in these earthquakes and 50 were injured; 198 communities were affected, including seven which were seriously damaged, and 38,000 people were given temporary accommodation in trailers, tents and hotels.

Although these events were not major seismic disasters, they had important consequences for civil protection and disaster relief in Italy, as they occurred shortly after the creation of a national Ministry for Civil Protection and thus constituted the first serious test of its resources and organization. Italy is struggling to emerge from a **laissez faire** attitude toward disaster relief and trying to plan effectively against future catastrophes. The 1984 disasters thus illustrate both the process and the dilemma of achieving effective organization against natural catastrophe. These events can only be viewed in the light of the prevailing capacity for emergency planning, while the experience gained in facing up to them will in turn contribute to the planning process.

Field work for the project reported here was conducted in central Italy during May and June of 1984, directly after the Umbria and Abruzzo earthquakes. Research goals at that time were:

1) To evaluate disaster relief.

2) To analyze new developments in emergency response since the 1980 southern Italian earthquake disaster and the creation in 1982 of a Ministry for Civil Protection.

3) To assess whether seismic vulnerability is being reduced as a result of new and more stringent risk classifications introduced after 1980.

4) To chart and evaluate changes in survey methods for damaged buildings resulting from recent improvements in the techniques and personnel employed for macroseismic survey.

5) To determine whether Italy's new atmosphere of seismic risk awareness has actually resulted in better preparedness, more rational behavior during the impact phase, and improved conduct of public affairs following a disaster.

Once the study was under way, the following goals were added. They constitute the scope of this report.

1) To explore the relations between the geology of the disaster areas and damage caused by the 1980 tremors.

2) To consider present disaster relief and preparedness in the light of the areas' seismic histories.

3) To compare national and local relief responses, particularly the different strategies employed in each community in 1984.

4) To describe temporary engineering and political solutions to structural damage and homelessness.

5) To evaluate epidemiologic surveillance methods.

6) To chart the development of a national macroseismic questionnaire.

7) To summarize the national scientific prediction and prevention effort.

8) To explain the development of a disaster relief ministry within the Italian government, and the evolution of a draft national law for civil protection.

SEISMIC EMERGENCIES IN ITALY

Overview

Natural hazards--principally earthquakes, landslides, floods and avalanches--pose a significant threat to about 70% of Italy (Alexander, 1985b). Natural disaster has claimed many lives in Italy: about 135,000 people have been killed in this century and, of these, 20,000 have lost their lives during the last 30 years (Solbiati and Marcellini, 1983). The last census of outstanding damage estimated its cost at about 100,000 billion lire ($51 billion;* **Il Progresso**, New York, November 27, 1984). Earthquake disasters occur in Italy on average once every 4.8 years (Ganse and Nelson, 1981), and 32% of the population lives in the roughly one-quarter of Italian municipalities that have been classified "at high seismic risk" (Consiglio Nazionale delle Ricerche, CNR, 1981a).

Although the very worst Italian seismic catastrophe for which documentation exists is that of Calabria in 1983-85 (Vivenzio, 1788), earthquakes have caused major disasters several times this century. About 90,000 people are believed to have died in the 1908 Straits of Messina earthquake and tsunamis. Only 2,224 homes remained standing among the 7,800 at Messina in Sicily, while only 176 houses were spared among 3,636 at Reggio Calabria (Solbiati and Marcellini, 1983).

In 1915 an earthquake killed 32,000 inhabitants of Avezzano and its surroundings in Abruzzo. The 1980 earthquake in Irpinia, central-southern Italy, occurred where two previous earthquakes, in 1930 and 1962, had caused damage and casualties (Provincia di Napoli, 1981). The 1980 disaster caused about 2,735 deaths and 8,842 recorded injuries, left more than

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*U.S. $1 = 1,950 Italian lire.

200,000 people homeless and caused damage in 637 municipalities spread over 23,000 sq. km. (Ventura, 1984a). Many of the emergency relief provisions for the 1976 Friuli earthquakes (in which 927 people died) were rapidly adapted for the 1980 disaster (Geipel, 1982). The final cost of damage estimate was 9,740 billion lire; reconstruction and social welfare programs absorbed about 3% of GDP over the period 1981-84 (Regione Basilicata, 1982-83).

Seismic disaster in Italy must be considered against the background of other natural and human-induced hazards. The 1963 Vajont dam disaster in the Piave Valley caused 2,100 deaths. The rupture of a dam in Val di Fiemme, Trentino, on July 19, 1985 killed 197 people and caused more than $4.1 million in damage (**Panorama**, Rome, July 28, 1985).

Floods in Calabria and on the River Po in 1951 (De Micheli, 1980) and in 1966 at Florence and throughout northern Italy (Alexander, 1980) did considerable damage to both town and countryside, causing serious economic setback to the affected regions. Landslides have created damage at several levels: nationally, the cost of landslide, flood, and erosional damage is estimated at $1.08-$1.35 billion per year; the cost to local communities has been serious. For example, in 1982 a single landslide damaged 11.4% of the city of Ancona, causing more than $700 million in damage (Alexander, 1984b), and in September 1983 a debris flow claimed 11 lives in the Valtellina, northern Italy (Azzola and Tuia, 1983).

Relatively minor earthquakes have proved effects that are far from negligible. At Tuscania the 1971 earthquake (magnitude R 4.5) killed 32 people and injured 300. The effect on housing was also serious: of 2,000 homes rendered unusable by tremors, 1,124 were located in the historic urban core of Tuscania (Gasparini and Stucchi, 1979). Similarly, the 1972

FIGURE 2

TWENTIETH CENTURY EARTHQUAKE EPICENTERS IN CENTRAL ITALY

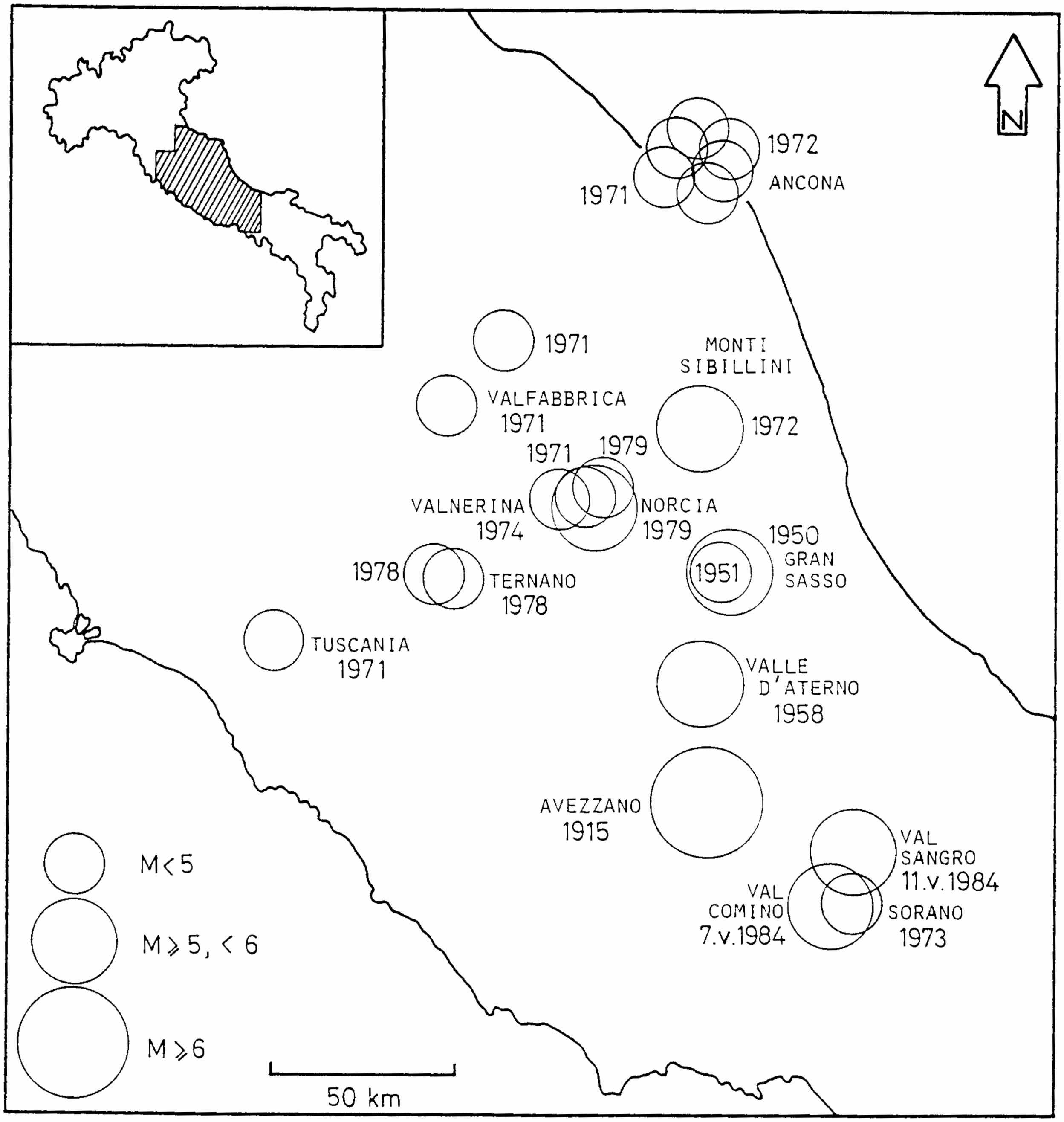


TABLE 1

SUMMARY CATALOGUE OF CENTRAL ITALIAN EARTHQUAKES

Date: D - M - Y	Co-ordinates: N	E	Intensity:	Magnitude:	Hypocentre depth km	Deaths:	Location:
30- 4- 801	41.9	12.6					Rome
6- 847	42.2	13.9					Molise
896	41.9	12.6					Rome
11- 6-1231	41.5	13.8	X	6.3*			Montecassino (FR)
30- 4-1279	44.2	12.1	X				Forlì
30-11-1298	42.7	12.7	X				Spoleto (PG)
1300	42.4	12.9					Rieti
1-12-1328	42.8	13.0	X			5,000	Norcia (PG)
9- 9-1349	41.6	13.9	X	6.3*	20	1,000+	L'Aquila-S. Elia (FR)
25-12-1352	43.5	12.1	XI			2,000	Sansepolcro (AR)
27-11-1461	42.4	13.4	X				L'Aquila
23- 7-1654	41.7	13.6	IX-X	6.1*			Sora (FR)
14- 1-1703	42.2	13.4	X			40,000	Norcia (PG)-L'Aquila
16- 1-1703	42.4	13.4	X				L'Aquila
2- 2-1703	42.2	13.3	X			5,000	L'Aquila
3-11-1706	42.0	14.2	IX	5.6*		16,000	Sulmona (AQ)
12- 5-1730	42.8	13.0	X			200	Norcia (PG)
24- 4-1741	43.2	12.6	X				Fabriano (AN)
1751	43.3	12.8	IX				Gualdo Tadino (PG)
3- 6-1781	43.6	13.5	X				Cagli (PE)
30- 9-1789	43.5	12.3	X			500	Città di Castello (PG) -Sansepolcro (AR)
28- 7-1799	43.1	13.0	X			60	Camerino (MC)
26- 7-1805	41.2	14.7	X			6,573	Molise, Isernia
13- 1-1832	43.0	12.7	XI			22	Umbria
22- 8-1859	42.8	13.1	XI			101	Norcia (PG)
13- 1-1915	42.0	13.6	XI	6.8	8	32,610	Avezzano (AQ)
26- 4-1917	43.5	12.2	X				Monterchi (AR)-Citeria (PG)
30-10-1930	43.7	13.3	IX	6.0		18	Senigallia (AN)
26- 9-1933	42.0	14.2	IX	5.5	14	10	Lama dei Peligni (CH)
6- 2-1971	42.4	11.8	IX	4.5	33	18	Tuscania (VT)
14- 6-1972	43.8	13.3	VIII	4.7	4	2	Ancona
19- 9-1979	42.8	13.1	VIII	5.5	8		Norcia (PG)
17-10-1982	43.2	12.6	VII	4.6			Valfabbrica (PG)
29- 4-1984	43.5	12.5	VII				Gubbio (PG)
7- 5-1984	41.7	13.9	VII	5.2	7	3	Val Comino (AQ)
11- 5-1984	41.8	13.9	VIII	5.0	7		Val Sangro (FR)

* Estimated M_s magnitude

Provinces: AN Ancona; AQ L'Aquila; AR Arezzo; CH Chieti; FR Frosinone; MC Macerata; PE Pesaro-Urbino; PG Perugia; VT Viterbo.

(Ganse and Nelson, 1981; Solbiati and Marcellini, 1983)

FIGURE 3
UMBRIA EARTHQUAKES

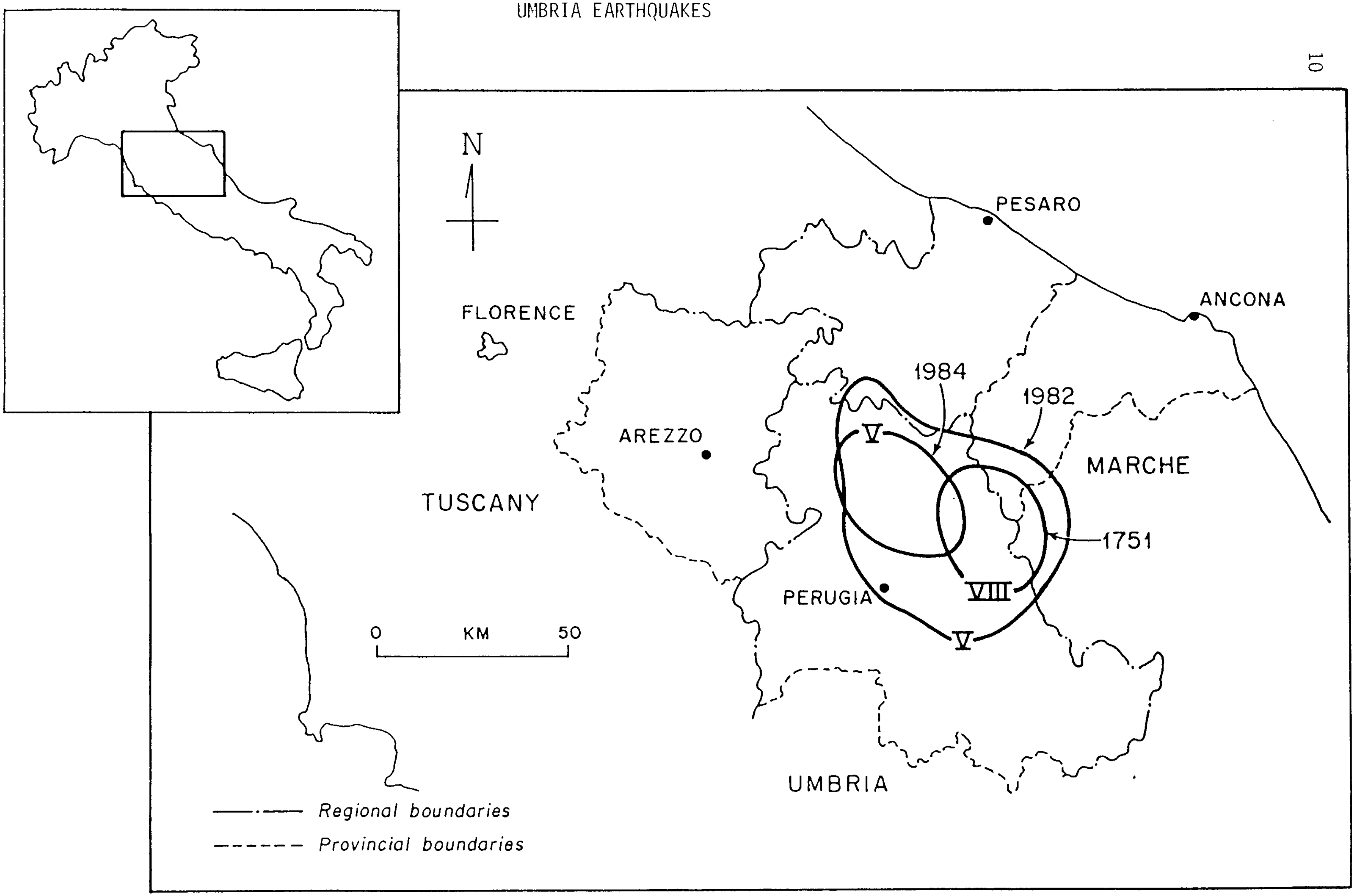


TABLE 2

SUMMARY DATA FOR 1984 CENTRAL ITALIAN EARTHQUAKES

Umbria 1984

Date	Number of Evacuees	Number of Affected Comuni	Trailers Supplied	Tents Supplied	Firemen at Work	Army Personnel at Work	Number of Evacuation Orders	Number of Buildings Surveyed
29 April	2576	6	100					
30 "	c. 3000							
1 May	c. 4000	12	252-472	308				
3 "	6081		1067-1197				1600	3742
10 "	6599	16	1300	523	190	53		

Abruzzo 1984

Date	Total Evacuees	Evacuees by Province (%)						Comuni Affected	Buildings Surveyed	Army Person-nel	Fire-men	Volun-teers	Tents Supplied	Trailers Supplied
		FR	AQ	IS	CE	CH	PE							
7 May	5,000							75		850	128		696	508
9 "	7,800	34.1	22.6	31.8	10.1	0.9	0.5			1537	156	140	960	730
10 "	8,146								2,136				960	1010
11 "	12,000													
12 "	22,270	26.9	35.9	22.5	10.1	3.8	1.0	168	11,600	1537	250	170	3036	2300
14 "	27,000													
15 "	36,000	34.7	29.9	21.8	11.8	1.3	0.6	198	17,171	2006	301		5607	5355

Ministry for Civil Protection command centers at Perugia and Umbertide (for trailers and relief supplies). The Superintendents of Conservation estimated that 140 architectural monuments were damaged, including 18 considered unsafe for public access. They requested 32 billion lire ($16.4 million) to finance urgent repair work, a figure representing half the cost of full restoration.

In several ways this event shows some typical characteristics of a minor Italian seismic emergency. The number of homeless people rose rapidly for five days as building surveys led to evacuation orders, and then leveled off within a further seven days. Immediate homelessness was alleviated by bringing large numbers of trailers into the area, as had been done on a much larger scale after the 1980 earthquake in the Mezzogiorno. In all, the emergency in Umbria attracted much attention from both central government and the Italian news media, but directly affected less than 2% of the total population of the municipalities involved (see Table 3). Even at Gubbio, the most severely affected town, only 9% of the inhabitants were evacuated, and many later returned to their homes.

