

VOLCANIC ERUPTION AND LOCAL POLITICS IN JAPAN: A CASE STUDY*

Hirotsada Hirose

Tokyo Woman's Christian University

INTRODUCTION

September 1, 1978, marks the 55th anniversary of the Great Kanto Earthquake which killed over 90,000 and injured more than 100,000 in Tokyo and vicinity. In this half-century, Japan has suffered various natural disasters. Innumerable people have been injured or have lost loved ones in these catastrophes. Property damage has been very high. Given these costs, have the Japanese learned from these experiences? Will they be able to cope with future earthquakes any better than they coped with the Great Kanto Earthquake of 1923? Or has the experience of the Great Kanto Earthquake been suppressed by defense mechanisms because it is a memory too horrible to bear, too frightening to allow learning?

The Japanese are said to be very pessimistic about tomorrow but extremely optimistic about the day after tomorrow. Natural disasters, of course, are “the day after tomorrow.” Why should the Japanese concern themselves

about “the day after tomorrow”? A recent survey undertaken by our committee revealed that the majority of the people in Tokyo are convinced that a major earthquake will hit the city, but only a relatively small number think that they themselves or their families will be casualties [1]. Most people feel that they and their families will be spared. However, the Tokyo Disaster Prevention Conference in 1971 estimated that another earthquake registering 6 or more on the Richter scale as the Great Kanto Earthquake did, would kill or injure some 560,000 people in Tokyo alone.

No two disasters are ever absolutely alike. With industrialization, Japanese ports and harbors are crowded with petrochemical plants and cities with gasoline stations, propane storage tanks, and other highly flammable substances. There are no empty lots in residential areas for residents to run to, and the streets are clogged with cars. The Fire Defense Agency predicts more than 700 fires if a Great-Kanto-Earthquake-class earthquake hits Tokyo today. Furthermore, stricken cities can suffer from the unexpected, as in the recent Sendai earthquake when a number of lives were lost under crumbling concrete block walls.

Nor can we disregard the role of mass media in a modern society such as Japan. The information broadcast on radio and television can facilitate smooth evacuation and alleviate an-

**Author's Note:* This paper is part of the report by the Mt. Usu Volcano Study Team of the Disaster and Information Study Committee (led by Professor Keizo Okabe of the University of Tokyo). The members of the Study Team are: Hirotsada Hirose (Tokyo Woman's Christian University), Osamu Hiroi, Yoshitomo Watanabe, and Takashi Muto (University of Tokyo, Institute of Journalism). The author would like to thank Professor E.L. Quarantelli for his comments on an earlier draft of this paper.

xiety. Sometimes, however, there are unexpected negative effects, as in the great anxiety and dysfunctional behavior caused by misleading reports on the Izu-Oshima earthquake in January of 1978 [2]. Over the past year, our group has followed the social, economic, and political impact of the Mt. Usu eruption in Hokkaido in early August, 1977. This volcanic eruption affecting small towns on Japan's northernmost island is in many ways an excellent model for disaster-study research. While the small town resembles a big city, the variables involved affecting behavior are fewer and more visible. Using this model, we would like to explain the nature of this natural disaster's impact as a first step toward an analysis of the social impact of natural disasters in general. This article reports on some preliminary impressions from an analysis of part of the data from our study.

CHARACTERISTICS OF THE THREATENED TOWNS

Mt. Usu is an approximately 730 meter high active volcano at the center of a 7.8 kilometer wide strip of land between Hokkaido's Uchiura Bay and Lake Toya. We say "approximately 730 meters" because the underground magma keeps pushing the mountain up and it is impossible to tell exactly how high the mountain is at any given time. The area severely damaged in the recent eruption includes the town of Abuta to the west, Daté city to the south, and the town of Sōbetsu to the east (the amount of damage, see Table 1). We will focus on these three communities and show how the volcanic eruption became woven into local politics.

