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Evacuation in Emergencies: An Annotated Guide to Research

Barbara M. Vogt
John H. Sorensen

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ENERGY DIVISION

EVACUATION IN EMERGENCIES: AN ANNOTATED GUIDE TO RESEARCH

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ABSTRACT

The purpose of this literature review was to explore the relevant sources of knowledge regarding evacuation related issues among recent work published in the social sciences and emergency planning fields. In organizing the material, we looked primarily for articles that included either a theoretical or empirical basis for the findings. By empirical, we mean that the findings were based on data taken from actual research gained through surveys, questionnaires, interviews or a combination of these, and the use of secondary sources. The theoretical material consisted of work that built on past research or which explored the use of models. Some conceptual work, raising issues not covered by the general format, were included if they attempted to synthesize aspects of the literature now segmented or which asked additional questions about topics related to but not necessarily within the strict realm of research studies.

The material was divided as to the emphasis placed on the individual or the organizational level of behavior. Empirically the individual, family or household response is easier to assess because of the bias that may intrude when individuals of organizations or agencies involved in the evacuation process are interviewed regarding their official status. The annotations of the literature as well as the specific key findings from each study, where appropriate, are organized by hazard type. An author index is provided. For those wanting a more synthesized review of the literature, a companion document is available (J. Sorensen, B. Vogt and D. Mileti, Forthcoming; Evacuation: An Assessment of Planning and Research, Oak Ridge National Laboratory).

INTRODUCTION

The purpose of this literature review was to explore the relevant sources regarding evacuation related issues among recent work published in the social sciences and emergency planning related fields. In organizing the material, we looked primarily for articles that included either a theoretical or empirical basis for the findings. By empirical we mean that the findings were based on data taken from actual research gained through surveys, questionnaires, interviews or a combination of these, and the use of secondary sources. The theoretical material consisted of work that built on past research or which explored the use of models. Some conceptual work raising issues not covered by the general format were included if they attempted to synthesize aspects of the literature now segmented or which asked additional questions about topics related to but not necessarily within the strict realm of research studies. For example, we included some articles written for emergency planners that questioned the liability involved in vertical shelter destination for refugees or another that mentioned "growth-cap" policies - areas generally regarded as political and outside emergency planning. That such issues are being raised in the disaster and emergency planning literature indicates that emergency management, especially that of evacuation of threatened populations, has become an established and relevant field for research agenda over the last decade.

The work builds on earlier published material such as that of the Disaster Research Center under the direction of Professor Quarantelli.

However, this work stresses the more delimited area of evacuation research instead of the broader category of disaster studies that includes evacuation issues within its confines and this study goes beyond the behavioral literature to include that of planning and logistics. In some of the research, the factors related to evacuation and that of the disaster experience in general are not well differentiated and, therefore, are included because of their relevancy. Thus we include discussions regarding, for example, convergence behavior which may impinge on the disaster experience in general but probably to a greater extent on the evacuees's problems in returning to the homesite.

Evacuation is thus conceived as a round-trip experience from both the temporal and spatial dimensions. Permanent dislocation because of a recurring or extended disaster is not a normal occurrence in the United States as it is in some foreign countries. Perry and Mushkatel (1984) work on the relocation of an entire town in Arizona, because of recurrent flooding, was the only empirical study of permanent evacuation included.

In addition, we excluded individual occurrences such as being hit by lightening or being involved in a multi-car accident. Thus we infer that a degree of disruption of social behavior must occur for inclusion in a disaster evacuation experience. Evacuation is viewed as collecive behavior because of this assumption of social disruption. Individually threatening or lethal events occur daily that require emergency action, but an event to be classified as a disaster in our definition must include abnormal or additional stress to a social system. Elected officials, agencies, or emergent groups must cope with events out of the ordinary realm of behavior even when well prepared for them.

We concur with Quarantelli (1980) that evacuation should be viewed as a proactive rather than a stimulus/response reactive process. In many articles, it is reaffirmed that giving warning to a threatened population is not enough incentive for the public to respond by withdrawing from the affected area. The general reaction is one of disbelief. For example, clarification of the threat from some outside source is the norm with an active search and waiting period until all kin members are accounted for before any action is taken. Drabek found evacuation by invitation a phenomena in his research on floods. Furthermore, if neighbors were seen leaving, the tendency to evacuate was found enhanced.

Little precise work has been done regarding the temporal aspect of evacuation probably because the individual variables affecting this segment of the research are difficult to quantify. Some models within the transportation literature assume a three-hour delay - one hour to develop means of warning the public, one hour to warn and one hour for people to prepare to leave their homes. In areas where storm surge or anticipated high winds may block escape routes, timing is a crucial aspect of emergency planning.