Abruzzo, May 7 and 11, 1984

Abruzzo (10,794 sq. km., 1981 population 1,239,738) has traditionally been one of the poorer regions of Italy, characterized by strong emigration and a predominantly rural/agricultural population. Like Umbria, large towns such as the provincial capitals have grown at the expense of small communities in the uplands, where less productive agricultrual land has been abandoned. Per capita income in Abruzzo in 1975 was only three-quarters of the national average. Although tourism has grown in

TABLE 3

POPULATION AND OTHER STATISTICS FOR THE 1984 DISASTER AREAS

Region	Province		Area km^2	Population 1976	Density /sq. km	Evacuees 15-5-84	As % of Popn.	Comuni
Umbria	Perugia	PG	6334	570,859	90	6599 (Perugia, Ancona, Pesaro-Urbino, Arezzo combined)	0.4	59
Marche	Ancona	AN	1940	427,527	220			49
Marche	Pesaro-Urbino	PS	2893	329,157	114			67
Tuscany	Arezzo	AR	3232	312,441	96			39
Abruzzo	L'Aquila	AQ	5034	301,129	60	10,760	3.6	108
Abruzzo	Chieti	CH	2587	366,031	142	470	0.1	104
Abruzzo	Pescara	PE	1225	285,705	233	214	0.1	46
Lazio	Frosinone	FR	3239	452,760	140	12,500	2,8	91
Molise	Isernia	IS	2909	94,670	62	7,862	8.3	52
Campania	Caserta	CE	2639	729,492	276	4,260	0.6	104

Region	Population	Density /sq. km	Number of Comuni	Percentage Seismic*
Abruzzo	1,239,738 (1981)	115	305	78
Molise	334,091 (1981)	75	136	76
Lazio	5,059,174 (1981)	294	375	74
Umbria	805,329 (1978)	95	92	75
Marche	1,409,845 (1978)	145	246	93
Toscana	3,594,607 (1978)	156	287	63

importance since the completion of the national highway network, it is concentrated on the coast, around Pescara.

The earthquakes of May, 1984, occurred in the Abruzzo National Park area (one of the region's vital resources) (see Figure 4). This natural reserve of more than 40,000 hectares lies in the Provinces of L'Aquila, Campobasso and Frosinone. The park's administrative center is at Pescasseroli (one of the epicentral towns of the 1984 tremors). Tourism and associated commerce provide 42% of employment and the annual visitor total has risen during the 1980s to more than one million (**Airone**, Rome, vol. 14, August 1984).

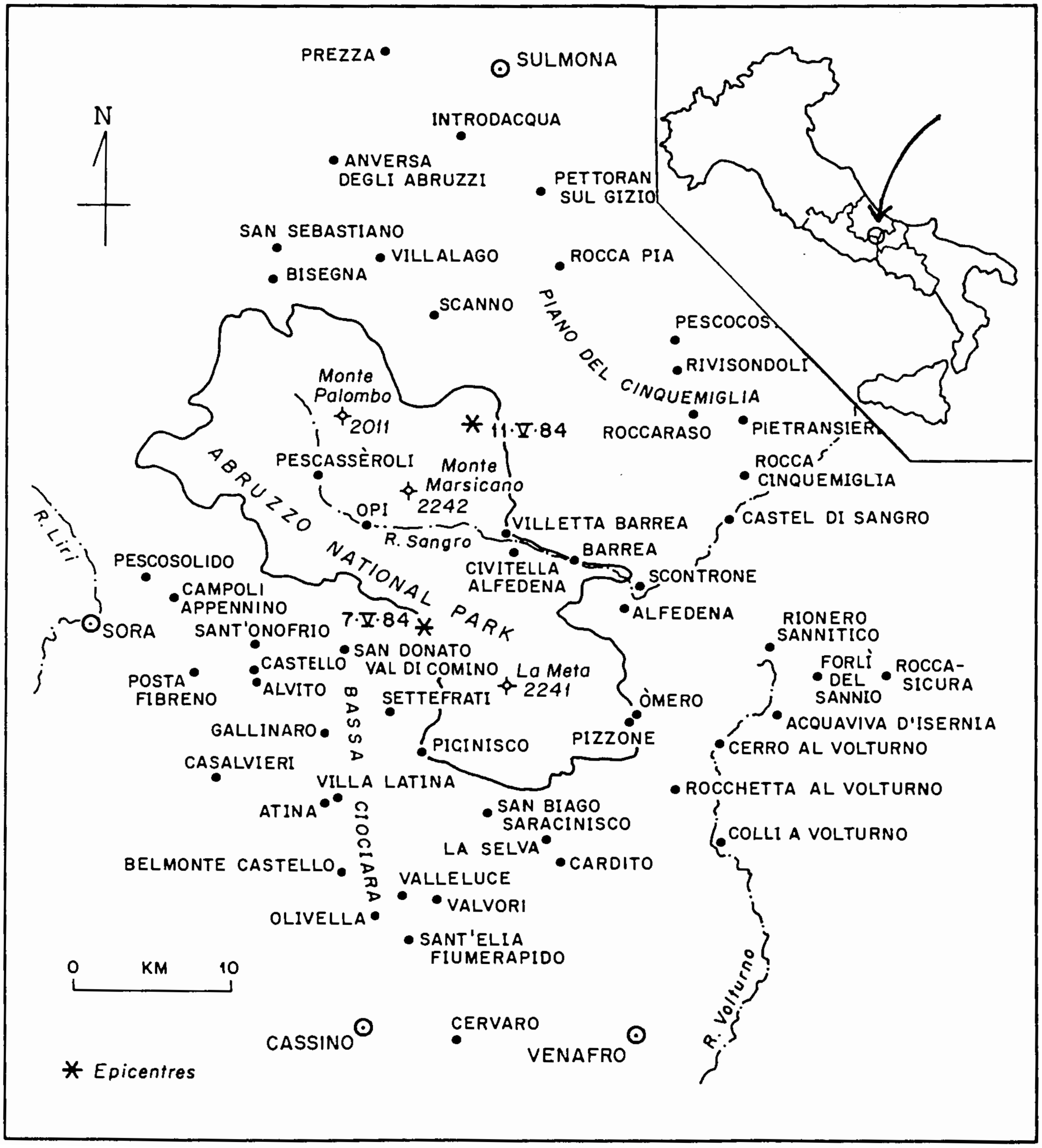
The provincial administration has refused to approve the urban plans of seven local municipalities, largely due to development pressure on the park land (Cederna, 1975). As will be seen, urban plans are vital to relief efforts under the present system.

Northern Abruzzi has some of the geologic characteristics of the Umbria-Marche basin. However, the main attribute is a carbonate platform, which outcrops in the Park, is intermediate in character between the external facies of the Adriatic platform to the east, and the internal faciesof he Lepini platform to the west. The main outcrop consists of continental shelf and reef carbonate deposits of Jurassic-Cretaceous age, which have been faulted and overthrust during uplift. Overthrusting in part guides the course of the River Sangro. The Abruzzo National Park is situated in an active area at the southernmost limit of the central Italian zone of high seismicity.

The 5:50 pm earthquake of Monday, May 7th created panic in a number of towns. Most building occupants ran immediately into the streets, where architectural ornaments and small amounts of masonry were detaching and

FIGURE 4

1984 ABRUZZO DISASTER AREA



falling from facades and roofs. At Cervaro the roof of a church fell onto a small congregation; three people were seriously injured and 19 others hurt. Some 233 trailers were sent immediately from Rome by the Ministry for Civil Protection, and 500 more were prepared rapidly to be sent. Tent camps were organized in 57 municipalities and some people were evacuated from their homes to hotels on the periphery of the affected area. In the Bassa Ciociara area to the south of the park, farmers objected to evacuation away from their fields and livestock.

On May 9th the National Geophysical Institute at Rome announced that the probability of another comparable earthquake was slight. However, on Friday, May 11th an earthquake occurred with an epicenter 12-15 km. north of that of the previous Monday (see Figure 4). Five tremors measuring VII-VIII on the MCS scale occurred in quick succession. Aftershocks to intensity VI occurred on the same day. Intitial reports gave the casualties as three dead and 50 injured. Some of these injuries would have been prevented if the population had not panicked. Amid rain and with a lack of tents and trailers, 25,000 people were evacuated. Unofficial evacuation also took place in the nearby city of Isernia, where an estimated 30,000 people slept out of doors on May 12th. Evacuations were mainly to the periphery of towns (to sports fields and campsites, for example), where tent and trailer camps were gradually established, some by engineers of the Italian army. Spare hospital beds were used to a smaller extent.

The evacuation was official in the sense that reoccupation required a certificate signed by the mayor of one's municipality. In the event of non-compliance, evacuation was enforced by local police units (**vigili urbani**). Evacuation was a precautionary measure, pending structural survey. By May 10th it had been determined that in the seven communities with the worst damage up to 50% of homes were damaged. Of these, 35% were judged unusable without structural repair. After the second earthquake, up to 70% of homes were damaged. Pescocostanzo and the 19th century urban core of Pescasseroli were both completely evacuated pending comprehensive house-to-house structural survey.

The May earthquakes may have been relatively minor in terms of seismic energy, but they provoked notable damage. Church towers were severely damaged at Barrea and Scontrone, hospitals were damaged at ATina and Venafro and an aqueduct was damaged at Castel di Sangro. Notal damage was sustained at Pescasseroli, Civitella Alfedena, Alfedena, Castel di Sangro, Pescocostanzo, Villetta Barrea and Barrea, among other settlements. Rockfalls and landslides blocked several roads, but firefighters drafted from as far as 300 km. away and national service personnel were able to clear the roads within 24 hours. Telephone and electricity were also reconnected within one day, but schools remained closed for six to ten days.

By May 12, 10 billion lire ($5.1 million) in national funds had already been spent on the relief effort. The Minister for Civil Protection issued an ordinance on May 10 allowing grants of 300,000 lire ($154) per month to maintain evacuated families who had found their own lodgings; 8.5 billion lire ($4.4 million) was allocated to urgent measures associated with the first Abruzzo earthquake. Two days later he proposed an ordinance to grant 15-20 million lire ($7,700-10,250) toindividual families for the reconstruction of their principal residences. The Prefect of L'Aquila estimated that such a measure would enable repair of 60-90% of the damaged private housing. On May 26, Decree-Law 159 was issued to extend benefits granted to the 1980 southern Italian earthquake survivors to the populations of Abruzzo. At no time during the emergency was the principle of giving grant assistance to victims called into question.

Pozzuoli, 1983-84

The Tyrrhenian seaport of Puteoli was founded by the Romans in 338 B.C. on the site of an earlier Samo-Samnite colony. From the outset it has suffered problems since it is situated on the active remainsof a large Pleistocene volcano with a magma chamber 3-4 km. underground and shifting centers of eruption. The hinterland of Pozzuoli consists of the Phlegraeian Fields, or Campi Flegrei (from the Greek for "glowing") in which the most active of several volcanic craters is the Solfatara, which last erupted in 1198 and which continues to emit steam, sulphurous gases and mud boils. In 1538 a volcanic cone 140 meters high, named Monte Nuovo, was thrown up in the Campi Flegrei amid a substantial earthquake swarm. Major seismic activity resumed in 1983.

The particular problem of Pozzuoli has been its susceptibility to **bradiseisms**, a term coined in 1883 by the Swiss-Italian geologist Arturo Issel. These are abrupt alterations in the geodetic level of coastal areas. The most well known illustration is the Temple of Jove Serapis, constructed at sea level in central Pozzuoli during imperial Roman times. Marks on the three remaining columns of the temple indicate an abrupt fall of 2.5 meters in the level of the temple, followed by a further and slower fall of 1.1 meters. The temple has since risen, but is still partially submerged.

From 1969 to 1972, the coast at Pozzuoli rose 172 cm, and then continued to rise at 5 cm per year until July 1983. Thereafter, swelling continued at varying rates, including a two month period of 2mm per day and short bursts of 4 mm per day.

These changes in level were acompanied by notable seismic activity. During September 1983 an earthquake of MCS intensity V caused panic in the city, while on October 4, 1983 a tremor of MCS intensity VI-VII caused severe damage to the urban core of Pozzuoli. More tremors further weakened built structures in the area and, at 9:32 am on August 11, 1984, an MCS intensity VI earthquake with an epicenter between Pozzuoli dockyard and the Solfatara caused the collapse of two houses at Agnano, as well as other damage.

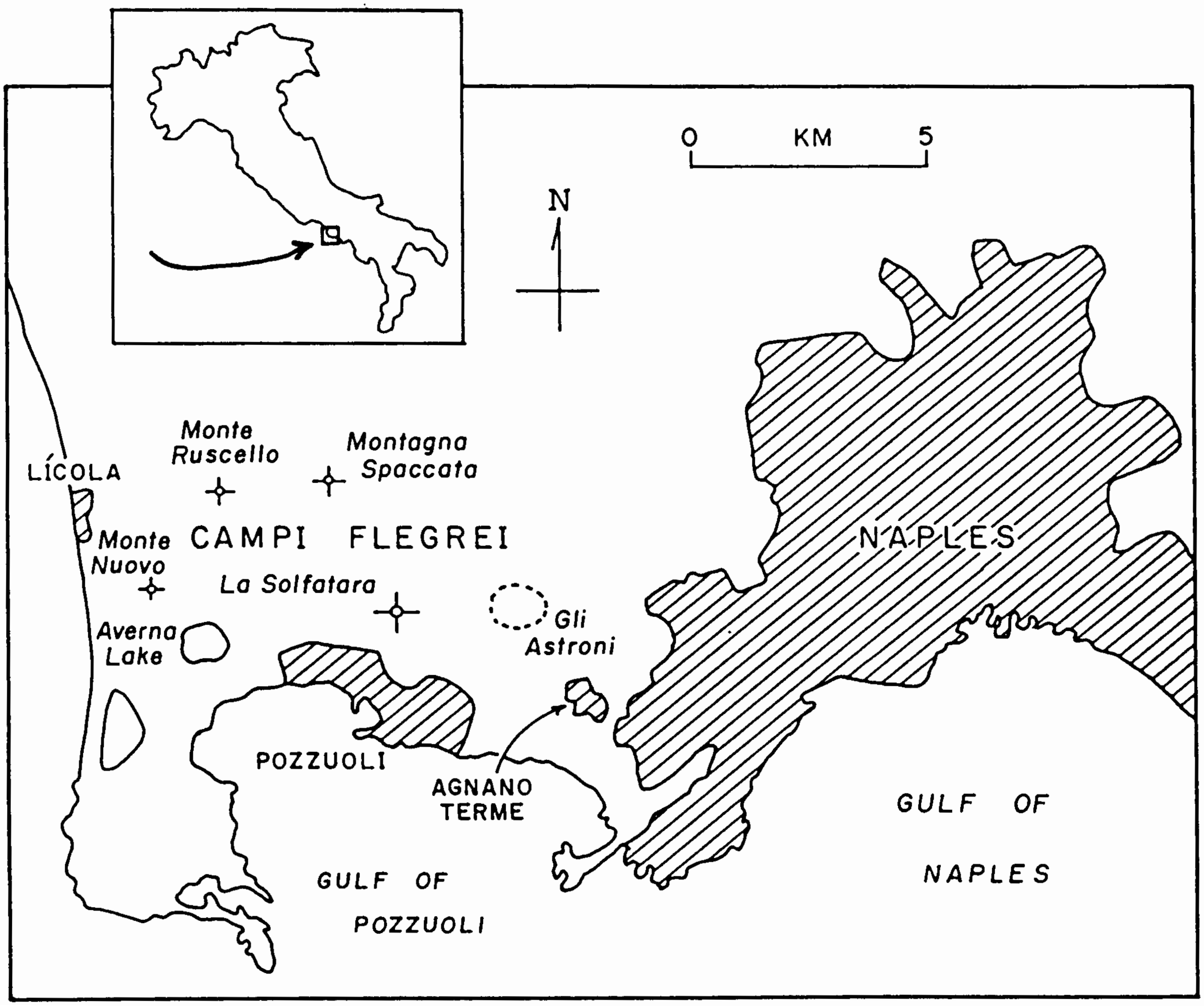
The effect on Pozzuoli has been profound. The city had grown by 21% in 12 years, to about 76,000 inhabitants in 1983. Eight thousand were employed in the port and 5,00 in manufacturing. Pozzuoli's position as a subregional market made it a nucleus for agricultural activity, and its status as a historical site attracted tourists. In 1983 and 1984, uplift left much of the port high and dry, while earthquakes threated to damage industrial plant and provoke mass layoffs.

The November, 1980, earthquake had already left damage and homelessness, and this situation was exacerbated by the bradiseismic activity. At the end of 1983, architects and engineers from Naples University were called in to survey the urban center, which had been evacuated at the order of the city council. Among the 2,553 buildings examined, 44% of the masonry structures were candidates for demolition and 47% of the reinforced concrete buildings were in need of repair.

Following the October 4, 1983 earthquake, 20,000 evacuees went to live with relatives, while others occupied schools and public housing (being built on the periphery of Naples for survivors of the 1980 earthquake) without authorization. Still others improvised their own shelter on the periphery of Pozzuoli, while a few kilometers to the north, at

FIGURE 5

CAMPI FLEGREI AND POZZUOLI AREA



Ercolano. Finally, the Director of the Vesuvian Observatory and National Volcanological Group was charged with informing the public and authorities of geophysical developments at Pozzuoli.

At the beginning of 1985, bradiseismic activity abated and it became possible to assess the situation. In all, 68% of buildings in the center of Pozzuoli had been damaged: major administrative, commercial and historic structures were unusable and some had already been demolished. On the periphery, more than one-quarter of the city's population needed resettling, and at the waterfront, port activities were compromised by the uplift of the harbor.

The structure of scientific monitoring had been sorted out and the Ministry for Civil Protection had, in consultation with the Naples Prefecture, formulated a detailed evacuation plan for volcanic eruption or similar hazards. Reconstruction and resettlement awaited more definite news on future bradiseismic activity. Plans for Pozzuoli will probably treat the city as a special case of the chronic housing problem of nearby Naples. Like its larger neighbor, Pozzuoli will decentralize as reconstruction progressively occupies the vacant land at the periphery, rather than the demolition sites at the center. Meanwhile, rumors circulate that a future eruption is possible, including the awesome prospect of a **nuée ardente** (glowing ash avalanche), whose ultra-rapid basal surge would certainly wreak havoc in such a highly populated area. Unlikely as this may be, there is no indicated that bradiseismic activity has ceased for the foreseeable future, or that an eruption is impossible.

