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COMMUNITY RESPONSE TO EARTHQUAKE THREAT IN SOUTHERN CALIFORNIA

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PART ONE
OBJECTIVES AND UTILIZATION

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16. Abstract (Limit: 200 words)
This volume is part of a study investigating individual and community response to earthquake threat in southern California. The overall objective is to provide a basis for understanding community response to earthquake predictions released to the public. The report reviews some of the relevant literature from which leads and hypotheses are derived and describes steps taken to disseminate findings and conclusions to potential users. Specific research objectives are enumerated and expected consequences of the research are discussed. Topics include the background and scope of the study; earthquake prediction in China; mobilization of altruistic sentiments for earthquake endangered groups; implementation of seismic safety legislation; and mass media and preparation for natural disasters. Also included are several papers presented at meetings and symposia on earthquake prediction.

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PART ONE
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Final technical report on National Science Foundation grants NSF ENV76-24154 and NSF-PFR78-23887, from 1976 to 1980, including preliminary work under US Geological Survey Grant 14-08-0001-G-347 in 1976. Any opinions, findings, conclusions, or recommendations are those of the authors and do not necessarily reflect the views of the Foundation or the Survey.

Ralph H. Turner--Principal Investigator
Joanne M. Nigg, Denise Heller Paz, and
Barbara Shaw Young--Co-Investigators

Institute for Social Science Research
University of California, Los Angeles
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AUTHORSHIP

The writing for most of this report was divided among the four investigators, and the investigators assume final responsibility for the entire report. However, substantial contributions to the authorship of parts of the report were made by others associated with the project.

James Goltz wrote most of Part Two on the media in essentially the form in which it appears in the final report. The media narrative was begun by Sharon Stevens, who refined many of the procedures for analyzing newspaper content and wrote rough draft versions of the narrative for periods one through four. James Goltz revised these drafts and wrote the remainder of the narrative and the concluding chapter.

Sharon Stevens, in addition to her contributions to the media narrative, prepared an account of the first year and one half of the Los Angeles building and safety ordinance controversy. This account was subsequently extended by Denise Paz and appears in Part Eight of the report.

Christine H. Turner assumed the responsibility for investigating the response to the current earthquake threat in the schools of Los Angeles County, and wrote the chapter that appears in Part Three of the report.

K. Jill Kiecolt wrote several descriptions of statistical procedures imployed in our analysis and these statements were subsequently incorporated into the body of the report.

Gerald Goetsch also wrote technical accounts of special statistical procedures and analyses for incorporation into the report.

Gloria Vargas monitored La Opinion for the entire three-year period and wrote a first draft of the special narrative for the first year and one half (Part Six).

Saul Solache prepared a draft of the final year and one half of La Opinion coverage of earthquake topics.

ACKNOWLEDGEMENTS

Our greatest indebtedness is to our three faithful research associates, K. Jill Kiecolt and Gerald Goetsch, who serviced our computer needs and advised us on statistical matters, and James Goltz who took charge of the newspaper analysis half way through the project. The three participated regularly and actively in our weekly research conferences and contributed many unacknowledged ideas to the final report.

Anita Anderson was our diligent and perceptive secretary and editor during two years of the project. Marcus Hennessy and Nancy Siris-Rawls carried on the secretarial responsibilities until the project's conclusion. In the early stages of the project Nannette Littlestone typed some of the interview schedules.

Shelley Garcia, Cynthia Hollos, Kathryn Kremer, Denise Nardi, Vicki Lee Rasson, and Eric A. Sas served helpfully as student assistants on the project. And Kathleen Carothers, while taking an independent study course under the Principal Investigator's direction, made an important contribution to our analysis of newspaper treatment of earthquake prediction topics.

Eve Fielder, as Director of the Survey Research Center, supervised the massive data-gathering and data-reducing operations, and was always responsive to our special requests. Vi Dorfman, as field supervisor, took charge of the actual interviewing, with the help of Suzy Chapman and Kathy Thompson. We cannot begin to name the dozens of interviewers who conscientiously and diplomatically conducted our interviews under Vi Dorfman's watchful eyes. Rita Engelhardt as Head of Statistical Services in the Institute has

frequently helped us with unfamiliar problems. Also on the staff of the Institute of Social Science Research, Donald Witzke helped us develop appropriate sampling designs, Cheryl Groves and Kathleen O'Kane supervised coding of interview protocols, and Matthew Futterman and Jack Katola developed programs to enable us to conduct our final interview waves by a potentially efficient computer-assisted interviewing procedure.

Howard Freeman, Director of the Institute, was ever helpful in accomodating our needs. Ann Cinderella, as Assistant Director of the Institute during most of the project, was helpful in many ways. At every stage in the project, when we encountered difficult administrative problems, we turned to Madeleine De Maria, as administrative assistant and subsequently as Assistant Director of the Institute. Invariably we received the kind of careful attention from Madeleine that we might have expected had there been no other projects similarly housed in the Institute.

As principal consultant to the project, Charles Wright made inestimable contributions. He met with the staff for two days during the initial questionnaire development stage, and again after preliminary findings had been written up in a first-year-and-one-half progress report, and provided subsequent detailed and perceptive suggestions on the basis of the nontechnical report entitled Earthquake Threat.

Howard Kunreuther also took unusual interest in the project and made discriminating suggestions at different stages. Helpful commentaries on our progress report were also received from Lewis M. Killian and Robert Stallings. Enrico L. Quarantelli welcomed the coinvestigators for a week of study at the Disaster Research Center of the Ohio State University at the start of the investigation. Our colleagues Philip Bonacich and David McFarland gave freely of their time in answering questions about appropriate statistical

procedures.

The project would never have been launched without the strong encouragement and help of Charles C. Thiel, Jr., of the National Science Foundation. And the special interest that William Anderson took in the project, in his official capacity as Program Manager for NSF and also as a coprofessional in the study of social aspects of natural disasters made him a source of constant support and counsel.

The willingness of Dr. Robert M. Hamilton, then Chief of Earthquake Studies in the US Geological Survey, to provide us with initial funding until the National Science Foundation review could be completed, accounts for the relative timeliness of the investigation. And Peter Ward, in charge of earthquake prediction studies for the US Geological Survey in Menlo Park, was constantly available and helpful throughout the course of the investigation.

THE REPORT

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Part One was written exclusively
by the four Investigators, with
technical assistance from
Jill Kiecolt and Gerald Goetsch
on Chapters Four and following.

PART ONE

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CHAPTER ONE

THE BACKGROUND AND SCOPE OF THE INVESTIGATION

The Developing Prospect of Earthquake Prediction

As recently as 1973, a report of public response to the 1971 San Fernando-Sylmar earthquake was issued under the title The Unpredictable Disaster in a Metropolis (Bourque et al., 1973). Forecasting earthquakes was commonly relegated to seers and fiction writers like those who warned that much of California would fall into the Pacific Ocean in June of 1969. But as early as 1968 a working group of the Federal Council for Science and Technology, impressed by progress in Japan, had recommended earthquake prediction as a valuable tool for saving lives in case of an earthquake (Ad Hoc Interagency Working Group, 1968). And in late 1973 and 1974 a spate of articles by leading seismologists optimistically recounted progress toward the practical realization of scientific prediction capability. In May, 1975, a popular article by Frank Press bore the headline: "With adequate funding several countries, including the U.S., could achieve reliable long-term and short-term forecasts in a decade."

Some of the optimism was stimulated by the report from an American scientific delegation to the People's Republic of China in 1974 that their hosts might have successfully predicted as many as eleven substantial earthquakes (American Seismology Delegation, 1975). The most impressive, and certainly the most extensively verified Chinese success came the following year when a magnitude 7.3 earthquake in the vicinity of Haicheng, on February 4, 1975, was predicted with almost pinpoint accuracy just a few hours before it happened (Haicheng Earthquake Study Delegation, 1977).

Early optimism was also based on the conviction that seismologists were close to finding a theoretical model which would adequately account for

the various signs often observed before an earthquake (Scholz, Sykes, and Aggerwal, 1973). The model would permit quantitative analysis so as to specify the place, time, and magnitude of the expected quake. Building especially on Soviet findings, American seismologists formulated the dilatancy theory, which promised a framework in which all the pieces of the puzzle could be fitted neatly together. In the meantime, American scientists were having some encouraging practical success. Peter Ward (1978) reported five small earthquakes that were predicted with varying degrees of accuracy in the United States between 1974 and 1977. In a definitive analysis of the state of the art released in 1976, the National Academy of Sciences Panel on Earthquake Prediction was appropriately cautious about current progress. But the Panel reiterated the conclusion that "With appropriate commitment, the routine announcement of reliable predictions may be possible within ten years in well instrumented areas, although large earthquakes may present a particularly difficult problem."

Enthusiasm for earthquake prediction was occasionally muted by anxiety over potential unsettling social and economic effects from warning the public about a coming earthquake. Especially if the warning involved weeks, months, or years of advance notice, might not disruption in the social and economic fabric of community life exceed whatever benefit could be anticipated from knowing when to expect an earthquake? Garrett Hardin (1967, 1973) imagined all of the worst possibilities in a witty and polemical essay that attracted wide attention. More serious efforts to estimate possible effects began with a working paper by J. Eugene Haas entitled "Forecasting the Consequences of Earthquake Forecasting," prepared for the University of Colorado Institute for Behavioral Science in 1974. Haas and Dennis S. Mileti (1977) then launched the first empirical study in which key decision makers in commercial and noncommercial sectors of the community tried to anticipate what steps they would

take in the event of a prediction, taking into account the decisions that were being comtemplated in other community sectors. Their conclusions were that lives would indeed be saved, but very likely at the cost of a crippling economic recession.

With a mandate to review the full range of social, economic, and legal aspects of prediction, the Panel on Public Policy Implications of Earthquake Prediction was established in the National Research Council (1975) as a counterpart to the Panel on Earthquake Prediction. Drawing widely on experience with warnings of other types of disaster, the Panel offered recommendations for both action and research. Central to several of the research recommendations was the need to study response to actual instances of earthquake prediction and warning as they occur. At the same time studies by Martin V. Jones and Richard M. Jones (1975) and by Leo W. Weisbecker and Ward C. Stoneman (1977) also explored potential social and economic consequences of prediction, while emphasizing the need for more focused research. In 1978 a report from the National Research Council Committee on Socio-economic Effects of Earthquake Prediction presented a more fully elaborated outline for research. The Committee underlined the importance of studying response to near predictions as well as predictions, reminding investigators that people may not distinguish between near predictions and scientifically adequate predictions. In the same year Arnold J. Meltzner (1978) cited California statewide opinion polls to document the low level of apparent public interest in earthquake safety.

Earthquake harbingers in southern California. On February 4, news of the tragic Guatemalan earthquake in which more than 20,000 people were killed and 200,000 left homeless heightened local awareness of earthquake hazard. Whatever meaning this disaster may have had for southern Californians, it did not directly stimulate increased attention to problems of earthquake preparation and survival in Los Angeles area newspapers. But on February 13, before the

Guatemala disaster ceased to be news, a front-page story in the Los Angeles Times announced the discovery that the earth's surface was uplifted over a vast area contered near Palmdale. The precise meaning of the Uplift remained a puzzle to seismologists, and scientists admitted that alternating uplift and subsidence can occur without accompanying earthquakes. However, four circumstances could not be ignored, namely: (1) an uplift of this nature is one important hypothetical precursor to an earthquake; (2) if the uplift were a precursor, its extent--covering approximately 100 miles along the fault--could indicate an earthquake in the magnitude 8 range on the Richter scale; (3) the NOAA study published in 1973 had estimated that a quake of similar magnitude centered in approximately the same location could cost as many as 12,000 lives in the greater Los Angeles area, with astronomical injuries and property loss; (4) seismologists had long warned that a serious earthquake was overdue in the southern portion of the San Andreas fault. While acknowledging the uncertain meaning of the Uplift, the California Seismic Safety Commission on April 8 officially declared that "the uplift should be considered a threat to public safety and welfare in the Los Angeles metropolitan area."

Although nothing approaching a true prediction had yet been issued, the southern California Uplift might well serve as a prototype for the first stage leading toward eventual prediction of a highly destructive earthquake affecting a major metropolitan area. The U.S. Geological Survey rapidly increased instrumentation and observation in the uplifted area. A succession of further developments might well occur, culminating either in a positive prediction, a reinterpretation of the Uplift as benign, or an actual earthquake that struck while scientists and responsible community leaders were still debating the significance of the anomaly. Accordingly it was decided to launch an investigation into public interpretation and response to announcement of the Uplift and whatever subsequent developments might occur. This report is

a summary of the findings from that investigation.

Subsequent events have justified the assumption of a developing scenario, though not yet the anticipation of a true earthquake prediction. On April 21, 1976, another front-page story in the Los Angeles Times reported that Professor James Whitcomb of the California Institute of Technology's Seismology Laboratory had "predicted" a quake between the magnitudes of 5.5 and 6.5 to occur any time from that date until April, 1977. The quake might occur on any of several faults in the area, and anywhere within an irregularly shaped circle some eighty-seven miles in diameter. It could not be determined at once whether this qualified prediction referred to the same phenomenon as the southern California Uplift, or whether Los Angeles now faced the prospect of two earthquakes. In subsequent discussion, Professor Whitcomb made it clear that he was merely engaged in testing a controversial hypothesis rather than issuing a confident prediction.

On May 28, the Los Angeles Times again carried a front-page story with the headline "Palmdale 'Bulge' Higher, Wider Than First Thought." This latest story suggested that the Uplift might relate to a fault on the Los Angeles side of the San Gabriel Mountains, rather than the San Andreas fault, and reported a growing conviction at the US Geological Survey that the Uplift indeed presaged an earthquake.

The year following the first announcement of the Uplift was marked by an abundance of earthquake-related news. There were more destructive earthquakes around the world than usual, with the July 28 Tangshan quake in the People's Republic of China and the May 6 quake in northern Italy receiving most attention. Just about the time that Professor Whitcomb was cancelling his near prediction, a forecast from outside of the established scientific community attracted nationwide attention. Henry Minturn, a self-styled geophysicist unknown

to the scientific community, was given a hearing by the local NBC radio affiliate on November 22, 1976. He claimed to have predicted many earthquakes successfully in the past, including a small one that occurred while he was in the studio. On the air he forecast an earthquake for the Solomon Islands on December 7, to be followed by a quake in Los Angeles on December 20. Although recognized earthquake scientists consistently disparaged Minturn's methods and his predictions, interest in the forecast mushroomed. Media coverage was extensive, though it ranged from positive to inquiring to devastatingly critical. After December 20 had passed without an earthquake, most of the media simply dropped further mention of Minturn, without so much as a recapitulation and assessment.

The Purpose of the Investigation

The most general purpose of the investigation was to gather a wide range of information concerning individual and community response to these events as they developed. The time required to develop a research proposal and the time required for review before a grant could be awarded precluded our conducting a sample survey until approximately one year after first announcement of the southern California Uplift. But we have been able to monitor newspaper and other media treatment of relevant events from the time of the original announcements, and to conduct sample surveys as events unfolded during the second and third years after public notification of the Uplift.

Data were gathered with two general aims in mind. One aim was to assemble as rich a case study as possible of a series of events whose eventual outcome could not be known at the time of the investigation. The uncertain and open-ended yet severe threat of earthquake disaster represented by the Uplift was a unique event at the time, yet one likely to be repeated in the future. The

other aim was to provide a basis for refining our understanding of what the community response will be when true earthquake predictions are released to the community sometime in the future. As the closest approximation we have had to a true earthquake prediction in the United States, announcement of the southern California Uplift constitutes what we chose to a call a near prediction. While it would be foolhardy to assume that community response to an earthquake prediction would be merely an intensified version of the response to a near prediction, we can profitably look to see what aspects of the response to a near prediction accord with prior assumptions and which do not. And it is likely that the issuance of true earthquake predictions will in many instances be preceded by the announcements of near predictions similar to recent discussions of the Uplift.

Specific research objectives. Several specific research objectives can be enumerated.

1. To describe and assess popular reception and understanding of reports dealing with the southern California Uplift and earthquake risk in the region, and what they imply for action by the populace. This objective includes the following elements of response: Awareness of events in connection with the southern California Uplift and with respect to the earthquake prospect in general; salience of concern with the impending earthquake danger, meaning the extent to which it is in the forefront of attention and a matter of preoccupation; fear and anxiety over the earthquake prospect; understanding of the earthquake threat in naturalistic or nonnaturalistic terms and confusion between scientific and nonscientific predictions and forecasts (including the prophetic version expounded by the television evangelist, Doug Clark, on Los Angeles television and in his book, Earthquake 1982!). Interviewing

was related specifically to the most recent scientific reports on the Uplift and earthquake forecasts, so that scientists and public officials could assess the interpretations that were placed on their announcements. Specific recommendations to scientists and the media concerning the clarification of past announcements and the strategy for future announcements have resulted from these findings.

2. To describe and assess what people believe about safety and danger in case of earthquake, about the possibility of saving lives and protecting property in the event of a serious earthquake, and what steps they have contemplated taking themselves or have already taken. Included here is the public attitude toward the release of predictions and near predictions. This research objective complements the first. The first objective deals with popular understanding and emotion, while the second concerns dispositions toward action. Findings should permit us to advise responsible public and private officials concerning the state of public readiness for an earthquake and to recommend specific steps to increase public readiness.

3. To describe and assess the extent of altruistic concern for the prospective victims of earthquake disaster. Response to an actual disaster is typically facilitated by a widespread spontaneous outpouring of altruistic feelings and actions toward the victims. The National Research Council Panel Report (1975) suggested that hazard-reduction efforts in response to a prediction might be hampered by the absence of any altruistic outpouring until after the actual quake had occurred, and hypothesized some necessary supports for altruism. Interviewing was designed to supply opportunities for the spontaneous expression of concern for potential victims, and for indicating awareness of categories of people who are especially at risk. Since an effective hazard-reduction program will require sacrifices by many, we should be able to

advise public leaders concerning steps that must be taken to insure a widespread readiness to sacrifice for the common good.

4. To describe and assess what people believe their public leaders are doing to prepare for an earthquake and to clarify the meaning of events, what confidence they have in scientists and public leaders concerned with these matters, and their disposition to cooperate in hazard-reduction measures. This objective shifts the research focus from a concern with mass (individual) responses to the prospect of collaborative response under the guidance of community leaders. Specific recommendations on how to secure cooperation should result from these findings.

5. To describe and assess the steps by which individuals are making up their minds on the issues raised under the first four objectives. People will be asked whom they have listened to, with whom they have discussed the issues, and what individuals, organizations, and media they rely upon in reaching their own decisions. Both the sources of information and the sources of confirmation will be examined. Recommendations here should indicate the best strategies in communicating with the public, and what types of community organizations can be most useful in relaying and reinforcing messages.

6. To identify the relationship between each of the foregoing considerations and selected circumstances that might usufully be taken into account by policy makers in devising and implementing a hazard-reduction program. The variables emphasized the following: Proximity to prior earthquake disaster (The areas of destruction and evacuation in the San Fernando earthquake of 1971 are within the vulnerable area, and the destruction area from the Tehachepi-Bakersfield quake of 1952 overlaps the northern vulnerable area); Living under specially vulnerable conditions, such as in unreinforced masonry

structures built before 1934, and below dams; Living in an ethnically or racially segregated neighborhood, with special reference to the large Hispanic and black populations; Levels of education and socioeconomic status. Findings should indicate how warning messages and hazard-reduction programs should be tailored to the special needs of these populations.

7. To isolate the pattern of developing individual and community response over time and in relation to the specific sequence of events. Trends in popular reception and understanding, dispositions toward action, disposition toward collaborative response and altruism, and sources of information and confirmation will be established. A crucial feature of the investigation was repeated interviewing to identify changes as they occurred. These data also permit periodic updating of all recommendations.

8. To note any unusual economic activity that might signal an economic response to earthquake prediction or near-prediction. A comprehensive economic study is beyond the scope of this investigation. But because of a possible domino effect, we attempted to be alert for any drastic economic responses.

9. To record and interpret the sequence of decisions and steps taken by public and private agencies concerned with public safety and planning, relating these to developing events, popular response, political pressures, and economic developments. The American Red Cross and similar agencies may be making special preparation. The involvement of labor unions and business organizations such as Chambers of Commerce is important both here and in connection with the next objective.

10. To record and interpret nonbusiness, private sector organizational response to the developing events. This includes treatment in the media of mass communication, sermons and other attention in religious organizations,

serious discussion in service clubs and other voluntary groups, humorous and faddish response such as earthquake tee-shirts and thematic recreational events.

11. To examine the significance of certain variables that will contribute to a less immediately practical but theoretically fundamental understanding of community response to disaster warning. Analysis would include such variables as: past individual experience with earthquakes and other potential natural disasters; the nature of past and future individual commitment to the neighborhood and community of present residence and work; the time perspective in which personal plans are being made; personal responsibility for the fate of others, especially family members; degree of personal isolation or integration into a meaningful social unit.

Expected Consequences of the Research

From the reports of the NRC Panel on Public Policy Implications of Earthquake Prediction (1975) and the NRC Committee on Socioeconomic Effects of Earthquake Predictions (1978) it is clear that no one yet knows just how to make constructive use of earthquake prediction. We do not know how best to issue predictions and warnings or how people are likely to respond when predictions and warnings are issued. We do not know what kinds of spontaneous adaptive responses can be expected from the public, what kinds of community-wide hazard-reduction measures they are prepared to accept and support, or to what extent they understand the basis and need for various measures.

The information we have secured should be of immediate use to all categories of people concerned with constructive handling of earthquake predictions and hazard-reducing activities. It should enable scientists to improve the manner in which they announce their findings and help the media to improve

their handling of the information. It should help both governmental and private-sector agencies to plan and implement more constructive responses to prediction and near-prediction.

The information and analysis should be of long-term use to scientists and to public and private-sector officials as they plan for future instances of earthquake prediction and near prediction. The careful study of the first such instance should provide a foundation for future policy-formation and research in this area.

The Research Design

As befits the aim of providing a comprehensive case study of community response to developing events over a three-year period, we gathered several kinds of data and examined them both cross-sectionally and longitudinally. The precise nature of the data gathered and the methods used to gather and analyze them will be clarified in the body of the report. In this introduction we shall briefly describe the major types of data, how they were gathered, and how they were used.

Media content. Before one can understand the nature of the community response to relevant events, it is necessary to identify those events and determine how news of the events was conveyed to the public. For this purpose it became crucial to monitor the coverage of earthquake news by the mass media. There is no way in which the public can respond to the "true nature" of events. Responses deal only with the nature of events as conveyed to the public through various communication media.

Comprehensive monitoring of media coverage would be a gargantuan task, far beyond the scope of this investigation. In a metropolitan area such as Los Angeles it would require round-the-clock monitoring of dozens of radio and television stations, and systematic perusal of dozens of newspapers

and other periodicals. We settled on the following procedure as a reasonable compromise: First, six newspapers were selected for complete monitoring throughout the three years, 1976, 1977, and 1978. Copies were made of every item dealing with earthquakes--news, editorials, letters, advertizements, etc.--in every issue of the six newspapers. Television specials and radio specials are usually advertized in the newspapers, so we were able to record or take notes on nearly all such specials that were aired after mid-1976. We regularly watched the evening news on the three major television networks and noted relevant items. With the help of a wide circle of friends interested in the project, we located relevant magazine articles and were informed of other television and radio items.

The record of newspaper content provided the framework within which reports of other media coverage were incorporated. The newspapers were carefully chosen so as to represent some of the important audiences in Los Angeles County. The two major metropolitan dailies, appealing to somewhat different audiences, were monitored. Three large-circulation "community" dailies were selected, one serving the San Fernando-Sylmar earthquake damage area and environs, one serving the politically conservative, highly educated, and high-income population of the "west side," and one serving the moderate income and more recently developed east-side suburbs. Finally, because of the substantial Spanish-speaking population, we monitored the leading Spanish-language daily.

The chief product of the media analysis is a detailed narrative covering the three years from just before the announcement of the uplift until the end of 1978, and covering the brief flurry of news and commentary concerning the moderate New Year's Day earthquake of 1979. The narrative provides the definitive record of events as they were conveyed to the public. An historian might not find the record of events entirely correct. For example, the magnitude of the New Year's Day earthquake of 1979 as reported in the

U. S. Geological Survey's Earthquake Bulletin (Person, 1979) several months later is greater than the magnitude reported at the time. But the revised and presumably more correct assessment of magnitude was made after public interest in the earthquake had dissipated and was never--so far as we can determine--conveyed to the general public. Hence the earlier and presumably underestimated magnitude is the only figure that is relevant in examining community response.

The narrative was given rigor by the use of content analysis. Different kinds of general and specific topics were identified. Items were classified and frequencies recorded. As a result we are able to observe the rise and decline of attention to earthquake topics in general, the shifting emphasis between earthquake prediction, earthquake safety, and accounts of actual earthquakes, and changing attention to specific topics such as the southern California Uplift and the building and safety issue. In addition to this longitudinal analysis, we are able to compare the emphases in different kinds of newspapers cross-sectionally.

Organizational response. The assessment of governmental and other organizational response was not a primary aim of this investigation. However it is impossible to understand the broad public response to events or the media treatment without some awareness of organizational response. Both the media and the public depend heavily on initiative and guidance from governmental agencies. Hence we have assembled a cursory survey of organizational response during the same three-year period. The sources of information for this review range from participant observation (e.g., in the Los Angeles Mayor's task force on earthquake prediction) to nonparticipant observation (e.g., Los Angeles City and County emergency exercises) to reports from informants within organizations and newspaper accounts. We attempted to contact agencies known to have

roles in emergency planning and to follow up news accounts of organizational activities. An important part of the organizational review is a survey of activities in schools throughout the County. A definitive study of school programs would constitute a major investigation. But we have used a variety of techniques in an effort to gain a fair impression of the extent and range of responses to earthquake threat by schools throughout the County.

Sample surveys: the basic field survey. A series of sample surveys of Los Angeles County residents provided the most important findings and occupied the greatest share of attention and resources. The data-gathering for these surveys was conducted by the trained and experienced staff of the Survey Research Center in the Institute for Social Science Research at the University of California, Los Angeles.

The major survey, the basis for most of the cross-sectional analysis, and the starting point for longitudinal analysis, was the basic field survey. A representative sample of 1450 adult residents of Los Angeles County were interviewed in their homes by Center personnel. Interviews began in late January and were completed in early March of 1977, approximately one year after announcement of the Uplift. The interview schedule was developed by the investigators, with help from staff of the Survey Research Center. The interview covered a wide range of topics related to awareness, concern, communication, and action in relation to the potential earthquake threat facing southern California at the time.

Sample surveys: special samples. As part of the cross-sectional analysis, we sought to compare responses of certain population segments in Los Angeles County. Because of the significance of Black and Mexican American minorities in the metropolitan area, it seemed important to search for characteristic similarities and differences between the responses of these groups and the White Anglo majority. Because of the recency of the 1971 San Fernando-Sylmar

earthquake, it seemed important to compare responses by residents of the damage area with responses from other sections of the County. Also, it seemed important to compare responses by residents of especially vulnerable areas with responses by residents in less vulnerable sections of the County. In each instance there was doubt that the number of respondents within these special interest categories would be sufficient for definitive analysis on the basis of the County-wide special samples, as necessary, for separate analysis. The goal was to include a minimum of 200 respondents in each special sample. For reasons that will be indicated later in the report, we were not able to reach that number in all instances.

The general procedure in assembling the special samples was a follows. For each of the special respondent categories (Black, Mexican American San Fernando damage area resident, potential inundation area resident, and resident in a neighborhood with a high concentration of old buildings), an attempt was made to estimate the number of respondents that would fall automatically into the County-wide sample for the basic field survey. Whenever this number was less than 200, the sampling design was augmented by oversampling from the appropriate primary sampling units. The goal for oversampling was set in each case so as to bring the total number of respondents up to 200 in each special category. In order not to bias the County-wide representative sample, the oversampled respondents were not included in the basic field survey analysis.

For the separate analysis of ethnic and racial differences and of residence in the 1971 earthquake damage area and currently vulnerable areas, the special samples were constituted by using respondents from the County-wide representative sample, augmented by the oversampled respondents. Thus special samples of Blacks and Mexican Americans were assembled for comparison

with a control group of White Anglo respondents drawn from the County-wide representative sample. Similarly the special samples of San Fernando-Sylmar earthquake damage-area residents and residents of vulnerable areas were constituted by combining respondents from the County-wide sample with oversampled respondents for comparison with a control group drawn exclusively from the representative sample.

Sample surveys: the panel study. Because of major concern with understanding the effects of the passage of time without the anticipated earthquake, longitudinal investigation was an indispensible part of the research design. Accordingly four waves of interviews were scheduled at five to six month intervals after the basic field survey. For the sake of economy these interviews were briefer than the basic field survey and were conducted by telephone rather than face-to-face interviewing. Interviewing was done, however, by the same corps of trained interviewers who conducted the basic field survey, through the UCLA Survey Research Center.

These interview schedules were designed with two objectives in mind. One was to provide a record of change and stability in key responses. For example, questions used to determine awareness of the southern California Uplift were repeated in all four waves, exactly as they were asked in the basic field survey. The other objectives was to determine response to events that occurred or recieved special media attention during the period after the basic field survey was completed. For example, during 1977 there were several reports of changes in the extent and elevation of the Uplift. In 1978 the Soviet embassy issued a prediction by a Soviet scientist for an earthquake in southern California, and later in the year a destructive earthquake occurred in nearby Santa Barbara County. Questions concerning these events were included in the appropriate interview schedules.

To facilitate the analysis of change, interviews were conducted both with new samples of respondents and with samples of previously interviewed

respondents. Each wave included samples of over 500 new respondents, representative of all County residents. The comparison of responses by these four samples and the basic field survey respondents provides the evidence concerning change and stability. Additional reinterviewed samples included in three of the four waves provided the basis for determining which kinds of respondents changed and which kinds did not change.

Sample surveys: contingent events. It was an important part of the research design to be prepared for certain critical events that might have important effects on public response. Accordingly, five special interview schedules were devised and pretested and printed up in sufficient numbers for immediate use. In addition, a corps of interviewers was briefed on each of the five contingency schedules. The five events for which we prepared were a damaging earthquake in Los Angeles County, a nondestructive earthquake of moderate magnitude that was felt throughout the County, the authoritative cancellation or downgrading of warnings concerning a short-term earthquake threat, the authoritative issuance of a true prediction or a dramatic intensification of the warning based on the Uplift, and the disconfirmation of a credible prediction by failure of the quake to occur during the specified interval. Only one of these contingent events occurred. The four unused schedules are included in the appendix to the report and will not be discussed.

The one contingent event that occurred was the moderate earthquake that was felt throughout Los Angeles County and advertized to the nation by way of the televised Rose Bowl football game on New Year's Day, 1979. During the month of January a new representative sample of 519 respondents were interviewed by telephone. Responses by the 509 persons who knew there had been an earthquake constituted the effective data set. Some of the standard response questions were repeated from the interview waves, but the emphasis was on the public interpretation of this earthquake, both in relation to prior earthquake

warnings or forecasts and in relation to the prospect of a future damaging earthquake.

Focussed field research. A small but significant part of the total investigation was an effort to assess the extent and kinds of collaborative group response to the earthquake threat. As distinct from either strictly individual and family responses or the responses of formally organized establishments such as government agencies and the schools, we sought to locate and study instances of "collective behavior." This required a more focussed and flexible style of field study than the sample surveys and more emphasis on searching for suitable groups than the study of organizations. In various ways that will be explained in the body of the report we located potential groups and attempted to make personal contact. The groups were then investigated in whatever ways were appropriate to their level of development. In three instances we became aware of rather massive controversy over earthquake safety proposals in which there was large-scale collaborative resistance. These three incidents were studied by the usual methods of interviewing key participants and assembling relevant documents.

The Content of the Report

In the balance of Part One of the report we shall review some of the relevant literature from which we have derived leads and hypotheses used in the investigation, and report some of the steps taken to disseminate findings and conclusions to potential users prior to completion of this technical report. Part Two consists of the media narrative and analysis. Part Three is the review of government and other organizational response, including the schools. The media and organizational accounts are placed first because they provide much of the background for interpreting the survey results.

Parts Four through Nine deal principally with findings from the various surveys. Parts Four and Five concern chiefly the basic field survey. Findings are divided so that awareness and communication over the earthquake threat are treated first in Part Four, and orientations toward action are the subject of Part Five. Part Six reports the analysis of the special samples from the San Fernando-Sylmar earthquake damage area and especially vulnerable areas. Part Seven relies less on the surveys and more on focused field research to examine instances of group response, as distinct from strictly individual response or organizational response. This includes collective resistance as well as support for earthquake mitigation efforts. Part Eight is the analysis of special samples for comparison among Blacks, Mexican Americans, and the White Anglo majority. Part Nine is the analysis of change and stability based on the four-wave panel study, and examination of response to the earthquake on New Year's Day, 1979.

Part Ten is a summary of main conclusions and recommendations. It is followed by an Appendix containing all of the survey schedules used in the investigation.

CHAPTER TWO

REVIEW OF RELATED WORK

No investigation originates or proceeds in an intellectual vacuum. Investigators must borrow widely and extensively if their products are to be rich and useful. In this chapter we identify only a few of the more obvious sources upon which we have drawn. Some have made quite specific and identifiable contributions to this investigation, while others have been assimilated into a less differentiated reservoir of ideas. These are sources that we recommend to others who plan to undertake research dealing with the social impact of earthquake predictions and cautions.