The spatial dimensions of evacuation often are assumed rather than explicated in the evacuation literature. To what distance an evacuee travels is generally less well known than to what destination, i.e., friends or relatives. There appears to be some agreement that official shelters are used as a stopping point rather than as a destination site for many people evacuating. Again the problems are compounded by the accounting by agencies on the numbers or amount of relief given. For

example, the Red Cross routinely gives estimates of relief based on the total number of meals prepared that includes all volunteers as well as the organization's personnel also at the location. Nor has the actual number of evacuating vehicles been calculated by standard measures. Rather the estimated numbers come from surveys asking people their intentions about using vehicles when evacuating. Thus whether the family car or a camper van, or both, are used is largely conjecture.

The material was divided as to the emphasis placed on the individual or the organizational level of behavior. Empirically the individual, family or household response is easier to assess because of the bias that may intrude when individuals of organizations or agencies involved in the evacuation process are interviewed regarding their official status. Some work has been done regarding the potential role conflict of officials between their emergency work and family roles.

Assumptions regarding organizational networks and interfaces especially at the state and national level in widespread disasters until recently have not been elucidated in the research. For example, although volunteer organizations such as the Quakers and the Red Cross are routinely involved in mitigating the effects of large scale disasters, little is recorded of their direct involvement except to note their aid in sheltering and feeding. Only one study in a Utah flood suggested the organizational aspect of the Mormon Church was responsible for the active response to prevention of disaster and to the cleanup process following the event. How the response of organizations are coordinated in unusual search and rescue operations was examined by

Drabek et al. in 1981 but the findings of interaction between organizations have not been extended to the general evacuation process.

Another problem overlooked by researchers in general is the difference in evacuation procedures for small versus large-scale disasters. Whether the area encompassed by the disaster is large or small, densely or lightly populated, even urban or rural is overlooked in noting the findings. Thus typologies of evacuation behavior are difficult to elucidate. Disasters that require evacuations across states are not examined either. The majority of studies use case examples with few involving any follow-up. Compilations of statistics also remain conjectual when massive evacuations such as at Mississauga which occurred without loss of life and little damage to property are compared to evacuations of beach areas during a hurricane where some residents boast of their ability to "ride out the storm." Research into the media's influence during evacuation has also been problematic.

The criticisms are not intended to disparage the general field of evacuation literature. However, as the need for evacuation procedures increase - and there is every indication that the numbers of people living in hazardous areas will continue to mount - the problems of planning and providing resources for evacuations in the most efficient manner becomes paramount for many communities. Without outside assistance either in the form of federal or state aid in planning and researching the agenda for evacuation is often beyond the reach of most communities. This bibliography is intended to aid both the student and planner in meeting that need effectively.

The annotations of the literature as well as the specific key findings from each study, where appropriate, are organized by hazard type. An author index is provided. For those wanting a more synthesized review of the literature, a companion document is available (J. Sorensen, B. Vogt and D. Mileti, 1985; Evacuation: An Assessment of Planning and Research, Oak Ridge National Laboratory).

NATURAL HAZARDS

EARTHQUAKES

Arnold, C., R. Eisner, M. Durkin, and D. Whitaker. 1982. "Occupant Behavior in A Six-Story Office Building Following Severe Earthquake Damage," Disasters 6(3):207-214.

At 4:16 p.m. on October 15, 1979, in Imperial County, California, an earthquake lasting 8 seconds seriously damaged the six-story Imperial County Services Building which subsequently has been demolished. This paper investigates the occupant's specific behavior during and immediately following the event. The effectiveness of previous training in evacuation and the importance of familiar actions and specific emergency drills are evident from reported behavior regarding personal evacuation procedures. Diagrams of occupant's evacuation routes are depicted.

Findings/Comments:

(1) Evacuation behavior shows force and value of emergency drill with 79% of evacuees following former drill procedures for bomb threats.

(2) 83% had previous earthquake experience and 70% based initial response on previous experience with earthquakes.

(3) "Instinctive daily-patterns" outweighed correct evacuation procedure according to earthquake drills with evacuees choosing exit most familiar to them. Exiting behavior shows power of familiarity in choice of exits.

(4) Although no order to evacuate was given, evacuation appeared as instinctive reaction after trembling stopped and no one panicked during exiting.

(5) Significance of leadership demonstrated with people following paths of "leaders" or established flows in evacuation.

(6) Expecting people to evaluate alternative routes in evacuation, i.e., between bomb threat and earthquake threat, is unrealistic in emergencies.

(7) Evacuation of entire six-story building took 4-5 minutes.

Committee on Socioeconomic Effects of Earthquake Predictions. 1978. A Program of Studies on the Socioeconomic Effects of Earthquake Predictions. Washington, D.C.: National Academy of Science.