Daté has a population of approximately 34,000. The main industries are scallop cultivation, ranching, and agriculture. The city is also an active commercial center, with several

TABLE 1

The Amount of Damage of the Suffering Districts^a

Losses incurred	
Agriculture	\$ 59,275,000
Forestry	64,490,000
Housing	17,995,000
Fisheries	7,485,000
Rivers and roads	3,355,000
National railways	3,080,000
Others	2,775,000
Total	\$ 158,455,000

^a Figures have been rounded off in thousands of dollars using a conversion rate of \$ 1.00 = ¥ 200.

major shopping areas. The farms in the area average 3.5 hectares, which is large for Japan, and grow various vegetables for markets in Sapporo, Tokyo, and elsewhere. On the whole this is a very affluent agricultural area. In recent years, the community has also developed as a residential suburb for nearby industrial Muroran. Politically, Daté is rather conservative. In the 1976 election, for example, the conservative candidate for governor won 10,541 votes, while the reformist got only 8,139 votes. Conservative candidates won even more strongly in the city council election.

Abuta is politically and economically divided into two distinct sections: Abuta-Honcho and Toyako-Onsen. Abuta-Honcho on Uchiura Bay thrived on herring and sardine fishing before World War II, but these industries have now been entirely replaced by scallop cultivation. In the hinterland behind the busy coastal streets, are expanses of farmland and grassland where farmers produce quality fruit and vegetables, or raise (through highly mechanized operations) dairy and beef cattle. Per-family farm income here is much higher than the prefectural average. Politically, the area is a stronghold of the Japan National Railways

and other local labor unions, with an orientation to the left. Of the town's total population of 13,000, about 60% live in the Abuta-Honcho area. About five kilometers from the center of town on the southern bank of Lake Toya, is the other 40% of Abuta's population. This area, called Toyako-Onsen, features newly developed hot-spring facilities capable of accommodating about 9,000 guests a day. The largest hot-spring resort in the entire prefecture, it contributes more than half of the town's total tax revenues of three million dollars. Unlike Abuta-Honcho, Toyako-Onsen is politically conservative. Indeed, Abuta-Honcho and Toyako-Onsen contrast in almost every respect. One is economically supported by agriculture and fishery, is politically liberal, and has a long history; while the other is a tourist town, is politically conservative, and is newly developed. This schizophrenia makes Abuta one of the prefecture's most contested areas in political matters. In the 1976 gubernatorial election, for example, there was little difference between the 3,726 votes for the conservative and the 3,441 votes for the liberal candidate.

Sōbetsu is a community of only 4,000, a mere half of the population it had when it was a flourishing mining town. With the mines closed, the town is supported by the Sōbetsu hot springs near Abuta's Toyako-Onsen springs. Tourism and agriculture are the town's mainstays. The farms allow a very comfortable living with such cash crops as fruit and vegetables. Politically, it is a firmly conservative district.

THE EVACUATION ORDER

There were around 1,700 earthquake shocks registered in the area around Mt. Usu starting the morning of August 6, 1977, the day before the eruption. The abnormality of so many shocks was clear to all. However, past experience indicated that it would be several days between such earthquake shocks and an actual eruption. Little suspecting that

the eruption would come the next day, the three municipalities of Daté, Sōbetsu, and Abuta assumed they had time to activate their evacuation plans.

At 9:12 a.m., August 7, as if to emphasize all of the previous day's earthquake shocks, Mt. Usu erupted, shooting smoke 12,000 meters into the air and spewing out rock and ashes. Volcanic rock and ashes were carried by northwestern winds and damaged farms, orchards, and pastures on the southern and eastern sides of the mountain.

Surprised, the three municipalities nevertheless established their Damage Control Headquarters immediately after the eruption. About one hour after the eruption, at approximately 10 a.m., these headquarters sent out city hall and fire department sound trucks to issue an evacuation order to residents in endangered areas. Sōbetsu issued an evacuation order first to the Shōwa-Shinzan area where volcanic rocks the size of baseballs had fallen, then to the private Sankei psychiatric hospital, and then to the Chōnichi-en home for the elderly. Daté issued an evacuation order to the Kaminagawa area, where considerable ash had fallen, and asked for a halt to bathing along the beaches in the Usu area. Abuta issued an evacuation order to the Izumi-Irie area, which had had heavy mud slides, and an "evacuation alert" to Toyako-Onsen. However, there were some problems with the "evacuation alert" because the fire department mistakenly presented it as an evacuation order, leading quite a few residents to flee to the opposite bank of the lake.