Sources will be reviewed under seven general headings. First are the foundation works on social aspects of natural disaster and disaster warning and those dealing directly with earthquakes. Second are works dealing with the reception and understanding of messages that convey warnings, whether they deal specifically with earthquakes and other natural disasters or with the more generic phenomenon of response to warning and potential misfortune. Third come studies dealing with action and inaction as responses to warnings. Fourth are studies of the circumstances under which altruistic concern is evoked by situations of threat or misfortune. Fifth are studies of the nature and source of beliefs about public leaders and scientists. Studies of communication and decision-making networks constitute the sixth group. A brief reference to literature on economic changes in response to warnings of disaster completes the chapter.

Background

Earthquake Prediction and Public Policy. The most direct antecedent and stimulus to this investigation are the deliberations of the National Research Council Panel on Public Policy Implications of Earthquake Prediction, published as Earthquake Prediction and Public Policy (1975). The Panel was commissioned to advise the Federal Disaster Assistance Authority concerning the warning of public officials and the general public, possible measures to reduce the loss of life and property from an earthquake on the basis of prediction, and the need for further studies and research. After attempting to estimate what a prediction might be like and what prime dangers from earthquakes might be reduced on the basis of foreknowledge, the Panel explored the issuance of predictions and how people might respond to them, examined the economic, legal, equity and political aspects of prediction, and then suggested some potentially constructive responses to prediction and offered a series of conclusions and recommendations. Although the Panel offered their considered judgments concerning each type of response to prediction, the report frequently emphasizes how important it will be to learn from the first experiences of earthquake prediction.

> Earthquake prediction is a new and unstudied field, and analogies to better-understood disaster-warning situations are often imperfect. Consequently, many of our conclusions must be advanced quite tentatively. . . . Experience with actual predictions of potentially destructive earthquakes will immeasurably improve our comprehension of the social and economic dynamics of prediction (pp. iii-iv).

And in the chapter on "Conclusions and Recommendations" it is observed that:

> There is much to be learned from carefully conceived research at the present time, but the greatest advancement in understanding will result from carefully planned monitoring of responses to actual predictions of moderate and major earthquakes (p. 4).

Besides offering a series of research recommendations to complement the action recommendations, the Panel specifically emphasized the importance of being ready to study the first instance of prediction in Research Recom-

mendation #1:

> High priority should be assigned to developing a standby anticipatory research capability to be utilized as future earthquake predictions are issued. The standby research plan should include comprehensive examination of the social, economic, legal, and political effects of the prediction and of the actual quake (p. 4).

The Investigators have selected a set of problems from the spectrum of topics highlighted in the Panel report, based on their special competencies and a judgment of priorities. The report suggests that all other aspects of community response depend in varying ways on how the prediction and warning are issued and received, and cites evidence from studies of other kinds of disaster warning to emphasize the likelihood of disbelief, downgrading of importance, and distortion of the messages (Chap. 4). Accordingly, the principal focus of this investigation will be on how the messages are presented and interpreted. The Panel report also emphasized the importance of public and private sector leaders in shaping community response. No effort will be made to penetrate deeply into the inner dynamics of decisions by business and financial leaders, as Haas and Mileti (1977) have already done on a hypothetical basis, or the intricies of political decision-making as projected by the political scientist, Arnold Meltzner (1978). But the main actions affecting public response and the announced decisions by such groups will be recorded and examined in relation to public response. Finally, the Panel report emphasized the contingency effects of economic adjustments on all other forms of community response. Thus this investigation is genuinely an outgrowth of the report, Earthquake Prediction and Public Policy, identifying problems for investigation on the basis of the experience of the Panel. Some of the specific points of articulation will be noted as various topics are reviewed.

Possibly the first effort by a behavioral scientist to anticipate what might be done in case of an earthquake prediction is a paper by Haas, entitled "Forecasting the Consequences of Earthquake Forecasting" (1974), already available as the Panel conducted its deliberations. Haas generalized from studies

of warnings of other types of natural disaster that people would initially discount the threat and would not panic, and that government officials would hesitate to issue warnings until convinced that the quake would occur. Certain types of organizations, however, would be compelled to respond. Subsequently Haas and Mileti launched a large-scale investigation of projected responses at many different levels in the community to some hypothetical earthquake prediction scenarios. Reports of preliminary findings from this investigation (Haas and Mileti, 1977) have emphasized the prospect of a rather devastating economic recession resulting from decisions in key business and financial circles. The prediction scenarios deal with much more definite predictions than the near predictions issued thus far in southern California. The Haas-Mileti findings do show a surprisingly large proportion of business establishments taking no action even with these rather definite predictions. However, the Haas-Mileti method has been especially helpful in revealing the kinds of additional information that organizational officials will seek. The data are quite consistent with the assumption that decisions by certain key organizations or officials may have either a domino effect or an inhibitor effect on action in the rest of the community. At the time of this writing a full report on the nature of the popular response as a variable in the total pattern of community response has not yet been released.

Three other publications explore some of the ramifications of the new earthquake prediction capability. These are the California Legislature, Joint Committee on Seismic Safety's Public Hearings on Earthquake Prediction (1974), the U.S. Geological Survey's Earthquake Prediction: Opportunity to Avert Disaster (1976), and Jones and Jones, Scientific Earthquake Prediction: Some First Thoughts on Possible Societal Impacts (1975). The latter in particular offers some hypotheses that may be useful in this investigation.

While the current investigation was already underway, at least three more important contributions to this literature were published. Leo W. Weisbacker and Ward C. Stoneman (1977) examined the wide range of contingencies that affect official decision-making in case of an earthquake prediction. They described an Earthquake Prediction Impact Statement procedure whereby political units could respond to concrete situations on the basis of strategies previously worked out to fit specific combinations of circumstances. As background for implementing the Earthquake Hazards Reduction Act of 1977 (Public Law 95-124), the Working Group on Earthquake Hazards Reduction of the Office of Science and Technology Policy in the Executive Office of the President prepared a report (1978) outlining the issues that must be confronted in forming effective national policy. A section on communication and education is especially relevant to this investigation. Finally, the National Research Council Committee on Socioeconomic Effects of Earthquake Predictions (1978) prepared an extended agenda for research on the socioeconomic aspects of earthquake prediction. Chapters on the potential effects of earthquake predictions on individuals, households, and social groups, and on the generation and dissemination of earthquake predictions are especially relevant.

Social Aspects of Disaster. The most general foundation for this investigation is the large body of literature reporting research into the social consequences of natural disaster. The most important set of field investigations is reported in the monographic Disaster Research Study series of the National Research Council. These and a wide range of other studies have been well summarized in several important publications, as follows: Charles Fritz, "Disaster," pp. 651-94 in Robert Merton and Robert Nisbet, eds., Contemporary Social Problems (1961); George Baker and Dwight Chapman, eds., Man and Society in Disaster (1962); George Grosser, Henry Weschler, and Milton Greenblatt, eds., The Threat of Impending Disaster, (1964); Allen H. Barton,

Communities in Disaster (1969); Russell R. Dynes, Organized Behavior in Disaster (1970); Dennis S. Mileti, Thomas E. Drabek, and J. Eugene Haas, Human Systems in Extreme Enviornments (1975). The last volume is in large part a convenient classified inventory of empirical propositions concerning how humans respond to natural hazards and disasters, individually and collectively. An attempt to assess research on natural hazards in relation to needed understanding is presented in Gilbert F. White and J. Eugene Haas, Assessment of Research on Natural Hazards (1975).

While a complete understanding of the disaster-response sequence is essential background for the current investigation, much of the disaster research deals quite specifically with response to warnings of disaster. Two useful examples from the NRC Disaster Research Study series are: Elliott Danzig, Paul Thayer, and Lila Galanter, The Effects of a Threatening Rumor on a Disaster-striken Community (1958); and Raymond Mack and George Baker, The Occasion Instant: The Structure of Social Response to Unanticipated Air Raid Warnings (1961).

Earthquake studies. Earthquakes have been less frequently studied than floods, hurricanes, tornadoes, and fires. But there has been a recent increase in attention to earthquakes. Haas (1969) documented the slow and disorganized relief effort in response to the western Sicily earthquake of 1968. Under National Research Council auspices, a comprehensive socioeconomic analysis was included in the monumental study of the 1964 Alaska earthquake (Committee on the Alaska Earthquake, 1970). By the early 1970's a number of public agencies were examining the earthquake threat, including socioeconomic aspects. Among the reports of these deliberations are those of the Task Force on Earthquake Hazard Reduction (1970), the Governor's Earthquake Council, State of California (1972), and the Joint Committee on Seismic Safety,

California Legislature (1974). Ayre (1975) has prepared a comprehensive research assessment dealing with earthquake and tsunami hazards, and the Earthquake Engineering Research Institute has developed a Social Science Field Guide for Learning From Earthquakes (Vol. 4, 1975).

Of special relevance to this investigation are studies in the Los Angeles area. It is of historical interest that a study of popular concern over environmental hazards in Los Angeles, conducted in 1961 and 1962 (Van Arsdol, et al., 1964) found insufficient concern to include earthquakes in the list of five hazards. More recently a study conducted by the National Oceanic and Atmospheric Administration (1973) developed careful estimates of probable death and property loss in the event of certain hypothetical earthquakes in the area, including one that approximates closely in magnitude and location the event first inferred from the Mojave Uplift.

The San Fernando quake of 1971 inspired a series of studies, several of which gave careful attention to the socioeconomic aspects of the quake. The most immediately relevant study is the survey of the disaster area and the larger County area done through the UCLA Survey Research Center (Bourque et al, 1973). Other studies including attention to socioeconomic aspects include the following: the report of the Joint Panel on the San Fernando Earthquake (1971); H.S. Lew et al (1971); Joint Committee on Seismic Safety, California Legislature (1971); Joint Committee on Seismic Safety, California Legislature, Special Subcommittee (1972); a student project from University of California, Riverside, dealing with potential impact of earthquakes in the Riverside-San Bernadino area (Elders, 1973); and the comprehensive NOAA study of the San Fernando earthquake containing a major section covering "sociological aspects" (Murphy, 1973). Reflecting the lessened concern over dam failure in the impact area four years later, and supplying valuable

comparative information based on a large population sample, is the Federal environmental impact report developed in anticipation of rebuilding the two dams (FDAA, 1975).

Two other important sources of background information on the social response to earthquakes in California are available to us. First is the unpublished but comprehensive Perkal collection of earthquake lore, to which we have had unrestricted access. The other is the record Field polls in California which have occasionally included questions to assess public concern over the earthquake hazard. A poll in 1971, soon after the San Fernando quake, continued to show a low priority of concern with the earthquake hazard in various parts of the State.

Reception and Understanding of Reports (Research Objective 1 and relevant aspects of research objectives 6, 7, and 11)

The literature on disasters and disaster warnings is replete with evidence that the nature of the danger confronting the community and the available courses of action are poorly understood by large segments of the community. In part this stems from deficient communication by scientists, public officials, and the mass media. In part it stems from the inaccessibility of some population segments to the customary communication media. In part it stems from the pattern of information diffusion and confirmation through informal networks after the messages have been presented by the media. These sources of distortion will be considered under a later topic. The NRC Panel report (1975) calls attention to these difficulties at several locations.

Distortion also arises from what Allport and Postman (1947) called **assimilation** of the message to the perspectives of the receiver. Whether people are favorably or unfavorably inclined toward science and scientists will

undoubtedly predispose them to accept or resist the scientific prediction. Whether they understand such concepts as probability, and whether they confuse such concepts as naturalistic determinism with fatalism and predestination, will undoubtedly affect their understanding of the predictive or near-predictive message. There is abundant evidence that people fit scientific information into nonscientific frames of reference, thereby transforming its meaning drastically.

In accordance with the NRC Panel recommendation 11, calling for a mechanism "for monitoring public understanding, credence, and response at all stages of the prediction-warning-earthquake sequence, and for making this information available promptly to responsible public officials" (p. 11), the most immediately practical objective will be to secure descriptive information and relay it to scientists and officials. Thus we can determine what people understand the situation to be, how many and which groups remain unaware of the situation, and how concerned they are over it.

As an initial point of reference for the descriptive account we have had placed at our disposal what is probably the most extensive collection of earthquake lore in existence anywhere. Joan Perkal in association with the Folklore Center at UCLA, and working with the UCLA Oral History Project, has accumulated a file of historical and current materials incorporating the popular lore of earthquakes, especially in California. We have drawn extensively on these materials in developing an inventory of beliefs about earthquakes to be used in designing our interview schedules, and in supplying an historical perspective for interpretating our findings.

But in order to extract the more general significance from these data, it will be helpful to borrow insights from the literature dealing with the sociology of science and the resistence to such scientifically grounded programs as flouridation of public water supplies (Crain, Katz, and Rosenthal, 1969) and nuclear power.

Scientific and nonscientific frames of reference. Frames of reference are the broad intellectual perspectives into which information is fitted in order to make it meaningful. One of our aims will be to identify the frames of reference used by the public in relation to earthquakes and the conditions under which they are employed. Of prime importance will be the frames used in explaining the causes of earthquakes, for these may affect people's responses to scientific earthquake predictions and their dispositions toward suggestions for hazard reduction.

Folklore is replete with assertions of causal relationships and premonitory phenomena to explain when and why earthquakes occur. In the collected folklore, there is constant confusion between causes and predictive signs, except in the references to animal omens which are always predictive. For example, the belief in "earthquake weather" is invoked as both a predictive device (although there are widely discrepant descriptions of what constitutes this phenomenon) and as a causal determinant (usually pertaining to electrical changes in the atmosphere which affect the earth). However, the folklore containing explanations of the causes of earthquakes can be tentatively incorporated into four major frames of reference. The first three can be classified as "prophetic" and the fourth as "scientific."

Prophetic explanations include religious-mystical, disrupted-nature, and cosmic frames of reference.

The use of the religious-mystical frame is frequently accompanied by a reference to retribution for evil or sinful ways. Earthquakes have been called "divine punishment" and a "warning of the end of days." The 1906 San Francisco earthquake was explained as resulting from the "visitation of a vengeful diety in punishment of the city's wickedness" by one observer. But retribution does not always underlie this frame. The World Prophetic Ministry (1963) has published a booklet in which earthquakes are identified as a "Sign of

our Times," fulfilling the "prophetic pattern of end-time happenings." They believe that earthquakes (which they state are on the increase) are due to the continuous fire that God put inside the earth which is destroying the foundations of the mountains and, in the process of being consumed, is causing them to shift their positions (taken from Deut. 32:22).

The disrupted-nature frame revolves around the ecological or cosmological balance of nature being tampered with or disturbed by man. It is an old explanation as illustrated by a 1925 Los Angeles Times article in which a long-time resident of the city, on her 101st birthday, stated that earthquakes were a recent occurrence in California and ascribed their cause to the cutting up of the land into city lots and the building of hundreds of houses. A more modern use of this frame involves references to space travel. In response to the 1971 San Fernando quake, folklore anecdotes reveal the causal link between space exploration and quakes: "Because there is a moonshot, there is an earthquake." Another common theme within this frame is the association of earthquake occurrences and underground nuclear testing. Often, concern is expressed that massive quakes will result from this testing, but without an effort to specify the causal link.

The cosmic frame of reference usually involves unusual astronomical phenomena. The visibility of especially bright comets, lunar or solar eclipses, or the purported alignment of planets are all cited as possible causes of quakes because of their "effects" on the earth's gravitation and/or rotation. Both this and the disrupted-nature frame often borrow ideas from science, but they distort or exaggerate them and substitute non-naturalistic dynamics.

In addition to these "prophetic" frames of reference, we can add the fourth--legitimate scientific explanations based on geological theories of the earth's structure. Scientific explanations depend upon a strictly naturalistic and mechanical understanding of fault movement, as related to

local environmental modifications such as the filling of reservoirs, or more global processes such as the movement of techtonic plates. Predictive theories range from long-term projections supplied by gap theories to the more immediate and specific predictions supplied by dilatancy theory or hypotheses based on single variables such as uplift and electromagnetic changes. Scientific analyses are presented hypothetically as subject to empirical testing, incorporate a plausible naturalistic connection between cause or predictor and effect, and take careful note of the amount of force necessary to produce the predicted effect.

It should not be assumed that these frames of reference are mutually exclusive; nor should it be assumed that people use only one frame of reference exclusively. It is quite likely that broadly diverse publics are aware, simultaneously, of most of these frames due to the common modes of explanation for phenomena within our culture. The frames of reference are being formalized here only as a way of categorizing popular beliefs about quake causes in an effort to determine how compatible or incompatible these belief frames will be with scientific predictions. Our concern is with the receptivity to and/or the interpretation of scientific information through one of the reference frames discussed.

Before stating some hypotheses concerning the receptivity to scientific information by various publics and how these frames of reference will be used to interpret this information into a meaningful context, let us look at some of the literature on public attitudes toward science and scientists.

Anti-scientific Attitudes. Several scientists have recently voiced their concern about the public's "anti-scientific attitudes." Weinberg (1970) discusses the political critics of science, especially the journalistic "muckrakers" and the radical young "scientific abolitionists," who frequently

portray scientific endeavors as being corrupted by bureaucratic maneuvering on the part of scientists for governmental support for their research projects. Sklair (1970) focuses on the historical tradition of the critic of technology who today is "revolting against the machine"--a refutation of the belief that progress, resulting from rapidly developing and expanding scientific and technological knowledge, will always bring benefits to outweigh its costs.

Morison (1969), rather than identifying particular groups with an anti-scientific stand, lists six commonly held beliefs about science which he sees as causing this anti-scientific "mood" in the public. These six beliefs include:

1. Science is identified with manipulation of the material world, but there is no insurance that it will be manipulated for the net benefit of man.

2. Science has contributed to increased production in industry and agriculture, but a rapid exhaustion of natural resources and contamination of the environment is now occurring.

3. Science is responsible for vast improvements in health, but many feel that there is a preoccupation with technology to the individual's detriment.

4. There is a questioning of the moral the ethical implications of advancement in biological science.

5. Because of its volume, science has difficulty providing a coherent and unified picture of the world, which causes a decline in intellectual satisfaction in the scientific community itself.

6. The goals of science are not directed toward solving problems of social welfare which have attained major importance for the public.

Unlike Weinberg's and Sklair's political critics and Morison's environmental and moral criticisms, Moore (1974) focuses on what he calls the creationism movement in California; that is, those people who reject evolutionary

and related scientific statements because "they do not lead to God." Moore traces the creationists' history in California and shows how influential they have been in censoring scientific materials, particularly in relation to the deletion of this information from state adopted school textbooks.

Perceptions of science. Does empirical research on public opinion of scientists support these writers' perceptions of an anti-scientific mood arising in society? In an important first attempt at empirically gauging the relationships between science, the media, and the public, the Survey Research Center of the University of Michigan (1958) conducted an extensive study to determine where people get information (particularly scientific) and how they use it.

The Survey Research Center and Withey (1962) report that when asked what it means to study something scientifically, only 12 percent of the respondents indicated an understanding of the scientific method; while 32 percent stated they didn't know what scientific study entailed. When asked what the limits were to the applicability of the scientific approach, 47 percent stated that science could study anything and only 16 percent mentioned specific areas that science couldn't study (religion, human behavior, aesthetics, humanities). From these findings, there appears to be a general confidence in scientific pursuits even though there is a lack of understanding concerning how science is conducted. But cautiously, Etzioni and Nunn (1974) point out that science, in relation to other social institutions, may be relatively remote from the public mind. In reviewing the SRC data, they found that all questions pertaining to science received the highest percentage of "don't know" responses.

When asked whether "the world is better off or worse off because of science," 88 percent responded that it was better off; while only 2 percent

said without qualification that it was worse off (SRC: 1958). But Oppenheim (Etzioni and Nunn: 1974), using three science attitude items included on the SRC questionnaire, discovered an increase in the public's perceived sense of threat from science between 1958 and 1964. Etzioni and Nunn (1974) attempt to explain this finding by comparing science to other institutions during the years 1966, 1971, 1972, and 1973. People were polled and asked how much confidence they had in the people who ran the institutions. They found almost no change in those with "hardly any or no" confidence responses; about 10 percent could be seen as having a definite anti-scientific attitude. The major shift they detected was from the "great deal" of confidence category to the "only some" category. Etzioni and Nunn explain this as more of a reflection of changes in public attitudes toward authority rather than toward science itself since this pattern was replicated in relation to all other institutions investigated. In fact, science gained respect (second only to the gain of medicine) relative to the attitude shifts toward other institutions.

Perceptions of scientists. SRC asked the following question: "Suppose all you knew about Mr. Smith was that he was a scientist. What guesses might you make about the sort of person he was?" Three-quarters of the respondants cited positive traits (intelligence, dedicated, creative, curious, humanitarian), three-sevenths cited negative traits, while 16 percent would not characterize scientists at all. But when asked about specific attitudes toward scientists, 90 percent agreed that "most scientists want to work on things that will make life better for the average person" and 67 percent agreed that "scientists work harder than the average person." When asked specifically about stereotypical conceptions of scientists: 70 percent disagreed that they pry into things they should stay out of; 51 percent disagreed (41% agreed) that they were odd and peculiar; 51 percent disagreed (31% agreed) that they

were not likely to be very religious.

From these findings, it appears that, in general, attitudes toward scientists are a little more favorable than attitudes toward the scientific community. Although there does appear to be a shift in public opinion from great confidence in science to a lesser degree of confidence, there is no indication of wide-spread anti-scientific attitudes.

Favorable "subpublics." Etzioni and Nunn (1974) stated that there is no monolithic "public opinion" concerning science. They begin an investigation into the "subpublics" that reflected more positive attitudes toward science. Positive relationships (but often not significant ones) were discovered for the following "subpublics:"

1. Age--18 to 29 years olds had the highest percentage (40%) of those with "great confidence" in the scientific community (the difference was not significant however).

2. Education--A positive relationship was found between education and confidence. They called this a significant relationship (gamma = .32) and saw educational attainment level as a more important predictor of confidence than age.

3. SES factors--They report a positive linear relationship between confidence and occupational prestige, and between confidence and income.

4. Geographical position--There is some indication that living on the Pacific Coast is positively related to "great confidence" responses. But whether one lives in an urban or rural area appears to have little predictive value.

An "Informed" public. Another area which should be taken into account before making hypotheses about public receptivity toward scientific earthquake information is the effect of media items on public awareness.

Withey (1962) found that 47 percent of the SRC sample had been exposed to the scientific approach to the study of phenomena in high school and/or college, but that 66 percent could recall specific scientific news items reported in the media. Clearly, more individuals are coming into contact with science through the media than through formalized educational channels. But this contact and the level of information retained is highly selective. Withey asked questions about scientific informational items on polio, flouridation, radioactivity, and satellites; all of which were well-publicized in the meida at the time of his study. He found that 9 percent of his sample know nothing about any of the items, but that 17 percent could answer questions about all four items. The items concerning medicine and health information were much more known than either of the other "scientific" events. This led Withey to conclude that people were more interested in scientific news items which were relevant to human behavior or welfare, which were actualities rather than hypotheses or future possibilities, and which were specific in their applicability rather than abstract.

Krieghbaum (1967) studied two major scientific media events and how they affected public awareness and attitude formation. Kreighbaum wanted to study "information transfer," that is, how familiar people were with a specific subject and how well they could discuss it in detail. He asked the question: "Would you tell me what is meant by the 'fall-out' of an H-bomb?" He sampled once in 1955 and again in 1961. During this period, there was considerable public discussion and media coverage of this topic, which was also a campaign issue in two intervening presidential elections. His findings are summarized below:

	1955	1961
Reasonably correct information	17%	51%
Incorrect information or did not know	83%	43%

He concluded that the media can arouse public awareness in a relatively short time, but long-range diffusion of random news coverage may not be sufficient to develop abstract scientific concepts or complex theories.

Deutschman and Danielson (1960) in a study of knowledge diffusion from major media stories, were interested in discovering who these "uninformed" respondents were. They found that "uninformed" individuals differed significantly in two ways from "informed" respondents. Educationally, they were more likely to have had only a high school education; occupationally, they were more likely to be in blue collar rather than white collar jobs.

Krieghbaum also cited studies conducted by the United States Public Health Service in 1964 on the association between smoking and cancer to illustrate the complexity of the relationship between education and opinion development. For non-smokers, the higher their educational level, the more likely they were to accept that this relationship had been proven. For smokers, the higher their educational level, the less likely they were to believe the relationship had been established. Krieghbaum compares these two studies to illustrate that education is not always the most significant factor in determing <u>how</u> the public will utilize the scientific information with which it is confronted. He concludes that one's emotional biases affect which news items are read and how they will be interpreted.

This conclusion fits well with Etzioni and Nunn's discussion of the complexity of attitudes which any individual holds at any one time. They argue that attitudes can be <u>mobilized</u> for or against scientific information depending on which "facet" (or explanatory mode) is activated.

<u>Cognitive mapping</u>. This is a concept that was not directly used in the investigation but was often present in the investigators' efforts to interpret findings. Cognitive mapping is a construct which includes those congitive processes which enable people to acquire, code, store, recall, and

manipulate information about the nature of their spatial environment. This information refers to attributes and relative locations of people and objects within the environment. It is an essential component in the adaptive process of spatial decision making (Downs and Stea, 1973). Cognitive maps, then, help us to solve many spatial problems such as choosing a safe and quick route to and from work, locating potential areas in which to buy a home or start a business, etc.

The term "map" is used as an analogy. Cognitive maps are not maps in the true sense. They are cognitive representations which have the functions of cartographic maps but not necessarily the physical properties of the latter (Blaut, McCleary, and Blaut, 1970). They are subjective representations as opposed to objective representations of the spatial environment. They are not only representations of physical components of the environment but also include responses to other kinds of stimuli.

As a research method, cognitive mapping is helpful in learning about how people use their environments and what it means to them symbolically. As Lynch (1960) suggests, cognitive mapping gives the individual a sense of security and orientation--he/she knows "how to get around." Although the maps may not accurately portray the environment, they provide a coherent pattern which helps us to organize our activities. Much of the literature on cognitive mapping is concerned with the perception of cities and has been written by geographers or others outside the discipline of psychology and almost exclusively outside of sociology. A classic study is Lynch's (1960) The Image of the City. He interviewed a small number of residents of Boston, Jersey City, and Los Angeles hypothesizing that a city image was composed of five element classes: paths, landmarks, edges, nodes, and districts. He argued that highly "imageable" cities were desirable both on aesthetic and pragmatic grounds. Carr (1966) basically agreed but suggested that there would be great individual differences

in the images and needs of the citizens based on the relative social value that particular districts have for them.

Several writers have been concerned with elements which comprise the cognitive map. Stea (1969) found that maps are affected by several factors including attractiveness, familiarity, scale being considered, barriers, and frequently used routes. Many studies of specific urban areas have confirmed that inputs other than physical forms are important in cognitive mapping. For instance, Gulick (1963) showed that sociocultural associations influenced the predominance of some physically nondistinct areas in the cognitive maps of inhabitants of several Arab cities. Ekman and Bratfisch (1965) found that in Sweden subjective distance to cities was inversely proportional to the emotional involvement of respondents in the city. Similarly, Lee (1970) showed that values and satisfactions associated with the downtown shortened the perceived distance in that direction as opposed to perceived distance to locations away from the downtown.

Another area of interest is the effect of observer variables on the urban image (Kameron, 1973). Carr (1966) emphasized the role of individual needs and values as determinants of the form of cognitive maps. Appleyard (1970) considered the effects of age, sex, occupation, and familiarity on the cognitive maps of residents of Ciudad, Guayana. Unlike Appleyard, Ladd (1970) found no relationship between age, grade level, or length of residence on the maps of black youths. Tindal (1971) studying the spatial extents of home ranges among black children in urban and suburban areas did, however, find that spatial orientations were related to age and sex. Francescato and Mebane (1973) in their examination of cognitive maps of Milan and Rome, found that there were group differences in city images between the middle and lower classes, natives and nonnatives, and the younger and older residents. The 30-and-under age groups gave more importance to paths than landmarks, while their

counterparts gave the two equal importance or reversed the relationship. The middle-class groups placed less emphasis on streets and more emphasis on districts than the lower-class groups. Finally, the nonnatives stressed paths away from the city more than the natives. This is an especially important finding if one considers knowledge of "escape routes" out of the city. As Ittleson (1970) has suggested, the identification of escape routes is probably one of the most primitive forms of orientation to the environment especially in novel environments with negative affect.

Chapin (1965) initiated a series of studies investigating activity patterns within the urban area. He suggested that the individual's action space (that area within which the individual has contact and within which his/her activities take place) is one of the primary determinants of his/her cognitions of the urban area. In support of this, Orleans (1973) examined the relationship between respondent's cognitive maps and the quality, frequency, and location of their social contacts. He found that respondents from the broadest scale populations, with more extensive social contacts, had generalized images of the entire Los Angeles metropolitan area. Respondents from narrower scale populations, with more constricted social contacts, had more attenuated cognitive maps, frequently limited to only a few city blocks.

Although the above studies look at cognitive maps in many different ways and often with conflicting findings, several variables seem especially important for the earthquake prediction proposal. Younger respondents may be more aware of roads, highways, and other travel routes than older respondents, which would have major consequences in an evacuation situation. Also, nonnatives to an area may be more willing to relocate or at least be more cosmopolitan in their outlooks concerning possible alternatives in the face of a prediction. Similarly, middle-class respondents because of their more extensive

cognitive maps, may be aware of more alternatives than lower-class respondents with restricted maps. They may also be more willing to participate in preparedness programs due to the wider base of their social contacts and their familiarity with their environment.

Identifying the prevalent cognitive maps may be of considerably more than academic significance to policy makers. A few examples will illustrate the practical significance of such knowledge. The San Andreas Fault is forty miles and more from various parts of Los Angeles. To persons with highly constricted cognitive maps, this may be as remote as a foreign country, and it may be impossible for them to see events there as having personal relevance. Awareness of the geographic setting of Los Angeles, ringed by ocean and mountains through which there are few roadways, with uninhabitable desert beyond, is crucial for considerations of evacuation and for developing a realistic survival plan.

Pattern of relationships. In making use of insights from the sociology of science and cognitive mapping, it will be convenient to apply a simple four-stage orienting model. We hesitate to designate it formally as a causal model, nor to enshrine it with the apparent precision of a path-analytic model. In the first stage we include such obvious variables as educational and occupational background, proximity to threat, and prior experience with earthquakes. In the second stage are frames of reference, attitudes toward science, and cognitive maps. These are the more general orientations that are used to assign meaning to scientific information. In the third stage are the accuracy of information concerning earthquakes, the accuracy of information concerning the near-predictions of earthquakes locally, and the credence assigned to the information, varying from gullibility to reasonably critical acceptance, to resistance. In the fourth stage are the action dispositions, both accom-

plished and projected. Action tendencies are the subject of the next section in this review of literature.

Action Response to Warning (Research objective 2, and relevant aspects of research objectives 6, 7, and 11)

Threat situations. From the general literature on response to warnings of disaster, the NRC Panel report (1975) highlights three important considerations impinging on all aspects of the potential response to earthquake prediction. Discussion of the estimated probability of occurrence will be deferred until decision theory is taken up. Imminence of threat and the need for personal verification merit immediate consideration.

Earthquake forecasts and predictions are of three types on the basis of imminence. First, there are the familiar indefinite forecasts, such as the observation that the long period of apparent quiescence on sections of the San Andreas Fault passing through San Francisco and nearest to Los Angeles means that serious quakes are inevitable within a few decades, and the implicit but even more indefinite forecasts expressed through fault maps and seismic risk mapping. These indefinite forecasts are comparable to the continuous prospect of disaster hanging over residents of flood plains, tornado areas, and hurricane country. This condition of "living at risk" has been observed to produce a "disaster culter" (Moore, 1964, pp. 195-213). The disaster culture typically contains elements that shield people from attending to the seriousness of the threat and often impede effective response to more imminent threat by minimizing danger or supplying false steps toward security, and also contains valid folk knowledge on how to deal with the hazard constructively. Because substantial earthquakes occur only at great intervals of time, because frequent experience with nondestructive quakes has a lulling effect, and because many

southern California residents are recent migrants to the area, earthquake culture may be less well developed and potent than other disaster cultures, and may contain little in the way of valid adaptive lore. It will therefore be important to separate popular beliefs into these two elements, and to determine how confidently people hold to their beliefs, and how large a share of the population hold fairly definite beliefs. Carey McWilliams' (1933) observation that the commonest view of "earthquake weather" closely resembles tornado weather, and that most of the early southern California settlers came from the midwest tornado regions, suggests the importance of probing for the importation of lore from experience with other disaster cultures.

Second from the point of view of imminence are the earthquake predictions that specify place, time, and magnitude with some definiteness, but normally with a lead time of months or years and an extended time window. In recommending that top priority be given to research that would reduce the time window for predictions, the NRC Panel (1975, pp. 3-4) acknowledged that this pattern of prediction is the most difficult for community leaders and individuals to cope with, and most likely to provoke defensive denial. It is clear that many people will not distinguish between this type of prediction and the indefinite forecast, and accordingly will see no occasion to alter their response from the long-term patterns of living at risk. It will be important, therefore, to determine which respondents make such a distinction, and what implications it has for their planned and accomplished adaptive responses.