HAZARD MANAGEMENT AND CIVIL PROTECTION IN ITALY

Evolution of an Organizational Structure

Brief History of Earthquake Relief in Italy

Italy has an unusually long and detailed documentary history of earthquakes (Barratta, 1901). Perhaps the first Italian earthquake to provoke widespread and systematic government intervention was that of Calabria, 1783, in which 30,000 people died and 400,000 were made homeless. The Bourbon monarchy of Naples expropriated ecclesiastical wealth to provide a reconstruction fund, thus achieving some measure of reconstruction in only a decade (Gasparini and Stucchi, 1979). The church itself played a leading role in disaster relief, with the apparent aim of maintaining its role as a guardian of social values and social control (Solbiati and Marcellini, 1983). However, neither the Bourbons nor the church did much to help after the disastrous earthquakes of 1851 and 1857 in southern Italy (Mallett, 1862). In fact, after the Unification of 1860, certain useful regulations, such as those governing the maximum height of buildings, were abolished due to dislike of anything Bourbonic. However, antiseismic building codes were adopted by the Papal States in the **regolamento pontificio** that followed the 1859 Norcia earthquake in central Italy.

National government intervention followed the Ischia (Naples) earthquake of 1883--perhaps in part because this town was a fashionable resort of importance to the families of cabinet ministers. One-fifth of the damage at Ischia was eventually paid for by government grants, ushering in the age of major public spending on disaster relief in Italy. But the measures adopted in 1883 were hardly better than those of the century before, as they did not include the resolution of urban planning problems caused by the earthquake (Solbiati and Marcellini, 1983).

The 1908 Messina earthquake provoked an arbitrary and rather authoritarian government intervention that had some parallels with the relief work after the 1906 San Francisco tremors. At Messina, a "state of public emergency" was declared and, as at San Francisco, 200 presumed looters were summarily executed. Looters, it seems, were much less socially acceptable than those people who profited from public and private reconstruction funds--i.e., by manipulating rather than contravening the system (Gasparini and Stucchi, 1979). This earthquake also provoked an argument between those who argued for stricter attention to and regulation of relief and reconstruction measures (including Giuseppe Marcalli, the leading seismologist of the day) and those who argued, using the tenets of the liberal economists, that the matter would resolve itself through market forces.

Until the early 1900s, most earthquake relief was locally organized and relied on private donation. But the major earthquake that struck Avezzano, in Abruzzo, in 1915 led to massive financial intervention by the state. A law of January 21, 1915 designated 30 million lire for disaster relief, and even the poor were able to claim grants of 2,000 lire to repair their homes. However, some temporary accommodations set up after this disaster remained in use as long as 56 years (Canosa, 1981).

Government policy in the period 1951-1980 was to rely on extraordinary measures immediately after a disaster (rather than on prior preparedness), and then only to reduce suffering during the postimpact phases. Burton, Kates and White (1978, Ch. 6) regard this as the lowest level of policy making for a national government.

One of the most tragic policy failures followed the earthquake of 1968 in the Belice Valley, western Sicily (Haas and Ayre, 1970). Here, 14 tremors in six weeks, of relatively low seismic energy, did serious damage to more than a dozen villages. One of the first government decisions was to favor emigration from the disaster area by simplifying the application procedure for passports and giving assistance with gransportation. This approach became known to Italian journalists as "two photographs and away," since identity photographs and a signed statement by the local mayor were all a survivor needed to leave the country. In the Pozzuoli disaster area in 1983-84 I found this procedure still widely in use.

Although some 14 laws governing reconstruction in the Belice Valley were eventually passed, and about 1,000 billion lire spent on public works, the net effect has not been encouraging. About 40,000 prefab units were constructed, incredibly, at an estimated 83% of the cost per square meter of full-scale reconstruction. Many of these flimsy dwellings were still in use when I visited the area 15 years after the disaster, while others had been abandoned, disfiguring the landscape. Political machinations and corruption are blamed for the absolute inefficiency of the reconstruction in Sicily (which has become a **cause célèbre**) and 33 legal cases have ensued over construction problems (Di Giovanna, 1974).

Potential litigation elsewhere over the quality of construction and maintenance of buildings damaged by earthquake has been thwarted by the slowness with which seismic building codes have been extended to newly-discovered risk zones. Such new zones include Lazio, Marche and Campania, which were affected by damaging earthquakes in 1971, 1972 and 1980, respectively (Geologia Tecnica, 1983).

The 1976 Friuli and 1980 Irpinian earthquakes represented the last such events in which government could rely entirely on **post facto** aid (Comitato Straordinario, 1981). Law 546 of 1977 granted 4,000 billion lire ($2050 million) over ten years for reconstruction in Friuli (Norsa, 1979). The objectives of this expenditure were, first, to save from destruction and to repair 3,000 damaged buildings and, second, to restore housing and employment to those who had lost them. The main problems were lack of a clear-cut definition of the disaster area, dispersal rather than concentration of government expenditure, the inflexibility of laws and plans, and the effect of inflation on funds (Cavallo, 1979).

Very special measures had to be instigated to pay for the estimated 21,224 billion lire ($10.9 billion) of damage caused in Irpinia in 1980 (Alexander, 1982a, 1984a). The 1980 earthquake occurred at a time when the whole organizational structure of relief, rehabilitation, mitigation and research in Italy was poised to change.

History of Seismic Monitoring in Italy

Systsematic observations of seismic events were perhaps first made in Italy by Gastaldi after the 1560 Nice earthquake and by Padre Elisio della Concezione after the 1783 Calabrian tremors. The first seismic monitoring service was founded in 1874 by Denza and De Rossi. It became a national service in 1885-87 under a Central Office of Meteorology and Geodynamics, which was responsible to four government ministries. In 1889 a network was established of 492 points distributed around the nation, and observations were collected by telegraph. The Italian Seismological Society was founded in 1895 and published a research journal for 50 years. The National Geophysical Institute at Rome was founded and, like the National Seismographic Service, came under the jurisdiction of the National

Research Council when it was established in 1939. In 1958 this structure absorbed the National Geophysics institute at Trieste and the Vesuvian Observatory in Campania, which had been founded in 1857 by the Bourbon monarchy of Naples (CNR, 1981b).

In 1984 the national seismographic network consisted of 36 stations, with the intention of increasing this to 50 stations, kept online to a computer located at the National Geophysics Institute (ING) in Rome. This system is designed to interface in real time with the US Geological Survey facilities at Golden, Colorado, in order to reduce delay and human error in the determination of epicentral locations. However, until August of 1982 the ING was not staffed around the clock, and problems with staff contracts for 24-hour operation were still unresolved in mid-1984.

Individual earthquakes (notably at Ancona in 1972, Friuli in 1976, and Irpinia in 1980) have fostered both the installation of temporary seismic monitoring networks and the improvement of permanent ones. A permanent regional network of eight stations was set up in the Marche Region after the 1972 earthquakes at Ancona (Gherlentini, 1983). In addition, the national electricity council has accelerometers stationed in manyof its electricity substations. Twenty-three of these instruments were activated in southern Italy during the 1980 earthquake (Berardi **et al.**, 1981).

Applied Research Organizations

In 1976 the National Research Council of Italy (CNR) funded a series of major research projects involving collaboration among universities and research institutes, including the **Progetto Finalizzato Geodinamica** (PFG) for research in the "earthquake defense" sector (CNR, 1980a, 1980b, 1981d, 1981e, 1984a). This five year endeavor (1976-1981) was intended to improve the stability of geophysical research by providing a more even level of funding. The project included structural geology studies, the compiling of seismic risk, magnitude and frequency maps, geotectonic and seismotectonic maps for the entire country, and the study of regional and local situations. The initiative also involved seismic microzonation studies and the creation of mobile and fixed seismic monitoring networks.

To evaluate the PFG it must be considered in the light of other organizations with which it interacted, that paralleled its work or succeeded it after it was disbanded in June of 1981. In 1976, the Ministry of Public works established a Seismic Service, empowered to complete the national seismic monitoring network, to collect and analyze macroseismic data, to study seismic wave propagation, to study antiseismic construction techniques, and to measure seismic effects on construction materials. The problem of overexpanded scope for the number of employees (15) was compounded by difficulties in renewing the financing of this unit.

Under a law of 1942 the Ministry of Public Instruction has jurisdiction over the Vesuvian Observatory. Observatory policy is set by its own director. The Vesuvian Observatory runs southern central Italian seismic networks, while the Trieste Observatory of Experimental Geophysics runs the northeast italian branch of the World Seismic Network (Boschi, 1984). Seismic study groups were also set up by the Regional Administrations of Piemonte and Emilia-Romagna, and by the Province of Trento, while the Provinces of Pesaro and Macerata run part of the national seismic network. The municipality of Ancona has assumed responsibility for its own microzonation (CNR, 1981f).

This heterogeneous structure of research and monitoring was roundly criticized in a CNR document of 1981:

> . . . the substantial organizational inefficiency of science has had its most visible demonstration during the destructive earthquakes of recent decades in Italy. Usually there has been not only a complete lack of rational operative coordination, but also a great disparity over the form to be taken by the various strategies for the scientific effort, as to how far it should have applied social dimensions, on the quantity and quality of information to be supplied to the general public, and so on. It is appropriate to remember the complete plethora of information, data, advice and contrasting predictions (many of which were out of date with respect to the level of contemporary knowledge) which was offered to the public thanks to the sudden and vast interest of the mass media immediately after destructive earthquakes. (CNR, 1981e, p. 113; translated by Alexander)

The CNR report concluded that:

1) Progress to date (1981) was insufficient in both scope and achievement.

2) The scope had been set too high for the utterly insufficient resources.

3) Land use planning, seismogenesis, the seismic performance of historic structures, and tsunami hazards had either been ignored or only very recently studied in Italy.

4) The various organizations suffered from duplication of effort, confusion of aims and lack of direction.

5) Founding new organizations (e.g., an equivalent of the US Geological Survey) would involve restructuring, and in some cases abolishing, all other organizations in this field and would take too long.

6) One overall plan of coordination was needed.

This report reflected contemporary government thinking that the PFG should be superceded by a more permanent Earthquake Defense Group (GNDT), which came into being in 1981, with bases in Rome and Milan. An introductory statement by the director of the GNDT listed 46 organizational foci, including tectonic and geophysical studies, definition of riskand statistical return periods, public education, monitoring and fieldwork, and studies of engineering methods (CNR, 1981e). The director's statement also listed nine other organizations with which the GNDT must work closely, including the National Geophysical Institute and the Geological Service of the Ministry of Industry. The Seismogenesis and Seismogenetic Regions section of GNDT became heir to the PFG, which was disbanded in 1981 at the end of its five year term. In assuming responsibility for the identification of priority zones for seismic research and fieldwork, this section was to exercise caution in the use of short-term seismic prediction measures. Such measures were to be used to distinguish active from inactive geological sturctures, rather than to make rapid predictions of individual seismic events. This was a wise decision, given that Italy is apparently not yet willing to finance a comprehensive network of instruments dedicated to short-term prediction.

The Seismic Risk Zonation section of GNDT also tied in with the work of the PFG. It was charged with investigating areas of the PFG's seismic risk map that had been designated "in need of further research." The "Prevention of Damage to Structures" section would help provide geophysical information upon which to base upgraded anti-seismic building codes (CNR, 1981b).

The Special Commissariat and Ministry for Civil Protection

At various times during the past, Italian governments have appointed officials with special responsibility for overseeing disaster relief. Law 996 of 1970 provided for a Government Relief Commissariat (or Extraordinary Commissariat in the case of a major catastrophe), to be located in the region affected by any given disaster, and a Director General of Civil Protection, to be based at the Ministry of the Interior in Rome. This **ad hoc** arrangement was employed after the 1976 Friuli and 1980 Irpinian earthquakes. However, the Extraordinary Commissioner of government relief bore a more direct responsibility to the Minister of the Interior than Law 996 had prescribed (Comitato Straordinario, 1981).

The post-1980 Commissariat in the southern regions required formation and suspension so many times--and the government had to deal concurrently with so many disasters--that it eventually made sense to found a permanent ministry. A bizarre incident appears to have provided the opportunity. In 1981, a small boy became trapped in a water well at Vermicino, near Rome. Despite an elaborate relief operation backed by worldwide interest and sympathy, the boy died before being freed. The government's Relief Commissioner was involved in the operation. Journalists have suggested, perhaps with undue cynicism, that the groundswell of public sympathy stimulated by this incident provoked the government to found the Ministry for Civil Protection.

The ministry came into being on August 1,1982, with a staff of about 100 (Camera dei Deputati, 1982, 1983a, 1983b, 1983c). The ultimate goal is to decentralize activities, plans, and stocks of equipment to the regional and municipal authorities. This objective is clearly a long way from being achieved. In 1984 only five regions had autonomous plans to combat natural hazards, while municipal plans had in no sense reached a state of national coordination.

Evolution of a Legal and Financial Structure

Like most other countries, Italy has had to evolve a legal structure to regulate the processes of relief, resettlement and reconstruction following the impact of natural disaster. As a generalization, it is fair to say that the main stimulus to legislation in this field has been the impact of the disasters themselves. The dates of enactment of individual laws often fall within the aftermath period of a particular disaster.

However, the cumulative impact of several disasters in relatively rapid succession has sustained public demand for a response from parliament and has resulted in the highest overall volume of legislation in any one period.

The Italian Law-making Structure

Laws must be approved by the national Chamber of Deputies and the Senate, and then signed by the President of the Republic. It takes time for a Parliamentary Bill to become statutory law. Because disasters often require more rapid legislation, other instruments have been employed. A Decree Law is an Act of Government that passes into effect immediately upon issue but lasts only 60 days, after which it must be formally debated and approved by both legislative houses. If this cannot be done in time, it may be reissued for a further 60 days, and this is often the point at which amendments are incorporated, based on the decree's effectiveness during the first period. Some laws and decree laws simply fulfill the function of regulating or amending previous laws.

Nationally, the speed of legislation on disaster-related problems increased greatly after the 1980 Irpinian earthquake. While this was viewed as welcome by those who had been campaigning for more effective and prompt response to disaster, there were also protests that the time available for consultation had been reduced below acceptable levels.

Disasters and Italian Law

Prior to 1900, laws governing disaster relief were rarely issued in Italy. In the first half of the present century such laws were enacted on average once a decade. Over the period 1951-1979, however, 17 disaster-related laws appeared, and 1980-1984 produced 39 laws and over 700 ordinances.

It is rapidly coming to pass that each disaster in Italy having repercussions at the national level requires a law to regulated resettlement and reconstruction (Cavallo, 1979). The principal scope of such laws is:

1) to enable ordinances to be made in the disaster area;
2) to enable public funds to be granted for relief, resettlement and reconstruction, and to identify the source of such funds within the national budget;
3) to identify by name those municipalities that have suffered damage,in order to qualify them for state aid;
4) to define the objectives of state aid;
5) to identify the procedure by which citizens and communities can apply for government funds;
6) to set limits to state aid (e.g., one million lire per squre meter of damaged property); and
7) to set up regulatory comissions to ensure equity in the distribution of state aid.

In practice, the deadlines governing applications for funds are often extended. Communities are required to have valid and functioning urban plans before government money can be used for reconstruction, and this often requires admustment or reformulation of such plans to acommodate the effects of the diaster.

The most important and comprehensive law of this kind is Law 219 of 1981, which dealt with reconstruction after the 1980 Irpinian earthquake. The law will probably serve as a model for much subsequent legislation (Consiglio Regionale della Basilicata, 1982). The time limits it set had to be prolonged, giving municipalities until the end of 1984 to formulate and present their reconstruction plans.

Law 996 of 1970 established the civil protection structure that served for the next ten years, during which some significant national disasters occurred. The 1970 law gave a planning role to committees at the regional level, and an operative and executive role to an Interministerial Committee of the central government (see Figure 6). The emphasis was on fighting fires, rather than mitigating other natural hazards, and the law had some serious drawbacks. It did not include the armed forces, which were managed separately. It encompassed disaster prediction and prevention, as well as relief and rehabilitation, but did not say how the former was to be accomplished. It did not regulate or coordinate the activity of volunteer relief workers and, finally, it did not provide a role for mayors and local communities.

A presidential decree law of 1981 took some definite steps towards remedying the deficiencies of the 1970 law. It set out the duties of the Minister of the Interior, the Commissioner of Government Relief for the disaster area, the Regional Inspectors of the Fire Service, Provincial Prefectrs, and municipal mayors in case of national catastrophe. However, the commissioner could only request the help of the armed forces, not direct their role in disaster relief. The scope of the commissioner's activities was also limited to directing relief and resettlement during the emergency period. Reconstruction required separate legislation.