In the afternoon, there were three additional small and medium-sized eruptions. Because they were smaller eruptions and volcanic activity appeared to be subsiding, the evacuation orders were cancelled toward evening, except for Sōbetsu's Shōwa-Shinzan area, Daté's Kaminagawa area, and a few other areas.

August 8 was overcast in the Mt. Usu area,

marking quite a change from the previous day's clear skies. Mt. Usu, which was quiet in the morning, erupted twice again lightly after midday and then strongly at 3:30 p.m. The rocks and ashes were carried by southeastern winds over Toyako-Onsen, where they rained down on the town, the fist-sized chunks of pumice breaking roof tiles and window panes alike. The surface of the lake was quickly covered with pumice and accumulated ashes 30 centimeters deep. Pumice and volcanic ash kept falling intermittently until dusk. Rain from the thunderstorms which developed in the evening made the ashes heavy and sticky. By this time, most of the tourists and residents had fled.

When the eruption hit Toyako-Onsen on the afternoon of August 8, the town manager was at the Toyako-Onsen branch of the Abuta town office. His first action was to order the residents in endangered areas to evacuate. The evacuation order was issued for the Konomi housing complex, which is only 1.5 kilometers from the crater and which had a lot of ash fall. The order was also given for part of the Izumi-Irie area. According to officials at the Toyako-Onsen station of the Nishi-Iburi fire department, both communications and evacuation were made extremely difficult by the falling pumice and ashes.

STEPS TAKEN BY ABUTA'S TOWN MANAGER

The town manager had done some disaster planning for Toyako-Onsen. Just the previous afternoon, he had designated Toya-mura village on the opposite side of the lake an emergency refuge and had decided that residents could use sightseeing boats for evacuation. By the end of August 7, most tourists had already left the town, half the residents had voluntarily evacuated, and the town manager had sightseeing boats ready to evacuate the remaining residents. However, pumice that fell on the lake immobilized the boats, closing that evacuation route. Also, since the town manager

was giving orders and instructions on-the-scene in Toyako-Onsen, he lost contact with the Abuta-Honcho town office and thus had to guess at the timing of the Toyako-Onsen evacuation order.

The dangers posed by the immobilization of the sightseeing boats, however, were averted when the 23rd Regiment of the 7th Division of the Self-Defense Forces (SDF) cleared one lane of Route 230 of its wet-cement-like rain-soaked volcanic ash. What if the route had not been cleared? The town manager is reported to have said: "They should never be told they're trapped. If you tell them to stay home because they're trapped anyway, they'll do anything to get out. Panic must be avoided at all cost — even if I have to lie to them."

Officials at the Toyako-Onsen branch town hall who had contemplated having to move out on ash-laden Route 230 were relieved when the road was cleared. In a questionnaire filled out by the residents of the four worst-damaged areas (Toyako-Onsen, Izumi-Irie, Sōbetsu-Onsen, and Kaminagawa) a very large majority of residents stated that they felt the SDF had performed most reliably [3].

The poor timing of the evacuation order was mitigated by two factors: SDF help and the fact that the eruption did not affect Toyako-Onsen severely enough to inflict devastating damage. This second factor especially enabled the town manager to say: "This evacuation is going to be proven unnecessary. Judging from the volcanic activity so far, the residents' lives are in no danger. They'll be safe if they stay inside, since all we have is ashes and pumice falling. But if we don't order an evacuation, I suppose the town will be faulted for not having done anything."

A manufacturer who serves as Chairman of the Tourism Association said: "Everybody here was so upset. The women started crying and the supervisory people, not knowing what else to do, had all they could do just to

calm them down. It looked as though the somma would collapse and I thought, for a moment, that even the lake was in danger. It was pitch dark, smoke was pouring out, and rocks were raining down. What with the lightening and all the rumbling, I was afraid that the somma would split.”