Third from the point of view of imminence are the warnings of disaster that should strike within minutes or hours. The tornado warning is a classic example of this pattern, typically following a period during which a tornado watch has been in effect to prepare people. The reported highly successful response to prediction in Haicheng, China, on February 4, 1975 (Results from

Earthquake Prediction, 1975), involved a few hours warning following a longer period during which the people had been alerted to the prospect of a quake. Mack and Baker (1961) have examined the contrasting situation in which people respond to an unanticipated air raid warning. Most of what is known about response to warnings from the disaster literature deals with such warning of imminent danger with or without an earlier alert. Yet seismologists are uncertain whether there is a real prospect of being able to issue warnings minutes or hours in advance of the developing quake under typical southern California conditions. Here again the popular understanding should be ascertained. Some people may have mistaken the southern California Uplift and Whitcomb announcements for warnings of imminent danger, and may by this time be viewing them as disconfirmed. The attention to possible adaptive responses is much affected by whether people believe that a warning of imminent danger will be issued. The practicality of evacuation, avoiding dangerous locations, and similar steps is largely contingent on this expectation.

Closely connected with imminence is the question of what can be done when the quake strikes--whether there is time for individual adaptive behavior, as there typically is in case of fire disaster. Some schools have instituted earthquake drills since the southern Calfiornia Uplift was first announced. These are patterned after the wartime bomb drills, with children diving under their desks and distancing themselves from windows. However, many poeple are known to think about earthquakes according to the more familiar pattern of fire disaster, and to speak of exiting from buildings at the first shock. It will be important to probe for anticipated responses relating to each of these degrees of imminence in warning, and to ascertain how clearly they are separated in the minds of the respondents.

The NRC Panel report (1975, p. 28) also emphasizes the distinctiveness of earthquakes in providing no external signs by which individuals can confirm the prediction with the testimony of their own senses. People do characteristically seek personal confirmation when an official warning is received, and the psychological need for confirmation may be so great as either to impede decisive action in the absence of such confirmation, or to produce widespread belief in advance signs that have not been proven valid. The latter may account for the persistent beliefs that unusual animal behavior precedes earthquakes and that there is a characteristic type of earthquake weather. In light of the ambiguity of such signs, some self-deception along these lines may actually facilitate adaptive response to warnings. Accordingly it is important to explore people's beliefs concerning observable precursors and their relationship to accomplished and planned actions.

The observable precursors may be cited in relation to each of the degrees of imminence. For example, a highly visible fault scarp or crack or sign of earth movement should lead to more positive adaptive responses to indefinite forecasts than a hidden fault. Somewhere between the indefinite forecast and the definite prediction we find a widespread belief that the frequency and severity of earthquakes, and perhaps other disasters, have increased recently, thereby making a local event credible as part of a larger set of events. For imminent threat, the beliefs in unusual animal behavior, earthquake weather, several seconds of audible rumbling as the quake approaches, and milder foreshocks preceding the main quake are thought to be widespread. By noting relationships between such beliefs and accomplished or projected adaptive responses at various degrees of imminence we should increase or decrease confidence in the hypothesis that such beliefs are functional for action. With such knowledge we will be in a better position to know how policy makers should (or

should not) take account of such beliefs in planning community response to earthquake prediction.

Disaster warnings: Panic, immobilization, and normalization. Perhaps the most persistent yet consistently refuted belief is that widespread panic follows warnings of imminent threat, or even predictions of more remote disaster. The early work of McCurdy (1943) showed that exposure to repeated bombing in wartime London enhanced morale rather than creating panic. One of the first findings from post-World War II disaster studies was the almost total absence of instances of collective panic. Press coverage and the prestigious psychological study of the 1938 Orson Welles broadcast of the War of the Worlds (Cantril, 1940) gave strong impetus to this belief, though a careful examination of Cantril's evidence shows a great deal of short-lived fear among individuals and small groups but nothing approximating mass panic. A recent radio broadcast in Sweden provoked media accounts of mass panic, but a careful and extensive survey conducted soon after the event (Rosengren, et al, 1974) supplied impressive demonstration that there had been no mass panic.

Much more common is the normalcy bias (McLuckie, p. 22), and the tendency for people to cling to the familiar in times of crisis. In extreme cases this becomes a pattern of passivity, in which people return to the place of danger, or are rendered incapable of taking even fairly obvious adaptive actions (Foreman, 1953). Such responses may be associated with a constricted social and intellectual world.

It would therefore be a waste of effort to explore the prospect of mass panic in the event of earthquake prediction and warning. But there are certain types of response that incorporate some but not all the elements of panic, and will be of concern to policy-makers. For example, the phenomenon of long lines outside gasoline stations during the Arab oil boycott, partly

because people refilled their tanks when they were still half full or more, was individually rational but collectively disruptive. Rational decisions by only a small fraction of southern Californians to leave the Los Angeles basin at the same time would quickly create massive traffic jams. Hence, while mass panic is not a serious prospect, it should be of value to review briefly the theory of panic response in search of clues to the nature and determinants of patterns of uncoordinated individual adaptation that are collectively disruptive.

There are four distinguishing features to collective panic. First, several persons in social contact with one another simultaneously exhibit intense fear and either flee (or demonstrate disorganization leading toward flight) or remain immobile. Second, each individual's fear and his evaluation of the danger are augmented by the signals he receives from others. Third, flight is indicated as the only conceivable course of action by the signals each is receiving from others. Fourth, the usual rules according to which individuals adjust their behavior so as not to work at cross-purposes are nullified. In the more dramatic instances of collective panic, people trample one another in vain efforts to reach safety.

Four types of causes for collective panic are recognized. First, collective panic usually occurs in the kind of situation arousing fear in any individual. Hence the psychological causes for individual panic are also fundamental causes for collective panic. Some students de-emphasize the collective behavioral aspects, assuming that collective panic is merely the simultaneous panic of individuals confronted with the same situation. Other students, however, find it less easy to dismiss the interaction among participants as an important cause.

A second cause of panic is the special character of the situation in which people find themselves. Students of responses to disaster observe that

collective panic occurs only when people perceive a danger that is both immediate and severe, when they know only a very limited number of escape routes from the danger, and when they believe those routes are being closed off so that the time for escape is extremely limited (Quarantelli, 1954). The requirement that all three conditions be present underlines the observation that intense fear in situations from which there is apparently no escape elicits no collective panic and very little individual panic.

Psychologists have suggested that terror has been over-emphasized in understanding collective panic, and that the breakdown of rules for orderly departure and mutual considerateness can be created in a laboratory without any intense emotion. This feature of panic can occur whenever the individuals see that taking turns or following the rules is likely to prevent their successful completion of a task to which they are committed (Mintz, 1951). Following a similar line of thought, Turner and Killian (1972) suggested that collective panic be viewed as part of a broad class of individualistic crowds. Individualistic crowds include such phenomena as the crush and breakdown of order that sometimes occur at a bargain sale, or the transformation of an orderly ticket-window queue into a shoving and pushing crowd. All the usual mechanisms of crowd behavior are in operation, but in contrast to the lynch mob or race riot, the situation encourages the intensified pursuit of individual rather than collective goals.

The situational explanation is not complete by itself, however, as indicated by such occasions as the sinking of the ocaan liner "Titanic" with great loss of life but without panic. The ship was visibly sinking, and there were known to be too few lifeboats for all the passengers, and yet men were frequently reluctant to board the boats until all women and children had first been rescued. Hence the third set of causes is the interstimulation of elementary

crowd behavior, the milling, rumor, and social unrest, through which the group forms a collective view of the situation and of the appropriate behavior. It is difficult to find any explanation for the difference in behavior between the "Titanic" passengers and passengers who have panicked in other maritime disasters, except that a norm of gentility and heroism came to dominate the collective definition through these elementary processes. Elementary collective behavior also is required to explain instances of collective panic in the absence of real danger, or to explain ticket-window crushes when there are actually plenty of good seats for all. In these cases a rumor of danger or shortage becomes the accepted collective definition, usually because it is not convincingly negated by persons in a position to speak authoritatively. The concept of elementary collective behavior is also necessary to explain the diversion of attention away from alternate escape routes in cases such as a stampede toward one exit to the neglect of others. Here the attention of the individuals is so riveted on the crowd that the possibility of conceiving other courses of action is drastically reduced.

Since the most dramatic feature of panic behavior is every individual's disregard for his fellows' lives, many students believe that the fourth set of causes lies in the quality of every individual's relations with his fellows. Sigmund Freud (1949) proposed that panic expresses the exceptional terror of the child who suddenly feels that he has lost the love of his parents. Without the love of the group leader, the entire foundation of the group life is undermined. Translating Freud's interpretation into more sociological terms, Kurt Lang and Gladys Lang (1961) view panic as the end point in a process of demoralization in which behavior becomes privatized and there is a general retreat from the pursuit of group goals. Thus the essential characteristic of demoralization is the emergence of isolated individuals fearfully pursuing strictly private goals, and released from all sense of group loyalty. When

panic is viewed this way the investigator looks for circumstances that have undermined group morale, that have destroyed the individual's trust in his fellows and eliminated the sense of common interest. This approach helps to explain why one group dissolves quickly into collective panic while another maintains its solidarity in the face of a similar threat. The strongest defense against collective panic is a well-developed sense of common purpose and an attitude of mutual trust among group members.

In making use of these observations about panic we shall be chiefly interested in patterns of individual response by people who are insensitive to their impact on the adaptations of others. Each of the types of causes will be the basis for possible selection of variables to relate to potential response. We hope the findings will help in devising strategies for inducing patterns of response that bring individual adaptation and community adaptation into harmony rather than opposition.

Experimental studies of warning response. Difference in response to tsunami warnings in Hilo, Hawaii ,and Crescent City, California, in 1964 reflected in large part the adequacy of the local warning system (Anderson, 1970). But even in a community alerted to the danger that an overflowing dam upstream might burst, only half the population evacuated when a uniformed fireman in a fire truck came through the town warning people that the dam had burst (Danzig, Thayer, and Galanter, 1958). Noting the reluctance of people to take credible warnings seriously, psychologists have devised experiments for isolating the variables that determine response. Characteristic of these investigations is a series of studies of efforts in discourage people from smoking. In pioneer studies Janis and Feschback (1953, 1954) and Janis and Terwilliger (1962) found that mildly threatening communication was more effective in changing attitudes and behavior than strongly threatening communication. The latter provoked more indications of emotional tension, but

apparently also motivated the subjects to resist the communicator's arguments, conclusions, and recommendations. Similar findings were secured by Leventhal and Watts (1966). Leventhal, Watts, and Pagano (1967) elaborated the experimental design to include giving instructions on how to stop smoking. Their finding is that high-fear communication strengthened desire to stop smoking, but had no effect on behavior, while instructions on how to stop smoking had no effect on desire but led to changes in smoking behavior. Summarizing some of the earlier studies in this tradition, Withy (1976) proposes that response to threat depends upon a combination of information about the threat and information about adaptation. Arousal of fear increases the probability of accepting a threatening message up to an optimal point, after which further arousal is inhibiting and confusing.

These findings are quite relevant to the earthquake warning situation. They suggest that realistic but forceful information about the earthquake threat is necessary, but that sensationalism and scare tactics are likely to boomerang. And possibly more important, widespread inaction may be resulting from the lack of any clear sense of what can be done. Preliminary informal investigation occasionally encountered the attitude that information about the southern California Uplift and the Whitcomb "prediction" should not have been released because "it only makes people anxious when there is nothing they can do about it anyway." Thus we expect to find less unfocused anxiety and less resentment against release of information among those who know of adaptive steps that can be taken, either for oneself and family, or for others and the community at large.

These findings are consistent with a wide range of psychological observations that people are less fearful (in a disabling sense) of objects and events that are predictable and manageable than of those that are unpredictible and unmanagable (Scarf, 1974), though it is often an illusion of control rather

than actual control that forestalls excessive fear.

Decision theory and acceptable risk. Economists attempting to predict decisions in the economic sphere have developed models of decision-making that have been found to have wide applicability to non-economic matters. Generally these models assume a rational orientation on the part of decision-makers, and the goal of maximizing gain and minimizing loss. They begin simply with a projected benefit/cost ratio. Applied to earthquake prediction, the models assume that rational individuals will consider the benefits that might be derived from some course of action such as avoiding potentially hazardous sections of the city for several months, and the costs to the individual in doing so. If the increased prospect of safety outweighs the inconvenience and loss of gratification, the individual will restrict his movements during the warning period. But decision theory takes note also of the probabilistic nature of the threat that is to be minimized. The rational person would multiply the probability that the destructive earthquake will occur as predicted by the projected magnitude of loss. To the extent that the probability is less than 1.00 he would discount the benefits to be gained by restricting his movements.

Investigators who have attempted to apply this model to human responses to disaster warning have questioned its predictive value. Undoubtedly some individuals do seek to maximize gains, but many or most do not. Instead, it has been suggested, people follow a pattern of "satisficing" or "making do," rather than maximizing gains. In practice this means that instead of multiplying potential gain by probability of occurrence, they first assess probability of occurrence. Unless the probability is very high--often close to unity--they pay no attention to the potential costs and benefits (Slovic, Kunreuther, and White, 1974; Kunreuther, 1978). Understanding the prevalent pattern of decision-making should enable us to make informed recommendations to public

officials concerning the type of information that should be emphasized in public communications and the timing of communication for different kinds of information.

Closely related to the question of decision models is the phenomenon of acceptable risk. Recognizing that we all normally live at risk from a panoply of known and unknown dangers, the question is not a matter of eliminating risk but of determining acceptable levels of risk. In a comprehensive review of the policy makers' problems in establishing acceptable risk in connection with a variety of dangerous products and situations, Lowrance (1975) notes the difficulties in measuring risk and the essentially philosophical nature of the problem of setting standards of acceptable risk. But the question of how individuals and responsible public officials set levels of acceptable risk for themselves is an important empirical question. It is important to note that risk-taking is often positively valued, as giving zest to life, and as a way of enhancing certain kinds of self-images. Klausner and a group of scholars (1968) have advanced a variety of explanations for risk-seeking behavior. The perspective of acceptable risk provides one useful way of organizing and interpreting information that subjects give us regarding steps that they will and will not take in response to a relatively confident prediction. Although the emphasis in our investigation will be more on actual than hypothetical situations, it will be useful to explore this question with a few carefully chosen brief hypothetical situations.

Action orientations, time perspectives, and commitment. The threat of a hazard such as an earthquake is always to some extent localized in time and space. Accordingly it is quite appropriate to assume that the individual's plan of action with respect to the threat will be affected by his orientation to time and space. Typical of many investigations of the effect of time-orientations on individual behavior and social structure are the works of Sorokin (1943) and Moore (1963). In general we assume that elderly people function in a

shorter time perspective than young adults, as indicated by the span of time for which they are actively planning. Often very young people and persons of lower socioeconomic level live from day to day rather than in terms of longer time-orientations. The general hypothesis is that it will be difficult to interest people in actions dealing with a threat that is projected to transpire beyond the limits of their usual time orientation. If this were confirmed, it would be very important in guiding public officials who must solicit public support of plans for dealing with the earthquake threat.

Similarly, we hypothesize that a strong commitment to the locality of threat will facilitate cooperation with proposed patterns of adaptive behavior. Lack of commitment to the local community is likely to mean either departure from the area of inaction. Commitment will be indicated by such variables as length of residence, family and friends, and work involvement.

Altruistic Concern (Research Objective 3 and relevant aspects of research objectives 6, 7, and 11)

The altruistic outpouring so consistently observed immediately after the impact of natural disasters is an important factor in the success of emergency rescue and rehabilitation. A widespread disposition toward self-sacrifice has also been observed in case of community crises that are much less dramatic and immediate in their impact than most natural disasters. Thus in Los Angeles at the time of the Arab oil embargo, citizens who were asked to reduce the domestic consumption of electricity by ten percent actually reduced consumption by more than 16 percent and maintained that level for several months on a voluntary basis. Some comparable sense of compassion, altruism, and willingness to engage in self-sacrificing behavior may be necessary if there is to be an effective hazard reduction effort in the community in

response to earthquake prediction. In guaging the kinds of demands to make on the community, the kind of information plan to launch, and the kinds of incentives to employ, public officials need to know whether any comparable tendency toward altruistic self-sacrifice can be expected in the event that a serious earthquake is predicted.

The NRC Panel (1975, pp. 102-103) expressed doubt that a comparable altruistic response would occur automatically in case of prediction, suggesting that the following necessary conditions were lacking: damaging effects of the prediction are not tangible, visible, instantaneous, or dramatic; the threat is unlikely to be experienced as a near-miss by many in the community; losses are more like an intensification of normal hazards of life than the uniquely catastrophic evidence of a collapsed or burned building; there will be ambiguity over responsibility and blame because issuance of the prediction is a human rather than strictly natural event. But if these are correct statements of conditions inhibiting altruistic response, they also identify some of the conditions that might be modified in an effective public program to increase the altruistic response rate in the community. If altruism is often determined by the focus of attention, there may be ways to refocus attention so as to create a common-misfortune bond among the citizens and an active concern for those who are most likely to be victims of the quake. Informal observations in Los Angeles up to the present time have revealed no evidence of such a focus.

In the hope of locating other correlates of altruistic behavior that might have a bearing on earthquake prediction, we have explored the disaster literature for explanations of the altruistic response, and then supplemented this search by going further afield into the literature dealing with altruism in other contexts and with individual helping behavior.

Altruistic behavior in disaster. Fritz (1961) has suggested several features of disaster that contribute to the development of a "community of sufferers." First, threats come from outside the system and their causes are clearly perceived and specified. Presumably the more clearly the individual understands the prediction as an impersonal account of compelling signs of nature, rather than the arbitrary or even willful judgment of scientists or officials, the more likely there is to be an altruistic response. Second, the remedial needs are immediate and imperative and action can be directed toward clearly discernable results in the external environment. Perhaps this condition is nearly unattainable in case of prediction. But it may be that people who clearly recognize the types of buildings that are vulnerable and understand how relative safety can be achieved in an earthquake are better able to experience concern for potential victims. Third, social distinctions are eliminated because all are victims, and suffering becomes a public rather than private phenomenon. Awareness of specific and more or less inescapable risk shared by everyone in case of prediction might then facilitate altruism, though again it is unclear whether anything approaching the condition of actual disaster can be expected. Fourth, disasters provide temporary liberation from normal worries because people are forced to live for the moment. Here too it may be difficult to find any approximation in the prediction situation, unless the quake is due within hours or minutes. Fifth, the sharing of loss extends the primary group, facilitating intimate communication and making emotional support available. Here as with some of the preceding conditions, the availability of neighborhood group activity in which people might join to consider and prepare for the quake might facilitate altruism.

The most ambitious effort to assemble and organize all of the findings and plausible speculations concerning the conditions that facilitate altruistic

behavior in disaster situations is Barton's (1969, pp. 205-279) discussion of the altruistic community. There is no need to repeat the 71 positions he offers here. For most of them it would be difficult to find a counterpart in the prediction situation. However, we have specified plausible counterparts whenever they seemed appropriate, in search of a few carefully selected hypotheses concerning altruistic concern in response to earthquake prediction. Two of Barton's groups of propositions may add useful dimensions to the discussion. Relative deprivation theory suggests a balance between one's own loss and information concerning the losses of others. If the same principle applies to anticipated losses, one key to altruism may be the conviction that "we" are likely to be among the more fortunate people in the event of earthquake, or that "we" will be better able to sustain our losses than many others in a quake.

Barton's propositons concerning a tendency to blame the victim raise the issue of blaming others and scapegoating as ways of neutralizing any tendency toward altruism. Barton finds roots for blaming the victims in moralistic and individualistic values, vested interests in causes of deprivation, and in media content. In case of prediction, vested interests will be those for whom disaster mitigation measures are likely to be costly or disruptive.

Like panic, however, blaming and scapegoating may be much less common than is popularly supposed. Bucher (1957) found surprisingly little blaming even following a series of three plane crashes into a residential area near a single airport. She specified some steps essential before widespread blaming will occur. And Turner (1972) found situational norms in effect to suppress divisive communications under certain crisis conditions. The conditions suggested by Bucher and by Turner will also be explored for their

possible application to the prediction situation.

General treatments of altruism. Although much if not most of what is written about altruism in general may not be helpful in the prediction situation, it seems important not to disregard some classic efforts to deal more globally with altruism. Pitirim Sorokin (1967) defines altruism as an act of sublime love in which the actor is a mere instrument of the supraconscious which transcends egos and the ego-centered conscious mind. Although Sorokin attributes much altruism to socialization early in life, he also proposes that a precipitant, such as a catastrophe, later in life, may evoke altruistic behavior. It does so when the crisis makes explicit the hidden contradictions in one's mind or conduct, or brings contradictions in a social group, institution, or culture to the surface. The first deeds after the precipitating event and the first ideological self-identification decisively influence the course of action that is taken. A helping hand in guiding people toward altruistic behavior at this time may be crucial. In cases of personal transformation there is a substitution of reference groups, with groups that reinforce altruism becoming more prominent. For the prediction situation, Sorokin's analysis is interesting in suggesting that the evocation of more than usual altruism requires that the crisis have a special psychological meaning for individuals, relating to the types of internal conflicts that are frequent among the populace. Sorokin also suggests the importance of salient personal examples, or models, a point developed more intensively by Robert Merton.

The study by Robert Merton (1946) entitled Mass Persuasion, analyzed a mass appeal to social responsibility and the effect it had in calling forth altruistic behavior. The 1943 war bond drive by Kate Smith helps to illustrate some of Sorokin's generalizations about altruism. Throughout the bond drive

Smith's appeal emphasized themes of sacrifice, participation in the war effort, familial and personal concerns. These themes emphasized the sacred context of the contribution, which may be analogous to Sorokin's notion of self-identification with the supraconscious. Appeals that were focused on sacred values, rather than on secular concerns, played the key role in actualizing altruistic behavior. While the bond appeals were addressed to a mass radio audience, the message relayed by Smith emphasized one's individual response to a patriotic duty. Merton demonstrated how the marathon drive was structured as a two-way communication process emphasizing a degree of social interaction between Smith and the listener. First the listener reacted to Smith and the message and then Smith responded to the audience by modifying her appeals. This helped to reinforce the sense of a personalized appeal, and the personalized character of her messages enhanced the social relationship. The relationship with Smith was particularly pertinent to listeners already emotionally involved in their orientation to buying war bonds and intending to buy bonds during the marathon drive. Kate Smith was viewed as a symbol of sincerity and the custodian of old values, willing to sacrifice her own time and energy for her ideas. Hornstein notes that if observers attribute motives of idealism to a model's action, the model is more likely to be emulated. Once the predisposed bond buyers made their contribution they felt part of an altruistic group unified around a group value.

The norm of social responsibility was a key factor in persuading those emotionally involved in the war effort but who had no intention of buying bonds during the drive. These individuals finally were persuaded to purchase bonds due to feelings of guilt which served to redefine the appropriate amount of bonds to be purchased and one's responsibility to the war effort. The demand to buy bonds as part of a moral obligation invited feelings of guilt and

personal inadequacy which called forth conformity to the norm of social responsibility. In Sorokin's terms, the war served as the precipitating factor creating a polarization of ethico-religious values in the community. The marathon drive helped to remind the listeners of their social responsibility and acted as a frustrating agent to bring about contradictions between one's ego and values. For those not previously disposed to purchase bonds, the feeling of guilt in relation to social responsibility was the factor initiating the altruistic act of bond buying.

From this review of Sorokin's and Merton's work, the following conditions might be considered important in eliciting altruistic behavior: significant leadership by one or more individuals who project images of idealistic self-sacrifice; messages couched in terms of sacred rather than secular appeals; utilization of organizations and groups within the community to enunciate the altruistic concern as a matter of social responsibility; the use of appeals that relate the community concern to widespread personal preoccupations.

Helping behavior. Perhaps the aspect of altruism most extensively investigated by behavioral scientists is the disposition to assist or ignore someone in distress. Research into this phenomenon burgeoned after the tragic murder of Kitty Genovese while a large number of nearby residents ignored her pleas for help. These largely experimental studies have stressed the state of the potential benefactor, the modeling of action, the modeling of inaction, and dependency of the recipient. The evidence on each of these variables is briefly summarized.

Staub (1968) found that children who saw themselves as having internal control over their environment shared more after being successful on a task than those who felt externally controlled. Gore and Rotter (1963) found that college students were more willing to help in a civil rights project if they

thought they had internal control over their fate than if they thought their fate was externally controlled. These findings suggest that perceived competence is related to sharing and helping behavior. Concerning naturalistic studies, Form and Nosow (1958) and Torrance and Ziller (1957) findings relating to reactions to disasters suggest that observers who percieve themselves as competent in emergency situations help more than those who do not. In disaster situations, the role requirements associated with competence, i.e., special training etc., mediate helping behavior.

Two studies in which the negative states of the benefactor were investigated are those by Darlington and Macker (1966) and Rawlings (1968). In the first study, the experimenters found that subjects who failed on a task which resulted in harm to another tended to engage in more helping behavior (agreement to donate blood) than when failure did not harm another. Rawlings (1968) found that the observation of a person receiving harm is enough in itself to induce helping behavior.

Blake et al. (1955) found that the amount graduate students donated toward a gift for a retiring secretary depended on the amount they thought others had donated. Schachter and Hall (1952) studied the effect of group influence on volunteering behavior. They found that students were more likely to volunteer when half the class raised their hands to volunteer. The low restraint group, however, was not more likely to fulfill their commitments than the high restraint group. A study by Blake et al. (1956) found that students who were asked to raise their hands to volunteer (without half the class appearing to volunteer) were less likely to volunteer than were those asked to volunteer privately by signing their names. These studies seem to suggest that the failure of other class members to volunteer establishes a group standard of noncompliance to which subjects adhere.

Similarly, bystanders may model the failure of other bystanders to respond to pleas of help. Reaction or lack of reaction of the group serves as a standard of behavior. In a series of experiments by Darley and Latane (1968), subjects responded most consistently and rapidly when they thought they were the only ones able to help, next when they believed they were part of a three person group, and least as part of a six person group. They explain this by the idea of diffusion of responsibility and blame. Studies by Allen (1968) and Korte (1969) also support these findings. In a study by Latane and Darley (1968), bystanders were placed in a personal threat emergency situation. They found that males tended to help more when alone in a smoke filled room. When others were present, their inaction may have defined the situation as a "nonemergency" for the subjects, thus resulting in less help. These studies point the importance of the apparent group definition of the situation.

Berkowitz and Conner (1966) and Wheeler and Wagner (1968) found that help was positively related to the amount of perceived dependency of the recipient. Schopler and Bateson (1965) and Schopler (1967) found that females helped more in high dependency, low cost situations and that males helped more in low dependency conditons. The locus of dependency is also a very important factor in determining helping behavior. Studies by Schopler and Matthews (1965), Berkowitz (1967), and Horowitz (1968) found that perceived internally caused dependency tended to elicit less help than when the dependency was seen as externally caused. This perception also affects the perceived legitimacy of the victim's need for help. If subjects defined need as legitimate (externally caused dependency was seen as more legitimate), they helped more.

These studies point to several important factors in predicting helping behavior. First, the state of the benefactor is particularly important. If

the benefactor feels he/she has internal control over his/her life, the person will tend to help more. Also, if the person has recently experienced success on some task and perceives him/herself as competent in the particular situation at hand he/she will help more. However, if the person has recently failed in some way which has caused harm to another and/or has recently witnessed another being harmed, he/she is more likely to help.

Modeling is also an important factor both in determining action or inaction. Studies have found that models can influence subjects to define the situation as needing help or as the opposite depending on the models' actions. Thus bystanders may define a situation as a nonemergency because of others' inactions even when the bystanders themselves are in apparent danger.

Finally, several studies have suggested that the perceived amount and locus of dependency of the victim is important in determining helping behavior. Benefactors are more likely to help in situations where the victim's dependency is seen as externally caused and, therefore, legitimate.

Beliefs about Leaders and Scientists (Research Objective 4 and relevant aspects of research objectives 6, 7, and 11)

The question of trust and distrust of public officials has received extensive attention from political scientists and political sociologists in recent years. The relevance of this question to earthquakes is underlined by a recurrent theme in the folklore of earthquakes. It was widely rumored after the 1933 Long Beach earthquake that "the authorities" knew the quake was coming some weeks ahead but hushed it up. It is commonly rumored after earthquakes and other disasters that the full magnitude of the disaster in loss of life and property destruction is being concealed from the public, and that authorities have covered up great errors in the rescue and rehabilitation

processes. These rumors probably have only limited circulation and even more restricted acceptance. The folklore collection merely indicates that they were heard, but not how widely they were circulated or believed. The survey findings after the San Fernando earthquake (Bourque, et al., 1973) indicate an overwhelmingly favorable view of the authorities and the agencies. Nevertheless, suspicions of this sort may be common enough within certain homogeneous groups to affect their cooperation in hazard-reduction programs. If suspicions of this character in case of actual disasters are more prevalent on the periphery than in the impact area where first-hand knowledge dispels misinformation and where involvement in practical activity eliminates much of the motivation for entertaining such beliefs, then everyone may, in a sense, be on the periphery in case of prediction because of the absence of any actual catastrophe.

Much, if not most, of the research on political trust is not particularly relevant for our purposes. On the one hand it relates a widespread pattern of distrust to essential features of modern society, as in mass society theory and anomie theory. Differing degrees of massification and normlessness in different segments of society suggest the obvious hypotheses concerning social class variations in political trust. But the principal implication of these theories is the widespread and relatively undifferentiated incidence of distrust in modern society. On the other hand much of the research has sought to relate attitudes, treated as personality variables, to political trust. Thus personal attitudes of alienation, authoritarianism, anomia, and most recently, internal-external control tendency have been correlated with political trust. While identification of such personality correlates may supply important intervening variables in understanding the social generation of trust and mistrust, it is less immediately helpful in planning an earthquake prediction response than an understanding of direct situational and social structural correlates.

The problem of political trust and cooperation was discussed in the NRC Panel report (1975). Since we have already examined attitudes toward scientists along with attitudes toward science, we shall concentrate on trust in public leaders.

The Panel report notes that building codes and land use planning have traditionally been politically sensitive matters. Political leaders may find themselves faced with a dilemma. In order to save lives in the event of prediction they must intensify the strict application of building codes and, with sufficient time, vacate or demolish buildings that are structurally unsafe or in unsafe locations. Since these buildings will often be in poorer neighborhoods where the populace are already cynical about building codes and land use planning, these efforts are especially likely to provoke a more generalized mistrust. If these are the prevalent suspicions among renters, homeowners often fear declining property values. The one attack by an official on the issuance of a near-prediction in southern California was from a Los Angeles City Councilman who charged that his constituents' property values would be adversely affected. Accordingly fear of reduced property values, increased rents, and residential displacement are likely to be associated with mistrust of public officials' planning for earthquake hazard reduction.

The NRC Panel report (1975, pp. 114-116) suggests further sources of political irritation and controversy that may lessen political trust. Inactivity and passive waiting can create distrust if people feel anxious or if they feel that something should be done. Distrust is more likely to develop in response to secondary consequences of the prediction such as unemployment in the building trades than in response to the prediction. The former may be viewed as something that officials should do something about while the latter may be accepted as an act of nature. Confusing and contradictory statements from political leadership will have a deleterious effect.

The problem is not merely one of trust. There is also the question of whether people have any idea of what various public leaders and their agencies are doing, and whether they assume that something is being done or not. Throughout the present situation little or nothing has been heard from Los Angeles Police or Sheriff's offices, from the Los Angeles Mayor or County Supervisors, or from such private agencies as the Red Cross. The Governor has issued no statement, and news releases have conveyed only fragmentary information about activities of the State Office of Emergency Preparedness and of the Seismic Safety Commission. Do people assume that these agencies are making quiet preparations, or that they are ignoring the possible threat?

Perhaps the most important hypothesis about mistrust of public officials in connection with earthquake prediction is that it is likely to become a symbolic focus for whatever major divisions and conflicts are active in the community at the time, unless the sense of threat and urgency is great enough to unify the community (cf. altruism discussion). Dynes and Russell (1975) and others have shown that conflict following natural disasters is typically an extension of prior community divisions. The earthquake threat was used actively by the proponents of the Nuclear Initiative (Proposition 15) on the June, 1976, primary ballot in California.

A final variable often shown to be important in determining both trust and knowledge of governmental activities is participation in some organized interest group that is able to project a group voice into the political scene and bring back some kind of response from the centers of political power. It is a plausible hypothesis that participation in different kinds of groups will affect different dependent variables in this investigation. Participation in labor unions, political organizations, and other political interest groups may enhance awareness of whatever government agencies are doing, and at least minimize the most extremely cynical views of political leaders. Participation

in service-oriented religious and charitable organizations may sensitize individuals to the common plight and to the disproportionate risk borne by certain groups of people, thus facilitating altruistic responses.