Over the period 1980-1984, civil protection in Italy underwent a series of improvements:

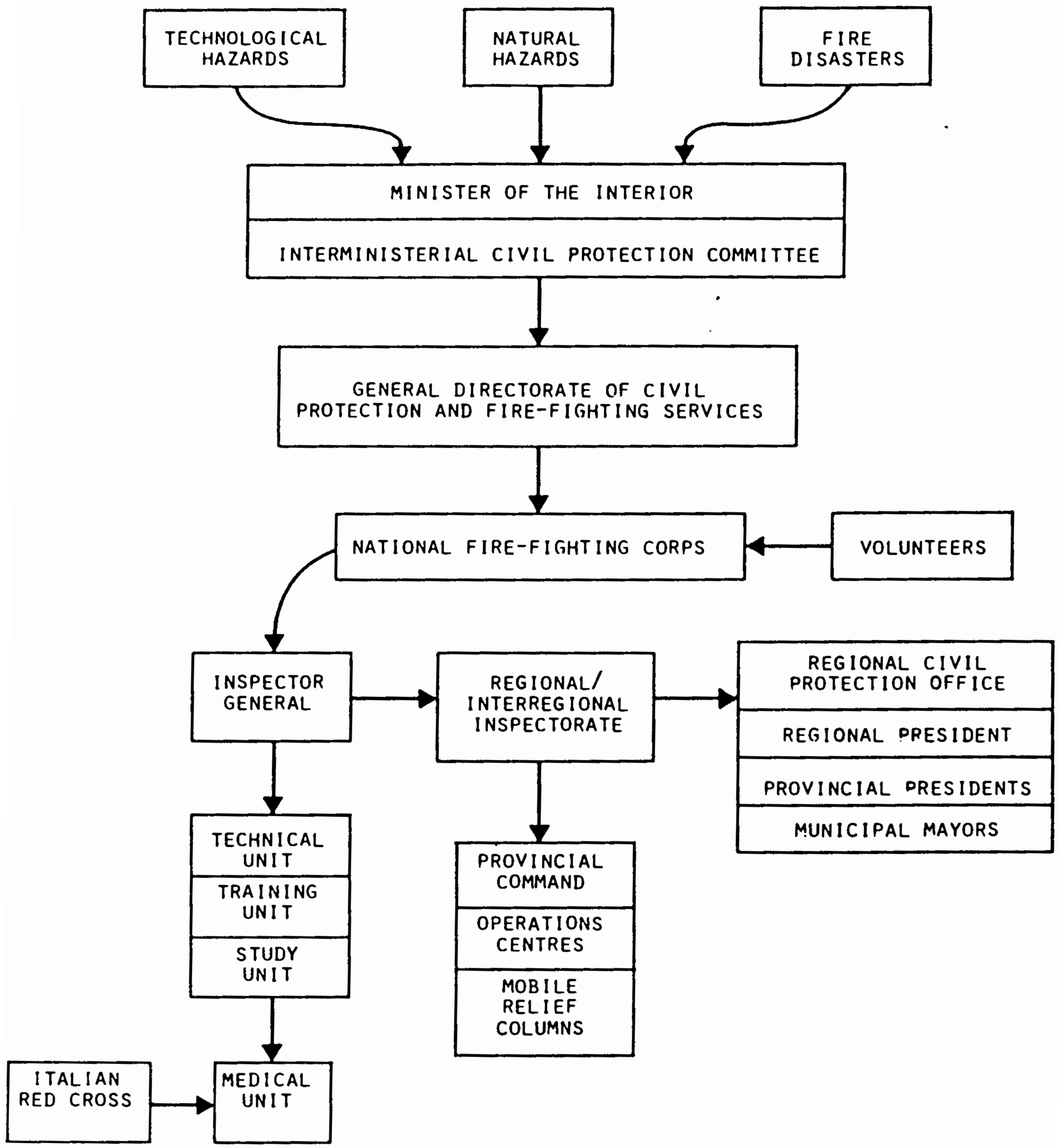
1) The speed of legislation increased greatly.

2) Funds became available for immediate use in a crisis without the need for parliamentary procedures (see the section on financial measures, below).

3) It became possible to make ordinances immediately.

FIGURE 6

LAW N. 996/8-12-1970



Emergency action was requested by the President of the Region of Sardinia during a period of major forest first in the summer of 1984. Resources were supplied by Rome straight away. Government reaction was equally prompt after the July 1985 Val di Fiemme dam burst (**La Stampa**, Turin, July 23, 1985). Much of the confusion and lack of information that once occurred directly after national catastrophe has been eliminated. However, the organization of disaster relief is still highly centralized in Rome. The region, province, and municipality have as yet no formal role to play in this structure.

Steps Towards a New National Civil Protection Service

Law 547 of 1982 consolidated the Special Commissariat for Campania and Basilicata into the new national Ministry for Civil Protection. A Prime Minister's decree law of 1984 set up a national Department of Civil Protection, headed by the Cabinet of the Government and the legislative office of the Ministry for Civil Protection. The department included a disaster prediction and prevention coordinating service, administrative and fiscal office, research methods office, emergency service, and press office. The emergency office included three emergency units: air service, sea service, and logistics office.

The brevity and instabilityof successive Italian governments had meant that the 1970 law required the presentation of at least four bills to parliament over a 20-year period before it was passed. Four additional bills have already been formulated to create the new civil protection law (which had not been passed as of May 1985; Camera dei Deputati, 1982, 1983a, 1983b, 1983c). These bills seek to create a fullscale national structure for disaster relief and mitigation, involving all levels of government, from local to national, as well as scientists, volunteers, charities and the armed forces. Those bills sponsored by rightwing and centrist parliamentary groups argue for a centralized chain of command, while the bill proposed by leftwing groups envisages a devolved chain of decision making. In part, the bills seek to consolidate a national structure that is already coming into effect in piecemeal fashion. It remains to be seen whether these measures will eventually be formalized into a single law.

Financial Measures

Article 20 of Law 996 of 1970, which dealt with the financing of civil protection measures, was left blank. Similarly, no explicit financial measures were included in the bills of 1982-1984. Yet, by 1984 the Italian government was estimated to have spent 3,800 billion lire ($1950 million) for relief of the 1980 Irpinian earthquake disaster, and 4,000 billion lire ($2050 million) on the much smaller 1976 Friuli disaster. The Ministry for Civil Protection was set up with a reservoir of funds, 180 billion lire ($92.3 million) at the outset, to be renewed as the need arose. Landslides at Ancona, Basilicata and the Val Tellina, floods in Marche and Emilia-Romagna, earth tremors at Pozzuoli, Parma, Umbria, Marche and elsewhere have each made demands on this fund (Alexander, 1983). Decree law 159 of 1984 granted 800 billion lire ($410 million) from renewed civil protection funds to the Umbria and Abruzzo disaster areas (**Gazzetta Ufficiale**, 1984), but only one-tenth of this sum was to made available during 1985.

The chief problems of financing relief, rehabilitation and reconstruction in Italy after natural disaster are the scarcity of funds relative to demand, and the delay in payment once central government has granted funds to a disaster area. At present there is virtually no talk of removing the burden from the Italian taxpayer to those who are likely to incur losses in the future (for example by starting a major natural hazards insurance program).

Classification of Seismic Risk in Italian Municipalities

One of the principal achievements of the CNR Geodynamics Applied Research Project (PFG) was the creation of a national seismic risk map (Figure 7) and a proposal for the seismic reclassification of municipalities throughout the country (Figure 8). Prior to 1981, 1,377 of Italy's 8,000 municipalities were classified as "seismic," meaning that particular restrictions on building methods were in force there. This did not necessarily mean that the restrictions were effective. The town of Sant'Angelo dei Lombardi, in the province of Avellino, was declared seismic in 1930. The town was 85% damaged or destroyed in the 1980 earthquake (with the loss of 482 lives), mostly through the collapse of recently built reinforced concrete buildings (Ciancetti, 1983; Sciré, 1984). However, the PFG proposed that the number of municipalities in official seismic zones be increased to 2,802, which is 35% of Italy's 8,074 **comuni** (CNR, 1981a).

The PFG assigned a value of seismic risk to each municipality on the basis of three criteria (CNR, 1981a). This led to three rather different maps that had to be integrated into one overall risk map (Figure 7). For any municipality to be placed on the final map, at least one parameter out of the three original ones had to indicate the probability of seismic damage exceeding intensity VIII. The proposal placed 1,375 municipalities into the medium risk category, and about the same number into the high risk category.

By using precise criteria based on over 1,000 years of reasonably detailed seismic information, the CNR effectively ended the practice of

FIGURE 7

SEISMIC RISK MAP OF ITALY (CNR, 1981a)

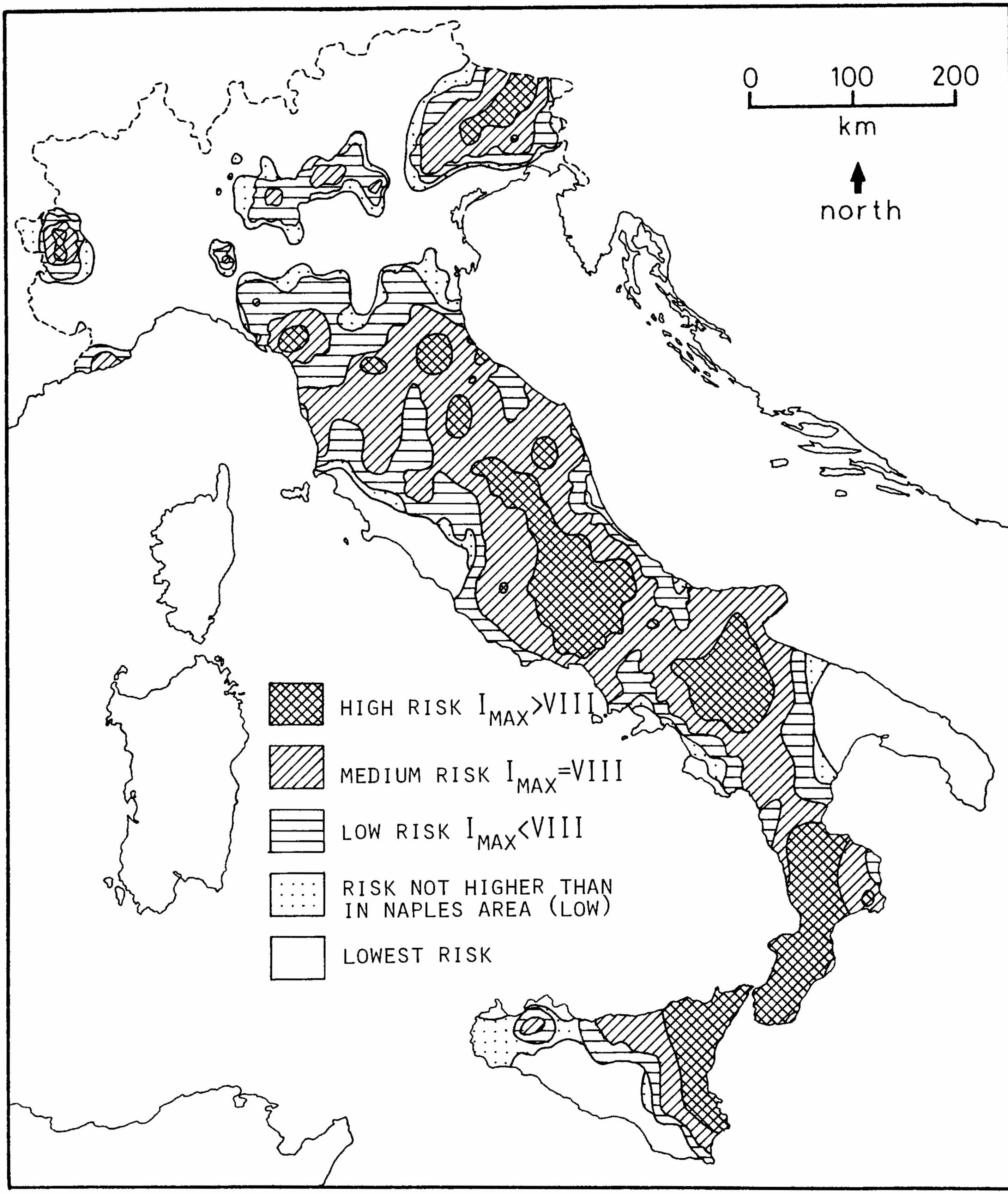
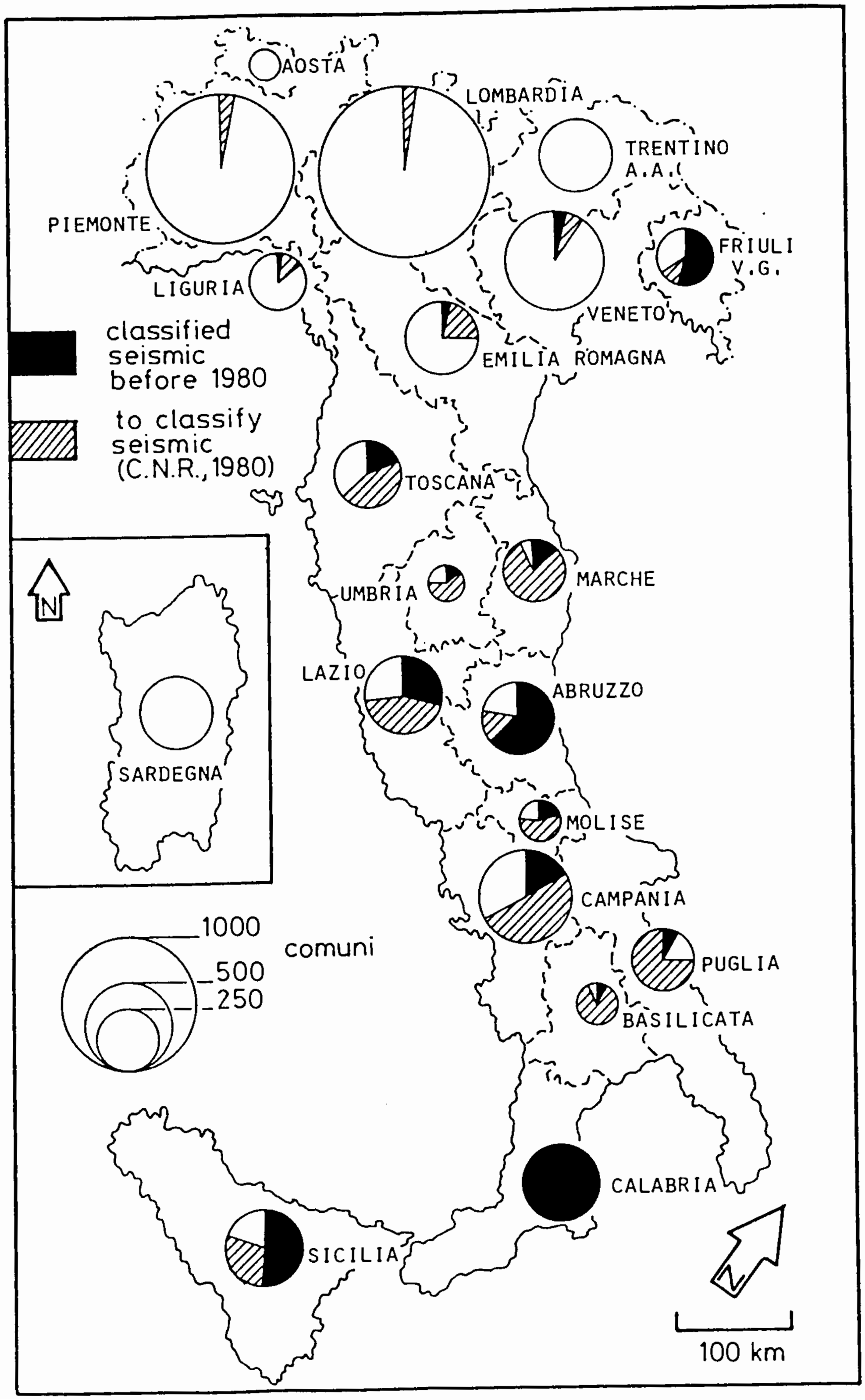


FIGURE 8

SEISMIC RECLASSIFICATION OF MUNICIPALITIES, REGION BY REGION



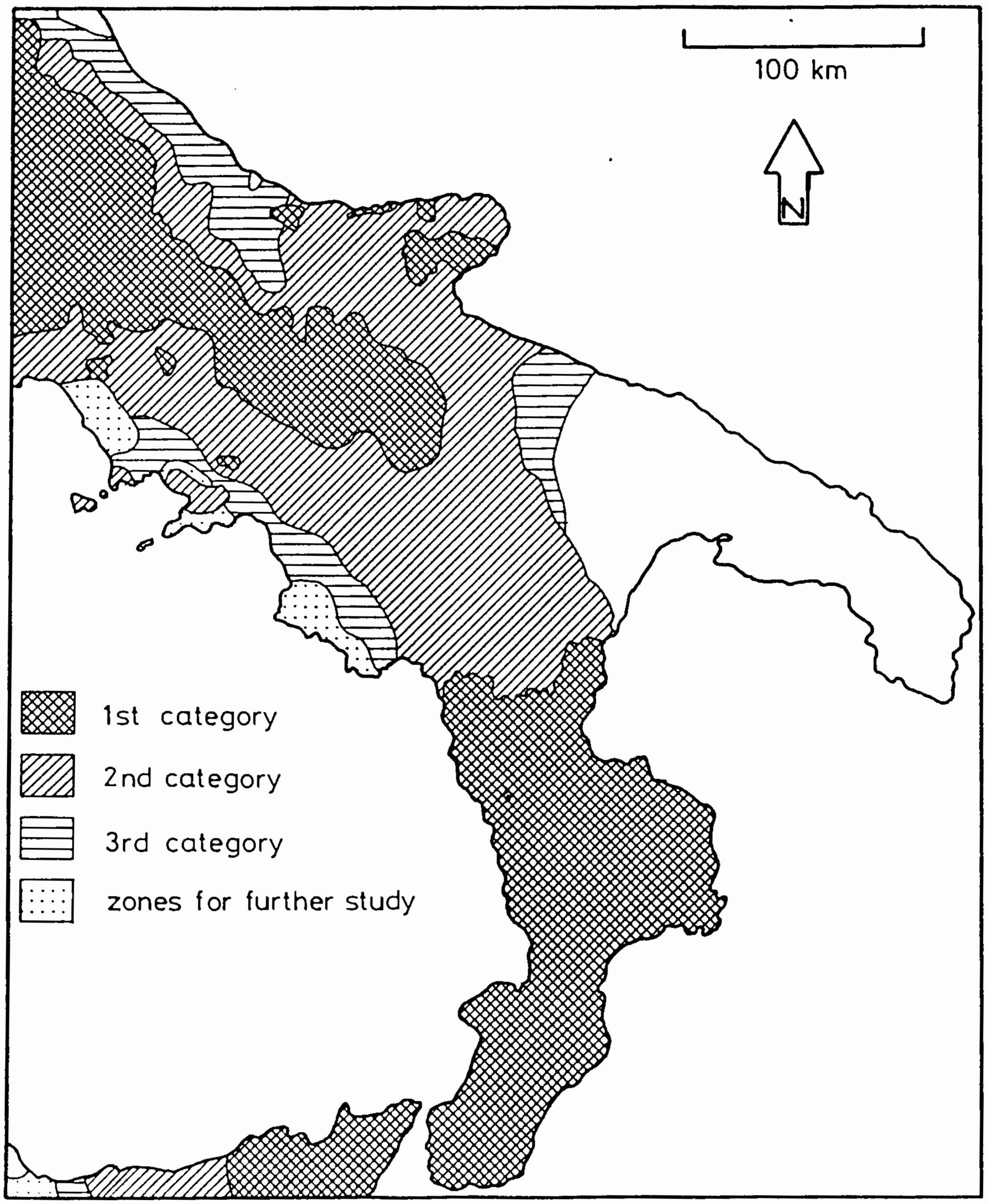
waiting to declare a community seismic until after it had been struck by a major earthquake. However, the PFG proposals, like the laws in existence prior to 1981, could not solve the problem of vast numbers of old, precarious structures, nor the problem of allocating scarce resources over a huge seismic area.