The town manager decided to issue an evacuation order about half an hour after midnight on August 9, and this was officially announced at 6:20 the same morning. It rained so heavily that day that a Heavy Rains and Flood Warning was also issued. By the time the evacuation started at 7 a.m., 1,700 people had gathered. Their destination was Abuta-Honcho, across the mountain. Fifteen SDF transport vehicles and five chartered buses went back and forth carrying people, completing the evacuation by 9 a.m., two hours later. About 100 residents, including inn owners, refused to be persuaded by the police and fire departments and stayed in Toyako-Onsen.

AFTER THE INITIAL EVACUATION

The police were in a less enviable situation than the SDF. In fact, the police did play a major role in maintaining order, but the people did not rate their performance very highly on our questionnaire. The main reason for this poor showing on the questionnaire was that the police policies were basically in conflict with economic interests. The Daté police were in charge of the affected areas. With the support of other police departments from around the country, they maintained policemen on 24-hour duty from the first eruption until November 14 to control traffic, to prevent crime, and to ensure the safety of those who chose to stay behind. When the Mt. Usu eruptions gradually showed signs of subsiding, residents found life as refugees boring and inconvenient, and calls for the evacuation order's rescission became louder as the tourist season ebbed away near the end of August.

The evacuees were housed at such public institutions in Abuta-Honcho as Abuta Elementary School and Abuta Junior High School. Much help was provided. The SDF and the Japan Red Cross supplied blankets. The telephone company installed toll-free telephones so that people could communicate with one another. NHK donated television sets. And the Abuta-Honcho housewives cooked for the refugees. Thus, the refugees were relieved of some immediate problems. Life at these institutions, however, was not pleasant. It was very noisy, and there was no room for people to stretch out. People had only one blanket and the hard floor on which to sleep. Fatigue soon set in. Many complained of insomnia and headaches, others of heart or stomach ailments.

Negative comments abounded in the replies to the questionnaires that we sent out: “I was at my wits' end with the worry and boredom.” “It was so cramped. I never want to do this again.” “It was all so sudden. I didn't have time to bring anything with me. All I had was a groundcloth and an SDF blanket. My back ached, and there were many nights when I couldn't sleep.” “I only had one blanket under me and another over me. It was terrible.” “I couldn't sleep for worrying.” “It was impossible to feel at home there.”

In order to cope with the developing situation, the Usu Eruption Evacuees Association was formed to strengthen solidarity among the evacuees and to facilitate group activities of their own. Committees and subcommittees were established at each refuge site, with about 20 people in each subcommittee. It was not until October 20, 73 days after the volcanic rains had first fallen on Toyako-Onsen on August 7, that all evacuees went home and the places of refuge were closed.

In the days between the initial evacuation and the lifting of the evacuation order much happened. Mt. Usu was quiet on August 10 and 11. August 12 and 13 saw one eruption each, with minor ashfalls and little damage to

Toyako-Onsen. There were still frequent earthquake shocks around Mt. Usu, and the Sapporo Meteorology Station warned of the danger of another eruption, but the danger seemed past to the displaced citizens. Once the fears of eruption had closed, evacuees started worrying about their houses – houses which now stood abandoned, their windows broken by the pumice rains and their roofs covered with ashes. Responding to their wishes, the town of Abuta allowed those evacuees that wanted to look around to go home for an hour on August 12. Three days later, this was extended to three hours to give people time to sweep ashes off their roofs and clean their rooms of pumice and ashes.

Fearful of possible danger, the Hokkaido and Daté police were cautious about letting ordinary citizens back into Toyako-Onsen. However, the Abuta town manager effected a de facto and gradual retraction of the evacuation order, with the one- and three-hour visits the first steps in a gradual lifting of the order.

SITUATION SPECIFIC TO TOYAKO-ONSEN

The prefectural government and the police were consistently more cautious than was the Abuta town manager. At his September 6 press conference, for example, the Governor said that it was still impossible to rescind the evacuation order, since Mt. Usu still had to be watched carefully. The Daté police also said any rescission would be premature, and that they hoped that a calm assessment was made of the actual situation.

Article 60 of the Basic Law for Disaster Policy assigns local mayors the responsibility of issuing evacuation orders. In fact, however, while responsibility is assigned, there is no authority given to enforce an order. Unless it is coordinated with police traffic control, it cannot have much effect. Yet the town manager spurned the advice of the more cautious

prefectural government and police on the evacuation's duration. There were several reasons for this.