Communication and Decision-making Networks (Research Objective 5 and relevant aspects of research objectives 6, 7, and 11)

Communication between scientists and the public and between officials and the public is not simple and direct, but is a complicated social process. Initially the communication media introduce their own slants and emphases by the way stories are written and the kinds of questions posed during interviews. Thus far the reporting in the Los Angeles Times and the major television networks seems to have been relatively accurate and balanced, but a one-hour earthquake special on television channel nine during spring, 1976, gave a badly distorted and sensationalist interpretation, linking the southern California Uplift to the "Jupiter effect," and describing the earth as opening up to swallow whole buildings. We have attempted to assemble a representative record of media content to compare with official releases and to relate to what people actually hear and believe. Besides the major metropolitan dailies, selected community papers such as the San Fernando Valley News were read. Because of the sizeable Hispanic population in southern California, we monitored the major Spanish-language newspaper.

After the accounts are released by the media they still pass through a complex social process, which we shall discuss under the headings of networks, communication blockages, and rumor.

Networks. Public opinion about the earthquake prediction and the appropriate individual and community response is formed through extended and criscrossing interaction chains. In a laboratory study DeFleur and Larson (1958) found that "when oral content is passed through chains, the number of

original items tend to decrease with each successive retelling; and when the content is successively retold by one person, the number of items tends to increase." The opportunity for the same person to repeat communications in the network (as compared with simple chains) augments the richness of communication. Undoubtedly it also strengthens confidence and facilitates thought about the message. Other evidence confirms that people are more likely to adopt a new opinion or to act on the basis of new information after receiving interpersonal confirmation.

Even though it is difficult to trace the development of collective opinions, it has been possible to trace the diffusion of more tangible innovations. Coleman, Katz, and Menzel (1966) used prescription records to study diffusion of the use of a new drug, gammanym, among physicians. Five stages were identified in the diffusion sequence. The first persons to adopt gammanym did so more cautiously than later adopters. The innovators were those doctors most deeply enmeshed in professional relationships. Their wide range of exposure led them to hear about the new drug from several authenticating sources, and their close and extensive professional relationship gave them the group support necessary for innovating. The second group to adopt the new drug was physicians who were less professionally involved but who were linked to several colleagues by friendship ties. Thus interpersonal linkages with other physicians were essential for early adoption of a professional innovation, but professional ties brought earlier adoption than friendship ties. In the next stage the sparse social ties of the more isolated doctors began to take effect. In these cases too, the investigators were able to demonstrate the part played by social ties by comparing the time of adoption within pairs of doctors linked by friendship and professional ties. The fourth stage included those doctors whose adoption of the drug seemed unrelated to the action of associates--persons whose actions reflected independent decisions. The final

stage was one in which practically no further adoptions occurred.

It would be foolhardy to generalize this model to other situations prematurely. But some parallels to the public opinion process can be hypothesized. 1) A new idea is tried out, and a collective opinion is reached most quickly by those persons who are seriously involved with the area to which the opinion applies. Coworker ties bring about the first diffusion; consequently there is likely to be a first definition of the issue within relevant work and organizational settings. 2) friendship ties carry the opinion process beyond its original serious nexus. But since the issue has already been formulated and aired, the friendship ties have more to do with lining people up on different sides than with defining the nature of the issue. 3) By the time persons with loose or sparse social ties come into the public, the discussion is likely to be well structured already.

The foregoing extrapolation is suggested merely for comparison with the sequence in actual publics, when it can be observed. But the analogy is completed by noting that most doctors first heard of the new drug from standard commercial sources, but almost 90 percent sought or waited for information from other sources before they actually prescribed it. Similarly, word of an earthquake prediction or a recommended course of action will be first introduced to most people through the mass communication media. But before they take a firm stand or act on what they have heard, they will probably seek information and confirmation through the direct personal channels at their disposal.

This practice of verifying communication by discussing it with someone else has been demonstrated in a rather different kind of diffusion situation. DeFleur and Larsen (1958) found that interaction with a neutral communicator did not supply the necessary help and assurance to make an interpretation.

Most people sought to discuss the communication with someone who could offer interpretation and confirmation.

Whether the relationships are those of colleagues, friends, or both, the pathways to public opinion consist of preexisting interpersonal relationships. Robert Park (1940) observed that "News circulates, it seems, only in a society where there is a certain degree of rapport and a certain degree of tension." But stable interpersonal relationships always tie people into small groups of friends or family members. Baur (1960) suggests that people bring matters into their primary groups for clarification specifically to resolve the ambiguities they feel because of conflicting viewpoints available to them in the community. The internal division of the public into factions creates "the stress of ambivalence . . . that induces people to seek clarification in primary relationships." Baur believes that persons with firm opinions on the issue are unlikely to shift under the impact of primary group discussion, but that persons who seek relief from ambivalence are candidates for alignment according to the social pressures and supports operative within their primary groups.

The members of publics are unequal in their effect on the outcome of the opinion process. The general rule that the views of persons whose prestige and reliability are already well established in the community carry more weight than the views of others applies to public opinion. Lazarsfeld, Berelson, and Gaudet (1944), in a classic study of an election public in Elmira, New York, identified opinion leaders at all levels of the community and in all walks of life. As Katz (1957) summarizes the two-step flow, "influences stemming from the mass media first reach 'opinion leaders' who in turn, pass on what they read and hear to those of their everyday associates for whom they are influential." Opinion leadership is fairly specific to the

matter under consideration, and each opinion leader is especially exposed to those items in the mass media that are appropriate to his sphere of influence. This observation suggests that opinion leaders are persons believed to be more competent regarding the issues at hand than their friends--and in most cases they are knowledgeable. Others become opinion leaders because they personify certain values or know a particular person.

Arnold Rose (1968) has pointed out that there is another type who has none of these characteristics but who exercises undue influence because his location puts him in contact with people from different integrated groups. Rose calls these people ecological influentials. The true opinion leader exercises influence because of his position of respect, but the ecological influential is important because he is the link between various groups. Examples are the bartender, the barber, the small-store clerk, the newspaper vendor, the garage mechanic, and the policeman.

Groups that are easiest to recognize are those that are either compact or highly organized and institutionalized. But there are other less easily detected groupings that play an important part in forming public opinion. Georg Simmel (1955) calls attention to social circles as important intermediary units between the individual and the community. The social circle is in many respects similar to the neighborhood and may take its place in serving some needs of city dwellers. Like the neighborhood, its members and leaders are not formally identified, and participation is not institutionalized. Interaction is dense--each member has other members as friends, though not all members know or are friends with all other members. Neighborhood membership is based on propinquity, but membership in a social circle is based on some common interests.

Charles Kadushin (1966) has rendered Simmel's conception more precise

and applied it to a circle he calls Friends of Psychotherapy. Without attempting to replicate Kadushin's sophisticated procedure, we looked for evidence of an "earthquake" or "disaster" social circle--a network of influentials who, through their informal interaction, largely determine what is accepted as orthodoxy on earthquake matters. Such a circle, including within it people close to key political decision makers and seismologists directly involved in earthquake prediction, while having no corporate existence, might largely determine most aspects of policy in earthquake response. A circle is unlikely to be identified through the community sample survey. It is more likely to be detected through a record of the names of persons cited as local authorities in mass media stories and through interviewing these individuals and spokesmen for major agencies concerned with earthquake response. Since the major political decision makers are unlikely to be members of such a circle, but their earthquake advisers may be, it will be important to understand to what extent there is such an informal group shaping public policy.

Communication blockages. The foregoing discussion concerns the channels through which information spreads and through which confirmation and clarification are sought. Sometimes there are blockages--positive interruptions in the communication chains that prevent or delay receipt of information. These blockages occur when members of one group do not communicate with members of another. But there may be a more generalized blockage to the transmission of what the teller regards as bad news. Rosen and Tesser (1970) and Tesser, Rosen, and Tesser (1971) have identified what they call a MUM effect. Experimental subjects often either omitted the bad-news portion of an urgent message or delayed longer in relaying bad news than good news. The effect was even observed in an impersonal and bureaucratized setting. We were led led to wonder whether a message suggesting the possibility of an

earthquake may be softened in the telling (this has probably already happened in the media and on the part of seismologists), and thus encourage a Pollyana attitude. We wondered whether neighbors would hesitate to warn the occupant of an unsafe building, and whether the transmission of warnings would be delayed at all stages in transmission. Since there is a widespread assumption that news becomes sensationalized in the telling, which may be true of news that does not directly affect the teller or hearer, any substantial MUM effect might pose an unexpected obstacle to the transmission of warning information.

Rumor. Finally, an event such as prediction of a severe earthquake is sure to give rise to rumor. Rumor is viewed as a collective effort to develop a shared conception of the situation and develop legitimate rules for behavior. In one of the early writings on rumor, Prasad (1935) discusses the factors giving rise to rumor. Prasad states that rumor arises when there is an unsatisfied need for information, created by a critical situation that demands explanation. In crisis situations, the formal channels of communication are either inadequate or temporarily disrupted. The group demands an immediate explanation of the crisis. Thus rumor emerges to describe, explain and predict events. Reliance on informal and unconventional channels supplements formal channels of communication. The speaker conveys news to the listener, seeks to confirm reports he has heard, and invites the listener to share additional information with him. Thus Prasad concludes that rumor arises in ambiguous situations and is a communicative action through which people attempt to understand the new situation.

Much debate has centered around the question of rumor content. Allport and Postman (1947) addressed the transmission and content of rumor, using an experimental research design. During the process of serial transmission the rumor undergoes a series of distortions designated as leveling, sharpening,

and assimilation. Leveling shortens the rumor so that it is more concise and easier to grasp. Sharpening refers to a tendency toward selective perception, retention, and reporting of details. The tendency for the rumor to become coherent and consistent with one's presuppositions and interest is called assimilation. Allport and Postman's study depicts rumor as a series of distortions, influenced by the frame of reference of the participants in the rumor process.

Peterson and Gist (1951) criticized the notion of serial transmission and argued that the social setting in which rumor takes place is important to its understanding. While in the early stages members of the rumor public vary in their attitudes, interests, and concerns, communication of the rumor tends to reduce divergences and produce a more common definition of the situation. While only one rumor circulated in the laboratory setting, several rumors are simultaneously disseminated in a community. Typically there is a central theme with a variety of detailed interpretations. They argue that rumor is not merely a series of distortions but is a collectively sanctioned solution to a shared cognitive problem centered around a central theme. Their study fails to confirm the leveling tendency, but they note that assimilation plays an important role in determining the collectively determined definition of the situation.

The discussions of rumor in the works of Turner (1964), Turner and Killian (1974), and Shibutani (1966) provide us with an analysis of rumor as process and as collective problem-solving activity. Arising in a situation where information cannot be validated through normal channels of communication, rumor is the process through which the emergent norm develops to give direction to collective action, according to Turner and Killian. Through interaction the group chooses between alternative and competing interpretations of the event.

The mechanisms of keynoting and symbolization are key factors that help explain how the group arrives at a selective definition.

Shibutani expands upon Turner and Killian's work in his analysis of the development of rumor through natural selection. Beliefs that are incompatible with the group's orientation are rejected so that the content becomes more harmonious with shared assumptions. When collective excitement is intense, reports that are incompatible with cultural standards yet consistent with the prevailing mood may be sustained. Consensus is established through the continuing exchange of gestures and sustained by a succession of communicative acts. Shibutani explains that the public's opinion of the credibility of the rumor depends upon ego-involvement. When ego-involvement is high, such as in cases of danger, critical ability is enhanced; whereas, when ego-involement is low, rumors are passed on for amusement, and communication is expressive. Shibutani addresses the question of the temporal and spatial dimensions of rumor. The size and geographic distribution of the rumor group are limited by the availability of communication channels. The speed with which rumor develops depends upon the intensity of collective excitement and the accessibility of channels. He postulates: when the intensity is mild the rate of development is moderate, forthe usual social barriers to interaction remain in effect. When tension is high, speed is limited only by physical barriers to contact.

Festinger (1948) examined the influence of group structure and functioning upon the rumor process. Festinger concluded that hearing the rumor is determined by the number and nature of the channels of communication in the structure that affects the individual. The larger the social network of communication and the smaller the restraining forces against communication, the greater the probability the individual will hear the rumor. Relevancy of the rumor to the listener and involvement of potential hearers in the area related

to the rumor incident were also found to be pertinent to hearing the item. Festinger notes that adequate channels of communication are not enough to facilitate telling the rumor to others. Telling is a function of having interests relevant to the content and of actual involvement in activities relevant to the rumor. He also noted that believers of the rumor tend to be highly involved in the activities related to the rumor and are more likely to relay it to others.

Danzig, Thayer, and Galanter (1958) expanded upon Festinger's discussion of rumor belief and its effect upon collective action. In a study of a rumor circulated after a flood in Port Jervis, New York, the authors concluded that evacuation of rumor believers was not affected by who told the threat message, while the denial message was more effective when it was communicated by officials. They postulated that geographic proximity to the threat rather than prior sensitization was a factor in determining flight. Danzig concluded that individuals can be expected to act simply and directly to remove themselves from danger if sufficiently informed of the nature and consequence of the threat. When the threat is ambiguous, he noted a tendency to seek clarification of the situation and a greater likelihood to make decisions inappropriate for action.

Economic Changes (Research Objective 8)

Since our aim is not to conduct a serious investigation of the economic impact of prediction and near-prediction, but to establish a monitoring procedure that will alert us to any economic changes that are drastic enough to initiate further social readjustments, no comprehensive literature search was conducted. The main outlines of what to look for are indicated in the "Economic Implications" chapter in the NRC Panel report (1975, pp. 67-89),

and in the longer technical manuscript submitted by Gerald Milliman to the Panel. The more recent progress reports from the Haas-Mileti (1977) study include quite specific estimates of the kinds and amounts of economic readjustment anticipated in the event of serious prediction in California. A broader background for understanding economic byproducts of disaster is supplied by the works of Cochrane (1975) and Kunreuther (1973 and 1978) and the NRC Committee on Socioeconomic Effects of Earthquake Predictions (1978).

Organizational Response (Research Objectives 9 and 10)

The sources dealing with organizational response have already been extensively cited. The NRC Panel report's chapter on Political Implications (1975, pp. 105-117) deals with government agencies and officials. The treatment of disaster literature by Dynes (1970) is focused directly on organizational response. The Haas-Miletti (1977) investigation has concentrated on organizational response to hypothetical prediction situations.

One hypothesis suggested in the NRC Panel report (1975, pp. 100-102) is that as the prediction comes to be taken seriously, the approach of locally and nationally based organizations will differ. The former will develop policy with a view to maintaining normalcy in the local community even to the extent of covering up the danger. It is of interest that a spokesman for the Palmdale Chamber of Commerce is already alleged to have urged a scientific magazine writer not to add to the bad publicity the community was receiving. Nationally based organizations, on the other hand, having other options, should examine the local risks in more realistic fashion and develop policy accordingly.

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CHAPTER THREE

Utilization

The project investigators have been mindful of the importance of making the findings from the investigation known to potential users promptly and in a form that facilitates their application to ongoing policy decision-making and implementation. Dissemination activities have been of four kinds. First, the four investigators have been available for informal and formal unpaid consultation by public and private officials involved in hazard reduction activities. These consultation services have ranged from participation in formally constituted advisory committees to informal interviews. No complete record of the less formal consultation has been kept, but a great many hours have been given to this kind of service. The result has been that on several occasions we have been consulted by responsible officials confronted with the necessity to make decisions in a crisis situation. For example, after the El Centro earthquake in 1979 the Principal Investigator was telephoned by a spokesman for the US Geological Survey and by the Head of the Seismology Laboratory at the California Institute of Technology concerning the way they could most effectively report the aftermath of that earthquake.

Second, the investigators have been available to agents of television, radio, and newspapers, and have contributed to a great many items of news and commentary in the mass media. On three occasions we have used the services of the UCLA Office of Public Information, which has been quite effective in calling our findings to the attention of a wide range of media representatives. Again, we have not kept a record of all references to our work, but

these have been extensive. In many instances, the findings from our research have become part of authoritative knowledge, no longer referred specifically to our project. For example, a November 25, 1979, extended discussion of the problem of seismically unsafe buildings in Los Angeles, in the Los Angeles Times, included the following passage: "A 1978 survey of people in the Los Angeles area by the Institute for Social Science Research showed that 41.1 percent believed hazardous buildings 'should be closed down until they can be reinforced for safety.' Another 47.2 percent responded that the buildings 'should not be closed down, but should be posted with signs warning people of danger in case of an earthquake.'" We are reasonably confident that we have made a significant contribution to more realistic understanding of public response to earthquake threat by dissemination of many of our findings through the mass media. Coverage in the mass media has also stimulated much informal consultation of the first kind.

Third, we have prepared and distributed nontechnical reports of our findings on a timely basis to a mailing list of responsible personnel involved in disaster mitigation activities and research. On three occasions we have issued "bulletins" reporting findings that we believed would be most useful if disseminated immediately. One bulletin reported the surprising finding that people overwhelmingly wanted more information about earthquake preparedness, safety, and prediction, at a time when the prevalent view by public officials, seismologists, and media representatives was that people wanted less news about earthquakes. A second bulletin reported the overwhelming public support for drastic action concerning unsafe buildings, and the more divided public view concerning potentially unsafe dams, at a time when Los Angeles City and other municipalities were delaying action because of organized opposition by special interest groups. The third bulletin documented the dramatic effect

of failure of scientists and media to address popular concerns about the meaning of the moderate New Year's Day earthquake (1979) for future earthquake prospects in generating rumor. These bulletins ranged from three to five pages in length, and were mailed to a few hundred recipients.

In addition to the bulletins we prepared a comprehensive but non-technical summary of the major descriptive findings from our basic field survey, conducted in February, 1977. This 150-page paper-bound report entitled Earthquake Threat: The Human Response in Southern California, has been distributed without charge to over 800 persons who are responsibly concerned with the mitigation of natural disaster hazards.

Fourth, we have participated as extensively as our time would allow in conferences where we could report our findings to potential users, or participate in the discussion of policy issues for which our findings were relevant.

The remainder of this chapter consists of a list of the more formal occasions involving participation in conferences and other services. Participation is by the Principal Investigator unless otherwise specified. The following chapters include the three bulletins and copies of published reports of our research.

July 8, 1976--Conference with Professor Kitao Abe and associates from Tokyo University, engaged in study of the Kawasaki earthquake warning.

July 27, 1976--Reported on the current project to a seminar at the Institute for the Study of Destructive Behaviors, preparing a disaster response plan under grant from NIMH, Norman Farberow, Chair, Veteran's Hospital, Brentwood.

August 12, 1976--Reported on the current project to staff at the San Fernando Valley Child Guidance Clinic.

August 24, 1976--Conference with Professor Geipel, Institute of Urban Studies, Technical University in Munich, Germany, concerning disaster planning.

August 25, 1976--Participated in Advisory Committee meeting for Haas-Mileti investigation of socioeconomic aspects of earthquake prediction.

September 1, 1976--Taped half-hour interview on appropirate response to earthquake prediction for local radio station KRTH.

September 24, 1976--Presented seminar on Social Consequences of Earthquake Prediction to the Population Research Laboratory, University of Southern California.

October 2, 1976--Lectured and participated in panel discussion in an all-day program offered by UCLA Extension Division, entitled "Earthquakes: Prediction, Risk, and Survivial".

October 27, 1976--Presented seminar on socioeconomic aspects of earthquake prediction in United States and China to the School of Social Welfare, UCLA.

November 11, 1976--Guest-lectured on social aspects of earthquake prediction in China and implications for the United States at plenary session of the Utah State Sociological Association.

December 2, 1976--Interviewed on earthquake preparation by Robert Abernathy for five-minute prime-time spot on NBC evening news.

January 14, 1977--Participated in meeting of the NRC Committee on the Socioeconomic Effects of Earthquake Prediction.

February 10, 1977--Interviewed for KNX radio (CBS) earthquake documentary.

February 17, 1977--Met with Howard Kunreuther and Alan Ginzberg to critique draft of report for CSEEP.

February 23, 1977--Participated in organizing meeting for Los Angeles Mayor's Task Force on Earthquake Prediction: Represented at bi-weekly meetings of the task force thereafter by Barbara Young, co-investigator.

March 8, 1977--Guest-lectured on socioeconomic aspects of earthquake prediction in course on earthquakes, Geology Department, UCLA.

March 25, 1977--Consulted with IBM Corporation Policy Committee on Seismic Prediction.

April 21, 1977--Joanne Nigg and Barbara Young presented a paper, "Factors Affecting the Emergence of Grass-roots Groups" at the annual meeting of the Pacific Sociological Association, Sacramento, California.

April 20, 1977--Testified at hearing of House of Representative Science and Technology subcommittee, relative to earthquake legislation, Washington, DC.

April 21, 1977--Organized, chaired, and served as discussant at session on "Collective Behavior, Social Movements, and Disaster", at annual meeting of Pacific Sociological Assoication, Sacramento, California.

April 29, 1977--Lectured on social and economic aspects of earthquake prediction and participated in panel at University of Redlands annual science conference devoted to earthquake prediction.

May 17-18, 1977--Participated in Natural Hazards Information Workshop, University of Colorado.

June-August, 1977--Barbara Young represented the project on the Los Angeles Mayor's Task Force to develop a plan for responding to an earthquake prediction (approximately weekly meetings).

July 11, 1977--Speaker on Social and Economic Aspects of Earthquake Prediction, Earthquake Engineering Conference. Meeting at Berkeley, California.

July 26-29, 1977--Member of Planning Committee for an International Conference on Earthquake Prediction, sponsored by UNESCO. Meeting at UNESCO headquarters, Paris, France.

September 2, 1977--Member, Advisory Committee, Leik and Clark NSF-funded research on Natural Hazards Warning Systems. Meeting at Minneapolis.

September 12-13, 1977--Member of Advisory Committee to USGS Earthquake Studies program. Meeting in Golden, Colorado.

September 14, 1977--Member of Advisory Committee, Mann and Wyner NSF-funded research on Responses of Local Governments in California to Seismic Safety Events. Meeting at Santa Barbara, California.

October 18, 1977--Speaker on Social and Economic Impact of Earthquake Predictions for Sigma Xi, Hughes Laboratory Chapter. Meeting in Santa Monica, California.

October 26, 1977--Member of Advisory Group on Earthquake Hazards Reduction, Office of Science and Technology Policy. Meeting in Washington, DC.

November 10, 1977--Presented preliminary findings from Basic Survey at special meeting of the California State Seismic Safety Commission, held in Palmdale, California.

November 16-18, 1977--Denise Paz presented preliminary findings from Basic Survey at the National Conference on Earthquakes and Related Hazards, Council of State Governments. Meeting at Boulder, Colorado.

December 1, 1977--Principal Investigator and Joanne Nigg taped a one-half hour radio broadcast on our research findings through the UCLA Public Information Office, for release over local radio stations.

December 7, 1977--Principal Investigator interviewed at length for a feature on earthquake prediction, broadcast nationwide over the Earth News network.

January 6-7, 1978--Advisory Group on Earthquake Hazards Reduction, OSTP, in Menlo Park, California.

January 13, 1978--Presentation on social and economic aspects of earthquake prediction for social science classes, Pacific Palisades High School, Los Angeles, California.

February 2-3, 1978--Participant, USGS Conference on the Use of Volunteers in the Earthquake Hazards Reduction Program, held in Menlo Park, California.

February 10, 1978--Speaker on Public Determination of Acceptable Risk in a panel on the Auburn Dam controversy, Earthquake Engineering Research Institute, meeting in Los Angeles.

March 8, 1978--Conference with Tony Bird and Karen McNally on citizen involvement in earthquake hazards reduction, Los Angeles.

March 10, 1978--Speaker on Social Response to the Earthquake Threat in southern California, colloquium on Mental Health and Illness, UCLA.

March 20, 1978--Advisory Group on Earthquake Hazards Reduction, OSTP, in Washington, DC.

March 23-24, 1978--Advisory Committee, Leik and Clark research on Natural Hazards Warning Systems, meeting at Minneapolis.

April 20-21, 1978--Member of Advisory Committee, Fred Bates' Guatemalan Earthquake Reconstruction Study. Meeting in Washington, DC.

May 4, 1978--Speaker on Community Response to Earthquake Threat at Earthquake Engineering seminar conducted by Paul Jennings at California Institute of Technolgoy, Pasadena, California.

May 23, 1978--Research findings on public desire for more earthquake information announced on ABC-TV Earthquake Special.

June 1, 1978--Speaker on Social and Economic Effects of Earthquake Prediction, Sigma Xi, University of California Santa Barbara Chapter.

August 16, 1978--Presented a paper, "Earthquake Threat in Southern California: A Case Study in the Popular Understanding of Science," World Congress of Sociology, Uppsala, Sweden.

August 16, 1978--Presented a paper, "Earthquake Volunteers in China and the United States," World Congress of Sociology, Uppsala, Sweden.

October 2-3, 1978--Planning Committee for UNESCO International Symposium on Earthquake Prediction, Paris, France.

October 26, 1978--Participant in Press Conference for the release of the report of the Los Angeles Mayor's Task Force on Earthquake Prediction, Los Angeles.

October 27, 1978--Participants in Press Conference for the release of the report of the Los Angeles Mayor's Task Force on Earthquake Prediction, Los Angeles.

November 6, 1978--Meeting with Earthquake Prediction Planning Group from Shizuoka Prefecture, Japan.

November 24, 1978--Meeting with Earthquake Prediction Planning Group from Shizuoka Prefecture, Japan.

December 13-14, 1978--Advisory Committee Meeting, Leik and Clark NSF-funded research on Natural Hazards Warning Systems, Minneapolis, Minn.

December 18, 1978--Meeting with Leon Knoppoff to discuss possible release of new earthquake near-prediction, Los Angeles.

January 16, 1979--Interviewed by Robert Locke, Associated Press, on socio-economic aspects of earthquake prediction.

February, 1979--Joanne Nigg and Denise Paz met with T. Michael Carter, University of Minnesota, Natural Hazards Warning Systems, to discuss interviewing techniques and research findings of use in planning the Minnesota research.

February 22, 1979--Participant in Workshop on Mass Communications and Disaster, National Research Council, Washington, DC.

February 23, 1979--Advisory Committee meeting, Fred Bates' Guatemalan Earthquake Reconstruction Study, NSF-funded. Washington, DC.

February 28, 1979--Meeting with Mr. Tazaki, concerning earthquake prediction planning in Japan.

March 2, 1979--Meeting with Risa Palm and associates concerning their research on earthquake hazard mitigation policy and real estate values.

March 6, 1979--Testified at Hearing of House of Representatives Science and Technology Subcommittee, relative to National Science Foundation Authorization, Washington, DC.

March 21-23, 1979--Participant and Panel Chairman, Natural Hazard Awareness Conference, Corpus Christi, Texas.

April 1-7, 1979--Member of Organizing Cimmittee, Presenter, and Participant, International Symposium on Earthquake Prediction, UNESCO, meeting in Paris, France. Presented major review paper on "Individual and Group Response to Earthquake Prediction".

April 2-6, 1979--Joanne Nigg presented the paper, "The Mobilization of Altruistic Sentiments for Earthquake Endangered Groups," at UNESCO International Symposium on Earthquake Prediction, Paris, France.

April 2-6, 1979--Barbara Young presented the paper, "The Determinants of Acceptable Risk: Case Studies of the Implementation of Seismic Safety Legislation," at UNESCO International Symposium on Earthquake Prediction, Paris, France.

April 9-11, 1979--Vice-chairman for Social Sciences, Panel of Experts on the Scientific, Social, and Economic Aspects of Earthquake Prediction, UNESCO, Paris, France.

Thursday, April 26, 1979--Panelist, KCET public television special on earthquakes and earthquake prediction, Los Angeles.

May, 1979--Joanne Nigg and Denise Paz met with Thomas Saarenen, Institute of Behavioral Science, University of Colorado, to discuss relevance of our findings to University of Colorado research.

May 4-5, 1979--Advisory Committee meeting, Earthquake Studies Program, US Geological Survey, Reston, Virginia.

July 29,-August 1, 1979--Participant and Presenter, Annual Hazard Research Conference, University of Colorado, Boulder, Colorado.

August 28, 1979--Joanne Nigg and Barbara Young presented a paper, "Community Resistance: A Response to Social Policy Implementation," American Sociological Association meeting, Boston, Mass.

August 30, 1979--Presented paper on "False Alarm Effect in Earthquake Prediction" at American Sociological Association meeting, Boston, Mass.

September 6, 1979--Presented summary of our research as Mexico-California Symposium on Earthquake Hazards in the International Border Region, Tijuana, Mexico.

October 11, 1979--Participant in CBS television special on earthquakes, Los Angeles, Calif.

October 21, 1979--Presented talk on "Socioeconomic Aspects of Earthquake Prediction" in weekend course on Earthquakes, offered by University of California Extension, Berkeley, California.

November 15, 1979--Participant in ABC television special on earthquakes, Los Angeles, Calif.

November 15, 1979--Participant in KTTV television special on earthquakes, Los Angeles, Calif.

November 21, 1979--Meeting with Mr. Sei Hoshino, Program Manager, Earthquake Hazards Mitigation Program, Tokyo Metropolitan Government, concerning development of an earthquake prediction response plan for Tokyo.

December 13, 1979--Presented selected aspects of our research findings and recommendations at the regular meeting of the California Seismic Safety Commission, Los Angeles, Calif.

January 28-30, 1980--Joanne Nigg presented paper on "Response to Prediction Awareness" and served as panelist at Conference on Earthquake Prediction Information, Los Angeles, Calif.

February 14, 1980--Meeting with officials of FEMA to discuss implications of our research, Washington, DC.

February 15, 1980--Presentation on our research to Interagency Coordinating Group for Natural Disasters, Washington, DC.

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CHAPTER FOUR

SPECIAL BULLETINS AND NEWSPAPER COVERAGE

This chapter consists of three bulletins distributed to potential users to provide timely dissemination of findings that might be of greatest use at the time of issue, two accounts of testimony before congressional committees concerning social and economic implications of earthquake prediction, and two newspaper items from the Los Angeles Times. The first newspaper item is an extended discussion of our non-technical report, Earthquake Threat: The Human Response in Southern California. The second item is a briefer commentary stimulated by our third bulletin.

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INSTITUTE FOR SOCIAL SCIENCE RESEARCH
LOS ANGELES, CALIFORNIA 90024

31 March 1978

A NOTE ON MEDIA COVERAGE OF EARTHQUAKE NEWS

The following information is being distributed in the hope that it will be useful to media representatives and officials charged with earthquake safety education.

* * * * *

From time to time it has been suggested that the public resents being periodically reminded of the danger from impending earthquakes. Some have argued that the public would prefer less media coverage of earthquake matters than they have been given. After the extensive media coverage given Henry Minturn's earthquake predictions during December of 1976 and their subsequent disconfirmation by events, this view was especially often expressed.

It is of considerable practical importance for media representatives and officials engaged in earthquake safety education to know whether the two years of news and discussion since the southern California uplift was first announced in February 1976 has produced a saturation effect. Are southern Californians "fed up" with news about the earthquake threat, or are they still interested and anxious to receive new and useful information?

In February, 1978, a set of five questions was included in a telephone survey of 500 adults, representative of the total adult population of Los Angeles County. For each of five types of earthquake information, respondents were asked their personal opinions on whether there had been too little coverage, just about the right amount of coverage, or too much coverage on

television, radio, and in the newspapers during the previous six months. The findings are reported in the accompanying table.

The findings are overwhelmingly one-sided, and the message is surprisingly unambiguous. From sixty-five to eighty-three percent of the respondents want more coverage of the "Palmdale Bulge and scientific earthquake prediction," "what to do when an earthquake strikes," "how to prepare for an earthquake," and "what government officials are doing to prepare for an earthquake." The consensus that too little is reported about preparations by government officials is particularly striking. No more than three percent feel there has been too much coverage on any of these topics.

Only on the topic of "predictions by people who are not scientists" do a substantial number feel that the coverage has been excessive. But even on this topic, somewhat less than a majority (43%) say the coverage has been excessive, and fully twenty-five percent would like more coverage.

There is plainly no evidence here to support the fear that well-conceived earthquake news and features will be rejected by a "saturated" public. Most of the public are ready for more extensive treatment of earthquake prediction than they have received in recent months.

Ralph H. Turner, Principal Investigator
Joanne Nigg, Co-investigator
Denise Paz, Co-investigator
Barbara Young, Co-investigator

All of the materials incorporated in this report were developed with the financial support of National Science Foundation Grant # ENV76-24154. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the Foundation.

The following questions were asked by telephone of 500 adults, representative of the total adult population of Los Angeles County, during the month of February, 1978, approximately two years after first announcement of the southern California Uplift. The percentages given below are based on preliminary tabulations, but the error can be no greater than one percent in any instance.

Now here are some questions about television, radio, and newspaper coverage during the last six months. We want your personal opinion on each of these questions. Would you say there has been too little coverage, just about the right amount of coverage, or too much coverage for each of the following?

	TOO LITTLE COVERAGE	ABOUT RIGHT	TOO MUCH COVERAGE	DON'T KNOW & NOT ANSWERED
Coverage on what to do when an earthquake strikes?	71.4%	24.2%	2.8%	1.6%
Coverage on how to prepare for an earthquake?	77.2	20.6	1.6	.6
Coverage on the Palmdale Bulge and scientific earthquake prediction?	64.7	29.5	3.0	2.8
Coverage on earthquake predictions by people who are not scientists?	25.2	28.4	43.0	3.4
Coverage on what government officials are doing to prepare for an earthquake?	82.6	13.4	2.0	2.0

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INSTITUTE FOR SOCIAL SCIENCE RESEARCH
LOS ANGELES, CALIFORNIA 90024

22 May 1978

NOTES ON PUBLIC AFFAIRS: CONCERNING BUILDING AND DAM SAFETY ISSUES

The following information may be of interest to public officials and others who are concerned with the difficult issues of building safety and dam safety in relation to the current earthquake risk in southern California.