By 1981 it was realized that a two-category map was inadequate, and some of the peripheral "special studies" zones (such as Pozzuoli) were incorporated into a third, low risk category (Figure 9). The earthquakes of the 1980s yielded information that made these changes possible, and the eventual risk map of southern Italy looked rather different than that proposed in 1981, thanks to the macroseismic data accumulated after the 1980 tremors (CNR, 1981c). The three-category risk map has been adopted gradually, region by region, as the norm upon which antiseismic building codes will be based.

Law 64 of 1974, the main national seismic law currently in force (Bruno, 1981), includes several very positive aspects. There is a clear explanation of the calculations required for antiseismic construction, and dynamic load characteristics are considered in building design. Criteria are specified toimprove the earthquake resistance of existing buildings. The most stringent norms are specified for construction on certain types of terrain that have the least stable behavior under seismic loading. Construction specifications are applied to two categories of risk zone. For example, the maximum permissible height of masonry structures in Category I zones is 7.5 meters. In Category II zones, where a lower probability of dynamic shaking is expected, the maximum height is 11 meters.

FIGURE 9

REORGANIZED SEISMIC RECLASSIFICATION IN SOUTHERN ITALY
USING DATA FROM THE NOVEMBER 23, 1980 EARTHQUAKE
(CNR, 1983c)



Evolution of a Standard Macroseismic Questionnaire and Damage Survey

Macroseismic questionnaires play an important role in Italy during the aftermath of an earthquake disaster. They have several functions:

1) Questions can be matched with descriptions of damage and perceived effects listed in the MCS and MSK intensity scales currently used in Italy (see Appendices I and II). Comparison of questionnaire results enables isoseismals to be drawn which can be related to the geophysics of earthquake source mechanisms (CNR, 1981c).

2) Individual building surveys useful to a macroseismic study may also be considered legal certification that a building has been damaged to a certain degree and thus requires specific repair. This will qualify the owner for repair funds, if they are available.

3) Statistical summaries of the degree of damage to individual dwelling units will qualify a municipality for government reconstruction aid.

4) Engineering specifications may be incorporated into the survey results for a particular building.

There is an increasing tendency to merge macroseismic surveys with damage surveys for inclusion in reconstruction lists. This makes eminent sense since it is extremely difficult to duplicate accurate building surveys during a chaotic disaster aftermath. However, several national and regional questionnaires remain in use, as follows.

National Geophysical Institute (ING)

The ING developed a questionnaire for use after the 1979 Norcia earthquake (CNR, 1980c). It contained boxes attached to short statements about the perceived effects of the tremors (sensations, visible and audible signs, movement or fall of objects, effects indoors or outdoors) and damage (to terrain, to hydrological systems, to walls, floors, roofs, or architectural details). The statements were given ratings based on both the MCS and MSK scales so that intensity level could be computed rapidly. Results were used to produce isoseismal maps and to classify damage

In 1984 the ING designed a questionnaire for widest possible use among all available respondents (ING, 1984). This questionnaire increased emphasis on the MSK scale for categorizing structures. The 1984 questionnaire also contained questions related to panic and "earthquake lights."

CNR-GNDT Experimental Macroseismic Questionnaire

This questionnaire covered the items listed in the MCS intensity scale. The reverse side of the 40-question form was left blank for observations (CNR, 1983a).

CNR-PFG: Shortened Macroseismic Questionnaire

This version was produced by the PFG for use in schools (which were considered to be a relatively controlled and dependable source of respondents). The scales wre mainly nominal, with space for short written phrases describing the effects of the earthquake. The questionnaire was produced directly after the 1980 Irpinian tremors for the purpose of reconstructing isoseisms.

Emilia-Romagna Region, Planning and Housing Department:
Preliminary Seismic Survey

Formulated in response to the 1983 Parma earthquake, this questionnaire began with a geological analysis of site factors. The scope was much wider than basic macroseismic survey; for example, it noted flooding, landslides and erosion damage to individual buildings. Technical staff used the results to pass judgment on whether buildings should be repaired or demolished (Emilia-Romagna Region, 1983).

The "Parma Questionnaire"

Macroseismic survey questionnaires were developed rapidly in the wake of the 1980 earthquake by the Regional Administrations of Campania and Basilicata. Local technicians acting on behalf of municipalities used them to determine the eligibility of individual households for state repair funds, subsidies and reconstruction grants (Lagorio and Mader, 1981). The Parma questionnaire was developed by CNR out of these earlier documents, with the same purpose in mind. Surveyors, architects or engineers were to complete the forms. A detailed set of instructions was included, covering the nature, width and length of cracks, whether and by how much elements of the structure were out of true, and so on.

Evaluation

Macroseismic surveys provide a **post hoc** assessment of the vulnerability of the built environment, and reinforce geophysical data on the expenditure of seismic energy from place to place. The main criticisms of the Italian methods are:

1) Too many agencies (e.g., CNR, PFG, GNDT, ING, regions and municipalities) are surveying the same damage, seeking data for varied purposes, including seismotectonic, political, administrative, engineering, and urban planning uses. It would not be impossible to combine these efforts into a single questionnaire that could be used to construct isoseisms, plan reconstruction work, certify buildings for occupancy or evacuation, and qualify householders for state funds.

2) The methods and categories used in questionnaires are insufficiently standardized, and there has been no research to determine data reliability.

3) No guidance is given as to what constitutes a representative sample at each site. There is no indication of how an intensity or damage value is to be assigned to a building or group of buildings. (The Parma questionnaire did calculate an overall index of damage.)

4) Engineers and architects who used the Parma questionnaire remarked that it was long, laborious and imprecise.

Since the 1970s there has been a marked increase in the complexity of postearthquake damage surveys in Italy. Questionnaires have proliferated and have often conflicted in their aims or duplicated data. Wide variations in reliability are likely in such surveys yet, as of 1985, nothing has been done to improve reliability. However, the aims of macroseismic and damage survey have been greatly clarified during the last five years. If the experience of technicians, officials and lay people who have dealt with the questionnaires is heeded, further refinements can be made. The knowledge is also available to create a single, integrated national questionnaire that could serve multiple needs efficiently and effectively.

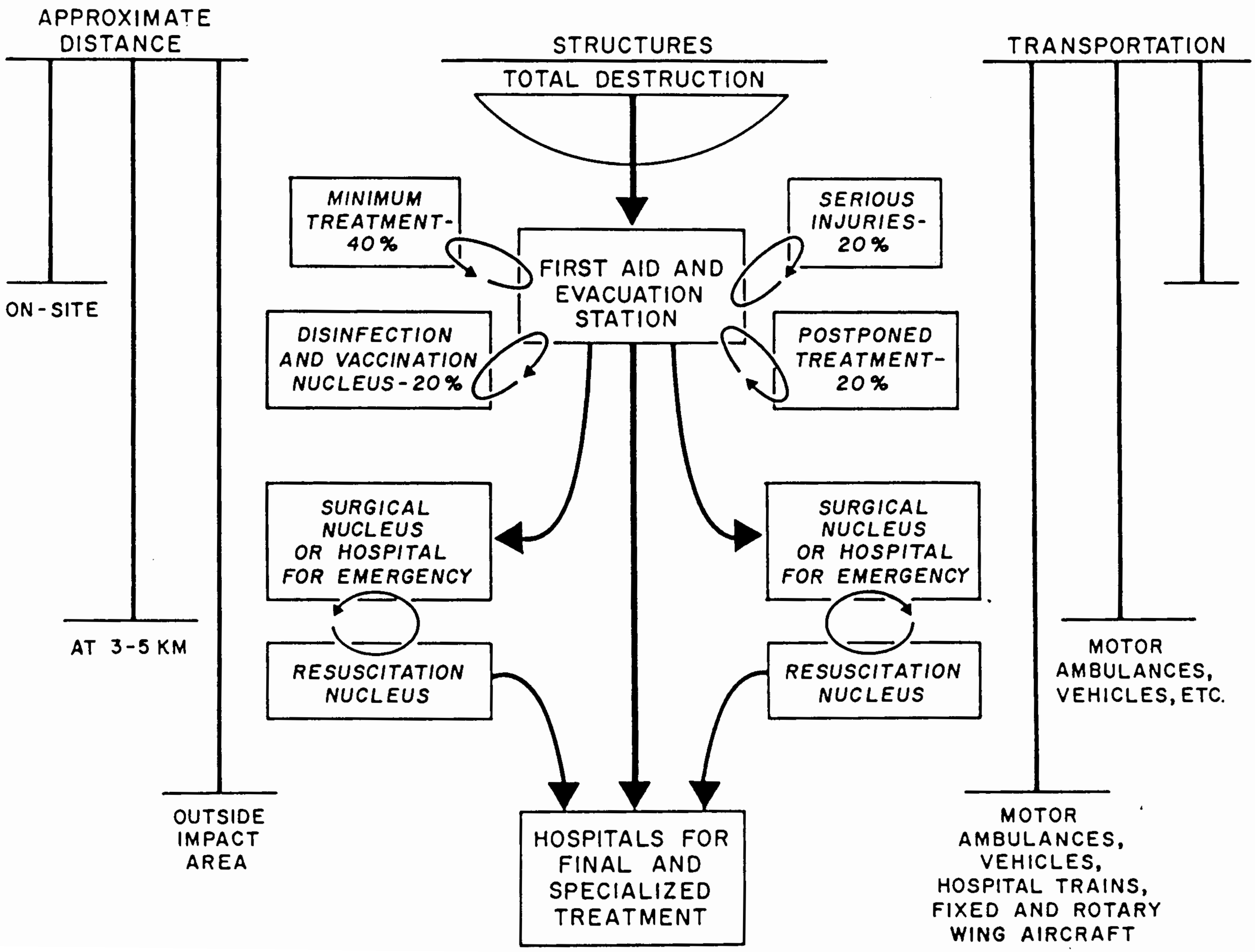
Epidemiological Measures

The 1984 earthquakes were an epidemiological nonevent, but were nevertheless given the status of an emergency by medical planners. A health plan for Maxi-Emergencies had already been formulated by the Sanitation and Public Health Commission of the Ministry for Civil Protection (Figure 10, cf. Manni, 1982). It was not applied in Umbria. In Abruzzo no signs of a rise in the incidence of illness or disease was detected. Nevertheless, the plan was put into action at immense cost. Water supplies to five towns were disconnected, pending survey of the supply network. Anti-typhoid vaccines were distributed to evacuees on May 12th, and an excessive number of medical personnel were drafted into the area to look after survivors.

The founding of a National Epidemiological Observatory in Rome during the aftermath of the November 1980 earthquake is a much more heartening

EMERGENCY MEDICAL ORGANIZATION

(after Manni, 1982)



development. In the event of a disease outbreak, the observatory could transmit information in a timely fashion and eliminate the need for indiscriminate vaccination (Greco **et al.**, 1981).

Growth in Public Awareness of Natural Hazards

The major disaster in Irpinia in 1980 was brought into the homes of millions of people with a freshness and immediacy that was devastating (Alexander, 1982a). Public opinion remained highly sensitized to earthquakes over the period 1981-1984.

The Ministry for Civil Protection strove to publicize the following rules of conduct, loosely based on those printed in California telephone directories:

1) While the ground is shaking, do not rush downstairs or use an elevator, as these are the weakest points in the building.
2) Afterwards, disconnect electricity and gas supplies andleave the house.
3) Outside, do not remain where masonry might fall.
4) Do not use the telephone, or the lines will become overloaded.
5) Remain calm.
6) Do not use candles or naked flames.
7) Avoid overcrowding.
8) Do not use your car, as the streets will become blocked with traffic.

There is precious little evidence that these rules are habitually respected in Italy. Panic is exceedingly common and frequently causes casualties. Panic victims may sometimes be the only fatalities (Alexander, 1985a). People tend to rush out of doors and to resort to the most familiar of modern instruments, the telephone and the car. During the immediate aftermath of an earthquake, the telephone lines are hopelessly overloaded, the streets are filled with panicking drivers, filling stations are besieged with demands for gasoline, and traffic jams are common.

DISASTER AND RECONSTRUCTION MANAGEMENT IN ITALY, 1984-85: A CRITICAL ASSESSMENT

Before Disaster Strikes

General Assessment

Article 20 of Law 741 of 1982 adopted the seismic classification of municipalities proposed by the Applied Geodynamics Project (PFG) of the CNR. Funds were to be supplied by the government to institute vulnerability reduction programs in those municipalities found to be at risk from earthquakes. Antiseismic building codes were to be applid for the first time in towns that had been newly added to the list. In some cases the change was dramatic: for example, in the March Region of central Italy, only 10% of municipalities had been classified seismic in 1980, but 90% were eventually included in the low risk seismic category (CNR, 1980a). Clearly, a major alteration in the official vision of national seismic vulnerability had taken place, based on the PFG's data.

The same national law also allowed regions to make their own laws for the prevention and reduction of seismic risk. The objectives of this measure were, first, to develop more accurate research into historic seismicity; second, to create risk maps and geotectonic maps at the local scale; and third, to concentrate efforts on saving the existing heritage of ancient--and often dilapidated--buildings.

The principle of devolving authority to the regional level and below is undoubtedly the right one, as it guarantees involvement by the people who stand to benefit directly from earthquake hazard mitigation. However, much depends upon the level of interest in the problem at the regional and local level. The southern region of Basilicata set up its first seismographic network in 1985, whereas the central region of Marche (less at risk than Basilicata) has had one since the earthquakes at Ancona in 1972. Other regions have not become involved at all (Boschi, 1984).

Marche collaborated with the CNR to study five municipalities affeted by the 1984 Umbria earthquake in order to develop its own macroseismic questionnaire (CNR, 1984d). While one regrets the proliferation of questionnaires, the initiative is welcome. In fact, Marche ranks with Tuscany and Emilia-Romagna as a leader in environmental involvement by a regional administration. However,this concentration of regional effort in the northern center of the country creates an inbalance that needs to be corrected.

The Garfagnana Evacuation

At the end of January 1985 an event took place in the northern Apennines, in the Garfagnana zone, that illustrated some of the worst pitfalls of Italian earthquake preparedness (**L'Espresso**, Rome, February 3, 1985).

Using criteria that were not fully revealed to the public, the Ministry for Civil Protection suddenly announced that an earthquake was "statistically probable" in the Garfagnana in the immediate future. Five members of the Italian Cabinet,including the Prime Minister and the Ministers of the Interior and Civil Protection, instigated a "state of alert." Using local television networks to make announcements, 56,000 inhabitants of 11 municipalities were evacuated. Police, **carabinieri**, firefighters, and volunteers were organized into groups; 20 railcars were sent to provide emergency accommodation and 13,500 beds were provided in these and in tents, while 11 camp kitchens were mobilized. The evacuation remained in force for several nights, but since no earthquake occurred it was eventually called off.

The evacuation caused no casualties, but there were some negative effects. There was chaos on the streets as most people took to their cars (where many remained throughout the emergency). Local trains were stopped (without authorization) by evacuees seeking shelter. Panic and rumor were widespread and, according to newspaper reports, looting was difficult to control. The exercise demonstrated that it is possible for mass evacuation to take place over a limited area of Italy. However, it demonstrated the lack of local emergency plans and the lack of an instrumental network able to make short-term prediction of earthquakes less of a guessing game.

The Emergency Phase

It can fairly be said that prompt government response to earthquakes postdates the 1980 Irpinian disaster, during which delays in early relief had become a national scandal (Alexander, 1982a). By 1984 the National Geophysical Institute in Rome (ING) was receiving real time seismic data from 36 (soon increased to 50) seismographic stations in the Italian seismic network. Within minutes of a significant earthquake, computer analysis at ING determines the epicentral location, calculates a simulated distribution of damage, and lists all known past events in the area (dating as far back as 1400 B.C.) (ING, n.d.). The Ministries of the Interior and for Civil Protection are alerted immediately, and the epicentral determination is complete within 20 minutes. Fire brigades, volunteer groups and technical squads are mobilized at this point. Helicopters conduct infrared photography and, within half an hour of the event, army relief columns are mobilized.

Increasing seismic awareness has stimulatd the creation of a much more rapid, immediate scientific and governmental response system than could have been expected before 1980. However, during the next phase of a seismic emergency, much depends on the way macroseismic questionnaires are used. For example, after survey had verified the safety of buildings, it was estimated that 70% of the evacuations carried out in Abruzzo in May of 1984 had been unnecessary (Figure 11). Reducing the perceived scale of an emergency depends upon rapid and accurate survey. Based upon the results, municipal mayors must act with alacrity to cancel unnecessary evacuation orders.