One reason, of course, was his concern about the evacuees' worry, boredom, and sleepless nights. But the main reason seemed to be pressure from Toyako-Onsen's inn keepers and souvenir-shop owners. The longer they stayed closed, the less they earned. Inn room cancellations mounted, and the tourist-service industry faced bankruptcy unless the evacuation order was rescinded and the area declared safe. On August 18, ten days after the eruption, the Toyako-Onsen Tourism Association pressed the town manager to rescind the evacuation order and to try to open up the town again as a resort area.

Yet the prefectural government and police did not see the issue that way. Their attitude was epitomized by the chief of the Daté police department's saying: "The main reason no lives were lost was that we lucked out. We were just lucky – in every way. We'd have been lost if the eruption had been a little earlier or later; or if the winds had blown directly to Toyako-Onsen. In every way, we just barely escaped the worst. There was a festival the night before, and estimates are that there was 50, 70, or even 100,000 people in Toyako-Onsen at the time. But the winds blew to Sōbetsu, and all the people in Toyako-Onsen took shelter. Then, after everybody was out, the smoke blew into Toyako-Onsen. We were just lucky there – almost too lucky... If people who live there die in something like this, that's one thing. But if people come to visit because we have told them it is safe and then they die too, that is something else again."

PRIORITY GIVEN TO THE ECONOMIC CRISIS

Had the Abuta town manager been anyone other than the person who occupied the position, rescission of the evacuation order would likely have been much delayed, placing

Toyako-Onsen in a considerably different situation. However, the town manager was an eloquent speaker and a man of action. He was just the man to exercise administrative and political leadership in the affected areas.

As already mentioned, the Governor and the police had expressed reservations about an early rescission of the evacuation order. Thus even if the town manager wanted to rescind the evacuation order, it would be impossible to restore the area to normal, let alone attract tourists to the area, unless he could persuade the police to remove the traffic barriers which they had erected in accordance with the Road Traffic Law and Article 76 of the Basic Law for Disaster Policy.

The situation was further complicated by the actions of another group. The Volcanic Eruption Early Warning Group of university professors and officials from the Meteorology Agency and the Science and Technology Agency who had banded together for volcanic studies, to coordinate information, and to monitor eruptions reported after an on-site survey that Mt. Usu was still dangerous and could erupt any time.

The town manager was asked about this some time later by a reporter for the *Muroran Mimpo* newspaper.

Reporter: "I think the most dramatic moment was the decision to rescind the evacuation order. It is generally said to be easy to issue an evacuation order, but most difficult to rescind it. I hear you said you were prepared to commit *hara-kiri* if anything went wrong after the order was rescinded."

Town Manager: "Heads of municipalities should always be prepared to commit *hara-kiri*. We obey the dictates of conscience and do what we think is right. If we are wrong and the people suffer as a result, then we should be prepared to atone for the error. If you can't accept the responsibility, you shouldn't accept the position... The thing that made it a difficult decision was that the shop owners and inn keepers wanted an

early rescission and their employees did not want to go back if it was going to be dangerous... So to avoid even the appearance of an arbitrary decision from on high, I had them organize the Evacuees Association and discuss the issues thoroughly. And I listened to what they had to say" [4].

On the one hand, the town manager asked the police to gradually relax the traffic controls, and on the other he had the evacuees organize the Association. As a result, he was able to work out a compromise allowing for an hour at home first, then three hours, then for the daylight hours beginning August 23, and finally rescission of the evacuation order on September 7. Daté and Sōbetsu followed suit. The police were thus pressured by the town manager and the shop owners and inn keepers who protested that delays would ruin the tourism industry. It is clear that the situation was viewed primarily as an economic crisis and only secondarily as a threat to the public safety.

TOYAKO-ONSEN REVIVED

The evacuation order was thus rescinded. There were, however, exceptions. For example, residents of dangerous sections such as the Konomi housing complex, elderly people, families with invalids, and those who had no immediate way of making a living, were not immediately allowed back. It was the socially disadvantaged who stayed longest at the refugee sites. As a precaution, the town of Abuta designated 20 reinforced concrete buildings as emergency shelters and organized a Citizens Protection Committee.