* * * * * * *

During 1976 and 1977 the prospect of a severe earthquake in southern California within the near future heightened concern over the safety of dams and of buildings constructed before 1934 of unreinforced masonry. The Los Angeles City Council debated proposals to require that warnings be posted on unsafe buildings and that buildings used in public assembly be vacated until brought up to acceptable standards of seismic safety. Similar issues were explored in other municipalities. The safety of certain dams in case of earthquake also became an issue, with controversy over whether to continue using the dams while a workable long-range solution was developed.

Public opinion was mobilized in the debate on these issues and expressed through public hearings, letters to public officials and newspapers, editorials, and through spokesmen for various interest groups. There has been relatively little information, however, on views held by the public at large. In connection with our continuing investigation of community response to earthquake threat in southern California we thought it might be useful to survey public attitudes on these issues in quite general terms and for Los Angeles County as a whole.

In July and August, 1977, two questions were included in a telephone survey of 977 adults, representative of the total population of Los Angeles County. Some of these adults had been interviewed previously on the subject of the earthquake threat, but not on these issues, while some were interviewed for the first time. Since there were no significant differences in the answers given by the two groups, we have combined them in reporting the findings. One question concerned building safety; the other concerned dam safety. The findings are reported in the accompanying table.

The first question asked what should be done about buildings that engineers say are likely to collapse in a strong earthquake. People were asked whether the unsafe buildings should be closed down until they can be reinforced, or merely posted with signs warning of the danger, or whether neither should be done unless the owners wish to do so. In light of the articulate and often effective resistance marshalled against even the moderate "posting" legislation, it is striking that a mere four percent of our sample would grant discretion to building owners. Just over two percent volunteered their own more palatable alternative--don't close down the buildings but repair them! But nearly nine out of ten people favor either posting the buildings or closing them down.

There is less agreement on the second question dealing with dams that might be unsafe in a major earthquake. Only one in eight favors draining the dams immediately, though another six and a half percent volunteer their own proposal to drain and repair the dams now. Just over a third favor the compromise proposal to lower the water level rather than drain the dams. Altogether just over half (55.3%) favor some kind of immediate action. In contrast nearly a quarter are willing that we "take our chances on an earthquake and keep on using these dams for water storage." On seventh will put their faith in earthquake prediction and continue using the dams until a damaging earthquake is predicted.

It should be remembered theat southern California was in the second year of a severe drought when this question was asked. We can only guess whether there would be less resistance to draining the water from unsafe dams now that the drought has been broken by the heaviest sustained rainfall on record here.

People often view a concrete situation that affects them personally quite differently from the way they view the same situation in the abstract. So these findings cannot be used to predict the amount of support and opposition that specific proposals will generate. But they probably give a more faithful account of how people feel on the broad policy issues than does the extent of mobilized opposition and support during a crisis. On this basis there is a clear mandate for local jurisdictions to proceed promptly with posting unsafe buildings and to require owners to reinforce or vacate them within a reasonable period of time. There is no consensus on dam safety, and policy makers will have to contend with sizeable opposing blocs who support and oppose immediate action.

Ralph H. Turner, Principal Investigator
Joanne Nigg, Co-investigator
Denise Paz, Co-investigator
Barbara Young, Co-investigator

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The following questions were asked by telephone of 977 adults, representative of the total adult population of Los Angeles County, during the months of July and August, 1977. This was approximately a year and a half after the first announcement of the southern California Uplift, and approximately six months after the Los Angeles City Council had temporarily disposed of the issue of unsafe older buildings in Los Angeles.

Quite a few people live and work in buildings that engineers say are likely to collapse in a strong earthquake. Which one of the following statements do you most agree with?

These buildings should all be closed down until they can be reinforced for safety.	41.1%
These buildings should not be closed down, but they should be posted with signs warning people of danger in case of an earthquake.	47.2%
These buildings should not be closed down or posted unless the owners want to do so.	4.3%
Other (answer volunteered by respondent)--Don't close down buildings but repair them.	2.1%
Other, don't know, and not answered	5.3%
	100.0%

Inspection has shown that a few of the dams in southern California might be unsafe in a major earthquake. Yet, at the same time, we need all the water we can get because of the drought. As I read the following statements, please tell me which one you most agree with.

Unsafe dams should be drained immediately to prevent the possibility of flooding.	12.4%
Unsafe dams should have their water levels reduced immediately to lessen any damage that may occur.	36.4%
Unsafe dams should be used for water storage until a damaging earthquake is predicted.	13.9%
We should take our chance with an earthquake and keep on using these dams for water storage.	23.5%
Other (answer volunteered by respondent)-- Dams should be drained and repaired now.	6.5%
Other, don't know, and not answered	7.3%
	100.0%

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June 22, 1979

A NOTE ON RUMOR AS A SUBSTITUTE FOR AUTHORITATIVE INTERPRETATION OF A MINOR EARTHQUAKE

Earthquake scientists are often unsure whether they should comment publicly on earthquake events, especially minor ones. Media personnel often wonder whether it is in the public interest to air scientific uncertainty about signs that might indicate whether a severe earthquake is imminent. Efforts by residents of Los Angeles County to interpret the significance of the minor earthquake on New Year's Day, 1979, provide an instructive example of what can happen when scientists and the media provide very little guidance.

An earthquake of magnitude 4.6 was felt throughout Los Angeles County at 3:14 in the afternoon on New Year's Day, while the annual Rose Bowl football classic was in progress. The tremor was not strong enough to damage structures, but the shock was unmistakable. For nearly three years County residents had been exposed to discussions of the southern California Uplift on the San Andreas Fault, with constant reminders that a major earthquake could be expected in the area at any time. The New Year's Day quake was the strongest and most widely felt tremor in Los Angeles County since first reports that the Uplift might be the precursor to a major earthquake. Under the circumstances we wondered how many people would try to interpret the minor earthquake as a sign that a greater earthquake

was coming soon, or alternatively as relieving seismic tension and reducing the imminent prospect of a great earthquake.

A random sample of 519 Los Angeles County residents were interviewed by telephone in the three weeks following the minor quake. A total of 367 people had felt the quake when it occurred, another 142 had learned about it soon after, and ten people still did not know there had been an earthquake when we interviewed them. It is interesting to note that among the people who actually felt the tremor, one third admitted to being frightened at the time, three fifths said they were not very frightened or not at all frightened, and one in twenty claimed to have enjoyed the experience. Thus while the New Year's tremor was not a momentous experience, it was nevertheless unsettling to a substantial minority of the people in Los Angeles County.

A series of questions was devised to find out whether people had thought about the possible relationship of this earthquake to a more serious quake in the future. Thirty seven people who felt or knew about the quake had heard someone say, in effect, "Now that we've had an earthquake recently there probably won't be a big one for quite a while." Less than half (16 people) thought that statement might be true. Thirty eight people had heard that the recent earthquake didn't make any difference in whether there would be a big earthquake soon. Three fourths of these people (29 people) thought this second statement might be true. But 184 people, or 36 percent, had heard that the recent earthquake could be a sign that a bigger one was coming soon. And 76 percent of them (140 people) thought that might be true.

Altogether 41.9 percent of the people who had felt or heard about the earthquake had heard one or more of these interpretations, and 32.0 percent thought that one or more of the interpretations they had heard might be true. If our sample is representative, as we have every reason to believe

it is, many hundreds of thousands of Los Angeles County residents were thinking about the small quake as a sign for the future.

The crucial question is where people got their ideas and interpretations. Did they get them from relatively authoritative sources, or from rumor? In our interviews with comparable samples of Los Angeles County residents during the preceeding two years the media--television, radio, and newspaper--were consistently given as the principal sources of information about future earthquake prospects. We asked the people in our New Year's Day earthquake sample whether they had heard of the southern California Uplift (Palmdale Bulge) and what was their chief source of information about it. True to the pattern in our previous interviews, 88 percent named the media or magazines and books as their chief sources. Only seven and one half percent named friends, relatives, or coworkers. But when we asked where they had heard interpretations of the New Year's Day earthquake, the answers were quite different.

On the average, fewer than ten percent named the media, books and magazines, or an authoritative source. Even with a sizable group unable to remember the source, over two thirds named lay people as their source. The most frequent answers were friends and coworkers. The significance of the small quake for the future had been the topic of widespread discussion at work and among friends. Without guidance from authoritative sources, relayed through the media, people turned to friends and coworkers for their interpretations.

Consistent with these findings, the investigators personally heard rumors about supposed earthquake forecasts during the month of January. The rumors were reported with a sense of conviction and concern. In light of a widespread disposition to interpret the New Year's Day earthquake as the harbinger of a major disaster, there is little wonder that people were unusually susceptible

to such rumors.

* * * * * * * * * * * * * *

Policy decisions should not be based exclusively on one set of observations. But the evidence here does demonstrate that silence by authoritative sources and the media does not stifle speculation about the meaning of earthquake events. What it does is force people to rely on rumor to fill the interpretation gap. Scientists may protest that they can not supply the public with confident answers to their questions. But scientists have constantly expressed uncertainty about the significance of the Uplift. Most people have responded by continuing to rely on the media and scientists for guidance when thinking about the Uplift. This is probably a healthier state of affairs than the widespread reliance on rumor to fill the interpretation gap concerning the earthquake on New Year's Day, 1979.

Ralph H. Turner, Ph.D.
Professor of Sociology
& Principal Investigator
Joanne M. Nigg, Co Investigator
Denise H. Paz, Co Investigator
Barbara S. Young, Co Investigator

All materials incorporated in this report were developed with the financial support of National Science Foundation Grants #'s ENV6-24154 and PFR78-23887. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the foundation.

SOURCE OF INFORMATION ABOUT SOUTHERN CALIFORNIA

UPLIFT AND THE NEW YEAR'S DAY EARTHQUAKE

Information source	Chief source concerning Uplift	Interpretations of the New Year's Day Earthquake		
		No bigger quake soon	Big quake coming soon	Makes no difference
Detailed percentages				
Media	84.0	10.8	5.3	5.5
Books & Magazines	3.7	--	--	0.5
Authorities	--	2.7	--	2.2
Family & relatives	2.1	8.1	2.6	6.6
Friends & neighbors	3.7	37.9	31.6	35.2
Coworkers & classmates	1.7	16.2	36.8	28.0
Don't know, others	4.8	24.3	23.7	22.0
Total	100.0	100.0	100.0	100.0
(Total number)	(294)	(37)	(182)	(38)
Summary percentages				
Media, publications, authorities	87.7	13.5	5.3	8.2
Lay people	7.5	62.2	71.0	69.8
Don't know, others	4.8	24.3	23.7	22.0

Pages 111-117 have been removed.

Due to legibility problems, the following has been omitted:

Hearing Before the Subcommittee on Science, Research and Technology of the Committee on Science and Technology, U.S. House of Representatives, 95th Congress, First Session, April 20, 1977, pp. 132-143.

U.S. Government Printing Office
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1980 NATIONAL SCIENCE FOUNDATION AUTHORIZATION

HEARINGS

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCE AND TECHNOLOGY

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

FIRST SESSION

ON

H.R. 2276

(Superseded by H.R. 2729)

FEBRUARY 15, 21, 26; MARCH 1, 6, 1979

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more federal research funds for the critical work which must be done in this area. I can assure you that the research is relevant to the actions which I, as an elected local official, must take in the very near future. Thank you for permitting me to testify before your committee.

STATEMENT OF DR. RALPH TURNER

Dr. TURNER. In my testimony this morning I should like to point out why we cannot hope to deal constructively with the problems of earthquake hazard unless research in physical science and engineering is complemented by a strong and continuing program of applied social science research. Let me begin with a concrete illustration.

Every community at risk from earthquakes, from New England and the southern seaboard to the Mississippi Valley, the Mountain States, the west coast, Alaska, and Hawaii, has many buildings that were not constructed in accordance with modern seismic safety standards.

Their collapse would mean tens of thousands of casualties in case of a severe earthquake in a densely populated area. We have sufficient geological and engineering knowledge to recognize the problem and to identify a program that would reduce the potential casualties to a small fraction of current estimates.

Yet there is not a major city in which substantial progress has been made to implement these plans! Why do we stand paralyzed when we have the technical knowledge to save lives?

The Los Angeles City experience since the San Fernando-Slymar earthquake in 1971 is instructive. Continuing efforts by the City Council to devise a workable and acceptable program for reinforcing or retiring the hazardous buildings are still floundering. Even the modest proposal to post signs identifying the hazardous buildings for the benefit of potential users was blocked in 1977.

But more important, careful social science investigation would have revealed the complex pattern of unintended consequences that are sure to follow implementation of a hazard reduction program such as this. Under some circumstances earthquake hazard reduction programs can destroy the economic base for those population segments who are least able to find alternatives or weaken the moral fabric of the community in ways that are known to lead to increased rates of crime and political alienation. Social and economic costs must be adequately understood and evaluated before we can weigh the costs against the benefits of any public program.

With well conceived social science research we can go beyond merely weighing costs and benefits to devise programs that will minimize the expected social and economic costs and maximize the benefits. The truth is that unless the implementation of technological program is part of a larger package that deals constructively with potential economic and social disruption, more people may be hurt than helped by earthquake hazard reduction programs. Social science research is the key to devising these larger packages.

Social science research is needed to improve the effectiveness of (1) disaster response in case of an earthquake, (2) earthquake hazard mitigation in earthquake-prone communities, and (3) the developing capability for predicting earthquakes.

(1) Severe earthquakes occur too infrequently in a given location, are too sudden in their occurrence, and are too massive in their impact for local officials charged with organizing disaster response to learn by trial and error as they have done with tornadoes, floods, and many other types of disaster.

If we are not to lose lives needlessly and endure unnecessarily extended community disruption and economic loss we must have careful social, economic, and legal studies to identify optimal guidelines for emergency response to an earthquake.

How must police and fire departments alter their usual modes of operation to deal with the unique features of earthquake disaster? What types of emergency relief are typically accomplished by local volunteers before official emergency teams and facilities can reach the scene, and what critical needs can local volunteers not supply?

What popular misconceptions about earthquakes must be promptly countered and what popular conceptions can be used to support constructive public behavior in the wake of an earthquake?

Should rumor be quickly countered or allowed to play itself out, and are such devices as rumor hotlines effective or a needless diversion of personnel and resources from more urgent and useful tasks? What resources indigenous to the local community can be used to establish emergency communication in case electrical power is lost and telephone, radio, and television communication are interrupted?

Under what circumstances are publicly provided shelters likely to be utilized and when are they likely to stand unused, diverting resources and personnel from more essential functions?

Over the longer period, how is it possible to administer economic aid justly, yet with a minimum of delay and demoralization? What kinds of economic aid facilitate the return to economic self-sufficiency and what kinds retard the process?

These are but a few of the many questions to which they are not yet satisfactory answers and for which social science research is essential.

(2) The problem of old and seismically unsafe structures illustrates the need for social science in facilitating long-term earthquake preparedness. Embedding technological measures in comprehensive social and economic package programs, tailored to the distinctive nature of the impact community, is probably the most important contribution that social science can make to earthquake hazard mitigation.

There are also unanswered questions about the optimal level of public awareness and concern over earthquakes and the most effective strategies for maintaining optimal awareness, personal earthquake preparedness, and public involvement in community-wide planning for earthquakes.

For example, our current research in Los Angeles County offers tentative support for the theory that increased fear and concern over the earthquake danger leads to higher levels of household emergency preparedness, but only up to a point. Very high levels of fear and concern seem to have a paralyzing effect.

There is also a widely held but unconfirmed belief that too frequent reminders of danger will lull people into complacency. As yet we have

very little knowledge and understanding by which to evaluate these suppositions.

(3) Earthquake prediction capability is a powerful weapon for saving lives, but a two-edged sword when it comes to economic loss and community disruption. Early investigations suggest that fairly drastic economic readjustments may follow release of an earthquake warning with an extended lead time, having both positive and negative consequences for the community.

One of the major conclusions by the Los Angeles Mayor's task force on earthquake prediction was the need for concentrated research to identify the kinds of economic readjustments likely to follow earthquake warnings under various circumstances and the most constructive way for government at all levels to deal with them.

But even to take advantage of the life saving potential from earthquake prediction requires a great deal more understanding than we now have. What are the feasible periods of time for keeping the public on the alert for a predicted earthquake?

How can we deal most effectively with the probabilistic rather than certain character of earthquake prediction, before the predicted time and after a possible false alarm?

What are the most likely effects of false alarm and how can a disconfirmed warning be turned to construtcive use? How can we insure dissemination of timely warnings to the more isolated segments of the community? How can we foster public discrimination between well grounded scientific predictions and ill founded forecasts from scientific and nonscientific sources?

When we speak of social science research into these three aspects of earthquake hazard mitigation, we have in mind several kinds of investigation calling for different professional skills.

As we have indicated, penetrating economic studies are in great demand. We have only begun to explore the legal ramifications of earthquake response, preparedness, and warning. Naivete about legal implications will insure obstructive delays in implementing important measures and unintended negative consequences that may outweigh potenial benefits.

Organizational studies are important to insure that programs are not so transformed in the process of implementation that they no longer have their intended effects. The human response and the role of individuals, families, neighborhoods, and groups in a process that often treats them as passive and impersonal agents must be better understood for plans to work well. And communication studies deal with the liefline upon which all hazard mitigation efforts depend.

While acknowledging the importance of the problems, critics sometimes doubt that social science research will be sufficiently practical. I would not deny that it is easier to devise research that identifies a problem than to plan research that will produce solutions.

But sometimes critics expect more from social science research than they do from research in the physical sciences and engineering.

No one expects a single piece of research in engineering to answer even a major share of the questions on how to construct an earthquake-safe building.

Yet critics sometimes demand that a single piece of social science research supply a comprehensive and final blueprint for responding to an earthquake or an earthquake warning. Like engineering research, social science research can and does make substantial increments of highly practical knowledge.

Two modest examples of my own research will suffice. As part of a National Academy of Sciences earthquake study team traveling to the People's Republic of China in 1976 I was anxious to learn how the Chinese use of amateurs in their earthquake prediction program worked and how these lessons might be translated for use in the United States.

Prior to this trip I carefully reviewed studies on the use of volunteers in a wide range of activities in the United States so as to know better what to look for in China.

Interviews with participants in the Chinese program and officials at the State seismological bureau responsible for organizing volunteer groups provided answers to many of my questions. I have since been able to make recommendations to the U.S. Geological Survey and readers of an applied journal concerning the most feasible ways to implement a volunteer earthquake prediction program in the United States.

A final question sometimes asked is whether there are enough social scientists who are interested and capable of executing first rate research on earthquakes to make use of an expanded research program of support.

Recent interest in earthquake research has brought such outstanding investigators as Peter Rossi, the current president of the American Sociological Association, into the field, and brought back one of the pioneers in American disaster research, Fred Bates.

The institute of behavioral science at Boulder, Colo., and the disaster research center at Columbus, Ohio, have produced a steady stream of specialists in disaster research, many of whom would like to extend their research to include earthquakes.

I have encountered great interest in earthquake research among our best doctoral students at UCLA. Some of these students were disillusioned by the severe cutback of funds last year and have begun to look for more dependable areas for study.

But there is already a substantial corps of high-caliber social scientists who have addressed earthquake problems and many more who find interesting problems in the earthquake field.

Congressional commitment to a stable program of support for applied social science research into earthquake hazard mitigation will insure a steadily increasing body of research workers in this field.

Thank you, Mr. Chairman.

Mr. ERTEL. Now, prior to addressing any questions that we have to you, possibly we ought to hear Councilwoman Picus.

STATEMENT OF COUNCILWOMAN JOY PICUS

Ms. PICUS. I am Councilwoman Picus from Los Angeles representing the third district. I chair the city council's building and safety committee dealing with earthquakes. I am very pleased to follow

Pages 121-124 have been removed.

Due to copyright problems, the following articles have been omitted:

1. Los Angeles Times, Thursday, August 23, 1979, page 3, 1st section: "Few in Poll See Quake Risk as Urgent," by George Alexander.

2. Los Angeles Times, Sunday, October 14, 1979, page 6, 1st section: "Forecasters Warn of Earthquakes, but Residents Unshaken by the Predictions," by Ken Lubas.

CHAPTER FIVE

EARTHQUAKE PREDICTION VOLUNTEERS: WHAT CAN THE UNITED STATES LEARN FROM CHINA?

This chapter consists of a paper read at the Ninth World Congress of Sociology, Ad Hoc Group on Disasters, Uppsala, Sweden, August 16, 1978, and published in the journal, Mass Emergencies, Volume 3, 1978, pp. 143-160.

Pages 126-144 have been removed.

Due to copyright problems, the following article has been omitted:

"Earthquake Prediction Volunteers: What Can the United States Learn From China?" by Ralph H. Turner, in Mass Emergencies*, Vol. 3 (1978), pp. 143-160.

*Published by Elsevier Scientific Publishing Company
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CHAPTER SIX

INDIVIDUAL AND GROUP RESPONSE TO EARTHQUAKE PREDICTION

This chapter consists of a paper read at the International Symposium on Earthquake Prediction, sponsored by U.N.E.S.C.O. and held in Paris, April 2-6, 1979. The paper will appear in the published Proceedings of the Symposium, to be released in 1980.

INDIVIDUAL AND GROUP RESPONSE TO EARTHQUAKE PREDICTION

Ralph H. Turner

The effectiveness of earthquake prediction as a tool for reducing the hazard of earthquakes depends upon developing community response plans that can be implemented when predictions are issued. The development of such plans depends in turn on understanding how individuals and groups will respond to the news of an earthquake prediction or warning, and to public efforts to carry out hazard reducing programs. Because of the relatively unprecedented nature of earthquake prediction, relatively little can be said with confidence about individual and group response. The purpose of this essay is to review what little can be said on the basis of available evidence and to identify issues of potential importance.

Sources of Information

Concern about individual and group response to earthquake prediction began less than a decade ago, and hypotheses must be formulated for the most part without empirical evidence from actual instances of earthquake prediction. In a pioneering working paper dealing principally with organizational response, Haas (1974) included hypotheses concerning individual interpretation of disaster warnings and disposition toward panic. Two significant attempts to assess the probable effects of earthquake prediction broadly and identify important issues for investigation appeared in the U.S.A. in 1975. Applying a "technology

assessment" approach, Jones and Jones (1975) suggested five conditions that should influence how citizens respond to an earthquake prediction, developed three scenarios describing hypothesized response sequences to predictions under various combinations of the five conditions, offered a series of generalizations about possible effects of prediction, and outlined action options available for decision-making in the face of uncertain threat. A panel of the U.S. National Research Council (N.R.C. Panel, 1975) prepared a more comprehensive assessment of public policy implications of earthquake prediction, concluding with an extensive list of recommendations for action and for research. A summary of findings and recommendations was published separately by the Panel chairman (Turner, 1976). Two years later, Weisbecker and Stoneman et al (1977a, b) completed an analysis of government decision-making under uncertainty that underlined some of the uncertain assumptions about individual and group response with which governments must cope. And Meltzner (1977) reviewed evidence of public unconcern over the earthquake threat and its consequences of denying government officials a constituency to support hazard mitigation programs.

In the absence of direct evidence on how people respond to earthquake prediction, all of these analyses made inferences principally from two kinds of research, namely: that dealing with response to warnings about other kinds of natural disaster, and more basic behavioral science research dealing with human response to threat and decision-making under conditions of uncertainty. Research on social aspects of disaster has been briefly but comprehensively summarized by Fritz (1961, 1968) and reviewed more fully by Baker and Chapman (1962), Barton (1969), Dynes (1970), and Mileti, Drabek, and Haas (1975). Recent developments are reviewed by Quarantelli and Dynes (1977) and in a volume edited by Quarantelli (1978). Important research dealing specifically with response to disaster warnings includes community response to a rumor of imminent catastrophic flooding from collapse of a dam (Danzig, Thayer, and

Galanter, 1958), response to an unanticipated air raid warning (Mack and Baker, 1961), response to tsunami warnings in two communities (Anderson, 1970), and response to a fictional news broadcast reporting the explosion of a nuclear power plant near Malmo, Sweden (Rosengren, Arvidson, and Sturesson, 1975). In the vast literature on decision-making under threat and uncertainty, four sources are especially useful. Leventhal (1970) presented an exhaustive and critical review of experimental research dealing with fear, compliance, and coping responses to fear communications. Grosser, Weschsler, and Greenblatt (1953) assembled a number of studies, several of which apply a psychiatric perspective on response to ambiguous threat. Slovic, Kunreuther, and White (1974) suggested a revision in standard economic models of rational decision-making to correspond more closely with empirical findings concerning response to disaster warnings. And Janis and Mann (1977) formulated a comprehensive theory of decision-making under stress, based on both experimental and field observations.

Empirical evidence relating directly to earthquake predictions is just beginning to accumulate. Haas and Mileti (1976, 1977) questioned selected business and public leaders and a sample of householders in California concerning response to hypothetical earthquake prediction scenarios. Although their findings deal primarily with economic response, they supply information on the credibility of warnings and other aspects of individual and group response. In New Zealand, Britton (1977) interviewed spokesmen for twenty-three large-scale organizations concerning their attitudes toward prediction and their concerns in case a warning were issued. In Japan, widespread rumors concerning a seer's forecast that an earthquake would occur on December 1, 1974, in the Kanto region of Tokyo, and announcement in 1974 of an abnormal land upheaval around Kawasaki City that might presage an earthquake, provided the occasion for a series of studies and comparisons involving surveys of large numbers of residents.

These studies are variously reported in published and unpublished papers in English and in Japanese (Abe, 1978; Haas, 1976; Ohta and Abe, 1977; Nakasato et al, 1978). A more recent program of research in the Shizuoka prefecture includes a study of response to hypothetical earthquake prediction scenarios (Abe and Akimoto, 1978c) and response to aftershock warnings and rumors following the Izu earthquake of February 14, 1978 (Abe and Akimoto, 1978a & b).

The report of a massive uplift on the San Andreas fault near Los Angeles in the United States in February 1976 provides another occasion for study of response to a near-prediction. Dunn (1978) reports interviews with 120 residents concerning their awareness of the uplift and their attitudes and actions in response to the earthquake threat. In research which is still underway, Turner, Nigg, Paz, and Young (1978) report interviews with approximately 1700 residents of Los Angeles County and continuing interviews with a smaller panel of residents over a period of twenty months, dealing with awareness and understanding of the earthquake threat, fear and concern, actions taken and expectations regarding government response, and the extent of altruistic and collective concern expressed. In some respects findings from this study can be directly compared with the Kawasaki and Shizuoka studies in Japan.

Finally, the extensive and often successful experience with earthquake prediction in the People's Republic of China, though less accessible to study by social scientists than events in Japan and southern California, is an important source of information. Chinese reports on their prediction successes, especially with the Haicheng earthquake of February, 1975, include "A Brief Summary of the Work of Premonitory Observation..." (1976), "A Report from an Earthquake Area" (1976), Chieh-Wen (1976), Seismological Delegation of the People's Republic of China (1976), "State Seismological Bureau is Holding a National Conference..." (1977), Teh-run (1975), "To Raise Seismology and Seismic Technology to a New Level" (1977), Yang-Kuan Street Revolutionary

Committee (no date), and Yingkou City Earthquake Office (1978). Two books on earthquakes and earthquake prediction sold in China for the lay reader are Di-zhen Wen-da Bian-xie-zu (1975) and Ying-Ko Shi "Liao-nan Di-zhen" Bian-xie-zu (1975).

Prediction Characteristics Relevant to Individual and Group Response

Several anticipated characteristics of earthquake predictions are likely to make their effects on individual and group behavior different from warnings of other kinds of disaster (N.R.C. Panel, 1975; Turner, 1976). The likelihood that predictions or near-predictions may be issued months, years, or even decades before the event creates problems of sustaining interest and vigilance and the possibility of unmanageable anxiety, while allowing time for selection among a great many possible adaptive responses. For severe quakes the prediction time window within which the quake is to occur may also be weeks or months in length, making precise planning difficult and short-term evasive responses relatively infeasible. The practice in the People's Republic of China is to withhold any general announcement of an earthquake warning to the public until signs indicate that the earthquake is imminent, but in western nations the public will generally be kept informed at each step in development of the prediction.

Research has shown that people seek to confirm any warning through the testimony of their own senses before taking protective action. Except when there is a series of foreshocks, as there has been for some of the predicted Chinese quakes, it is not apparent that there will be any visible signs on which people can rely. The need to confirm the warning personally may explain why two-thirds of southern Californians believe that people can detect when an earthquake is coming by watching for unusual animal behavior, 44 percent believe there is a distinctive kind of "earthquake weather," and 39 percent

believe in earthquake premonitions (Turner et al, 1978). The relative frequency of nondestructive quakes and the infrequency of destructive quakes in a given location means that experience may lull people into false security, and that each destructive quake will be the first such experience for a large proportion of the population.

Jones and Jones (1975) proposed that how people will respond to an earthquake prediction will depend upon five sets of conditions: the community characteristics of the area into which the earthquake prediction system would be introduced, the system's design and administration of the system, the magnitude of the earthquakes predicted, the relative accuracy of the early predictions produced by the system, and the degree of professional consensus supporting the official predictions. Haas and Mileti (1976) asked business and community leaders what constituted a credible prediction on which they would feel impelled to act. The reputation of the prediction source was most important; agreement among scientists, expressed certainty or probability, and specificity of location were next most important; and estimate of magnitude, specificity regarding time of occurrence, and length of lead time were also considerations. Abe (1978) found that many more Japanese believed and acted on the Kawasaki announcement issued by a governmental agency than did so in the case of a fortune teller's forecast of an earthquake in the Kanto area in 1973. In southern California in 1976 many people had heard about the possibility of an impending earthquake from both scientific and nonscientific sources, but they were more likely to take the former seriously. However, the most frequently mentioned announcement was the prediction issued by an unqualified amateur and featured on local television stations, and many people mistakenly identified the amateur as a university scientist. In this instance the fact that the prediction was for a specific date (December 20, 1976) gave it a manageable quality that was lacking for the vaguer but more

scientifically credible uplift announcement and for a subsequent ambiguous prediction with a one-year time window, issued by a reputable university seismologist (Turner et al, 1978). Thus while scientifically reputable predictions may be more widely believed in western societies, the specificity of a prediction with respect to time and location may have more to do with whether people take low cost protective actions.

Fear, Panic, Mental Disorder, and Outmigration

Scientists and public officials often express concern lest the release of an earthquake prediction and warning should cause widespread disabling fear in the community, leading to a rise in mental illness because of the unrelieved strain and anxiety of anticipating disaster, stimulating scapegoating and divisive conflict in the community, and causing mass panic and considerable outmigration from the threatened area. In general, disaster research has indicated that after brief initial disorientation, people subordinate their fear to the maintenance of life as usual, that serious scapegoating is less frequent than supposed, that mental illness and panic flight occur under only rather extreme and rare combinations of circumstances, and that leaving a threatened community is more difficult for most people than making the best of the situation in a familiar setting.

In both Japan and southern California the majority of people admitted fear and concern over the earthquake prospect, though the majority in the latter area denied any increase in concern since announcement of the uplift, and the earthquake threat was not salient in relation to other everyday concerns. Fear was expressed in both locations through periodic rumor flurries and demands for more definite information in place of ambiguity, though only a small minority of persons may have actively contributed to these responses. In Japan fear has been shown to vary with density of population and vulnerability

of construction, remoteness and inaccessibility of relatively safe locations, and recency of migration to the area (Nakasato et al, 1978). In southern California fear was unrelated to residential vulnerability, prior earthquake experience, and newspaper readership. Fear was slightly less intense among persons who were strongly attached to their local community, and less for the elderly and the retired, for males, for whites as compared with ethnic minorities, and for those who were fatalistic or skeptical about earthquake prediction (Turner et al, 1978).

Nothing approximating mass panic was observed. However, if the widely accepted theory that panic occurs when there is a feeling of possible entrapment, a perception of collective powerlessness, and a feeling of individual isolation in a crisis situation (Quarantelli, 1954) is true, panic flight might be predicted in case of a very short-term prediction, issued with a high degree of confidence, under circumstances in which people believed safety depended upon escaping the impact area and there were only limited avenues for escape. The Chinese report no instances of mass panic. According to accepted theory, their policy of identifying safe areas close to dwellings or other buildings in which people can seek refuge quickly and easily, and providing useful work to be done while waiting in a situation that provides group support (Haicheng Earthquake Study Delegation, 1977) should have forestalled panic. Unfortunately, reports of mass panic from situations which are similar to an imminent earthquake warning in which comparable forethought has not been taken cannot be accepted at face value because, as Rosengren et al (1975) have convincingly shown, mass panic may be reported authoritatively in the public press in situations where careful investigation fails to reveal evidence that any panic occurred.

A more realistic concern than panic is the prospect of social disorganization as individuals and families deal with their immediate problems in an uncoordinated fashion. Many residents of Shizuoka province tried to telephone home or workplace

after the January 18, 1978 aftershock warning (Abe and Akimoto, 1978b). The hypothetical earthquake warning study in the same region indicated massive traffic congestion from movement between workplace, school, and home as family members sought to be reunited before the impending disaster (Abe and Akimoto, 1978c).