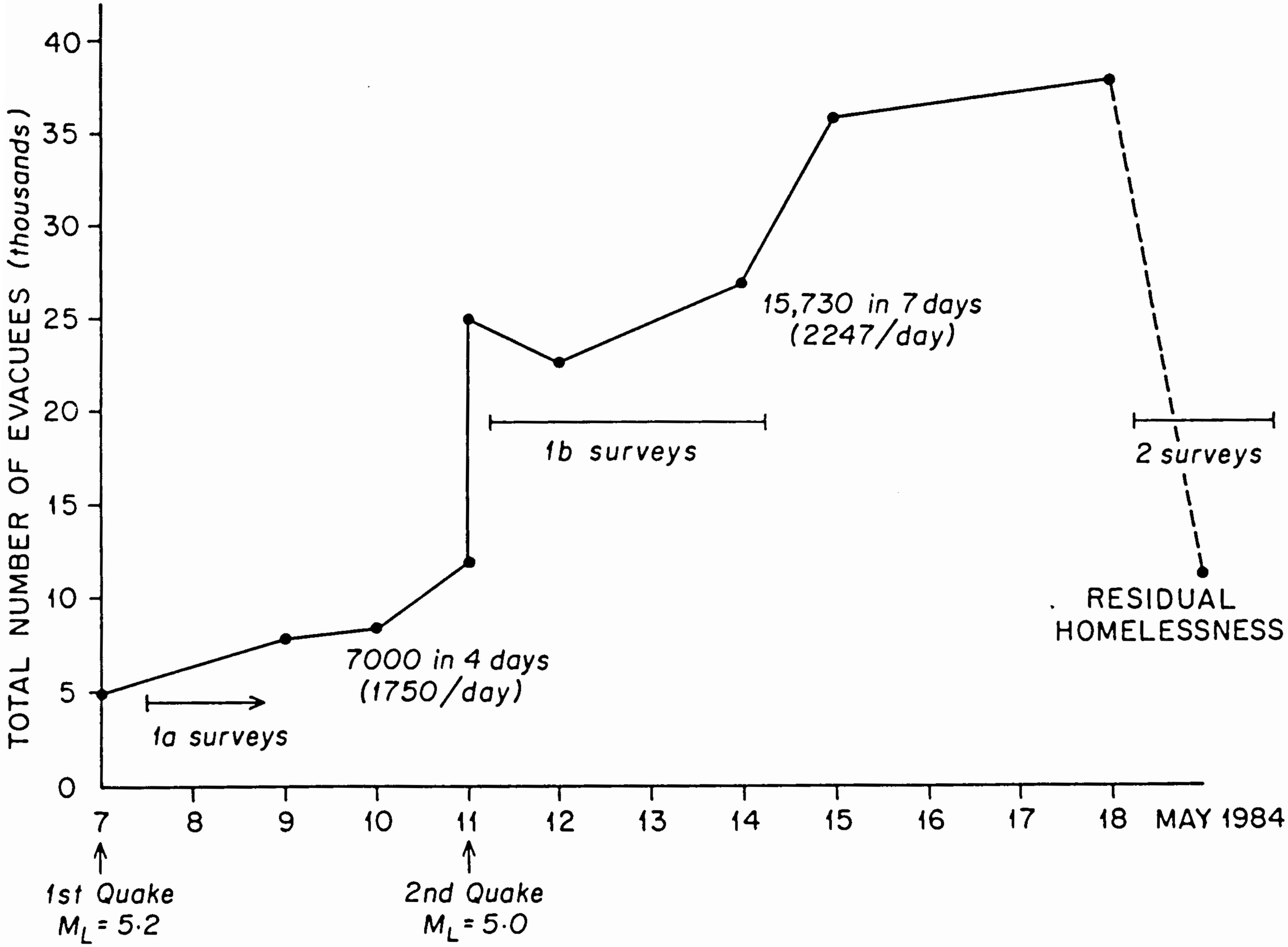
The Resettlement Phase

The so-called Parma questionnaire (CNR, 1984b, 1984c) was first used during the protracted emergency at Pozzuoli, and later adapted for use after the Parma earthquake of November 9, 1983. Despite the smallness of the affected area, it took a week to administer the questionnaire and analyze the results. It was not until 11 days after the event that the CNR was able to hold a press conference at which reliable data could be presented to refute exaggerations of the epicentral intensity then current among journalists (CNR, 1983b). The CNR was criticised for not having included Parma in the major seismic risk zone of the national earthquake risk map. It countered by arguing that classifying such places (and there are many) as seismic would not help to solve the cost and technical problems of upgrading the seismic performance of the many historic buildings there.

Damage surveys in 1984 at Pescasseroli in Abruzzo involved four teams of three technicians each, using unstructured notes and then a variety of printed forms from several sources. Despite this welter of

FIGURE 11

EVACUATIONS AFTER THE 1984 ABRUZZO EARTHQUAKES



questionnaires, the local technical squads had to devise their own form. The Parma questionnaire had an engineering/architectural orientation, while the local municipality needed to determine who owned and occupied which properties, as well as which buildings were uninhabitable.

At the municipal level, resettlement usually proceeded as follows. Using local technical help, the mayor evaluated the safety of the entire urban core (phase one surveys). This usually led to mass evacuation, although in Abruzzo there was a diverging pattern. In some settlements, precautionary total evacuations were made regardless of distance from the epicenter. In others, only occupants of dwellings presumed to be damaged were evacuated. This created a pattern of decreasing numbers of evacuations with increasing distance from the epicenter.

Phase two surveys were full-scale technical inspections which began later and took longer to carry out. These usually resulted in the granting of certificates of reoccupancy to a high proportion of evacuees. Their net effect was to reduce homelessness to its residual level (Figure 11).

In Abruzzo, mayors tended to adopt one of two approaches to the problem of damage. The mayors of towns heavily dependent on tourism (e.g., Pescasseroli, Rivisondoli) tended to not restrict access to damaged urban cores. These mayors hoped to discourage cancellations by tourists who might otherwise have been alarmed by an apparently high level of damage. By contrast, the mayor of Barrea, an agricultural settlement in L'Aquila Province, had the entire center of town enclosed in wooden barricades and imposed an 8:00 pm curfew. This had the dual effect of drawing attention to the damage at Barrea and permitting a full scale comprehensive reconstruction plan to be drawn up, ready and waiting for government funds. Buttressing of damaged buildings at Barrea was substantial enough to suggest it was meant to last until sufficient funds could be obtained for major repair work--conceivably years ahead. Regardless of which strategy they adopted, the mayors of the seven "epicentral" municipalities in Abruzzo formed an alliance to resist any demands upon the state for reconstruction funds by the 191 other municipalities that claimed to be damaged.

As a general rule, the post emergency phases of an Italian seismic disaster may be seen as a free-for-all in which it is in the interests of local politicians to exaggerate the level of damage in order to compete effectively for reconstruction funds. Further observations on this situation are given in Alexander (1983).

The principal roles of the Ministry for Civil Protection are to provide shelter to those deprived of their homes by natural disaster and to restore as much "normality" as possible in the minimum possible time. Earthquakes tend to breed a phobia for buildings and small, mobile trailers are very much in demand after seismic emergencies (Ventura, 1982a, 1982b). After the 1980 Irpinian earthquake, 15,000 trailers were collected from the disaster area and put into storage at Persano, near Salerno. They were to be refurbished using 36 billion lire/$18.5 million (2.4 million lire/$1,230 per trailer) of government money, but budgetary restrictions froze this funding. In the 1983-84 emergencies, 40 billion lire had to be taken from the annual reservoir of natural disaster funds in order to buy 5,000 new trailers. This expedient wastefulness was roundly criticized in the Italian press.

The Reconstruction Phase

This section examines and summarizes the reconstruction process as it functioned during 1984.

During the aftermath of an earthquake in Italy, the municipal mayor, provincial corps of engineers or fire department can order the buttressing or demolition of damaged structures if public safety is deemed to be at risk (Valussi, 1977). The mayor can also issue ordinances authorizing minor repairs, again to safeguard the public. At Alfedena, in Abruzzo, buttressing and demolition were carried out by the corps of engineers of the Province of L'Aquila directly after the May 1984 earthquakes.

Reconstruction requires much more planning time. In the first place, a community in need of government reconstruction funds must have an approved General Urban Plan (PRG) and may need either a detailed plan for a particular zone or a Reconstruction Plan. The General Plan is formulated at the municipal level and approved by the region, which may, however, delegate this responsibility to the subregional associates of municipalities. The effect of natural disasters has been to change the original intent of the PRG, which was to regulate new additions to urban areas, rather than to regulate the quality of reconstruction (Ventura, 1984b).

The 1984 reconstruction owed much to Law 219 of 1981, the 1980 earthquake reconstruction law. This legislation prescribed capital contributions by the state of up to 100% of the cost of reconstruction of a first home, 30% for other residential premises and 75% for business premises. In both 1981 and 1984, up to 200,000 lire per square meter were granted for structural repairs. But Law 219 failed to cover the following points adequately:

1) the specific details, rather than simply the general principles, of state grants;

2) the criteria used to define dwelling units, which in a multiple-occupancy building may be complex and fragmentary;

3) the possibility of financing the compulsory purchase and public redevelopment of damaged property;

4) the possibility of extra funds being made available to save properties considered to be national monuments; and

5) the problem of prior estimates of reconstruction falling below final costs (due to inflation), given that both the state and the property owner could legally refuse to foot the extra bill.

In the event a municipality lacked an approved general plan or one suited to reconstruction it could take several years to reach the minimum level of urban planning required for reconstruction to begin. However, if this was not the problem, then the administrative process was greatly speeded up by 1984. For instance, only 80 days were allowed homeowners to apply for state repair funds during the aftermath of the Abruzzo earthquakes, and the applications had to be based on structural surveys completed within 48 days of the second earthquake. Some 800-900 of such requests were received by the municipality of Pescasseroli, and more than half of them pertained to property located in the older, central part of town (1600-1900 A.D.). Under the restriction of the deadlines described above, the municipal planning office was hard pressed to put together a rational plan for 500 dwellings requiring major structural intervention in a complex urban fabric.

Contractors are paid an advance for their reconstruction work. In Italy many construction companies are cooperatives and require special bidding for reconstruction contracts. This has posed some problems since northern Italian cooperatives tend to be the largest and are in a better position to qualify for state contracts. In the Mezzogiorno there are laws governing the preferential use of local labor, and hence small, southern construction companies have evolved a complex subcontracting relationship with their larger northern counterparts.

This system is uncomfortably similar to that of mafia-style groups such as the Neapolitan **camorra.** Elaborate arrangements have evolved for swindling away reconstruction funds by creating false subcontracting companies and disseminating bribes. The reaction of the authorities has become equally sophisticated. The provincial prefect must countersign the contracts. The contracts may form part of the General Urban Plan, and this must be approved by the Regional Committee of Control. In addition, Law 726 of 1982 gives power to the prefects and High Commission of Public Security to conduct inquiries into the business affairs of firms bidding for public contracts. The Department of Public Security scrutinizes all contracts worth more than 5 million lire. This unwieldy bureaucratic procedure is deemed necessary because of the large sums involved.

The case of Sant'Angelo dei Lombardi, devastated by the 1980 Irpinian tremors with the loss of 482 lives, will serve to illustrate the post earthquake planning process as applied to the 1984 disaster areas. Law 219 of 1981 required municipalities that had been devastated by the 1980 earthquake to prepare General Urban Plans (PRG) by May 1982. On September 16, 1981, the municipal council of Sant'Angelo dei Lombardi accepted a reconstruction plan for the historical center of the town. A modified PRG had to be produced, given that 60% of the housing stock had been severely damaged or destroyed. It was completed by December 23, 1982 and subjected to a public consultation process, which lasted until March 19, 1984, by which time 44 modifications had been approved and incorporated (Sciré, 1984).

There were several problems unique to Sant'Angelo dei Lombardi. First, "in the interest of public safety," a German military engineering squadron had begun to demolish large areas of buildings (about 130 dwellings in all), directly after the earthquake. This did more damage than the tremors themselves in that part of town, according to the municipal reconstruction office. Undoubtedly, it added to the time required to adapt the urban plan. Second, about 2,044 new homes would be needed by the year 1993, according to a projection made in the new PRG that did not include substantial resettlement of survivors. Third, most dwellings in the center of town formed part of **insulae**, or interlocking, multiple-occupancy property, which made it necessary to obtain agreements among owners of different parts of the **insula** before reconstruction could go ahead (Alexander, 1984a, 1984b).

In fact, Sant'Angelo dei Lombardi is the only town in Irpina where substantial use was made of the power of delegation vested in Law 219 of 1981. Article 17 of this law established planning offices responsible for coordinating the reconstruction of historical town centers in the 1980 epicentral area. This office created the reconstruction plan at Sant'Angelo dei Lombardi. Private homeowners had the power to delegate reconstruction to the planning office, and 26% did, thus forfeiting the right to decide how the state grants would be applied to their properties. This option had not been exercised by more than 6% of homeowners in previous Italian earthquakes, largely through fear that bureaucratic delays would result. However, at Sant'Angelo dei Lombardi, delegation allowed a much more comprehensive approach to reconstruction. Contracts for the work were subject to a public bidding process, even though the property to be reconstructed remained private. Further demolition was carried out where strictly necessary and, four years after the earthquake, six or seven building concerns were at work in the center of town.

Delays between the end of the emergency phase and the start of reconstruction do not necessarily mean inefficiency (as the information media would often have us believe), but may be necessary to reformulate or adapt urban plans and to allow proper public consultation. The lessons of reconstruction in Italy are that it has to be carefully managed and that government must honor its pledges to provide funds within the deadlines it sets itself. Generally, a small to medium sized earthquake disaster will generate reconstruction that lasts 12-15 years. A large catastrophe or badly managed situation will generate reconstruction lasting 20-25 years, or even indefinitely if funds are not well spent.

THE FUTURE OF NATURAL HAZARD MANAGEMENT IN ITALY

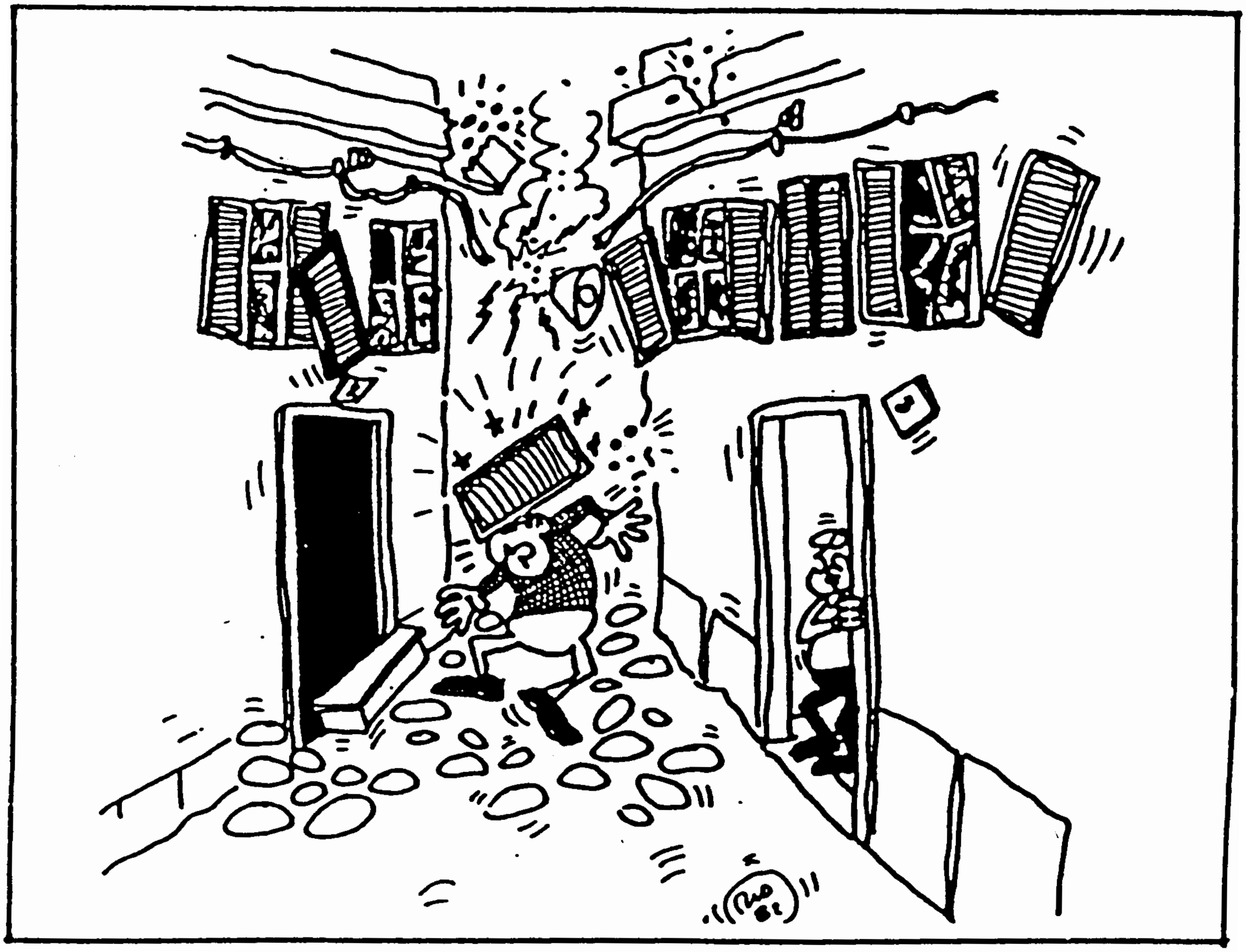
There are signs that the increasing awareness of natural hazards in Italy during the 1980s will endure rather than subside. First, damaging geophysical events continue to occur (including new tremors in Abruzzo during May 1985), and continue to require a government fund to pay for their effects. Second, much more is now known about the seismicity, and hence the vulnerability, of Italian municipalities, and the risk cannot be ignored. Third, there is now a higher level of public involvement, matching the increased awareness. The towns of Atina (in Lazio), Alfedena (in Abruzzo) and Isernia (in Molise Region) have set up volunteer "militia" groups to help organize local seismic mitigation. In Marche, Regional Law 42 of 1974 makes environmental education mandatory in the region's upper-middle schools. This may include natural hazards material, such as the CNR's audio-visual presentation "What are Earthquakes and How Can We Protect Ourselves Against Them?" (see Figure 12; CNR, 1983b).

It seems reasonable to assume that present trends in Italian hazard management will continue. The Ministry for Civil Protection will become larger and better established, seismic norms and zonation will continue to be upgraded. The regional and local levels will continue to increase their involvement, although perhaps not to the desirable level of full-scale local mitigation and evacuation plans in every vulnerable community. Natural hazards will continue to claim an increasing share of national wealth, but perhaps fewer victims, than in the past. Legal measures and macroseismic survey will continue to become standardized, but are not likely to lose any of their complexity.

Unfortunately, there is no sign of reappraisal of the national attitude toward state intervention in disaster aftermaths. More, rather

FIGURE 12

ILLUSTRATION OF THE DANGERS OF RUNNING OUT OF DOORS
DURING AN EARTHQUAKE
FROM "WHAT ARE EARTHQUAKES AND HOW CAN WE PROTECT OURSELVES?"
(CNR, 1983b)



than less, state aid is tacitly considered desirable. There is no sign of a shift in government policy toward encouraging populations at risk to subsidize their own risk through mandatory insurance. Natural hazards insurance in Italy is virtually nonexistent and does not appear to be imminent. The government must bear the cost of disaster, yet does not seem to have examined whether this is anything more than merely a political expedient.