Prior to September 7, about 900 people, including those that owned cars, had gradually come back to Toyako-Onsen. Another 400 returned when the evacuation order was lifted in its entirety on September 7. However, the total rescission was of symbolic significance in that it was an official declaration by the town manager that Toyako-Onsen was "safe".

With rescission, community life returned to Toyako-Onsen. However, at this stage, no tourists were allowed in yet. All roads leading to the town had been blocked by the police since the August 8th rock- and ash-fall. Accordingly, the town manager had to repeatedly ask the Daté police to relax the traffic controls after September 7. On September 10, the Toyako-Onsen Tourism Association and 13 other organizations held a Citizens Rally to end the livelihood crisis caused by Mt. Usu's eruption. The rally was attended by 2,000 residents, including evacuees, and it was reportedly quite critical of the police traffic control (NHK, 1978).

It was two weeks after the rescission of the evacuation order that the police lifted their traffic controls. It took that long because the Daté police, although sympathetic to Toyako-Onsen's difficulties, put their priority on tourist safety and demanded that Toyako-Onsen's anti-disaster measures be improved first. In response, Abuta came up with an anti-disaster plan including the Citizens Protection Committee, escape routes for guests, etc. On September 22, they held an "evacuation drill." Impressed with these anti-disaster measures, the Daté police relaxed the traffic controls the following day, September 23.

Let us look at the questionnaire findings. In both Toyako-Onsen and Isumi-Irie, there were far more respondents who approved than disapproved the issuance of the evacuation order. Yet concerning its rescission, the vast majority felt it came too late. For example: "It took too long. The professors slowed this up with their timid reports." and "They were overly cautious. It could have been rescinded earlier." At Toyako-Onsen, we were often told that lifting the evacuation order was more difficult than issuing it. The questionnaire results bear this out clearly, as there was considerable citizen dissatisfaction over the timing of the order's rescission.

When an evacuation order is issued due to

a typhoon or flood, the evacuation lasts two to three days at most. But such limited duration evacuations are impossible in the face of incessant earthquakes or an unpredictable volcano that might erupt at any moment. On the other hand, people cannot stay away from their homes indefinitely. Fear of eruption and attachment to the home are two forces pulling in opposite directions, yet the people finally resolved this in favor of going home. This was shown not only by the fact that many of our respondents felt that the order's rescission came too late, but also by the strong demands that the order be rescinded and traffic controls lifted despite the warnings of the prefectural government and police.

AFTERMATH OF THE ERUPTION

The Abuta town manager frequently says: "Toyako-Onsen suffered 50 million dollars in damages, but got 150 million dollars worth of free advertising." Advantage was taken of some possible positive aspects of the disaster, which others have since sought to emulate.

After the eruption of Mt. Usu, the political situation in Abuta underwent a major change. The town manager got maximum political mileage out of this once-in-a-lifetime chance. Although a few residents did call him dictatorial or fascist, he was regarded by the majority as a very reliable leader. Some even consider him a future candidate for governor. The traditional political enmity between Abuta-Honcho and Toyako-Onsen dissipated, albeit temporarily, in the face of an emergency that called for solidarity. In the subsequent election for town manager the entire town, including the labor unions, supported the incumbent making it the first uncontested election in 20 years.

One of the questions on the questionnaire asked residents to evaluate the contribution made by the head of their municipality and to compare the contributions made by the

different mayors and town managers. In response, residents of Abuta thought that their town manager did very well, better than the rest. Residents of Sōbetsu gave their town manager a passing grade but they said the Abuta town manager had done more to Abuta residents than the Sōbetsu town manager did for Sōbetsu. Likely, Daté residents thought their mayor did very well but that Abuta's town manager had done even better.

The Abuta town manager gained the near-unanimous support of the town council as he listened to the people and sympathized with their desires. In 1978, he opened a Museum of Volcano Science and a Pheasant Park as new tourist spots in the Lake Toya area. He has also used the volcanic rock and ash that fell in Toyako-Onsen for landfill in part of the marsh to create promenades around the lake. Moreover, he has applied for a government subsidy under the Special Law on Volcanic Eruptions to build new sewerage facilities so that a projected 3.5 million tourists a year will not pollute the lake. If all of these plans work out, then fortune and misfortune will have simultaneously occurred and Lake Toya may be revived as an outstanding tourist resort.