Critics of earthquake prediction have pointed out that the issuance of a prediction transforms an "act of God" into a partially controllable event, making human institutions responsible for what was a matter of luck before and setting the stage for blaming and scapegoating (Weisbecker et al, 1977). But even in situations in which human error could plausibly have contributed to the disaster, research has shown a surprisingly strong tendency to grant authorities the benefit of the doubt (Bucher, 1957; Farhar, 1976). After a year of living with the threat posed by the uplift, southern Californians still expressed a generally positive view of scientists and an only slightly skeptical view of the way government officials were dealing with the earthquake threat. Relatively few suspected either scientists or officials were holding back information from the public because of self-interest (Turner et al, 1978). Ohta and Abe (1977) found that only 11 percent of their respondents felt annoyed at the Kawasaki near-prediction, and were surprised to note that those who took the prediction more seriously or felt much uneasiness about it were especially likely to view the information about the earthquake prospect as worthwhile rather than annoying. Even after two official warnings about aftershock danger following the 1978 Izu earthquake had stimulated false rumors which exaggerated the specificity of the warnings, a large majority of residents in Shizuoka prefecture favored the publication of earthquake predictions, although the majority was smaller in the area devastated by the quake (Abe and Akimoto, 1978b). From other research there is evidence of antagonism on the part of groups who feel they have been singled out from the larger community to be

inconvenienced by programs for disaster mitigation, such as people whose homes or places of business are ordered evacuated or demolished because they are exceptionally vulnerable. And a minority of the population is highly critical of anyone who predicts disaster. But scapegoating has not been the prevalent response thus far.

Although claims of widespread severe mental illness after natural disaster have generally been discredited and there is no evidence to suggest such developments in response to the Kawasaki or southern California uplifts, we cannot rule out the possibility that living under a much more credible threat of a severe earthquake for several months might produce such an effect. Jones and Jones (1975) hypothesized that in case a moderate earthquake were predicted for the near-term future, there would be selected instances of greater stress, such as insomnia and irritability, among sensitive people, and in case of a major earthquake predicted ten years in advance there would be widespread instances of such emotional disturbances as alcoholism and suicide as the predicted date drew near.

For most people in a threatened area, outmigration is not a realistic possibility because their employment and property keep them where they are, alternative arrangements elsewhere are not easily and quickly made, and they feel most secure in their own homes. The fear of looting and vandalism is often the ultimate deterrent to leaving home in an emergency. Furthermore, unlike tornadoes, hurricanes, and floods, destructive earthquakes seldom recur in the same location except at intervals of decades. Hence long-term commitment to a community is unlikely to be weakened by the short-term danger. The question, then, is whether a substantial fraction of these people who are less tied to the local area will take advantage of the opportunity to move to a safer location. Jones and Jones (1975) opined that an earthquake prediction would have little effect on population movement, except immediately preceding

the predicted date for a very large earthquake and for shorter movements to safer locations within the immediate area. Neither the Kawasaki nor the southern California uplift appear to have stimulated noticeable outmigration. Only ten out of 1450 persons in the southern California study mentioned earthquake danger as a reason for considering changing their place of residence (Turner et al, 1978). In San Francisco, California, in 1976, 5 percent, 19 percent, and 40 percent said they would move or leave the area temporarily if an earthquake were predicted with twenty years, one year, or one week's advance notice, respectively. These figures were slightly higher than the rates reported from a similar survey taken six years earlier, before the prospect of earthquake prediction had been widely discussed and before the damaging 1971 San Fernando earthquake had taken place (Sullivan, Mustart and Galehouse, 1977). However, based on their interviews, Haas and Mileti estimated that under the most credible prediction of a severe earthquake nearly 60 percent of the population would leave the area just before the predicted date, about ten percent of them permanently. While it seems unlikely that so large a proportion would actually make the move in case of a real earthquake threat, attempts to move out by even a much smaller fraction of the population could be quite disruptive to the community.

Inaction, Denial, and Acceptable Risk

Inaction, apathy, and denial of danger are more often cited in the disaster research literature than panic as prevalent responses to published warnings. Surveys of California residents directly after the San Fernando earthquake of 1971 (Meltzner, 1977) and again in 1974 (Weisbecker et al, 1977) indicated relatively little knowledge or concern about the earthquake threat. Few of the New Zealand respondents (Britton, 1977) intimated they knew anything about earthquake processes. A year after announcement of the uplift, two out

of five southern Californians interviewed had not heard of it and fewer than half had heard and understood its connection with a possible earthquake (Turner et al, 1978). On the other hand, in Japan awareness of the Kawasaki announcement was much higher (Ohta and Abe, 1977), perhaps because of more immediate experience with damaging earthquakes and more vulnerable living conditions. In southern California, in spite of this limited knowledge, and in spite of many scientific and nonscientific earthquake cautions that people say they do not take seriously, nearly half of the people expected a damaging earthquake within a year (Turner et al, 1978).

Threatening situations are often met not by simple apathy and disbelief but by active denial of danger, which is often interpreted as a psychological defense mechanism. The observation that residents of the city of Palmdale, located in the center of the southern California uplift, expressed themselves as less concerned about the prospect of a coming earthquake than did interviewees at greater distance from the uplift lends suggestive support to the hypothesis of defensive denial (Turner et al, 1978). While the majority of Dunn's (1978) interviewees in communities near the southern California uplift expected a major earthquake in their lifetime and acknowledged that an earthquake would cause major damage in their area, residents in each community sampled mentioned other locations they viewed as more susceptible to earthquake danger than their own. On the other hand, most of the Japanese subjects admitted uneasiness about the earthquake prospect and there was a general tendency to exaggerate the imminence of the disaster (Ohta and Abe, 1977).

Another explanation for passivity in the face of threat is an attitude of fatalism, that there is very little people can do to enhance their safety in the face of a natural event such as an earthquake. In southern California from a third to a half of the people endorse fatalistic attitude statements concerning control over earthquake damage. However, fatalistic

attitudes appear to apply less strongly to the fate of a specific individual than they do to the chance of lessening harm in the community at large (Turner et al, 1978). It is well known that such fatalistic attitudes vary greatly among different cultures, and are more characteristic of members of lower socioeconomic strata and disadvantaged minority ethnic groups.

Still another explanation for inaction is an unjustified faith in public authorities. Britton (1977) suggests that in New Zealand people are apathetic because they assume that an emergency will be taken care of by police, civil defense, government, fire service, and hospitals. In southern California most interviewees placed responsibility for looking after especially vulnerable groups of people on local government, and persons who were least informed about the earthquake danger expressed the highest confidence in government preparations for an earthquake (Turner et al, 1978). Dunn (1978) found that many people had quite unrealistic expectations concerning recovery of earthquake losses through insurance.

Each of the foregoing explanations for inactivity in the face of earthquake threat assumes that inaction is essentially an irrational or uninformed response. Slovic, Kunreuther, and White (1974; Kunreuther, 1978), however, suggest an empirically based model of rationality which can also explain inaction in the face of many threats. Following the economist, Herbert Simon, they observe that everyday rationality is not guided by an effort to maximize the ratio of benefits to costs, because too many of the facts that must be weighed are uncertain and undeterminable. Rather, "bounded rationality" deals with a restricted set of information in an effort to achieve satisfactory rather than maximized outcomes in the short run. One application of bounded rationality is to examine relevant information sequentially rather than simultaneously. Thus instead of looking at the probability of disaster and its consequences simultaneously, the individual looks first at the probability, which is judged

on the basis of personal experience and comprehensibility rather than abstractly. Unless the threat seems highly credible and imminent there will be no serious assessment of the impending danger. It is generally consistent with this model to assume that when people live under a complex and interdependent set of conditions, it is not rational to disturb the delicate balance unless the threat is highly credible or adjustments can be made at minimal personal cost.

Taking note of the fact that risk is relative and that people accept a variety of risks as a feature of normal life, engineers and policy makers have attempted to establish principles for determining what constitutes acceptable risk (Lowrance, 1976). It has been observed that the risk of injury or death in an automobile accident, which citizens in western nations accept without qualms, is often greater than risks people find unacceptable. Evidence in southern California indicates that residents are more sensitive to the risk of living on or near an earthquake fault than they are to the risk of living in a locale that would be inundated in case of dam failure. For some significant minority of the population there is positive value attached to risk taking, such that living in a community where an earthquake has been predicted may add zest and interest to life. The experience with other kinds of disasters leads to the expectation that there will be a great convergence of materiel, messages, and persons into the threatened area, and some of the people will come as curiosity- or thrill-seekers (NRC Panel, 1975). While less than one percent of the southern California sample said they would try to be where an earthquake was predicted to occur, the positive incentive to confront and overcome risk plays a sufficiently important part in society (Klausner, 1968) that its manifestation in a true earthquake prediction situation should be explored.

Adaptive Response and Disaster Subculture

If fear seldom leads to mass panic and inaction is often dictated by

bounded rationality, to what extent will people act adaptively in case of an earthquake prediction? In the few hours following the Izu earthquake aftershock warning a small but substantial minority of residents bought supplies and returned home and an even smaller number evacuated to nearby "safe" areas (Abe and Akimoto, 1978b). From a third to a half of the Kawaski residents reported having taken such elementary steps as preparing first aid supplies, storing food and water, and preparing a flashlight and transistor radio (Ohta and Abe, 1977). Much smaller proportions of southern Californians made such preparations, with just over half of the adults who had children living in the household having instructed them on what to do in case of an earthquake (Turner et al, 1978). This is consistent with the smaller proportion who were aware of the uplift and took it seriously as a sign of a coming earthquake. In Kawasaki about a third of the people said they had spent some money on earthquake preparations and 44 percent said that they had made some change in their life styles, including increased sensitivity to news about disaster and establishing closer contact with family members. Actions were more often taken by people who believed the prediction, trusted public officials, and felt uneasy over the prospect, by older people, people with prior disaster experience, and long-time residents in their current domiciles (Ohta and Abe, 1977). In the case of the much more credible and serious earthquake prediction scenarios presented hypothetically to their California subjects, Haas and Mileti estimate that nearly everyone would be taking protective action as the predicted "earthquake week" approached, including turning off gas and electricity, taping windows and securing objects in storage areas, and cooking, eating, and sleeping outdoors (Haas and Mileti, 1977). Based on a shorter term hypothetical prediction of a Tokai region earthquake in Japan, 80 percent would turn off gas at home and turn on television or radio and about half would make other emergency preparations (Abe and Akimoto, 1978c).

It seems likely that whether people make adaptive responses will depend largely on whether they receive clear instructions and have confidence that following these instructions will actually enhance their safety, and on the encouragement and example presented by respected public leaders. Janis and Mann (1977) develop a conflict model of emergency decision-making that specifies the unique combination of circumstances that will facilitate vigilance, leading to effective coping if the danger materializes. In the presence of an authentic warning that poses serious risks whether the individual does or does not take protective action, two considerations become crucial. If it appears unrealistic to hope to find a better means to escape danger, the response will be defensive avoidance. If the foregoing possibility appears realistic but there is insufficient time to search and deliberate over alternative courses of action, the response is hypervigilance, of which the most extreme form is panic. But if a realistic hope is matched by sufficient time, and the evaluation of risks remains high, the response will be sustained vigilance leading to effective coping if the danger materializes. Applied to earthquake prediction, this model suggests a good chance for effective coping if the threat is experienced as substantial and people are convinced that there are realistic steps that can be taken with good effect.

The importance of public leadership was suggested by comparing earthquake prediction withthe United States energy crisis at the time of the 1973 Arab oil boycott (NRC. Panel, 1975). An earthquake prediction resembles a slowly developing emergency in which signs of impending danger are not directly visible to the public. Some observers have concluded that an initial public willingness to make sacrificial changes in life style to deal with the energy crisis was dissipated by indecisive public leadership, and that the same might be true of an earthquake prediction. On the other hand, with strong public leadership--demonstrably lacking in the U.S. energy crisis and the southern

California earthquake threat--there is considerable probability that adaptive responses might be taken.

Whether earthquake prediction leads to adaptive responses also depends upon whether the threat is seen as one to be dealt with on a strictly individual and family basis, or one requiring some kind of collective attack. Research has repeatedly demonstrated that coping with the immediate crisis of an earthquake or other natural disaster is immensely facilitated by an outpouring of altruistic concern in which people readily set aside their customary activities and interests and make personal sacrifice for the collective good. The NRC Panel (1975) expressed doubt that an earthquake prediction would evoke a similar intensification of community solidarity, in the absence of which an attitude of every individual or family for themselves might impede constructive collaboration to cope with the earthquake hazard. Some indications that the earthquake threat is not viewed in strictly individualistic terms have emerged from the southern California study (Turner et al, 1978). Asked whether there were some groups in greater danger than others in the event of an earthquake, nearly two-thirds of the interviewees expressed awareness of some such groups. Most felt that something could be done for these groups in advance of an earthquake, and that the chief responsibility for doing so lay with government. Only four percent were willing to leave the decision on whether to correct potentially hazardous conditions to the owners of the affected buildings.

Jones and Jones (1975) concluded that prediction of a moderate to major earthquake would mean increased public awareness of the earthquake hazard resulting in greater community solidarity, expressed through development of cooperative self-help organizations and voluntary associations to help the poor, elderly, and disabled find safer places to live. In the People's Republic of China, thousands of citizens ranging from peasants to professionals have been recruited into a network of amateur earthquake prediction units following

designation of a long-term or medium-term earthquake prediction. Following issuance of an imminent earthquake warning, Chinese communities have organized quickly to look after the aged, the infirm, and others in need of special assistance. In California there have been numerous grass roots efforts to establish self-help groups in response to the earthquake threat, and calls for establishment of an amateur prediction network patterned after China's. The vagueness of the threat and the uncertainty over what sustained hazard-reducing actions could be undertaken has made most of the self-help groups short-lived. In both China and the United States, some of the most effective voluntary group activities build upon preexisting interests of the participants that can be constructively combined with earthquake preparation activities. For example, some of the most effective amateur groups in China and the most promising groups in California consist of students and teachers in high school science programs

Collective response can be either supportive or resistive toward earthquake hazard reduction efforts. In southern California the most dramatic instances of popular mobilization since announcement of the uplift have been to resist hazard mitigation steps that would have been costly to people in certain locations. In each instance community pride and autonomy became issues, and the ingroup was mobilized to resist encroachments by what it viewed as impersonal external forces. In the event of a more credible earthquake prediction, it will be important to understand the conditions that determine whether community solidarities become parochial and divisive or unifying for the entire threatened community.

It has been proposed that constructive response to disaster threat is facilitated by the existence of a disaster subculture (Moore, 1975; Quarantelli, 1978, pp. 41-44). Based on past experience with disaster, a community may develop a standby set of organizational procedures and individual response

patterns, supported by a system of beliefs and values, which guide response to the threat of disaster. The Chinese accumulation of folk wisdom, such as the observation that a swarm of foreshocks and a brief period of quiescence often precede a severe earthquake, has played an important part in facilitating effective response to an earthquake prediction. The strict legislative standards for earthquake-resistant construction in California have been enacted following disastrous earthquakes. However, disaster subcultures are thought to develop most effectively when the same type of disaster recurs frequently, like tornadoes that recur annually in the midwestern United States, and when there is usually some advance notice. In the absence of a fairly comprehensive disaster subculture, each earthquake caution or prediction must be handled without the guidance and support of traditional wisdom. The more frequent occurrence of damaging earthquakes in Japan and the disastrous fires resulting from the inflammable and closely built housing may have contributed to a more complete earthquake subculture than in southern California, helping to account for the more active response of Kawasaki residents to their uplift. A recurrent experience of nondestructive earthquakes may contribute to development of a popular subculture that works against taking the earthquake threat seriously, as in China where a lifetime's experience of nondestructive earthquakes in southern Liaoning province led some of the elderly to resist evacuation when the 1975 Haicheng earthquake was predicted (Haicheng Earthquake Delegation, 1977).

Unequal Ability to Respond

Citizens are not equally vulnerable to the risk of earthquakes or equally capable of responding constructively to an earthquake prediction. Public policy is sometimes directed toward assisting the average person and neglects those who are disadvantaged. The NRC Panel (1975) pointed out that warnings

of imminent danger take longer to reach people in isolated residences and apartment houses, people who are unattached, widowed, or otherwise isolated, and sight- and hearing-impaired individuals. A goodly proportion of the large Spanish-speaking population in southern California read only the major Spanish-language newspaper, and that newspaper failed to report discovery of the uplift until ten months after all major English-language newspapers had done so. It has generally been assumed that the elderly in western societies, who are often somewhat isolated, may receive information later than others do. However, the discovery that awareness and understanding of the southern California uplift increases with age (though fear of earthquakes decreases with age) may indicate that age is not an impediment to being informed in a society where nearly everyone has access to television and radio (Turner et al, 1978). In societies that include the aged and the unmarried in extended family households or communal units of some kind, the possibility of differential exposure to warnings should not be so great.

Cultural and educational background and group attitudes toward constituted authority affect the ability of people to understand warnings, recognize the significance of warnings for themselves, and appreciate the aims of public hazard reduction programs and the benefits to be gained from cooperating with them. Fatalistic attitudes are more prevalent among some cultural and religious groups than others. Suspicion of government on the part of some economically deprived classes may prevent cooperation in public programs which are designed to enhance their safety in case of an earthquake (N.R.C. Panel, 1975). While most southern Californians were aware of groups in special danger, reference was most often made to people in unsafe housing or physically vulnerable locations, rather than to categories of people such as the aged, the infirm, children, and people in institutions (Turner et al, 1978). A heightened consciousness of these groups will be necessary if there is to be effective community planning to

help them in case of emergency.

An important part of earthquake prediction response planning in the People's Republic of China is provision for special attention to those who are less able to look out for themselves. The fact that responsibility for coordinating the immediate response to an earthquake warning is delegated to the commune or brigade and other local units facilitates attention to people with special needs, as did the now defunct neighborhood civilian defense units that flourished during the Second World War in western nations. Local units organized the most able bodied citizens to help the elderly and infirm vacate their dwellings and construct temporary shelters for them (Haicheng Earthquake Prediction Delegation, 1977).

Education and Public Information

Individual and group response to earthquake prediction depends upon the timely and effective communication of appropriate information about the earthquake threat and advice and instructions concerning actions to be taken. Constructive interpretation and use of these communications in turn depends upon background knowledge and understanding about earthquakes and resources for coping with earthquakes. Communicating with people to indicate that they are in potentially great danger is a highly sensitive matter, and conveying an understandable account of so technical a matter as earthquake prediction is difficult. The likelihood of misunderstanding is so great that the N.R.C. Panel (1975) included as one of its major recommendations that in the event of an earthquake prediction an agency should be designated to monitor public understanding, credence, and response at all stages of the process and make this information available to public officials.

The public are not simply the passive receivers of information; there is an active information seeking process that goes on. There are national

differences in the extent of reliance on different media sources for information. In Kawasaki, newspapers were most often given as the media source from which people learned of the near-prediction and as the most influential in forming opinions about the earthquake prospect (Ohta and Abe, 1977), but radio and television were critical in the shorter term aftershock warnings in Izu (Abe and Akimoto, 1978a & b). In southern California, although major newspapers supplied more complete information and better analyses, television was overwhelmingly given as the most important source of information about earthquake predictions and cautions (Turner et al, 1978). In China information about predictions was communicated to revolutionary committees in the local civil units, who in turn informed the people. At times when significant events were announced or rumors were in circulation, many people in southern California called the earthquake laboratory at a local university or public officials for more information. The disposition to call directly to such authoritative sources for information may be less strong in many other countries. In southern California, each new development in the earthquake scenario led to a wave of calls for speakers to address schools, service clubs, church groups, and other neighborhood organizations. People seeking speakers typically called the familiar emergency organizations such as the local police department or fire department. Although the number of requests for speakers declined after the first year, the public appetite for information remained high. Two years after announcement of the uplift, from two-thirds to seven-eighths of the sample interviewed expressed the view that there was too little coverage of earthquake prediction and how to prepare for an earthquake (Turner et al, 1978).

The most effective strategy for public education about earthquakes and earthquake prediction, as necessary background for interpreting specific warnings and instructions, is a matter of debate. One issue is how much

technical understanding is possible or useful for the general public. Another issue is when to launch a serious educational program in light of the long interval of years between serious earthquakes and the possibility of a long period of advance notice of a predicted earthquake. The need for some technical education in American society is suggested by the fact that most southern Californians interviewed, in contrast to Britton's small and selected sample of New Zealanders, thought they understood something about what caused earthquakes and were willing to explain their views to the interviewers. There may be significant national differences in the need for personal understanding.

A critical question is how to deal with nonscientific ideas that people have acquired as part of traditional folk knowledge. The accepted approaches among Chinese and American scientists on this matter have been quite different. The Chinese have consciously assumed that there should be no necessary conflict between folk wisdom and scientific knowledge, and that folk wisdom can serve as the foundation upon which scientific understanding is built. It should be noted, however, that recent Chinese publications suggest a lessened emphasis on folk knowledge and an increased emphasis on the need for technical scientific understanding. American scientists have more often assumed that a great deal of folk thinking must be eradicated before appropriately scientific attitudes can be instilled, often leading to confrontation and conflict between scientists and the public. While southern Californians express overwhelming faith in science, more than half believe in both scientific and nonscientific bases for earthquake prediction, revealing a deep seated eclecticism that is unlikely to be eradicated by any short-run educational program (Turner et al, 1978).

Because of the technical nature of knowledge about earthquake dynamics and prediction, scientists are often not disposed or able to deal directly with the public in educational programs, though this may be less so in China than in the United States. Typically educational programs are conducted by

people who are not themselves scientists but translate science for the public. In the United States the larger newspapers have science writers who specialize in this task. The television "special" may have come to be the most significant device for popular education on current affairs in the United States. A traditional assumption that the public schools educate children on matters of current concern, and that children in turn inform their parents and stimulate their interest in acquiring further information, is apparently not working in southern California. Adults with school children in the home were less likely than adults without school children in the home to be aware of the uplift and to understand its meaning and relevance (Turner et al, 1978). The Chinese have used documentary motion pictures displayed in public theaters to explain the underlying dynamics of earthquakes and the rationale for earthquake prediction. A unique feature of the Chinese educational program has been the use of amateur earthquake prediction groups to conduct public education in their own and neighboring communities. This may be an especially effective procedure for insuring education that is geared to the backgrounds and interests of local publics.

The Yang-kuan Street Revolutionary Committee (no date) in Yingkou City, China, reports an effective locally organized educational program organized before the well predicted Haicheng quake of February 1975. Investigation had revealed two kinds of nonconstructive attitudes among the people, namely, a belief in the inevitability of destiny, so that one might as well eat and enjoy life, and a hopeless belief that nothing could be done, leading to unproductive worrying. In order to combat these attitudes, three kinds of educational classes were conducted, in the dynamics and causes of earthquakes, in the nature of premonitary earthquake signs, and in procedures for hazard reduction.

Whether there will be subtle changes in attitude and frame of reference

during a sustained period in which people live under the prospect of a destructive earthquake, requiring changed approaches in public education, is yet to be determined. Jone and Jones (1975) speculated controversially that many subtle changes would occur in citizen life style and values, leading to more pragmatic and fatalistic attitudes and to a greater tendency to discount future concerns.

Conclusions

The foregoing account is little more than a sampling of knowledge about individual and group response to earthquake prediction. Enough is known to put to rest the more bizarre fears of mass panic and wildly irrational response to earthquake prediction, and to supply assurance that most people can cope more or less adequately with the uncertain prospect of disaster. The impression remains, however, that mass interest and activity in response to earthquake threat are not at all proportional to the magnitude of possible earthquake disasters. But this may be true chiefly because there are few actions most people can realistically take which can be expected to contribute substantially to their safety, and that people look principally to government to address the problem.

Present knowledge is quite incomplete and based largely on analogies from warnings of other kinds of disaster. This knowledge and the findings from studies of imagined response to hypothetical situations must be rapidly replaced with knowledge from studies of response in actual prediction situations. At present very little research of this kind is taking place, and only in Japan and the United States. The greatest potential source of information is the extensive experience with earthquake prediction in the People's Republic of China, which, however, has not been studied with the methods and from the perspective of social science. Although the evidence

for universal human responses is strong, differences between findings in Japan and the United States suggest the effects of prior earthquake experience and differences between national cultures. Hence it is essential that research be conducted in many countries, including China and the U.S.S.R. Thus far we have no reports of research from developing countries, although disastrous earthquakes are frequent in several of them.

Finally, available evidence suggests public readiness in earthquake-prone communities to participate in education for earthquake preparedness, and in volunteer activities to facilitate prediction. Except perhaps in the People's Republic of China, this readiness has not been used to an optimal degree.

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CHAPTER SEVEN

THE MOBILIZATION OF ALTRUISTIC SENTIMENTS FOR EARTHQUAKE ENDANGERED GROUPS

This chapter consists of a paper read at the International Symposium on Earthquake Prediction, sponsored by U.N.E.S.C.O. and held in Paris, April 2-6, 1979. The paper will appear in the published Proceedings of the Symposium, to be released in 1980.

THE MOBILIZATION OF ALTRUISTIC SENTIMENTS FOR EARTHQUAKE ENDANGERED GROUPS

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Disaster literature frequently focuses on the spontaneous outpouring of altruistic behavior for the victims of natural disasters. However, there is some question whether this expression of concern would also follow the prediction or warning of a major disaster. This is particularly so when the predicted event is an earthquake, since scientific earthquake prediction is still a developing field. This paper will investigate the possibilities for mobilizing widespread altruistic sentiments and actions toward potentially endangered social groups prior to the occurrence of a damaging earthquake. It is important to determine whether earthquake hazard mitigation is seen within a framework of collective responsibility or whether individuals will display a concern only for their own families, since the most devastating earthquake hazards--the collapse of older unreinforced masonry buildings, dam failure, the need to evacuate, fire control--are not problems which can be solved by an individual, but require collective commitment and application of resources.

Studies of altruism and helping behavior have focused on the act of assisting others who are perceived to be in need. Most of this research has been psychological in orientation, focusing on individual acts or individual predispositions observed and measured within well-controlled experimental settings. The major problem addressed in most of these works concerns the motivation for engaging in actions which do not appear to benefit the helper. This concern with motivation stems from the belief that it is the intention behind the act, rather than its consequences, which determine its moral value, and from the emphasis on exchange theories within psychology. Major concerns within psychological approaches to altruism are the problems of equity and reciprocity (Walster and Piliavin, 1972) and personal characteristics of benefactors and recipients (such as psychological states, social roles, and demographic variables) which motivate or inhibit the expression of altruistic acts (Krebs, 1970; Gergen et al, 1972).

Taking a different approach, social psychologists have directed their

attention toward situational features which cause "helpfulness" norms to emerge, those norms which require the aiding of others in need--Blau's (1964) norm of social responsibility, Leeds' (1963) norm of giving, and Schwartz' (1975) humanitarian norms. Unfortunately, most of these works have been theoretical or have been applied to research findings almost as an afterthought.

Our concern in this paper, however, is with "cooperative altruism," an awareness that there are occasions of crisis and catastrophe which are common to many and which require cooperative endeavors to overcome (Warriner, 1972). This definition specifically does not stipulate any individual motivational mechanism for the expression of cooperative altruism. Surely, psychological mechanisms are important in sensitizing people to the awareness of endangered or needy others (Aderman and Berkowitz, 1970) and in acknowledging the legitimacy of others' dependency and need (Latané and Darley, 1970; Schopler and Matthews, 1965; Berkowitz, 1968). However, as Berkowitz (1972) maintains, any analysis of altruistic behavior must recognize the complex interplay between an individual's predispositions and external forces in the situation itself.

Since both of these dimensions are important if we are to understand the dynamics of cooperative altruism, this investigation has been divided into two parts--an analysis of individuals' "posture toward altruism" and speculations concerning the ability to mobilize cooperative altruism based on situational factors which may inhibit or facilitate its expression.

Posture toward Altruism. An individual's "posture toward altruism" is a combination of an awareness of conditions in the social environment which expose some people to greater potential earthquake dangers and the individual's sentiments toward the remediability of those conditions. For analytic purposes the concept has been broken down into three factors--(1) awareness of endangered others, (2) a belief that the hazard is remediable for those endangered groups, and (3) an attribution of responsibility for ameliorating those conditions. This concept constitutes a continuum along which a community's posture could

be distributed, ranging from a belief that all remediable actions are the responsibility of the potential victims themselves to a belief that the community (either through formal or informal channels) has a collective responsibility for correcting those conditions. Using data from a survey conducted in Los Angeles County with 1450 randomly selected residents, a multi-part, open-ended question was designed to elicit information on the respondents' perceptions of groups that are in particular danger from a destructive earthquake and who is responsible for remedying those conditions.

(1) Social awareness. "Social awareness" is being defined as one's knowledge about people who may be especially exposed to dangerous conditions in their personal environment in the event of a destructive earthquake. According to our findings, almost two-thirds (N=912) of our respondents could be classified as "Socially Aware" because they believed earthquake-related dangers were greater for some groups of people than for others. This magnitude of awareness within our sample was a very important finding because a widespread awareness of potential disaster victims is the first requirement for the development of a multi-targeted expression of altruism.

The 912 Socially Aware respondents cited a total of 2007 mentions of specific groups whose members were considered "endangered" (Table 1). The specific groups have been classified under more general headings for analytic purposes. (No assessment was made as to whether these groups were actually endangered in any objective sense; the respondents' perceptions of earthquake-related dangers were more important for the purpose of assessing their posture.)

The issue of what to do about pre-1934 unreinforced masonry buildings (a topic which was widely discussed by the local media at the time this survey was being conducted) clearly made people aware that these structures constituted a potentially hazardous condition for those who lived in and used them. These references to older, multi-storied structures constituted the largest general response category (36.0 percent). References to ecological conditions and

TABLE 1

FREQUENCY WITH WHICH SPECIFIC ENDANGERED GROUPS ARE MENTIONED

Type of Endangered Group	Frequency		Percent	
I. Structural References		722		36.0%
1. Old/Unsafe/Pre-1934 Buildings	383		19.1	
2. Apartments/High-rise	339		16.9	
II. Ecological References		501		24.9
1. Proximity to Disaster Agent (by fault, near epicenter)	173		8.6	
2. Flooding (below dams, by water)	137		6.8	
3. High Density Areas	97		4.8	
4. Hillside Homes	94		4.7	
III. Physically/Socially Impaired		375		18.7
1. Elderly	199		9.9	
2. Disabled	146		7.3	
3. Poor	30		1.5	
IV. Institutional Settings		246		12.3
1. Children in Schools	130		6.5	
2. People in Hospitals/Prisons/Group Residential Facility	116		5.8	
V. Other	163	163	8.1	8.1
Total	2007	2007	100.0	100.0

TABLE 2

NUMBER OF RESPONDENTS WHO CLAIM MEMBERSHIP IN ONE OF THE ENDANGERED GROUPS THEY MENTIONED

Is Respondent a Member of An Endangered Group?	Frequency	Percent	Adjusted Percent[2]
Yes	159	17.4	17.8
No	734	80.5	82.2
No Answer[1]	19	2.1	----
Total	912	100.0	100.0

[1] No answer to this question was recorded for 19 respondents, possibly due to interviewer error.

[2] Percentages based on 893, those who actually answered the question.

circumstances constituted the second largest general category, almost 25% of all mentions. Proximity to the potential disaster agent (either to a fault or to the quake's epicenter) and exposure to possible inundation (either for those living below dams or near large bodies of water) were the most numerous of such ecological mentions (8.6 and 6.8%, respectively). Reference to some type of impairment, physical or social, constituted the third largest category of mentions (18.7%). Of all specific endangered groups, the elderly were the third most frequently mentioned (9.9%), after the two structural groups. Groups in institutional settings, constituting the fourth general category of endangered groups (12.3%), included those who are institutionalized routinely (either temporarily, as children in schools, or on an extended basis, as those in prisons and nursing homes) and persons who are considered to be unable to respond appropriately on their own when a quake strikes. The category "Other," comprising 8.1% of all mentions, is a residual category in which other specifically mentioned groups received fewer than eight citations.

These general categories constitute two primary ways of referring to, or identifying, endangered groups. Structural and ecological responses--the type of dwelling resided in, or the proximity to hazardous conditions (60.9%)--refer to <u>environmental</u> factors as sources of potential danger. Reference to persons who are socially and/or physically impaired or who are in institutional settings (31.0%) emphasizes the <u>personal</u> attributes of members; they suffer diminished capacity or ability to prepare for or respond to earthquake threat because of age (advanced or youthful), illness, restricted mobility, or poverty. Environmental references were used nearly twice as often as personal attributes in identifying endangered groups.

There may be some question whether the awareness of these respondents is actually self-interested, that is, whether it is motivated by an awareness that these dangers are present in their own environments and that they are personally

exposed to higher risks than others. Table 2 indicates that in only 17.8% of the mentions do respondents identify themselves as belonging to an endangered group; therefore, membership in such a group is not particularly necessary to be aware of endangered others. Of those who claimed membership, 16% cited only one group, and less than 2% cited membership in two or three groups. Self-interest does not appear to be a prominent factor in social awareness, particularly in reference to the two categories concerned with personal attributes which may hinder preparedness.