The 1984 disaster zones are representative of what happens when low-energy, shallow-focus earthquakes affect inadequately protected structures. The level of government involvement in the aftermath probably represents "overkill"--partly "to be seen to be doing something" and partly to test the newly acquired national hazards management structure. One must conclude that the response--in terms of relief, resettlement and reconstruction aid--rather than the geophysical magnitude or seriousness of the damage, governs the importance of the event in the national eye.

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APPENDIX I

MERCALLI-CANCANI-SIEBERG EARTHQUAKE INTENSITY SCALE

Translated from the Italian by D. Alexander

GRADE I. Imperceptible: detected only by seismographs.

GRADE II. Very light: felt only by a few nervous or sensitive people in situations of perfect calm, and almost always on the top floors of buildings.

GRADE III. Light: even in densely populated zones the tremors are only perceived by a small portion of the inhabitants, who are indoors. The tremors are akin to the vibrations caused by the passing of a vehicle at high speed and are not immediately recognizable as seismic.

GRADE IV. Moderate: few people out of doors perceive the earthquake. Indoors, many but not all people observe some light oscillation of furniture and fittings. Ornaments grouped close together vibrate against one another as if a heavy truck is passing nearby over a bumpy road. Windows, doors, beams, panels and ceilings creak. Liquid in open containers is lightly disturbed. Indoors, one has the sensation that a heavy object (a sack, or piece of furniture) has been overturned, or alternatively one feels as if chairs or beds are moving as aboard ship on a heavy sea. Generally, these movements do not cause fear, unless people are nervous or frightened as a result of previous earthquakes. In rare cases, sleeping people are awakened.

GRADE V. Reasonably strong. If it occurs during waking hours, the earthquake will be felt by many people in the streets, and even in open country. In tall buildings the entire structure will be observed to move. Plants and the weaker branches of trees and bushes will move quite evidently, as if in a moderate wind. Hanging objects will swing: for example, curtains, hanging lamps, lampshades that are not too heavy; domestic bells will toll, pendulum clocks will stop, or oscillate with greater strokes if direction of earthquake waves is equal to the normal direction of oscillation, or, otherwise, normal to the stroke of the pendulum; occasionally, pendulum clocks that have stopped will restart; springs within clocks will resonate. Electric lights will flicker or go out as a result of movement of the power lines. Hanging pictures are displaced or rattle against the wall. Open containers full of liquid will spill small quantities of their contents. Ornaments and similar objects may fall over; or objects leaning against walls will be slightly displaced. Furniture will shake and rattle, doors and their frames will rattle, and some windows may break. Almost all sleepers will be woken, and small groups of people will flee towards open spaces.

GRADE VI. Strong: Everyone feels the earthquake and is afraid. Many seek refuge in open spaces, and some people have a sensation of instability. Liquids are strongly agitated. Pictures, books and similar objects fall off walls and shelves; porcelain is shattered. Very stable furniture and fixtures, including isolated fitments, are shifted, if not overturned. Small bells in churches and chapels will toll, and so will those of clocks in towers. Solidly constructed detached houses will suffer light damage, including cracked plaster and fittings of ceilings and walls. Greater damage, but still not dangerous, will be suffered by badly constructed buildings. A few tiles will fall from roofs and bricks from chimneys.

GRADE VII. Very Strong: Notable damage will be provoked to furnishings, including very heavy objects, some of which will be overturned and smashed. Great bells will toll. Water courses, ponds and lakes will be agitated and will become turbid as sediment is churned up from their beds. Here and there, sand and gravel banks will fail. The water level or discharge of fountains will fluctuate. Many well-constructed buildings will suffer moderate damage: small cracks will occur in walls, large pieces of plaster and sometimes bricks or tiles will fall and some houses will lose their roofs. Many flues will be cracked, stones will come out of walls, unstable chimneys will collapse onto roofs, damaging them. From towers and tall constructions architectural details that are badly attached will fall. Frame houses will suffer serious damage to both the frame and the infill panels. Badly constructed or badly repaired houses may occasionally collapse.

GRADE VIII. Ruinous: Entire trees oscillate, or even break apart. Even the heaviest furniture is carried far from its original resting point and sometimes overturned. Statues and commemorative stones in churches, cemeteries and public parks are turned on their pedastals or thrown down. Solid stone walls are thrown down or burst open. About a quarter of houses are seriously damaged; some will have collapsed and many will be uninhabitable. Most frame buildings will collapse. Wooden houses are crushed or overturned. Church and factory towers often collapse, damaging other structures as they go. Slopes consisting of partly or wholly saturated ground form cracks. Sand and mud are thrown up from wetlands.

GRADE IX. Destructive: About half the stone-built houses are severely damaged; many collapse and almost all become uninhabitable. Frame houses are lifted from their foundations, and collapse. Dislocated beams contribute greatly to the general destruction.

GRADE X: Completely destructive: Severe damage to about three quarters of the building stock; most structures collapse. Solid constructions in wood, and bridges, are badly damaged and some collapse. Riverbanks, dams, etc., are more or less badly damaged, rails are slightly buckled, and tubes (gas, water and sewerage mains) will be severed, broken or crushed. Paved and asphalted roads will crack and form pressure ridges. Soil that is not too dense and is fairly wet will fissure with cracks up to tens of centimeters wide; while, parallel to water courses, cracks up to a metre wide may develop. Landslides will occur on slopes and blockfalls will also occur. Large mass movements will occur on the banks of rivers and steep valley flanks; mud and earthflows will be provoked on shallower slopes without much relative relief. Pools and springs vary in discharge and water-level. Water is thrown onto the banks from rivers, canals, lakes, etc.

GRADE XI. Catastrophic: All masonry buildings collapse, and only wooden buildings of great strength and elasticity survive. Even the largest and safest bridges collapse as a result of the fall of stone columns or settling of those in steel. Rails are greatly folded or are snapped. Pipelines are severed irreparably. Various changes occur in the form of the land, the area involved depending on the nature of the soil: great fissures and cracks open; and, above all, soft and saturated terrains are damaged both horizontally and vertically. Mud and sand boils occur in various ways. Landslides and rockfalls are common.

GRADE XII. Greatly catastrophic: No man-made structures remain standing. The form of the land is greatly altered. Groundwater and surface-water flows are altered: waterfalls are created, lakes disappear, rivers are diverted.

APPENDIX II

MEDVEDEV-SPONHEUR-KÁRNÍK EARTHQUAKE INTENSITY SCALE

Translated from the Italian by D. Alexander

1. Type of building

A Structures: construction in natural stone, rural buildings, houses in adobe (in mudbrick with or without a clay matter) and houses made of mud or lime.

B Structures: construction in common bricks, in large blocks, prefabricated construction with wooden frame, construction in dressed stone.

C Structures: reinforced construction, well-made wooden structures

2. Meaning of various terms with approximate value:

a) single, some, few	5%
b) many	50%
c) most	75%

3. Classification of damage to buildings (by category)

Category 1. Light damage: slender cracks in plaster, fall of small pieces of plaster.

Category 2. Moderate damage: small cracks in walls, collapse of large pieces of plaster, fall of roof-tiles, cracking or partial collapse of chimneys.

Category 3. Strong damage: abundant and deep cracks in walls, collapse of chimneys.

Category 4. Destruction: openings in walls, possible partial collapse of buildings, the various parts of structures lose their cohesion, internal walls collapse.

Category 5. Total destruction of buildings.

Elements on which the scale is based

a) people and their surroundings

b) structures

c) natural phenomena

THE M-S-K SCALE

GRADE I: Imperceptible tremor, detected only by seismographs.

GRADE II: Slightly perceptible tremor, noticed only by a few people indoors and especially on the upper floors of buildings.

GRADE III: Weak tremor, not noticed by everyone. Indoors, few people notice the tremor and outside it is only detected under special circumstances. The vibration is similar to that produced by a small truck passing nearby. An attentive observer would notice the slow oscillation of pendant objects, especially on upper floors.

GRADE IV: Tremor felt by most people at home and a few people in the open. Some sleepers are awakened, but not alarmed. The vibration is similar to that produced during the passage of a heavy truck. Doors and windows, plates and pots, rattle; furniture shakes; walls and ceilings crack; suspended objects and liquids in open tanks oscillate lightly. The shock is felt in stationary automobiles.

GRADE V: Awakening

(a) All people who are indoors and many who are outside feel the tremors. Many sleepers are awakened. A few people rush outside their houses. Animals are disturbed. Entire buildings shake; suspended objects oscillate substantially. Hanging pictures rattle against the wall and are dislodged. Pendulum clocks may stop. Unstable objects may fall or rotate. Open doors and windows slam. Liquids in open tanks and containers are slightly spilled. The vibration is felt within buildings much as that produced by the fall of a heavy object.

(b) Slight damage to buildings of type A.

(c) Variation in discharge at some springs.

GRADE VI: Alarm

(a) Tremors detected by most people indoors and outside. Many people indoors are alarmed and run outside. A few people lose their balance. Domestic animals flee from their stalls. In a few cases china and glassware may break and books fall from shelves. Heavy furniture may be displaced and small bells in towers and steeples may ring.

(b) A few buildings of type B and many of type A will suffer category 1 damage; a few buildings of type A will suffer category 2 damage.

(c) Wet ground may produce cracks up to 1 cm in width in a few places; a few landslides will occur; spring discharge will fluctuate.

GRADE VII: Damage to buildings

(a) Most people are alarmed and seek refuge in the open. Many lose their balance. The tremors are also felt in moving automobiles. Large bells ring.

(b) Many buildings of type C suffer damage of category 1; many of type B suffer category 2 damage. Most buildings of type A are damaged to category 3 and some to category 4. Landslides occur in roadcuts and some roads subside, cracking their pavements; joints in pipelines are damaged. Stone walls are cracked, including dressed stone.

(c) Waves form on the surface of open water, and water bodies are made turbid by agitation of bed sediments. Levels and discharges in springs fluctuate. In a few cases dry springs begin to flow again or flowing springs dry up. Sand or gravel banks collapse from place to place.

GRADE VIII. Destruction of buildings

(a) Alarm and panic: automobile drivers panic. Here and there, branches fall from trees. Furniture is moved and sometimes overturned. Some light fittings are damaged.

(b) Damage to buildings, as follows:

Most buildings of type C are damaged to category 2

Some buildings of type C are damaged to category 3

Most buildings of type B are damaged to category 3

Most buildings of type A are damaged to category 4

(c) Small landslides occur in workings or steep-angled roadcuts

The ground surface may form cracks a few centimetres wide. Lake water becomes turbid. New lakes form. Springs dry up or start flowing. Others have fluctuating discharge.

GRADE IX: <u>General damage to buildings</u>

(a) General panic among humans and animals. Furniture and household objects are widely damaged.

(b) Damage to buildings, as follows:

Many of type C suffer damage of category 3

Many of type C suffer damage of category 4

Many of type B suffer damage of category 4

Some of type B suffer damage of category 5

Many of type B suffer damage of category 5

Monuments and statues fall. Underground pipelines are partly broken; tanks and cisterns are considerably damaged. Roads are damaged, rails may occasionally be bent.

(c) The water-table rises on plains, with or without sand or mud boils. Cracks in the ground are up to 10 cm wide, move on steep slopes and river banks. Numerous minor cracks are also formed. Rockfalls, mudflows, earth and debris flows and slides all occur. Large waves are formed in water. Springs dry up or appear where they did not exist before.

GRADE X: -- <u>General destruction of buildings</u>

(a) Effects on people and animals are not considered above grade IX

(b) Damage to buildings, as follows:

Many of type C suffer damage of category 4

A few of type C suffer damage of category 5

Many of type B suffer damage of category 5

Most of type A suffer destruction of category 5

Serious damage to bridges, dams and reservoirs. Buckling of railway lines; fracturing or buckling of underground pipelines. Heaves form in the surface of roads.

(c) Cracks in the ground up to 1 inch wide. Abundant fractures in the ground surface parallel to water courses. Slopes in soft material fail. On steep slopes and river banks large landslides may occur. Liquefaction failures in coarse sediments, alteration of spring discharge, overtopping of canals, rivers and lakes. New lakes form.

GRADE XI: -- Destruction

(b) Severe damage to the best-constructed buildings, to bridges, dams and railway lines. Roads are rendered impassable. Underground pipelines are destroyed.

(c) Vertical and horizontal movements, varied types of landslides, cracking and fracturing all occur at the surface of affected terrains.

GRADE XII: -- Alteration of topography

Damage as in Grade XI, with effects especially pronounced where the ground surface is greatly altered by the tremors. Virtually all structures above or below ground are strongly damaged or destroyed.

(c) The ground surface is greatly modified. Substantial cracks open, sizeable landslides and rockfalls occur on many slopes, including the banks of rivers and lakes. Waterfalls are created: river courses are altered; rivers are damned by landslides.

MSK	Accel. cm/sec^2 in range of periods 0.5-0.5 sec	Velocity cm/sec in range of periods 0.5-2.0 sec	Swing of centre of gravity of pendulum of fundamental period 0.25 sec and logarithmic decrement of 0.8.
5 Awakening	12-25	1.0-2.0	0.5-1.0
6 Alarm	25-50	2.1-4.0	1.1-2.0
7 Damage to bldgs.	50-100	4.1-8.0	2.1-4.0
8 Destruction of bldgs.	100-200	8.1-16.0	4.1-8.0
9 General damage to bldgs.	200-400	16.1-32.0	8.1-16.0
10 General destruction of bldgs.	400-800	32.1-64.0	16.1-32.0
11 Destruction	-	-	-
12 Alteration of topography	-	-	-

I_{MCS}	Total Collapse		Partial Collapse	Deep Cracks	Superficial Cracks
	I_{MCS}	I_{MSK}			
VII	-	-			
VIII	-	5			
IX	50	25			
X	75	50			

	I_{MCS}	I_{MSK}			I_{MCS}	I_{MSK}			I_{MCS}	I_{MSK}			I_{MCS}	I_{MSK}		
		A	B	C		A	B	C		A	B	C		A	B	C
VII	-	-	-	-	-	5	-	-	50	75	-	-	-	-	50	-
VIII	5	-	-	-	25	75	-	-	-	-	75	5	-	-	-	75
IX	25	50	5	-	50	-	50	50	-	-	-	50	-	-	-	-
X	50	75	50	5	75	-	-	50	-	-	-	-	-	-	-	-

Earthquake Report

Earthquake in southern Italy, March 21, 1982

By David E. Alexander,
Department of Geology and Geography,
University of Massachusetts,
Amherst, Massachusetts

The author was living in Basilicata, central southern Italy, at the time of the November 1980 earthquake [magnitude from surface waves (M_s = 6.9), which killed 3,000 people and left at least 270,000 homeless (see Earthquake Information Bulletin, *1981, vol. 13, no. 1, p. 18#22). On behalf of the International Disaster Institute (based in London, England), he subsequently wrote a report on the problems of medical intervention, emergency management, geomorphology, the stability of structures, international aid, and relief associated with the catastophe and its aftermath. Having lost his own home as a result of the earthquake, Alexander joined an interuniversities research group from Britain and northern Italy that lived among the refugees of the devasted villages to study topics varying from cultural anthropology in relation to crisis reaction to the vulnerability of characteristic building types to strong ground motions. He also studied epidemiological aspects of the disaster and, at the time of the renewed tremors in 1982, was preparing to conduct further research into postearthquake landsliding in the epicentral area.*

'hile the populations of southern Italy were still recovering from the earthquake of November 23, 1980, further damaging tremors occurred on the morning of Sunday, March 21, 1982. The 1982 earthquake had a magnitude from surface waves (M_s) of 4.85 and reached intensities of VI to VII on the Modified Mercalli Scale. The preliminary epicenter was located at about 39°59′ N., 15°38′ E. in the Gulf of Policastro (Tyrrhenian Sea) 6 miles from the coast of the Basilicata Region (40 miles southwest of the November 1980 epicenter). The focal depth was estimated at 12 miles; during the first 72 hours after the main tremor, about 30 aftershocks occurred per day.

No deaths were reported, and few people were injured by the earthquake; but an initial estimate put the total of people rendered homeless at 1,357. Of these, 682 were residents of the Province of Potenza (Basilicata Region) and 675 of Cosenza Province (in Calabria). At Maratea (in Potenza Province), 138 houses, mostly in the older central part of town, were damaged, 79 of them seriously. This led to the issue of 70 evacuation orders during the first 3 days after the earthquake; 130 evacuees were accommodated in nearby tourist hotels, awaiting transfer to trailer homes, 100 of which arrived within a week of the disaster. Evacuation orders were also served at 5 other locations in Potenza Province, including Lagonegro (affecting 37 dwellings), Rivello (20 dwellings), and Trécchina (17). At Papasidero, in Cosenza Province 13 miles southeast of Maratea, 80 percent of the dwellings suffered notable damage, principally cracking masonry walls, and 250 people were rendered homeless. Another 10 settlements were damaged in Cosenza Province, including Aieta (70 percent of the dwellings were damaged, and 35 people were rendered homeless).

Several hundred workers were laid-off at a textile yarn factory at Maratea, which was substantially damaged, and industries also were forced to close at nearby Lagonegro. As most hotels in the coastal resort of Maratea are new ferroconcrete structures; they did not suffer notable damage, and the tourist trade was expected to be relatively unaffected.

Close to Maratea, the 1982 earthquake caused rockfalls that blocked four roads for a period of days. At the same time, there was renewed landsliding in the town of Bisáccia, located 30 miles northeast of Avellino on siliceous, calcareous and argillaceous sediments. Bisáccia had experienced landsliding damage since the 1930 earthquake (which killed 18 inhabitants and damaged 1,537 houses; the November 1980 tremors caused damage to about 1,000 homes, much of it as a result of landsliding along three fault planes located directly under the town. By March 23, 1982, the number of evacuation orders on buildings in Bisáccia had risen to 1,921, 70 percent of which were homes and the rest were barns, stalls, and cellars. A total of 480 mobile homes had been supplied since the 1980 earthquake, but nearly three-quarters of them still lacked utilities and had, therefore, not been assigned to homeless families by the end of March 1982.