There are, however, problems. For one, because the ground is settling, several water pipes break every day in Toyako-Onsen alone. What does this portend? What does the July 15, 1978 eruption, the largest since last November, tell us? What of the sloppy ash slides which killed three after heavy rains on October 24? The danger is still there. Even if 80% of Mt. Usu's energy is already released as the seismologists say, it is not yet an absolutely safe mountain.

DISASTER FORECASTING AND PUBLIC POLICY

Fear of generating panic is one of the main reasons people in positions of responsibility hesitate to issue an evacuation order when natural disaster threatens. It was to avoid panic

that the Mexican government hesitated to sound the alarm in the Rio Grande flood (Clifford, 1956). When Florence was on the verge of being flooded, the local Italian authorities saw the danger of panic as greater than the danger of floods, and no alarm was issued (Quarantelli, 1977).

This course of action may be justifiable when the threat is extremely local and panic is judged the greater danger, but it is inexcusable when there would be major damage over a widespread area. Instead, the government hesitates for other reasons — mainly political and economic — to issue an alarm for such area-wide disasters as earthquakes or volcanic eruptions. Particularly in a large metropolitan area, delay can be fatal, yet the losses from a commercial stoppage also are enormous. In Japan, activities that might cause secondary disasters are required to stop operation when an earthquake alarm is issued, but it takes enormous amounts of time and money for petroleum complexes and steel mills to get back to normal after a shut-down. Traffic stoppages would inconvenience residents by reducing the flow of food and daily necessities into urban areas. Discontinuance of gas service would also be an inconvenience. There are countless such examples.

The other main problem is that the present state of art does not enable us to forecast major earthquakes or volcanic eruptions as accurately as we do floods, tornadoes, and typhoons. Accordingly, there is a very good chance of false alarm. Those in authority must weigh the risk of a false alarm against the risk of exposing their community to a major disaster. The Abuta town manager faced the same problems. Like any reasonable official, he wanted to delay the alarm as long as possible and to rescind it as quickly as possible. In order for us to check this administrative propensity and thus to minimize the damage inflicted by a disaster, we felt it necessary to establish the following principles:

1. *All news is good news.* We have to establish the principle that all relevant information is being given to the public. At the same time, we have to improve our communication network so that the information is not distorted in transmission. The mass media play a particularly important role. Mass media must be able to sense and to respond to the citizens' information needs.
2. *Disaster-prevention should be second nature.* The struggle to protect citizens from disaster is, in a sense, a state of war. Therefore, adaptive disaster-related behavior must become second nature if we are to prevent disorganized and uncoordinated responses and to alleviate political and economic confusion.
3. *Objective criteria for alarms should be established.* We must establish a system under which an alarm or evacuation order will be issued if the estimated loss from its nonissuance (expressed as a function of the total losses from the disaster times the probability of its occurrence) is greater than the loss (political and economic confusion) from its issuance. The main variables in this system would be the probability of damage, the size of the damage, and the political, economic, and social conditions prevailing where disaster is expected. Con-

sidering the wealth of natural and social expertise at our command, such criteria are more than overdue.

NOTES

- 1 This survey by the Disaster and Information Study Committee in January 1978 questioned 1,093 Tokyo-residents adults, men and women, on natural disasters.
- 2 The Izu-Oshima earthquake hit on January 14, 1978. Four days later, Shizuoka Prefectural government released an "aftershock report" calling for alertness to the possibility of residual tremors. Yet this report, which went out on television and over the Propane Gas Dealers' Association's communication network, was mistaken for an earthquake alarm by the people. See Okabe (1979).
- 3 This was a mail questionnaire survey sent to 200 people in each of the areas asking them to evaluate the degree of damage, the governmental response, the evacuation, and other pertinent aspects.
- 4 See the *Muroran Minpo* newspaper, evening edition, June 12, 1978.

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