(2) Perceptions of remediability. Although there is a fairly widespread awareness of potential earthquake victims, social awareness in itself does not provide us with sufficient information to identify the existence of a potentially altruistic posture toward these earthquake-endangered groups. We must determine whether respondents believe that anything can be done to mitigate these hazardous conditions or whether they believe, fatalistically, that nothing can be done to aid these groups before another damaging earthquake occurs. If this second view prevails, an almost negligible opportunity for altruism to develop exists, since an altruistic response is based on the belief that actions taken on behalf of needy others will provide relief for them.

Table 3 illustrates overwhelmingly that our respondents believe in the remediability of earthquake-related hazards for endangered groups; at least 75% of all respondents who mentioned endangered groups believed that something could be done. Respondents are particularly optimistic about the ability to reduce earthquake hazards for those who live in older buildings (90.9%), those in areas of possible inundation (91.2%), children in schools (92.3%), and those who reside in hospitals, prisons, or other group care facilities (92.2%). The respondents were slightly less optimistic about the ability to take remedial actions on behalf of those who live in apartments and high-rise structures (79.9%) and those who are in close proximity to the disaster agent (75.6%).

TABLE 3

CAN ANYTHING BE DONE TO REDUCE EARTHQUAKE HAZARDS ACCORDING TO SPECIFIC ENDANGERED GROUP MENTIONED

Category of Endangered Groups		N	%	N	%
I. Structural				Yes: 619	85.7%
				No: 102	14.1
				DK: 1	.2
Old Buildings	Yes:	348	90.0		
	No:	35	9.1		
Apartments/ High-rise	Yes:	271	79.9		
	No:	67	19.8		
	DK:	1	.3		
II. Ecological				Yes: 413	82.6
				No: 87	17.4
Proximity to a Disaster Agent[1]	Yes:	130	75.6		
	No:	42	24.4		
Flooding	Yes:	125	91.2		
	No:	12	8.8		
High Density Areas	Yes:	79	81.4		
	No:	18	18.6		
Hillside Homes	Yes:	79	84.0		
	No:	15	16.0		
III. Physical/Social Impairment				Yes: 332	88.5
				No: 42	11.2
				DK: 1	.3
Elderly	Yes:	176	88.4		
	No:	23	11.6		
Disabled	Yes:	130	89.0		
	No:	15	10.3		
	DK:	1	.7		
Poor	Yes:	26	86.7		
	No:	4	13.3		
IV. Institutionalized				Yes: 227	92.3
				No: 19	7.7
Children in Schools	Yes:	120	92.3		
	No:	10	7.7		
People in Hospitals/ Prisons/Group Facilities	Yes:	107	92.2		
	No:	9	7.8		
V. Other[1]				Yes: 116	71.6
				No: 46	28.4

[1] Two cases are missing data on this variable and have not been included in computation of percentages.

TABLE 4

SIGNIFICANCE OF MEMBERSHIP IN EACH ENDANGERED GROUP ON MELIORABILITY OF HAZARDS

Endangered Group	Test	P
I. Structural		
1. Old/Unsafe/Pre-1934 Buildings	Fisher's[1]	.05
2. Apartments/High-rise	Chi square[2]	n.s.
II. Ecological References		
1. Proximity to Disaster Agent (by fault, near epicenter)	Chi square	.005
2. Flooding (below dams, by water)	Chi square	.05
3. High Density Areas	Fisher's	.001
4. Hillside Homes	Fisher's	.05
III. Physically/Socially Impaired		
1. Elderly	Fisher's	n.s.
2. Disabled	Fisher's	n.s.
3. Poor	Fisher's	n.s.
IV. Institutional Settings		
1. Children in Schools	Fisher's	n.s.
2. People in Hospitals/Prisons/ Group Residential Facility	Fisher's	n.s.

[1] Fisher's exact test was used instead of a chi square test, since at least one expected cell frequency was less than five for these 2 x 2 tables.

[2] Yate's corrected chi square formula was used in these computations since continuity could not be assumed given that the tables had only one degree of freedom.

Respondents had more positive feelings of remediability toward those categories where personal attributes defined the hazardous groups than they had for groups who are endangered by environmental conditions. Although the overall differences between the general categorical percentages of remediability are not large, this finding is interesting when related to the respondents' frequency of categorical mentions (Table 1). The endangered groups which fell into the environmental category were by far the most frequently cited potential victims; yet they were also the groups for whom more respondents believed nothing could be done. The less frequently cited groups (defined by personal attributes) received the highest "confidence vote" from the respondents that something could be done to mitigate hazards for them.

Again, a question is raised concerning the effect that membership in an endangered group has on one's perceptions of remediability. Is a member of an endangered group more likely than a non-member to believe that something can be done to decrease the amount of earthquake danger his or her group is exposed to?

The relationship between membership in an endangered group and belief in remediability was tested for each of the endangered group; the results are found in Table 4. The significant correlations indicate that the belief in remediability of hazardous conditions is strongly related to <u>not</u> claiming membership in a particular type of endangered group. In other words, members of these groups were more likely to believe that nothing could be done to lessen the hazardous nature of their conditions than were non-members. Environmental conditions were particularly seen as unalterable by members, especially the ecologically hazardous areas.

This conviction that something can be done to aid endangered groups <u>before</u> another damaging earthquake occurs indicates that there is a potential receptiveness for hazard-reduction planning. Indeed, a widely distributed social awareness coupled with a belief in the remediability of hazardous conditions may set the stage for widespread disappointment in earthquake planning if nothing

is actually done for these endangered groups.

(3) Attribution of responsibility for remediability. A potentially altruistic posture toward an earthquake prediction is partly dependent also upon who is seen as being responsible for mitigating the dangers for each group. It is doubtful that any altruistic response could develop if the Socially Aware believed that members of endangered groups were responsible for taking the necessary remedial actions themselves.

Each respondent who said that something could be done for an endangered group prior to the next earthquake was asked who was responsible for doing something for each specific group mentioned. The respondents were not read any suggested response categories.

To compare the frequency of answers across group types, row frequencies were calculated for each endangered group (Table 5) and for the four analytic categories (Table 6). The most evident finding in these tables is the designation of government entities as primary responsible agents across all group types. For both Structural groups, the local government is believed to be the primary responsible agent, and for the Impaired groups, combinations of governments are designated as chiefly responsible. The Institutionalized groups also follow the same pattern as the Impaired groups, with the exception of references to Administrators and Managers of group care facilities. However, when these groups are collapsed into a single category (Table 6), the importance of governmental entitities again becomes evident.

Ecological groups, as a general category, also follow the pattern of the Impaired and Institutionalized categories; however, for two groups--those in danger from flooding and those who live in hillside homes--respondents stressed the importance of the group members themselves taking responsibility for decreasing potential earthquake danger. This sentiment was particularly strong for those who live in hillside homes, where residents received the largest percentage of responses ("Own Responsibility") from those who had mentioned that endangered group. This finding

TABLE 5

ROW PERCENTAGES OF RESPONSIBLE AGENTS FOR SPECIFIC ENDANGERED GROUPS

Endangered Groups	Responsible Agent: Own Responsibility	Friends/ Family	Local Govt.	Local/ State/ Federal	Indiv./ Govt.	Prop. Owners	Admin./ Mgrs.	Other	Total
I. Structural References									
1. Old/Unsafe/Pre-1934 Buildings	10.8	0	40.5	37.9	2.9	4.7	0	3.2	100.0
2. Apartments/High-rise	22.1	0	31.1	26.6	1.9	9.7	2.2	6.4	100.0
II. Ecological References									
1. Proximity to Disaster Agent (by fault, near epicenter)	23.1	0	27.7	37.7	1.5	.8	.8	8.4	100.0
2. Flooding (below dam, by water)	24.2	0	25.8	44.4	1.6	0	1.6	2.4	100.0
3. High Density Areas	11.8	0	46.1	27.6	5.3	4.0	2.6	2.6	100.0
4. Hillside Homes	35.5	0	27.6	29.0	2.6	0	0	5.4	100.0
III. Physically/Socially Impaired									
1. Elderly	3.4	6.9	31.6	49.5	2.9	.6	1.7	3.4	100.0
2. Disabled	5.4	3.9	26.3	49.6	1.6	0	5.4	7.8	100.0
3. Poor	11.6	0	38.5	42.3	3.8	0	0	3.8	100.0
IV. Institutional Settings									
1. Children in Schools	8.4	3.4	33.6	36.1	1.7	.8	10.1	5.9	100.0
2. People in Hospitals/ Prisons/ Group Residential Facilities	1.9	1.9	16.3	50.0	.9	0	22.1	6.0	100.0

TABLE 6

ROW PERCENTAGES OF RESPONSIBLE AGENTS FOR GENERAL ANALYTIC CATEGORIES

General Category	Responsible Agent: Own Responsibility	Family/ Friends	Local Govt.	Local/ State/ Federal	Indiv./ Govt.	Prop. Owners	Admin./ Mgrs.	Other	Total
Structural	15.7	0	36.4	32.9	2.5	6.9	1.0	4.6	100.0
Ecological	23.7	0	30.5	36.2	2.5	1.0	1.2	4.9	100.0
Impaired	4.9	5.2	30.1	48.9	2.4	.3	3.0	5.2	100.0
Institutionalized	5.4	2.7	25.6	42.6	1.3	.4	15.7	6.3	100.0

suggests that an altruistic response may not emerge for people exposed to such hazards if an earthquake prediction is issued, since such a strong sentiment exists for the self-responsibility of such groups.

One further question concerning the designation of a responsible agent needs to be addressed: Does membership in an endangered group affect who is seen as responsible for remedying the hazardous conditions affecting that group? When a chi square was computed to investigate this relationship, these variables were found to be highly uncorrelated, regardless of the endangered group considered. Being a member of an endangered group, therefore, did not have any effect on who was seen as being responsible for remedying the hazardous conditions.

In summary, we can conclude that currently there is a fairly widespread collectively-oriented posture toward altruism for potential victims of future earthquakes. Social awareness of endangered groups and perceptions of remediability are widespread throughout the Los Angeles area, and a sentiment for collectively attacking those earthquake hazards also exists. Whether those maintaining this posture can be mobilized into action, however, depends on situational factors which are present or absent after the earthquake prediction is announced.

The Mobilization of Cooperative Altruism. Drawing on the findings and concepts in the altruism and collective behavior literature, two situational factors--the influence of models on bystanders and the personal opportunity for altruistic expression--stand out as important in the mobilization process. By mobilization we mean a process through which public initiative and resources are activated in the interests of an agreed-upon goal or goals (Bridgeland and Sofranko, 1975).

(1) The influence of models. Researchers in the field of altruism have studied the effects that models, usually experimental confederates, have on influencing the behavior of potential helpers. In general, modelling is believed to assist the "bystander"--the potential helper--in defining the situation with

which he is confronted and to make him aware of behavioral alternatives. The sight of a model carrying out a particular action can heighten the bystander's own inclinations to behave in a similar way (Blake et al, 1956; Hebson et al, 1958; Rosenbaum and Blake, 1955; Rosenbaum, 1956; Bryan and Test, 1967; Wagner and Wheeler, cited in Berkowitz, 1972). The model's actions, therefore, assist the bystander in defining what is "proper" behavior in a situation (Berkowitz, 1972).

In this respect, modelling is similar to the notion of "keynoting" used by collective behaviorists. Turner and Killian (1972:47) state that when an audience is considering various possible explanations of what the situation is and what actions may be appropriate, a keynote (defined as a symbolic gesture or utterance) may shift support in the direction of the keynoted image. The notion of keynoting presupposes the existence of latent support for this activity which has not been expressed because of doubt or timidity.

Undoubtedly, several interpretations of appropriate behavior will occur following the announcement of an earthquake prediction, and several prominent models or keynoters will be presented to the community through the media. Some keynoters will obviously be members of scientific or governmental agencies who are sought out because of their expertise or role responsibilities in the prediction process. However, the possibility of "non-legitimate" models receiving public attention should not be overlooked. Already southern Californians have been shaken by an earthquake prediction from an inauthentic amateur scientist.

Drawing on the altruism literature, let us briefly examine the features of the modelling process that would be particularly important in mobilizing altruistic sentiments.

Models or keynoters might be successful in activating these sentiments if they emphasized the salience of the moral standard that people should not be hurt and that if nothing is done, many could be seriously injured in the coming quake (Berkowitz, 1972). This emphasis will be particularly useful if coupled

with the belief that the conditions causing the victims' exposure to danger are beyond their control or that their injuries are unwarranted (Rawlings, 1970; Schopler and Matthews, 1965; Berkowitz, 1968).

The visibility of models who espouse these beliefs is important in overcoming "reactance" of bystanders, that is, their tendency to rationalize away the need to take any action at all (Latané and Darley, 1970; Berkowitz, 1972). One of the best substantiated findings in the literature on public response to an ambiguous situation is the tendency to interpret the situation in terms of "normalcy," that is, to assume that everything is all right until events clearly prove otherwise. Keynoters are especially important in overcoming this tendency to interpret the situation in normal, non-exceptional terms.

The cues provided by these models indicate that an emergency situation actually exists, and that bystanders should be motivated to respond to potential victims by offering assistance (Waltser and Piliavin, 1972). However, this brings us to a second factor in the mobilization process--the opportunity for expression.

(2) Personal opportunity for expression. After a disaster strikes, both individuals and organizations have the opportunity to offer aid directly to its victims. Dynes and Quarantelli (1968) discuss the possibility that the functions of organizations can be expanded, extended, and innovated to handle newly-arising problems and that individuals can directly aid others in their immediate area who are in need of assistance. However, in the situation following the issuance of an earthquake prediction, it is doubtful that individual bystanders will see any obvious ways in which to directly or personally offer assistance to potential victims.

This personal opportunity for expressing altruistic sentiments is, however, a very important factor in the altruism literature. Schwartz (1975), discussing the stages necessary to activate humanitarian norms, says that if the bystander perceives that something can and should be done for the victim but sees no opportunity for himself to do anything, norm activation will not occur, blocking any

further action. Walster and Piliavin (1972) paint an even darker picture of the response to blocked opportunity, stating that bystanders may even begin to derogate the victim (i.e., to interpret the injury as the victim's fault) if they can find no way to help.

In a discussion of volunteerism in disaster situations, Shaskolsky (n.d.) maintains that community-based altruism requires organizational structures within which altruism can be displayed and sustained. Collective behaviorists have found that emerging social movements were doomed to fail unless they were built around previously established communication and organizational networks. Without these underlying structures, even people with similar concerns about over-taxation could not coordinate and carry out a successful "tax revolt" (Jackson et al, 1960). Similarly, even though people may have an underlying collective posture toward altruism, they may not be able to put it into effect outside of existing social networks and organizations.

At present, no such structures exist, nor have they even been considered necessary by those concerned with community response to earthquake predictions. Wilson and Orum (1976) have stressed the importance of social networks and the organizational infrastructure in the process of mobilizing people to take collective political action. Given that a widespread collectively-oriented posture toward altruism already exists, some concern should be given to channeling those sentiments into already-existing organizational structures (such as community service organizations) in order to enhance people's perception of personal responsibility for remedying earthquake hazards. If this program were successful, spokespersons of these groups could even become models or keynoters at the time the prediction announcement is made, providing the rest of the community with definitions of appropriate behavior and giving them already-established structures within which to express their altruistic sentiments.

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CHAPTER EIGHT

THE DETERMINANTS OF ACCEPTABLE RISK:

CASE STUDIES OF THE IMPLEMENTATION OF SEISMIC SAFETY LEGISLATION

This chapter consists of a paper read at the International Symposium on Earthquake Prediction, sponsored by U.N.E.S.C.O. and held in Paris, April 2-6, 1979. The paper will appear in the published Proceedings of the Symposium, to be released in 1980.

THE DETERMINANTS OF ACCEPTABLE RISK:

CASE STUDIES OF THE IMPLEMENTATION OF SEISMIC SAFETY LEGISLATION

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Local communities often resist the efforts of governmental agencies to implement new public safety legislation. Recently there have been three such attempts in southern California, each dealing with a different problem or potential hazard, and each aimed at reducing the loss of life and property in the event of an earthquake of destructive magnitude. In each case, sustained community conflict (i.e., citizen resistance to implementation efforts by the legally responsible government agency) has emerged, stalling the hazard-mitigation intent of the legislation. An analysis of data from these case studies (collected through extensive interviews with officials of the implementing agencies, local government representatives, and involved citizens) indicates that this resistance has developed because of competing constructions of reality, which stem largely from different assessments of acceptable risk. This paper will present a theoretical framework to explain the development of these competing constructions of reality and delineate the factors leading to differential assessments of risk by the two groups. First, however, it is important to briefly review the literature on risk taking and risk assessment.

Risk Taking and Risk Assessment

The concept of "risk taking" usually implies a willingness to take a chance on sustaining injury, damage, or loss in some form after a careful evaluation of alternatives. Two primary branches of research which have investigated risk-taking behavior are economics and psychology.

The traditional approach used by economists when addressing problems of decision making under conditions of uncertainty has relied on an "expected utility" model (Friedman and Savage, 1948; von Neumann and Morgenstern, 1947; Luce and Raiffa, 1957). This model proposes a rational decision-making process in which an individual chooses among fixed alternatives to which known consequences are attached. In most instances, monetary values have been attributed to the various choices. If the individual's preferences then satisfy certain basic

axioms of rational behavior, the choice made can be seen as maximizing one's outcomes, that is, making the best of all possible decisions.

Economists using this model have typically studied corporate and national decision making, or individual and corporate insurance choices. Because the subjects of their investigations have usually been large, organized systems, their models have been quantifiable. For the cost attributions of alternatives, they could rely on corporate records, world market values and trends, population statistics, and actuarial tables. When this model is applied to individual decision making concerning environmental hazards and risks, however, the fit is poor. Major problems with this model when applied in this manner involve the assumptions that all alternatives are known to the individual, that objective costs can be attached to alternatives, and that a systematic calculus is used to evaluate the choices.

Simon (1956, 1959), aware of these problems with the expected utility model, introduced the theory of "bounded rationality" which takes into account the limitations of the decision makers' perceptual and cognitive abilities. Simon's theory of bounded rationality asserts that "the cognitive limitations of the devision maker force him to construct a simplified model of the world to deal with it. The key principle of bounded rationality is the notion of 'satisficing,' whereby an organism strives to attain some satisfactory, though not necessarily maximal, level of achievement" (Slovic et al., 1974:189). This adaptive behavior within the situation falls far short of the ideal of "maximizing" proposed in the traditional economic models; the individual may actually avoid the problems of evaluating utilities.

In research on adjustments to natural hazards, the utility model has been found deficient, while support has been found for the bounded rationality model. Slovic et al. (1974), generalizing from studies on decision making under conditions of uncertainty, state that people do not follow the principles of probability theory when judging the likelihood of uncertain events; rather they tend to

replace the laws of probability with "intuitive heuristics" which simplify the decision-making process. Using findings from studies on flood plain dwellers' perceptions of risks in their environment, Slovic et al. point out several mechanisms or adjustments used by the residents to reduce the belief that flooding in the near future was possible (i.e., to reduce their perception of risk). One of these mechanisms, for example, is the belief in the cyclical nature of natural disasters.

Psychological research in the area of risk is somewhat disappointing. Psychologists have attempted to formulate a profile of the risk-taker by identifying the personality traits of those who are more willing to expose themselves to risks. Laboratory experiments, frequently involving ability tests, gambling probabilities, and questionnaires eliciting "risk relevant" information (e.g., reaction to competiation, job preference, financial risks taken, etc.), have been used to compose a multitude of personality inventories, indices, and traits which are indicative of a risk-taker.

Slovic (1962), however, found that there was very little communality (or correlation) across these diverse measures of risk taking. He also points out that one of the major reasons for this lack of validity is the failure of researchers to consider subjective assessments of risk under conditions of uncertainty (Slovic, 1968). Slovic proposes that risk taking is determined more by individual perceptions of risk and what the individual believes can be realistically be done about them than by any objective indicator of risk taking. His stress is placed on understanding how people assess risks--what processes they use to ascertain the extent of the threat involved and the options they have available--rather than on requiring the existence of a mathamatically precise model of decision making.

Case Studies

Before analyzing the way in which the implementing agencies and the local communities differ in their assessments of risk (and the reasons for this), it is helpful to provide a brief synopsis of the three case studies used.

Ventura. In June, 1977, city officials of Ventura, California received formal notification from the California State Geologist identifying part of their city as a potentially hazardous earthquake fault zone. This identification was part of the implementation of the Alquist-Priolo Geological Hazard Zone Act requiring delineation of potential damage areas along known active surface faults throughout California. (Once such a zone is established, local governmenta are required to withhold building permits until investigation has determined that the site is not threatened by surface displacement from future faulting.) Upon receipt of the preliminary review maps, city officials discovered that the area identified as the proposed Ventura Fault Zone bisected two city projects. The city hired a local geological consulting firm to complete additional trenching at the two sites in order to comply with the law. The firm, however, could find no evidence of surface faulting at either site. This began a lengthy and sometimes hostile attempt on the part of city officials and the community to stop the establishment of the Special Study Zone and to provide additional evidence to refute the State's allegation that an active fault did exist in the area.

Los Angeles. In October, 1974, the Los Angeles City Council began to develop a Seismic Safety Ordinance requiring all pre-1934 unreinforced masonry buildings (built before the disastrous Long Beach, California earthquake) used as theaters to be brought up to current structural, plumbing, and electrical codes. Over the next two years this ordinance was changed several times due to the protests of several special interest groups such as representatives of the movie theater industry. The final ordinance stated that all pre-1934 buildings must be brought up to structural codes and that these would be posted before they were repaired to warn occupants of the hazard. Building owners would have until 1987 to make all repairs before demolition. This final version resulted in several hostile and emotionally charged city council meetings. One councilperson charged that the ordinance would cause the loss of nearly 50,000 jobs in his district alone because

of loss of business and cancellations of building insurance policies. He gathered nearly 400 constitutents to protest the ordinance. In light of the overwhelming opposition, the council deferred voting on the matter. Later, after several similar meetings, the council adopted a compromise bill setting up a two-year program to survey and identify the pre-1934 buildings but not to post the signs.

Littlerock. The California State Department of Water Resources (DWR) notified the Littlerock Creek Irrigation District (LCID, owners of the Littlerock Dam, located in the Antelope Valley in southern California) that a meeting would be held in June, 1976, regarding the revocation of LCID's permit to store water behind the dam. DWR had determined that the dam would be unsafe during either a maximum design earthquake (of about 8.3 magnitude) or a maximum design flood (of two to three feet overtopping of the spillway). While officials of DWR saw this action as a culmination of a ten-year effort to get LCID to rehabilitate the dam, the latter group felt it had already taken appropriate steps, making the issue a low priority one. The heavily-attended revocation hearing was the catalyst which produced widespread community discussion about the state's action. It was also the beginning of a community-based attempt to halt DWR's actions, resulting in a temporary court injunction prohibiting DWR from draining the dam.

It is important to remember that in each of these communities, the people resisting the seismic legislation were potential victims. For example, the community of Littlerock is located directly below the dam, and the local residents clearly denied the official assessment that they were "living at risk" by committing local resources to a legal battle.

Defining the Situation: Assessment of Acceptable Risk

In order to understand the factors leading to differential assessment of acceptable risk, it is necessary to look at the process by which people define a situation as threatening or risky under conditions of extreme uncertainty.

Researchers have suggested that the process of developing contradictory definitions of the same situation is primarily based on two major components: personal factors, such as past experience and present perceptions of the environment; and social factors, such as perceptions of how others are responding and comparisons of one's information and perceptions with those of significant others.

Considering the personal factors in the risk assessment process, Kates (1962) has suggested that individuals are not easily able to conceptualize disasters that have not occurred or that they have not experienced before. People appear to need direct experience with misfortune to stimulate action. Thus, Kates (1962) and Burton and Kates (1964) both point to the fact that elaborate adjustments to cope with natural hazards often evolve only after repeated experience with the hazard. However, unlike many other natural disasters, major earthquakes occur very infrequently in any specific locality. Most residents are not likely to be able to draw upon personal experience in evaluating the threat or risk.

An assessment of risk also involves individual perceptions of the environment. Several researchers (Fritz and Marks, 1954; Fritz, 1961; Wallace, 1956; Moore, 1964) have pointed to the fact that individuals tend to assess and interpret threat by referring to physical cues. One well-established finding is that it is frequently necessary for people to be able to observe changes in the local community's environment for a threat of an impending disaster to be taken seriously and for precautions to be initiated (Anderson, 1969). However, there are no observable external signs by which people can verify the threat of a coming quake as there are in other natural hazards such as floods, tornadoes, and hurricanes.

Although individual factors are important, social factors in the risk assessment process may be more influential. Individual decision making does not take place in a vacuum. Rather, an individual's perceptions and subsequent action choices may be largely shaped or limited by interaction with others in one's

social circle. For example, Fogelman and Parenton (1959) point out that as Hurricane Audrey got worse, "congregating behavior"--that is, discussions of what to do, where to go, etc.--increased, expanding from family members to neighbors to city officials. Moore et al's (1963) study confirmed the hypothesis that those who evacuate during the pre-disaster period are much more likely to have discussed the potential danger with others than those who do not evacuate. Similarly, Drabek (1969) found that the majority of his sample attempted to confirm evacuation requests, with nearly 45 percent appealing to peers for such confirmation.

Defining and interpreting the risk situation, then, is a process in which the individual draws upon both personal and social factors in order to discriminate dangerous or threatening conditions from benign ones. However, as Williams (1964), discussing the way people respond to warnings of disasters, has pointed out, most people would rather believe they are safe than in danger. If incoming information is not clear or is accompanied by contradictory information, the subsequent definition of the situation is likely to lead to a delay in action or to an assessment that action is not necessary. When we consider earthquakes, defining the situation as threatening and/or determining an acceptable level of risk is especially problematic. Since such a disaster agent has no observable precursors in the local environment and the science of prediction is still new, the situation facing the public can be characterized by a lack of explanatory definitions, cues, and expectations with which to guide behavior. Individuals, then, tend to organize their experiences and perceptions concerning the risk situation within larger overarching frameworks of knowledge.

Risk Assessment: the Scientific and Common Sense Frameworks. For each implementing agency, the type of evidence considered important and the methods used for assessing that evidence fall within a larger framework of knowledge--the scientific frame. The scientific frame, as it applies to the technological problem of seismic safety, provides the agencies' geologists and engineers

with a common vocabulary and way of addressing theoretical problems; it gives them a cohesive in-group bond. These agency scientists think in terms of statistical probabilities of an event occurring, of confidence limits set around a probable occurrence, and of hypothetically structuring an event's occurrence contingent upon other factors. The California Division of Mines and Geology, for example, considers that any surface displacement along a fault in the last 11,000 years is sufficient evidence to indicate that the fault is "active." Since evidence of movement along the Ventura fault in the last 6,000 years was found by USGS geologists, this fault clearly was identified as active. As such, it came to the attention of the Special Study Zone program. But since the surface faulting was not easily recognizable from a topographic analysis because of the erasure of displacement features by natural forces over time, the Division of Mines and Geology came to rely on trenching maps which were charted using very specialized geological skills. DWR, when evaluating the structural stability of dams within California, computed a "maximum design earthquake" for each dam site. This maximum magnitude quake is determined by the dam's proximity to the San Andreas fault and to the next nearest active fault. On the basis of past seismic activity on both of these faults and the design characteristics of the dam, a decision is made concerning the structure's ability to withstand the largest-probable quake. Geologica theory, engineering principles, and statistical probability are tightly interwoven in DWR's final evaluation of the dam's safety. The NOAA report, the basis for the Los Angeles City Council's attempt to implement a seismic ordinance, made extensive use of statistical probabilities and engineering principles in projecting extensive loss of life and property in case of a major earthquake.

In general, the local residents (with the exception of a few physical science professionals among them) do not share this scientific frame for assessing potential risk. In fact, the scientific vocabulary and manner of qualifying

statements in probabilistic terms give the local residents the impression that the state's scientific representative isn't really certain about the risk involved. For example, during the community meeting in Ventura, a citizen addressing the Division of Mines and Geology representative caustically said:

> Regarding your data, I keep hearing the same words over and over: 'I think, I feel, I believe.' Although you have been working on this data for several years, you are very indefinite and vague. Yet you want us [the city and county] to come up with precise geological evidence to prove that the fault is not active in only two or three months. I think this is ridiculous. (He picked up his briefcase and walked out of the hearing to the applause of the audience.)

The local residents use a "common sense" frame for assessing risk to their own communities from a future earthquake. This frame had two elements which were used by the locals as the core of their knowledge concerning potential earthquake-related risk--visual assessment and past experience. Unlike the statistical probabilities used by the implementing agencies, these two elements were used by the locals to determine whether or not a destructive earthquake would occur.

First, locals frequently relied on their visual assessment of the supposedly hazardous area in order to call the legitimacy of the scientific evaluations into question. During the Ventura community meeting, a few members of the audience wanted to know where to go so they could "see" the fault scarp which the Division of Mines and Geology contended was evidence of a possible future hazard in the surrounding structures. When it was explained that it would be very difficult for a lay person to identify the scarp, one audience member stated that someone should be available to point out this feature to the local citizens. Perhaps, in instances of possible natural disasters (particularly those whose occurrence is difficult to predict), a lay person using a "common sense" framework of knowledge feels the need to visually certify that in fact the potential threat exists. In the case of the seismic ordinance, visual assessment took a slightly different turn. While interviewing the director of a property owners' association, one of

the authors was conducted out onto the street where several well-maintained and seemingly sturdy buildings were pointed out to her as being pre-1934 structures. As anyone could see, the director maintained, it would serve no purpose for such beautiful stone and brick buildings to be condemned and eventually destroyed, "leaving the downtown area looking like a bombed-out city after a war." During a recess at the April 18 court hearing on the Litlerock Dam, a Chamber of Commerce member turned to one of the authors and said, "Can you imagine! They want to tear down--not just shut down--our beautiful little dam. And they haven't even told us specifically why." In this common sense frame, appearances take on an importance for the locals. They become tangible phenomena, symbols which can be defended by those who lack the conditional and theoretical explanations and understandings of the scientific frame.

Second, locals repeatedly referred to past experiences in recent history of earthquakes and their effects on the community. Whenever the topic of the dam's safety was brought up, Littlerock residents quickly recited a list of the area's major earthquakes and how the dam had withstood them without any damage. At one of their early meetings, the Littlerock community group also had a long-time resident display pictures of the dam's spillway being overtopped by two feet of water with no resulting failure. For these citizens, the ability of the dam to withstand the worst earthquake and storms in current history was central to their belief concerning the dam's stability. History was composed of "actual" facts, not hypothetical suppositions. Similarly, a spokesman against the seismic ordinance maintained that within the city of Los Angeles only one person had been killed in the last twenty-five years due to the earthquake-caused partial collapse of a building. Frequent mention was also made of the collapse of a new earthquake-resistant hospital in Sylmar following the 1971 earthquake, while pre-1934 brick buildings two or three blocks away were not affected. Such examples from local history were used by the local residents to illustrate that

the potential risk was not really as severe or imminent as the agencies contended.

Jointly, these two elements in the common sense frame were used as evidence for the local citizens' versions of reality, as the objective assessment of "real" hazards in their local communities. In light of specific issue-oriented common sense evidence, their assessment of risk from a future earthquake was low in each of the communities being studied. The importance of this element for heightening conflict and for sustaining community resistance should not be overlooked. Within each of the issue-oriented communities, reasons why actions were taken were given in the idiom of the constructed reality and relevant evidence was used as the basis for that action.

Symbolic Damage and Acceptance of Risk. A concurrent feature of the risk assessment process is the local community's discrimination between the certain effects of the agency's proposed actions and the possible effects of inaction.

In general, the agencies saw themselves taking positive steps to protect lives and property from a possible catastrophic earthquake which scientists say is inevitable in the next ten years or so. For example, DWR maintains that even if only one person is in jeopardy due to dam failure, there is sufficient reason for taking action. The agency arguments are based on the possible effects of a destructive earthquake if the hazard-reduction legislation is not implemented.

The local communities, while not necessarily negating the public safety intentions underlying the legislation, focus on the certain effects implementation would have on their way of life. Littlerock residents point out that most local growers would be forced to cease farming and/or desert their farms entirely because they could not afford to pay irrigation costs for water from the state's water project. They maintain that revocation actions would bring to an end a small town, agricultural way of life by undermining the local economy and eroding the tax base for local schools. These effects relate to some kind of tangible damage to the community and its way of life.

More important, however, are the anticipated effects of implementation on community values and principles commonly held by the majority of local residents. By focusing on this anticipated symbolic damage, the community's assessment of acceptable risk is based on moral principles rather than on something more tangible (e.g., economic considerations).

In reviewing the case studies, three issues focusing on symbolic damage to the communities become apparent. First is the issue of damage to the community's image or sense of autonomy or pride--the idea of what the community stands for. For example, Littlerock residents felt their small town way of life was threatened by DWR's actions; residents of Ventura and Los Angeles felt they were being denied self-determination with respect to both individual and community use of property. Second, the issue arose of discriminatory treatment. Ventura residents, for instance, continually questioned why their community had been singled out especially when there are other communities (i.e., Los Angeles) with histories of greater earthquake activity. Both Ventura and Littlerock residents felt their communities had been singled out because they were small municipalities rather than powerful metropolitan cities. Los Angeles residents most affected by the proposed seismic safety ordinance, on the other hand, felt they were being discriminated against on the basis of economic and racial characteristics.