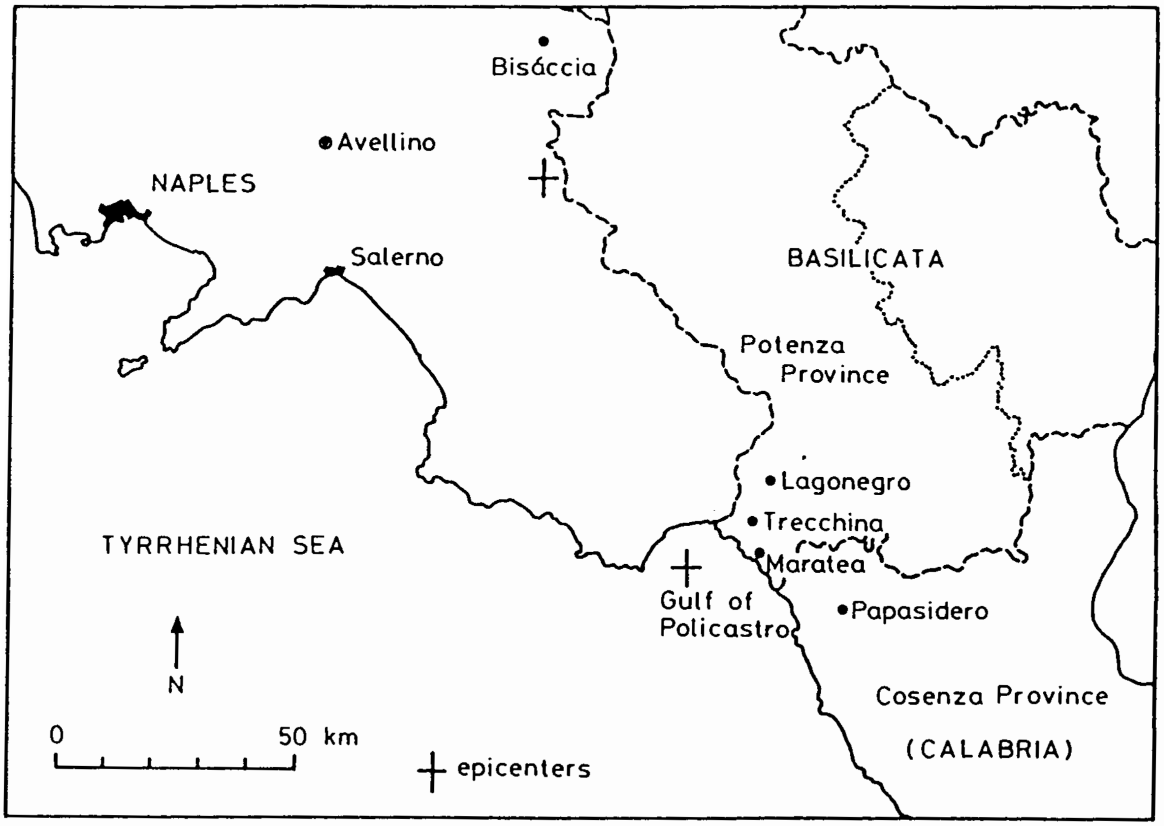
The 1982 earthquake generated a very rapid response from the Italian authorities who had remained sensitive to such problems after the 1980 disaster. Manpower, equipment, and the first 33 trailers for the homeless arrived from Naples and Salerno a few hours after the tremors; Signor Giuseppe Zamberletti, the Government's Special Commissioner for Disaster Relief, visited Maratea and its environments on the same day. Thus, the 1982 disaster highlighted the importance of preparedness and readiness on the part of the authorities in relieving the sufferings of the homeless; and it also demonstrated that an earthquake of relatively low magnitude, occurring in a sparsely populated area, can cause significant damage and disruption, especially where there are many poorly maintained, low-strength masonry buildings.

The information given in this note is derived from reports printed in two Italian newspapers, *Il Mattino* of Naples and *La Gazzetta del Mezzogiorno* of Bari, and from personal research conducted by the author.

Further reading

Alexander, D. E., 1981, *Preliminary assessment of landslides caused by the earthquake of 23 November, 1980, in southern Italy, Disasters: International Journal of Disaster Studies and Practice,* vol. 5, no. 4.

Alexander, D. E., 1982, *The earthquake of 23 November, 1980, in Campania and Basilicata, southern Italy, Report No. 4,* International Disaster Institute, London, 164 p.



Map of Southern Italy.

APPENDIX IV

ITALIAN LAWS RELATING TO EARTHQUAKE RELIEF AND MITIGATION

Abbreviations:-

L.	Legge	State Law
D.L.	Decreto-Legge	Decree-Law*
D.M.	Decreto Ministeriale o Inter-Ministeriale	Ministerial or Inter-Ministerial Decree*
D.P.C.M.	Decreto del Presidente del Consiglio dei Ministri	Prime Ministerial Decree*
D.P.R.	Decreto del Presidente della Repubblica	Presidential Decree*
R.D.	Real Decreto	Royal Decree (pre-1948)*
R.D.L.	Real Decreto-Legge	Royal Decree-Law (pre-1948)*
L.R.	Legge Regionale	Regional Law
Ord.	Ordinanza	Ministerial Ordinance*

* of limited duration

N.B.: Laws are given by number and date (day-month-year).

(a) Laws Concerning Earthquake Relief and Civil Protection

Since the latter part of the nineteenth century in Italy most natural disasters have entailed some kind of subsequent legislation. This has, however, often been erratically formulated and applied: for example, the Bourbon monarchy of Naples established by decree a reconstruction fund (the Cassa Sacra) after the 1783 Calabrian earthquakes, but apparently did not legislate to reduce the suffering caused by the 1851 and 1857 seismic disasters in the Kingdom of Naples (Gasparini and Stucchi, 1979). This account will be confined to legislation enacted after the Unification.

The 1883 earthquake at Casamicciola on the island of Ischia, near Naples, gave rise to

(1) R.D. 3859/22-10-1886, concerning the repair and reconstruction of state property.

(2) R.D. 350/25-5-1895 gave authority to the national roads commission, A.N.A.S., for the repair of state roads following natural disaster, but it was not until 1961 that extra state funds were provided for this, under

(3) L. 59/7-2-1961.

(4) L. 473/7-4-1925 (ex-R.D. 1915/2-9-1919) "Regulation of Services of First Aid Relief" was one of the early laws concerning disaster relief that, like many of its successors, dealt only with aid after the event, not with reconstruction, and certainly not with the prediction and prevention of natural catastrophe.

(5) L. 833/15-3-1928 (ex-R.D.L. of 9-12-1926) placed the task of providing disaster relief in the hands of the Minister of Public Works, where it stayed for some decades.

(6) L. 3136/18-12-1952 (ex-D.L. 1010/12-4-1948) gave the Minister of Public Works the power to appropriate state funds for disaster relief. Repair and reconstruction measures were financed by individual laws, relating to specific disasters, and by general measures, including

(7) L. 50/13-2-1952 (ex-D.L. 1334/15-12-1951), concerning the financing of repair and reconstruction in the manufacturing sector, and

(8) L. 590/15-10-1981, concerning the same measures applied to the agricultural sector.

(9) L. 292/14-3-1968 regulated grants made by the state for the repair and reconstruction of historic buildings, and

(10) L. 44/1-3-1975 set further limits on such payments.

(11) D.P.R. 1534/30-6-1955 "Decentralization of the services of the Ministry of Public Works," gave the Minister the power to delegate responsibility for disaster relief to lower authorities.

(12) L. 669/13-5-1961, a law which regulated major fire-fighting activities, placed responsibility for the relief of fire disasters in

the hands of the Minister of the Interior.

(13) L. 996/8-12-1970 "Regulations for the relief and assistance of populations struck by disaster--civil protection," the main disaster relief law until the 1980s, transferred the responsibility for mitigating natural catastrophes from the Minister of Public Works to the Minister for the Interior. However, this law, which grew out of the aftermath of the 1968 earthquakes in western Sicily, was not operationalized until after the 1980 Irpinian earthquake disaster, when (14) D.P.R. 66/6-2-1981 "Regulations for the execution of L. 996/1970" was issued.

(15) L. 176/26-4-1976 established for the first time a national seismic monitoring service, supervised by the Ministry of Public Works.

(16) D.P.C.M. 12-6-1981 established a National Earthquake Defence Group (G.N.D.T.) under the auspices of one of the 1980 earthquake reconstruction laws, L. 874/1980 (see below).

An Extraordinary Commissariat had been set up under L. 996/1970 for the relief of the 1976 Friuli and 1980 Irpinian earthquake disasters, and the latter term of office, which had repeatedly been prorogued, was consolidated into a permanent Ministry for Civil Protection (M.P.C.) under (17) L. 547/12-8-1982 (ex-D.L. 428/10-6-1982). Article 2 of this law dealt with the funding of the new Ministry.

(18) L. 938/23-12-1982 (ex-D.L. 829/12-11-1982) explained the powers, delegated to the Minister for Civil Protection (Art. 1, Para. 2).

(19) L. 80/18-4-1984 (ex-D.L. 19/28-2-1984) and subsequent legislation, prolonged until mid-1985 the emergency powers that had been granted in November 1980 to the Extraordinary Commissariat and later transferred to the Ministry for Civil Protection.

(20) L. 748/23-12-1983 (ex-D.L. 623/7-11-1983) dealt with the regulations necessary to fund the reconstruction of public housing damaged or

destroyed by natural disaster, using rules that had been developed in Naples during the 1980 earthquake aftermath.

(b) Laws Pertaining to Specific Earthquakes

(21) L. 546/8-7-1977 was the main law governing the regulation and financing by the state of reconstruction after the 1976 Friuli (N.E. Italy) earthquakes. This law was supplemented by the Region of Friuli Venezia-Giulia in L.R. 30/26-6-1977, which sought to preserve damaged historic buildings, and L.R. 63/23-11-1977, which sought to aid their reconstruction.

(22) L. 115/3-4-1980 gave regulations for reconstruction work that were specific to the September 1979 earthquake at Norcia, in Umbria Region.

(23) L. 874/22-12-1980 (ex-D.L. 776/26-11-1980) and

(24) L. 875/22-12-1980 (ex-D.L. 779/5-12-1980) were emergency laws for the relief and resettlement of survivors of the 23rd November 1980 earthquake in Southern Italy. Article 1 of L. 874 described the powers of the newly-reconvened Special Commissariat for the Earthquake-Affected Areas. Other articles dealt with matters such as the requisitioning of temporary shelter, the restoration of public services and the suspension of certain financial obligations for citizens of the disaster area.

(25) L. 104/30-3-1981 (ex-D.L. 11/31-1-1981) was the first of various acts to prolong the terms and powers of the Commissariat's operations in Campania and Basilicata.

(26) L. 128/15-5-1981 (ex-D.L. 19/13-2-1981) dealt with the official status as damaged communities given to individual municipalities in the 1980 disaster zone. The municipalities were listed by category (seriousness) of damage, in view of the reconstruction funds to be granted them.

(27) L. 219/14-5-1981 (ex-D.L. 75/19-3-1981) was the main reconstruction law relating to the 1980 earthquake. The 85 articles dealt with all aspects of the recovery process and provided a model on which to base similar legislation after subsequent disasters.

(28) L. 456/6-6-1981 (ex-D.L. 333/26-5-1981) had to be enacted in order to extend the deadlines for relief work, and for application for government grants to citizens needing to finance repair work. This was necessary, as the deadlines set under L. 219/1981 were too tight to be met, given the complexity of the legislation.

(29) D.P.C.M. of 30-4-1981, 22-5-1981, 13-11-1981 and 30-4-1981 provided an official listing of all communities that the government judged had been damaged by the 1980 earthquake.

(30) D.L. 129/2-4-1982, "Measures on behalf of the populations of Basilicata, Calabria and Campania Regions affected by the earthquake of 21 March 1982" extended some of the concessions made to survivors of the 1980 Irpinian earthquake to residents of a much smaller disaster zone to the south of Irpinia (see Appendix III).

(31) L. 187/29-4-1982 continued the legislation on the 1980 disaster, giving rules for the ground operations of the Extraordinary Commissariat (later the Ministry for Civil Protection) in Campania and Basilicata. A very important article of this law gave regulations for the purchase or requisition, deployment, use, recovery and repair of mobile trailers used as temporary housing for the survivors of disaster.

(32) D.L. 159/26-5-1984, "Urgent measures in favour of the populations affected by the seismic events of 29 April 1984 in Umbria and 7 and 11 May 1984 in Abruzzo, Lazio and Campania" extended some of the provisions of L. 219/1981 to inhabitants of the 1984 disaster areas.

(c) Ordinances of the Extraordinary Commissariat and Ministry of Civil Protection

Several hundred 'temporary laws' were issued by the government's Extraordinary Commissariat for Campania and Basilicata, and later by the Ministry for Civil Protection. They began to appear soon after the 1980 earthquake and continued to be issued until 1984 or later. The following is a selection of the most important ordinances.

(33) Ords. 55-56/18-12-1980 delegated to Campania and Basilicata Regions the task of providing temporary shelter for livestock.

(34) Ord. 64/24-12-1980 granted subsidies to families sheltering the homeless and pensioners requiring lodgings as a result of the 1980 disaster.

(35) Ord. 69/29-12-1980 set up two special Resettlement Offices in order to co-ordinate and plan the siting of resettlement communities.

(36) Ord. 80/6-1-1981, concerning regulations for the reconstruction of housing, was one of the most important ordinances, as it regulated the subsidies granted to house-owners for rebuilding work.

(37) Ord. 84/17-1-1981 granted subsidies to manufacturing firms that had lost stocks or machinery in the 1980 disaster.

(38) Ords. 96-97/17-1-1981 delegated to the Regions the task of purchasing prefabricated buildings for use by industrial and commercial firms.

(39) Groups of technicians were established in damaged communities in order to facilitate surveys of damaged housing and the correct reapportionment of subsidies for repair and reconstruction. This was dealt with on and after 3-2-1981 in Ords. 114, 115, 126-132, 134, 135, 137, 138, 161, 164, 186, 189, 202, 228-230, 239, 241, 242, 251, 258, 259, 265-269, 273, 277-279, 282, 299, 300, 305, 306, 310, 311, 322, 332, 338 and 339.

(40) Ord. 136/18-2-1981 granted repair funds to private home-owners

for the reconstruction of condominia.

(41) Ord. 140, which modified Ord. 80, gave the vital technical regulations for translating the results of post-earthquake structural surveys into criteria for granting subsidies for repair.

(42) Ord. 146/3-3-1981 added the need for preserving public safety to the procedures for structural survey outlined in Ord. 80.

(43) Ord. 163/14-3-1981 gave a resumé of modifications to Ord. 80.

(44) Ord. 168/23-3-1981 instituted local technical commissions to oversee demolition work, in order to ensure public safety.

(45) Ord. 176/26-3-1981 spelt out regulations for the granting of repair funds, and indicated which householders qualified for them.

(46) Ord. 178/24-3-1981 waived rate taxes on publicly owned lands in the disaster area.

(47) Ord. 198/8-4-1981 empowered the Public Works Departments of regional administrations to oversee the survey of damaged property and the issuing of compensation to its owners.

(48) Ord. 204/14-4-1981 allocated 25 specialists in public hygiene to epidemiological surveillance in the 1980 disaster zone.

(49) Ord. 205/15-4-1981 increased the number of sanitary inspectors in the disaster zone.

(50) Ord. 212/16-4-1981 gave a deadline for official recognition of the results of damage surveys carried out on private dwellings in the 1980 disaster area.

(51) Ord. 231/30-4-1981 regulated subsidies to home-owners.

(52) Ords. 237 and 238/2-5-1981 granted funds to restart and advertise tourism in the disaster zone (Region of Campania only).

(53) Ord. 248/8-5-1981 transferred the responsibility for public health in Basilicata from local health-care units to the Regional Council, for the duration of the earthquake aftermath.

(54) Ord. 275/18-5-1981 prolonged the deadline for the receipt of applications for housing repair grants.

(55) Ord. 296/13-5-1981 authorized Campania Region to employ extra medical personnel to ensure that disease did not break out in the 1980 epicentral area.

(56) Ord. 298/30-5-1981 granted funds to Italian consolates in foreign countries so that migrant workers from the disaster area could return and repair their homes.

(57) Ords. 301 and 302/2-6-1981 gave further regulations for government grants pertaining to the repair of private housing.

(58) Ord. 316/11-5-1981 gave priority to the epicentral area in respect of the apportionment of repair grants.

(59) Ord. 321/12-6-1981 extended subsidies for repair work in the epicentral area.

(60) Ord. 323/16-5-1981 was designed to streamline local planning procedures that might constrain rehousing and reconstruction.

(61) Ord. 327/16-6-1981 extended the time-limits on the validity of structural surveys.

(62) Ord. 347/1-7-1981 prolonged the period in which housing repair subsidies could be awarded.

(63) Ord. 230/5-6-1981 "Rules for repair of buildings and works damaged by the earthquakes of 7 and 11 May 1984" applied some of the regulations developed since 1980 to the 1984 disaster zones.

(d) Seismic Zonation

(64) D.P.R. 616/24-7-1977 reserved for the State the right to compile and add to the list of communities officially declared to be at risk from earthquakes.

(65) Particular additions to the original list of 1377 municipalities

declared 'seismic' have been made by Decrees of the Ministry of Public Works on 7-3-1981 and 3-6-1981 (Basilicata, Campania and Puglia Regions), 23-9-1981 (Sicily), 19-3-1982 (Tuscany Region), 27-7-1982 (Liguria and Sicily), 10-2-1983 (Marche) and 1-4-1983 (Lazio).

(e) Anti-Seismic Building Codes

(66) L. 64/2-2-1974 "Building codes, with particular prescriptions for seismic zones" is the main anti-seismic building law.

(67) D.M. 39/3-3-1975 "Approval of technical regulations for construction in seismic zones" operationalized L. 64/1974.

The incursions of organized crime into public administration and reconstruction after disaster have brought forth a mass of legislation. These so-called 'anti-Mafia' laws are:

(68) L. 1423/27-12-1956, L. 575/31-5-1965, L. 15/4-1-1968, D.L. 629/6-9-1982, L. 646/13-9-1982 and L. 936/23-12-1982. In each successive case the measures to curb corruption, extorsion and theft have become more stringent, especially as a result of the serious problems experienced with the Campanian *Camorra*, who acted to gain illicit control of the post-1980 reconstruction funds and enterprises.

(f) Addendum

(69) D.P.C.M. 14-9-1984 dealt with the organizational structure of the government's Department of Civil Protection.

Sources: *Geologia Tecnica* (1983), *Gazzetta Ufficiale della Repubblica Italiana* (1981-84), Consiglio Regionale della Basilicata (1982), Comissariato Straordinario (1981).

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