Finally, the idea of the predictability of life and the perpetuation of normal life patterns comes into question. For example, for Littlerock residents to admit that their dam is unsafe is to acknowledge the inability to carry on life as usual and to acknowledge that they have not planned or ordered their lives in the best possible way. This idea also applies to Ventura residents' acceptance of the Special Study Zone and Los Angeles residents' acceptance of the vulnerability of their older buildings, many of which are historical landmarks. Along with this idea goes the acceptance of the inability to control events. In other words, the notion is raised that once standards are accepted and complied with,

DWR may initiate new standards, the Los Angeles building codes may be revised, or the State Geologist may change the criteria used to establish the Special Study Zones, requiring the communities to comply with these new standards at a later date.

Thus local communities weigh the intent of the legislation against what they have come to believe will be the certain effects, both tangible and symbolic, of implementation on their communities. In all three instances, the effects are seen as far outweighing any possible benefit. The general contention of the local residents is that the consequences of the actions are a substantially greater threat to the local community than is the threat of a possible destructive earthquake. They are therefore willing to accept a greater degree of risk than are the implementing agencies.

As the dynamics of this type of conflict evolve, the goals of both the implementation agencies and the local communities are frustrated; the agencies feel they are being hindered in carrying out their duties, while the communities feel they are being coerced into a situation which will have adverse effects on their style of life. The conflict, entrenchment, and resentment must be decreased in order for public welfare to be safeguarded, but implementation processes must not ignore the effects of legislation on local community life.

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CHAPTER NINE

MASS MEDIA AND PREPARATION FOR NATURAL DISASTER

This chapter consists of an oral presentation made at the Workshop on Disasters and the Mass Media, Washington, D. C., February 22, 1979, being published in the Proceedings of the Workshop, 1980.

The Mass Media and Preparation for Natural Disaster

RALPH H. TURNER

This paper relates to the media's treatment of the prospect of imminent disaster and preparation for potential disaster, rather than dealing with the reporting of actual disasters. Most of the sociological observations have been inspired by research that a team of UCLA sociologists is currently conducting into media handling and community response to the prospect of a damaging earthquake in Southern California.

This investigation was prompted by the United States Geological Survey (USGS) announcement in February of 1976 that there was an uplift on the San Andreas fault near Los Angeles that extended for as much as a hundred miles along the fault. Although the USGS could not specify what the uplift signified, in the past such uplifts had sometimes preceded significant earthquakes. Some scientists believe that the magnitude of an impending quake is indicated by the extensiveness of the uplift. If that were the case, the Southern California uplift-- of Palmdale bulge, as it is known--might well signify an earthquake the size of the great 1906 San Francisco earthquake or the 1964 Alaska earthquake. After the announcement of the Southern California uplift, some events occurred that, at least for the balance of 1976, contributed strongly to the conviction that a severe earthquake was imminent in Los Angeles county. Indeed, the UCLA field survey of 1,450 adults in Los Angeles county, conducted primarily in February 1977, indicated that almost half of the

*These observations are based on research in process under a grant from the National Science Foundation, ENV 76-24154, Ralph H. Turner, Principal Investigator; Joanne Nigg, Denise H. Paz, and Barbara S. Young, Coinvestigators.

populace believed that a damaging earthquake probably or definitely would occur there within 1 year.[1]

Most of my comments here relate to the characteristics of the media and their handling of earthquake news. I will conclude, however, with some comments on audience response to the media.

Characteristics of the Media and Media Handling of News

Medium Identity and Conceptions of Responsibility

Early in our investigation, in the course of discussions with media representatives, we were impressed by the fact that most media editors are governed by a high degree of responsibility concerning what they report, how they report it, and what the effects of their reporting are likely to be on the public. On the one hand, they feel a strong sense of responsibility to arouse the public from its apathy and unawareness, while on the other, they are seriously concerned lest unwise and ill-considered items stir up inappropriate public responses. This sense of responsibility appears grounded in the sense of identity that each television station or network and each newspaper develop. Thus a newspaper like the *National Enquirer*, which is sold at supermarket checkout counters, relies on sensationalist identity for its sales and has a totally different conception of responsibility from establishment press, television, and radio.

On the basis of a detailed monitoring of news reporting by six major newspapers in the Los Angeles area for a 3 year period (1976-78) and a less intensive monitoring of television and radio coverage of earthquake news, we have been generally impressed with these media's highly responsible news treatment. If these media have erred, they have erred less in the direction of sensationalism than in the direction of underplaying threat and rumor. There are some exceptions, which will be mentioned, but that seems to be the general practice.

Research is needed to discover how each unit of the media develops its special sense of identity and accompanying

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[1] R. H. Turner, *et. al.*, *Earthquake Threat: The Human Response in Southern California* (Los Angeles, California: University of California, Institute for Social Science Research, 1979), p. 39.

sense of responsibility, how these concepts are modified in response to changing events, and how they are applied in particular instances. The following comments, based on our research, relate to this general question.

1. The media's sense of responsibility is most directly reflected in decisions on what to report and what not to report. The record we kept indicates substantial differences among the newspapers and television channels in what they report. To some extent, the differences are merely a function of personnel. For example, ABC television in the Los Angeles area has a popular weatherman who happens to be interested in disasters and who therefore features an exceptional amount of disaster coverage. The *Los Angeles Times* has an outstanding science editor who covers earthquake matters to a degree not approached by the other papers, radio, or television. Beyond such idiosyncratic consideration, however, the element of responsibility clearly enters in, and our research suggests two areas in which media responsibility affected reporting.

Three important rumor waves occurred at different times in 1976. The waves involved widespread dissemination of rumors about supposed earthquake predictions, as indicated by large numbers of calls to Caltech, the USGS, and other possible information sources. In general, the media chose to disregard these rumors. This decision was clearly made on the grounds that the rumors lacked substantiation and that the media's airing them would lend credibility. At the same time, the media's decision to ignore these widespread rumors rather than to treat them as events, and their later decision to subject them to amusing and critical discussion, may perhaps have been counterproductive. A substantial minority of the population believe that the scientists, public officials, and news people know much more about the prospect of earthquakes than they are willing to tell the public--and that responsible public leaders are withholding information indicating that awful things are going to happen, for fear of the consequences. By ignoring rumors rather than airing them and presenting authoritative contradiction, the media may have fostered the conviction that valid information was being withheld. The entire question of what constitutes responsible media treatment warrants thorough exploration.

In late November 1976, through some peculiar coincidences, NBC television and radio became impressed with a man named Henry Minturn, who falsely represented himself as having a Ph.D. in geophysics and who claimed to have

successfully predicted a large number of previous earthquakes. Minturn issued a specific prediction for an earthquake in Los Angeles on December 20, 1976. At first, the other media ignored this announcement, but once the Minturn phenomenon had reached remarkable proportions, most of the media began to take note of it. Generally, they followed the lead of the *Los Angeles Times*, which presented a carefully researched report totally unmasking Henry Minturn and his supposed methods. An important feature of the Minturn phenomenon, however, was the populist sentiment to which it appealed. Henry Minturn appeared to be able to employ relatively common sense methods without extensive funding and equipment and incomprehensible scientific theories. The fact that the leading establishment media initially ignored Minturn may well have confirmed in the public's mind the image of Minturn as a Don Quixote or Sister Kenny, bringing truth that was resisted by the establishment.

2. A second theme we find in media treatment of news about a prospective earthquake is a concern with protecting the public. Newspaper, television, and radio editors are anxious to avoid any reporting that may produce mass panic or other undesirable responses. Most media representatives share the popular misconceptions about the likelihood of mass panic in response to provocative announcements. This protective concern is evident in the way in which the news media typically report accounts of predictions or near predictions of damaging earthquakes. Almost invariably, the establishment media combine warnings with reassurances that tend to undermine the seriousness of the threat that is being discussed. To what extent that practice leads the public to discount the prospect of danger is unclear.

Our survey of the public revealed that people drew different conclusions from the earthquake predictions and near predictions that came from scientific sources as compared with predictions and near predictions from other sources. In general, the earthquakes that people envisage on the basis of carefully qualified scientific announcements were of less intensity (involving less property damage and loss of life) than those they envisaged on the basis of non-scientific sources.[2]

National television and radio officials and local station officials appear to differ considerably in their assessment of responsibility. In the course of our

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[2]*Ibid.*, p. 32.

investigation into the Minturn affair, local TV and radio personnel insisted to us off the record that the network people (based in New York) had decided to accord Minturn a high degree of credibility over the objections of local news people in Los Angeles. The latter believed they were in a better position to understand the phenomenon in question and to assess Minturn's credibility and the effects of publicizing his views. The Los Angeles people believed that the national network personnel were less sensitive to the potential consequences of giving credibility to an irresponsible prediction in Los Angeles. Whatever the merits of this argument, local and national news editors doubtless differ on occasion with respect to what is newsworthy, and their differences obviously reflect different concepts of responsibility and differing degrees of sensitivity to local concerns.

3. Finally, any assessment of responsibility must be made in relation to some assumed time span. An announcement that is responsible when viewed in a longer time span may be irresponsible when viewed in a shorter time span, and vice versa. It may sometimes be necessary to stir people to a considerable state of agitation in order to get them to prepare for threatening events. The major newspaper and television and radio networks appear to emphasize a very short time span. The media are constantly analyzing their impact, daily and weekly, with the result that any short-term discontent, disorder, or public anxiety that can be attributed to an announcement from the media leads to an immediate reassessment by the media of their news reporting. If such constant self-examination does exist, it may well detract from the media's ability to play an effective part in encouraging long-term preparation for disaster.

In implementing their conception of responsibility, the media depend on constant feedback. I believe we have too little understanding of the nature of this feedback and how it is interpreted and evaluated. Again, I can merely offer some suggestive illustrations.

Media personnel in Southern California generally evaluated the widespread publicity given to Henry Minturn's prediction as a major fiasco. As a consequence, the media subsequently appear to have downplayed or even suppressed earthquake news that would have been freely publicized prior to the Minturn affair. Some media representatives clearly sensed that the public was fed up with hearing about earthquake danger; moreover, many news editors

believed that their own careers might be in danger if they were to make the same mistake that the news editors responsible for publicizing Henry Minturn made. The result, then, has been a period of great caution. In one set of our interviews, we specifically inquired whether people felt that there had been too much, not enough, or just about the right amount of coverage of five different types of earthquake news. The answers surprised us--overwhelmingly, people felt that there had been too little coverage.[3] Thus the media editors appear to have been quite wrong in their judgment that the public was uninterested in earthquake news. The question then is, What feedback led the media to embark on the policy of restricting news coverage of earthquake-related matters?

In assessing feedback, it is important to know the extent to which feedback may be distorted by projection. In this case, did media representatives project their own preconceptions on the public, rather than open-mindedly gaining a true understanding of public response?

Another question concerns the extent to which media representatives are overly sensitive to communications from vocal minorities. We already have abundant evidence that the scientific community grossly misjudged the public's response to Caltech Professor James Whitcomb's near prediction of an earthquake. Because the Caltech telephone lines were swamped with calls and because one vociferous Los Angeles councilman declared that the city should sue Caltech and Whitcomb for damage to property values of his constituents in the San Fernando Valley, many earth scientists became convinced that the whole population was highly incensed about the Whitcomb announcement. In fact, a study of city council proceedings and our own survey of public attitudes indicate that these protestations came from an almost trivial minority and were in no sense indicative of the general public response. Nevertheless, we suspect that the media generally depend on this kind of feedback in assessing whether they are acting responsibly or irresponsibly.

Newsworthiness

To retain their audiences, radio, television, and newspapers must, of course, make their reports newsworthy, and to

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[3] *Ibid*

varying degrees these reports must seem timely and entertaining. A second general research area is the way in which these inherent media requirements affect the communication of disaster warnings and educational information.

As Robert Park long ago indicated, currency is the most important criterion of news.[4] This fact is dramatically indicated by the way in which the media drop stories without bringing them to completion. After belated but extensive coverage of Henry Minturn's predictions, for example, very few of the media made any commentary after the predicted earthquake failed to occur. Instead of completing the story and making an assessment after the prediction had fail, the media simply dropped the matter. As a result, we found some months later that many people were still unclear as to whether Minturn's prediction had failed, come true, or remained in the offing. Similarly, Professor Whitcomb's near prediction received extensive coverage, but most of the media ignored his announced cancellation some months later; even the *Los Angeles Times* hid the story on the back pages of the first section. It is also very difficult to find reports of the outcomes of city council and other government discussions of earthquake safety issues once decisions have been postponed and public interest has lagged. It seems likely that this tendency on the part of the media not to follow events through to their completion facilitates the development and persistence of public misconceptions, which, in turn, affect responses to later warnings.

The media's concern with currency is also reflected in the way stories on topics related to current news are produced. At the time when the Minturn prediction was current, the establishment media, while trying systematically to ignore Minturn, nonetheless felt it appropriate to take advantage of the aroused interest to present other materials relating to earthquakes. For example, one of the major television stations asked me to participate in a 5 minute interview on prime-time news to discuss preparations people should make for a possible earthquake. It was agreed that no reference whatever would be made to Minturn's prediction. Yet choosing that time to review on TV the kinds of earthquake preparations people should be making may inadvertently have had the effect of lending credibility to the one clear-cut prediction in the public arena at the time.

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[4]R. E. Park, "News as a Form of Knowledge," *American Journal of Sociology*, Vol. 45 (March 1940), pp. 669-686.

Another question relevant to the currency of news is, Just what does make an event? In our news monitoring, we have been struck by the extent to which developments in earthquake prediction are reported at the time of national scientific meetings and the like. Often, what is reported is not new and could just as reasonably have been reported 6 months earlier or at any other time; yet somehow a meeting of experts is a newsworthy event, and information that is not news at another time suddenly becomes news. This phenomenon suggests the need for an investigation of the way in which particular occasions turn relatively timeless considerations into current events and current news.

Another feature of the media's news treatment is the elementary level at which all presentations must be made. This matter is of particular concern when it comes to reporting such technical subjects as the grounds for earthquake prediction. The media tend to start every presentation as if the audience knew nothing--which, of course may be a correct assumption. The result, however, is repetitious treatment of the same points. Commitment to this kind of presentation leaves the media little opportunity to develop understanding of complexities--except in the relatively comprehensive newspaper accounts that are probably read in full by very few people.

Television and radio professionals apparently attribute a very limited attention span to the public. Even in the occassional hour-long special, the media tend to jump fairly quickly from one topic to another. Similarly, in the typical television and radio interview the moderator asks a question, cuts off the speaker after a brief answer, and jumps to quite another question. If the actual interview is not conducted in this way, the interview is almost certain to be put together in this fashion when it appears on television or radio. Most of us have had the experience of being interviewed for 15 minutes or a half hour and then having a 1 minute spot made for the interview, with brief excerpts from our remarks being presented and questions dubbed that are different from the questions asked in the original interviews. The consequences of this assumption of limited attention span on the part of the public are certainly worth investigation.

Finally, considerable attention has been given to the media's characteristic tendency to entertain. The transformation of television news from strictly news reporting to a kind of entertainment in recent years has been widely noted. Just how this transformation affects what gets communicated about the prospect of a disaster still bears

careful investigation. Two possible implications come to mind. First, careful reading of the news reports concerning Henry Minturn and careful monitoring even of the broadcast media reports indicate generally that the media's intention was to cast aspersions on Minturn. Nevertheless, in the effort to make Minturn interesting and entertaining to the public, the media appear to have presented the story in such a way that many readers and listeners missed the intended interpretation. Thus the attempt to entertain and attract interest may have led to a mode of communication that enhanced Minturn's credibility, even though reporters and news editors themselves did not believe in his prediction.

A second example of how the media's attempts to present the news entertainingly may distort its impact is evident in the media's tendency to use either extreme or amusing examples to illustrate the possible impact of a disaster. The extreme examples appear to the typical auditor or viewer as personally inapplicable, while the amusing incidents tend to diminish the seriousness of the event. In both cases, the effect of the entertainment approach is to lessen the relevance and seriousness of the actual threat.

Other Features of the Media

Several other characteristics of media coverage that may have effects on the treatment of the prospect of disaster also are suitable subjects for research and investigation.

Much media coverage of disasters is characterized by a remarkable lack of continuity. This problem stems in part from the fact that different reporters or editors are assigned to the same story at different times, and all tend to take up the story midstream, without having time to relate their work to previous reporting. In my own experience of being interviewed by reporters, with one or two notable exceptions, nearly all of the people who interviewed me were taking up the topic of earthquake preparedness or earthquake prediction for the first time and were not even familiar with the standard sources. In fact, on occasion I have informed media representatives of a special feature on the topic that had been done by the same radio or television station at an earlier time, of which they were quite unaware.

Along with a lack of serial continuity, there also is a lack of coordination among reports that deal primarily with different topics. For example, the *Los Angeles Times*

has dealt very responsibly with the need for earthquake preparedness, has supported the legislative measures to implement safety procedures, and has presented careful reports of significant advances in earthquake prediction. However, a story in the same newspaper about the current school busing controversy bore the headline "Quake Rules Peril City Magnet Schools." The implied message of the article was that one of the more constructive approaches to voluntary achievement of integration was being subverted by some earthquake regulations that forced the magnet school to abandon its building. The newsman responsible for writing this story, of course, knew nothing of earthquake preparedness, and there was no effort to reflect in his story the knowledge that was available in other departments of the *Los Angeles Times*.

Our investigation and other researchers' have demonstrated clearly that the general public fails to comprehend many scientific concepts such as probability and risk. It is also well known that the public tends to combine a respect and awe of science with considerable belief in nonscientific concepts and prophecy. An important question is, How should the media deal with these problems? We have heard news programs in which the newscasters ridiculed the scientist's carefully qualified statements of probability and his unwillingness to guarantee certain consequences or to state categorically that a given theory was or was not true. Insofar as that attitude of ridicule supports a more primitive type of folk thinking, the media, of course, are not effectively preparing people to appreciate the nature of scientific thought.

The popular film *Earthquake* provides a good example of the way in which the media support the popular tendency to respect both scientific and nonscientific thought. The film shows a scene in which the great earthquake is predicted on the basis of scientific evidence in a laboratory; that scene is followed by another in which a girl forecasts great disaster through the cutting of cards. In that fashion, the motion picture lends credibility to the notion that both scientists and nonscientists can foretell the future. I think we still have much to learn about the way in which the media can and do deal with the discrepancies between scientific and nonscientific thinking. Acquiring such knowledge is important if the public is to comprehend such ideas as probability, risk, and cost-benefit ratios--ideas that the public must understand if it is to take advantage of scientific knowledge about impending disaster.

Finally, various newspapers and radio and television

stations appeal to different constituencies, and on this basis they give a different kind of news coverage. We need to know more about the effects of the constituency on the coverage. In our investigation, we have systematically compared the treatment of earthquake topics in Southern California's leading Spanish-language newspaper with treatment in the major English-language newspapers. The Spanish-language newspaper, which is the sole newspaper read by a considerable proportion of Mexican-Americans, totally ignored news of the Southern California uplift and generally downplayed news of the local earthquake threat. The same newspaper was filled for weeks with stories of the Guatemala earthquake. Clearly, the paper tends to focus on the broader Latin scene rather than on the local scene. In contrast, the San Fernando *Valley News*, the major newspaper serving the impact area of the San Fernando/Sylmar earthquake, gives considerably more attention to earthquake topics than other newspapers do and seems to give a distinctive slant to earthquake news. Similarly, certain of the independent television stations have featured the religious prophetic and secular prophetic treatment of earthquakes, whereas the major network stations have scrupulously ignored these kinds of sources.

Audience Response to the Media

I shall mention only briefly some of the questions that seem to be important with respect to audience response because these subjects have been more widely researched.

Our investigation has shown that individuals seem to have only a rather vague and limited awareness of the media's many predictions and announcements concerning the earthquake prospect. More people were convinced that there would be a damaging earthquake than were able to specify particular predictions, announcements, or cautions that led them to this conclusion.[5] Apparently, then, the public response to media treatment is not to recall specifics or details, but rather to gain a general impression about what is in the air and what is expected to happen. As a consequence, the public cannot specifically relate information such as the report that James Whitcomb was canceling his near prediction to its own general conviction that there is going to be a serious earthquake. The

[5]Turner *et al.*, *op cit.*, p. 43.

relationship between general impressions and specific information merits further investigation and may have serious implications for the effectiveness of the media's disaster preparedness and news presentations.

Researchers have much more to learn about how audiences differentially evaluate the authenticity of the cautions, advise, and forecasts concerning impending disaster. Our own investigation shows that most of the scientific and prophetic announcements are properly identified as scientific and prophetic by people who remember them. Many announcements that are not actually from scientific sources, however, are attributed to them. Moreover, if we compare the announcements that are taken seriously with the announcements that are not, the media treatment of the announcement appears to have a substantial effect beyond the source to which the public attributes the announcement.

A popular radio program item is the call-in or talk show, in which a glib master of ceremonies invites the public to telephone in and then carries on conversations with the callers. Many such talk sessions in Southern California have been devoted to earthquake issues. The people who call in appear to include a disproportion of the agitated, reaching sometimes even to the lunatic fringe, and are therefore not believed to be representative of the public. To what extent the public views these shows as pure amusement or takes them seriously we do not know. There is clearly a world of discourse going on here that we know little about and whose consequences we understand very little.

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CHAPTER TEN

HUMAN RESPONSE TO EARTHQUAKE THREAT IN SOUTHERN CALIFORNIA

This chapter consists of the statement prepared for presentation at the Mexico-California Symposium on Earthquake Hazards in the Internation Border Region, September 6, 1979. The statement will appear in the published Proceedings of the Symposium, 1980.

HUMAN RESPONSE TO EARTHQUAKE THREAT IN SOUTHERN CALIFORNIA*

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In 1974 and 1975 the public was made generally aware that scientists might soon be able to predict earthquakes. At the same time, discussion began over what would happen when a prediction was released to the public and how the prediction might be handled most effectively so as to insure a constructive public response. Efforts were made to think about this problem by analogy to our experiences with other types of disaster warnings, because we had no direct experience with earthquake warnings. Then in February, 1976, the United States Geological Survey announced the existence of an extensive uplift along the southern San Andreas fault. While no one would go so far as to predict an earthquake on the basis of this evidence, scientists explained that such uplifts had, in the past, preceded earthquakes. If indeed this uplift did signify an impending earthquake the destruction and loss of life could be extensive. Announcement of the Uplift, while certainly not a true prediction, was the nearest thing to the prediction of a potentially destructive earthquake released to the United States public. It seemed important to study the actual public response to this announcement.

Two months later Dr. Whitcomb of the California Institute of Technology

made an announcement that was variously interpreted as a prediction or an hypothesis test and which added to the sense that a severe earthquake was in the offing. Near the end of the same year the mass media gave wide publicity to Henry Minturn, a man who represented himself as a geophysicist, who predicted an earthquake for December 20, 1976, in the Los Angeles Region. The upshot was that 1976 was a very busy year for the southern California public so far as near predictions of earthquakes were concerned.

Midway through 1976, we began a program of research to study the public response to the widely announced earthquake threat. We attempted to determine the extent of public awareness of the earthquake threat, the credibility assigned to various kinds of forecasts and near predictions, the extent of fear and concern over the earthquake prospect, how people received and sifted information, how receptive they were to receiving more information, to what extent they had faith inscientific predictions and to what extent they believed in nonscientific forecasting of earthquakes, what they thought public authorities should be doing, and what they were doing to protect themselves.

Beginning in mid-1976 and ending in January, 1979, we gathered three kinds of data. First, we attempted to monitor the treatment of earthquake topics in the media, so to get an idea of what the public is exposed to. Second, we tried to get a record of organizational responses in Los Angeles County and also any sign of grass roots organization to cope with the earthquake threat. And finally, the largest part of our study consisted of a series of surveys of popular attitudes and understandings.

The first survey, involving 1450 people, was done in February, 1977, approximately one year after the announcement of the southern California Uplift. We followed up this survey with panel interviews at intervals of five to six months to the end of 1978. We also prepared for several contingencies,

including a large or small earthquake, cancellation of an earthquake warning, and intensification of warning. Only one of the contingencies happened. There was a small, but nevertheless substantial, quake in southern California on New Year's Day of this year. Just a few days later we were able to conduct telephone interviews with about 500 people. We asked how they interpreted the earthquake and how they related it to predictions, near predictions, and forecasts they had heard. We have a partial report of the findings, entitled "Earthquake Threat" which is available to people who are interested. Today I will review some of the findings from this report, and some additional findings that we have developed since the report was prepared.

First, to what extent does the word get out to people? One year after the announcement of the Uplift, 41 percent of the people hadn't heard about any kind of "bulge in the earth near Palmdale." The remaining 59 percent who <u>have</u> heard includes 16 percent who didn't understand that the Uplift might be the sign of a coming earthquake. So we get down to essentially 43 percent of the people who a year after, had heard of the Uplift and understood that it might be a sign of a coming earthquake. We also asked people: if it were a sign of a coming earthquake, did they think there would be damage where they lived? We are raising the question here of whether it was relevant to them. We are now reduced to 25 percent of the populace who have heard of the Uplift, understood that it might signify an earthquake, and seen it as relevant to their own personal safety. That's a rough indication of how well the word gets around on a potentially grave matter that was extensively and repeatedly discussed in the media over the period of a year.

We also asked people about various predictions, forecasts, and cautions they had heard in the past year. Most people were able to tell us about one such announcement that they had heard, and a few people were able to tell us about more than one. What kinds

of announcements did they tell us about? What had they heard and what did they remember? The greatest number mentioned what we call pseudoscientific announcements. There were chiefly announcements by Henry Minturn, the supposed-geophysicist, and the very popular view that some day soon much of California will break off and fall into the Pacific Ocean. Those seemed to be the widely known views. Next most often people remembered vague and general sorts of warning announcements. Only 15 percent were able to specify any kind of announcement from a scientific source that they remembered. Even fewer, fortunately only six percent, specified what we call prophetic forecasts--by seers and religious prophets. Of all these announcements only about a third were taken seriously.

So you see, the people are in an environment in which they hear a great deal, but what they are hearing is relatively vague and nonspecific. Much of it is nonscientific, but is frequently mistaken for scientific. It is interesting that even though we get down to only 30 percent of the people who can remember any kind of forecast or near prediction that people felt merited serious consideration, when we asked them if there was going to be a damaging quake in the Los Angeles area in the next year--a relatively short time period--43 percent said "probably" or "definitely." So again, awareness of the imminent prospect of a serious earthquake is more general than the memory of any specific announcement that people have heard. There is a sort of general earthquake expectancy.

This conclusion was reflected further when we asked people in November of this past year about their interpretations of the nearby Santa Barbara earthquake. A considerable number of people felt that the Santa Barbara quake was a sign that "the big one" was on its way for Los Angeles. Subsequently, after the small New Year's Day quake, an even larger fraction of the people felt that "the big one" was on its way. So we find people interpreting everything

that happens as a further sign supporting the expectation they have for a quake.

We wondered to what extent people believed in scientific predictions. Here we found that 42 percent of the people actually felt that scientists could predict earthquakes fairly accurately now. I doubt that most scientists would endorse that view, so if anything, the faith is greater than is justified. An even greater 84 percent said that scientists would be able to predict earthquakes accurately in the future. There is a high degree of faith in science.

However, many people also believe in various kinds of nonscientific forecasting of earthquakes. We looked at belief combinations and found that the majority of the people--55 percent--believed that scientists can or will be able to predict earthquakes accurately and also believed in some sort of nonscientific forecasting. What we have to understand is that while there is great faith in science, the people are not going to put all their eggs in one basket. Many will still look to seers, amateurs and nonscientific forecasters as well as to scientists.

Generally speaking, people admitted a rather intense fear of earthquakes. On the other hand, when we asked them about the problems and concerns that they had, they didn't spontaneously bring up earthquakes. The earthquake problem has a fairly low priority among more pressing daily concerns, and is a source of anxiety principally when it is brought to their attention.

We were quite surprised to find that most people felt that media coverage of earthquake topics was quite insufficient. They wanted more coverage and they wanted more information. Contrary to the widespread assumption that people want to be sheltered from potentially disturbing information about earthquake threat, people wanted to hear more. Their feelings about the release

of actual predictions were somewhat more mixed, however. If scientists are almost completely sure of themselves, then the public overwhelmingly wants the predictions released, without any delay. But when we asked about a prediction to which scientists assign a fifty percent probability of occurrence, the majority of people were somewhat doubtful about having it released. If it were to be released, they would prefer to have it held back for a while, and not released too far ahead.

There is a good deal of fatalism about earthquakes. Many people feel there isn't much to be done about the earthquake threat. However, that fatalism is much stronger with respect to the general consequences than the specific consequences of earthquakes. The majority of people believe that no matter what we do, earthquakes are going to cause a lot of damage and death. But on the other hand, most people believe that there are things that they can do for themselves so that they won't suffer the full brunt of the disaster. So it's at least encouraging to realize that most people feel that something can be done.

Generally, people are most aware of the danger that comes from unsafe structures and the danger from being located on or near an earthquake fault. They seem almost unaware of the danger from the possibility of dams collapsing. For some reason or another, even though people in Los Angeles lived for days with the threat that the Van Norman Dam would break in 1971, that eventuality doesn't seem to have penetrated their consciousness as a real danger. When we compare the attitudes of people who live in the potential inundation areas beneath dams with the rest of the community, there is no greater awareness of earthquake threat and no greater concern for earthquake preparedness.

Relatively few people have made any specific preparations for themselves and their families, with the exception that in about half the households

with children, adults say they have instructed their children on what to do in an earthquake. Generally speaking, greater awareness of the earthquake threat goes along with more personal preparedness. It is also true that more fear and concern seems to be associated with more preparedness, but that is true only up to a point. When people become extremely fearful, they tend to be less well prepared. There is a constructive level of fear and concern wheich will lead people to make preparations, but a more extreme level of fear and concern tends to be immobilizing. We need to bear this principle in mind as we try to create awareness.

We found that people who live in the 1971 San Fernando Valley earthquake area show greater awareness of the earthquake threat and greater knowledge than people in other parts of the county. But that awareness seems to apply only to the people who lived there when the 1971 earthquake occured. The newcomers into the area have not been infected by any imperative local concern. So the recent destructive quake has not had a lasting effect on the community except through the memories of individuals.

We have also made a rather extensive comparison of the attitudes of Blacks, Mexican Americans, and a White Anglo control group. There are quite extensive differences and these differences are not reducable simply to socio-economic status. They are clearly cultural differences. In many cases, the Mexican Americans and the Blacks are the most different, and the White Anglos are intermediate in their characteristics. There isn't time to go over those differences, except to point out that people dealing with communities containing large Mexican American and Black populations should take account of the rather different patterns of communication, awareness, support systems, tendencies to believe and disbelieve, trust in government, and matters of

group concern that will effect response.

Finally, by comparing our original survey with the later panel surveys, we secured evidence on stability and change in these attitudes. There is a very important question of what happens when you have a relatively long term alert like this with an early build-up of concern. When nothing happens after a few months or a year or more, does a reaction set in? Is there a false alarm effect?

Most of the responses and attitudes we looked at were relatively stable and did not change much over the two years that we followed them. The extent of awareness of the Uplift remained rather steady, and it appeared that personal and household preparedness was rather stable. There was however, a substantial drop in the number of people who expected a serious earthquake within a year, and there was an increase in the reluctance to have uncertain predictions released to the public. Both of these changes are consistent with what we might expect when people are waiting and waiting and nothing happens. However, all of this change happened in a very short period between February and August of 1977, with rates remaining steady thereafter. So these changes do not fit the pattern of a steady loss of confidence over time.

We also have a strikingly opposite observation. Throughout this two-year period, there was a steady increase in the extent to which people believed that scientists could predict earthquakes accurately. This observation runs quite contrary to the notion that people should have been increasingly disillusioned as they waited and waited for a predicted earthquake to occur. Apparently, the continuing attention to these matters by the media has increased the general awareness of earthquake prediction and the general faith in the possibility of predicting earthquakes.

In sum, the two year period of waiting does not seem to have lessened the public disposition to respond in case of a credible warning of imminent earthquake danger.

We were curious as to whether the emphasis on government economy associated with the discussion and passage of Proposition 13, to limit property taxes, would have had an adverse effect. In our early surveys, people overwhelmingly looked to government to take the lead in dealing with earthquake hazard, and overwhelmingly endorsed the the spending of even large sums of government money on reducing earthquake hazard. So we asked people, after the Proposition 13 vote, if they now thought the right amount, too much, or not enough money was being spent on earthquake safety. The majority of people said there was not enough government money being spent. Now this was just a few months after the majority of them had voted for Proposition 13, to cut taxation. We then asked if their views had changed as a result of Proposition 13. Most of them said they had not. Those who said their views had changed generally said they now believed that more money rather than less money should be spent.

In general, then, changes that occurred over this two year period seem mostly to have been in the direction of maintaining a modest degree of earthquake readiness rather than in the direction of eroding support for earthquake safety. In balance, these findings are moderately encouraging about what the effects of long-term warnings might be.

Footnote

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