This report concerns the possible consequences arising from earthquake predictions and suggests both methodological and theoretical research to

anticipate and deal with the consequences. The report classifies the issues into five groups: the reactions of individuals and households, reactions of businesses and effects on the regional economy, governmental issues, legal problems, and generation and dissemination of prediction. The Committee recommends three sets of research areas including longitudinal monitoring, development of methods and theories for prediction of the behavior monitored and their relationship to policy analysis. The conceptual framework focuses on process including both the short-term and long-run effects within the time window. The comprehensive analysis includes the evaluation of policies regarding predictions, the reactions of individuals and organizations, the subsequent effects on laws and social institutions and the role information plays in the process. The consequences of a prediction depends on the the nature of the prediction, the structure of the community or region in which the prediction is made and the legal and political constraints that limit the responses of individuals, organizations and institutions. Legal problems regarding liability in terms of responses and the role of the media are also examined.

Findings/Comments:

(1) The Committee report is conceptual in nature but ascertains that significant research needs to be accomplished in the area of earthquake prediction and the consequent effects on individuals, organizations including businesses and government, and for the analysis of legal and policy issues.

Kielcolt, J. and J. Nigg. 1982. "Mobility and Perceptions of a Hazardous Environment," Environment and Behavior 14: 131-154.

Using a socio-ecological model as a basis for analysis, this study examines mobility decisions of persons living in areas subject to earthquake hazards. Face-to-face surveys of 1,450 residents were conducted during a three-month period from January to March, 1977, in the Los Angeles County area to determine the level of awareness, perception, attitudes and knowledge of earthquake threat. Data indicates that life cycle factors are more influential in decisions to move than mediating cognitive and behavioral variables. Objective earthquake threat and perception of threat are minor considerations in mobility decisions. Variables most important in decision to move are age (strongest negative relationship), satisfaction with community, length of time in community, whether community is perceived as "real home," home ownership and the number of groups with which resident is affiliated. Unlike knowledge of earthquake problems, knowledge of environmental problems was found related to mobility. The authors suggest one factor may be that no crisis had been activated to disrupt everyday life. Model of mobility considerations given.

Findings/Comments:

(1) Contrary to Van Ardsdol et al. (1964) findings, ecological location has little effect on perception of hazard. No relationship was found to exist between exposure to earthquake hazards and mobility decisions.

(2) Individual and community characteristics exert greatest pressure in decision to move (i.e., length of time in community, home ownership and number of groups to which one belongs).

(3) Fear and number of earthquake topics discussed significantly related to moving when background variables are controlled.

(4) Thus earthquake threat and perceptions of threat are minor considerations compared to life cycle variables and one's social and economic ties to an area in explaining decision to move.

Mileti, D. S., J. R. Hutton and J. H. Sorensen. 1981. Earthquake Prediction, Response and Options for Public Policy. Boulder, Colorado: Institute for Behavioral Science, University of Colorado.

Human response to earthquake predictions presents many problems both at the individual and the institutional levels. This work reviews and examines the the range, causes, possible decisions and behavior elicited by such predictions, and discusses the options for public policy to optimize the benefits of prediction while minimizing social cost. The history and status of earthquake prediction is reviewed briefly including the most vulnerable seismic areas along with the range of adjustments. Because of lack of experience with earthquake predictions and, therefore, an absence of empirical data, public response remains unpredictable. Using a scenario approach, six factors from the data appear to explain hypothetical response patterns: image of damage, exposure to risk either through insurance coverage or other preparations to decrease vulnerability, access to information, commitment to area and resources available.

Findings/Comments:

(1) Image of damage is positively and directly related to most earthquake prediction response for both families and organizations for both vulnerability reduction and emergency preparedness, for relocation, reduction and reallocation strategies.

(2) Evidence confirms that holding earthquake insurance may reduce risk but constrain other preparedness measures (pg. 105).

(3) The greater the earthquake risk to organizational decision-maker or family, the more likely the response by decision-maker to decrease vulnerability (risk) as well as to increase emergency preparedness.

(4) Decision-makers with access to good information are more likely to reduce vulnerability and to increase emergency preparations.

(5) Ties to place increased actions to reduce vulnerability.

(6) The more resources available the greater the choice to reduce vulnerability and increase preparedness, i.e., the benefits accrue to affluent, not the poor.

(7) Principal means of changing land use is through management and regulation -- changing location, i.e., permanently evacuating areas of high seismic risk to areas of lesser risk.

(8) Selective or total evacuation of risk zones immediately after or before impact could prevent losses from both actual event and its induced effects.

(9) Evidence from China suggests the role of amateur program as part of earthquake prediction plays important part in preparing people for earthquakes including evacuation activities. Within the seismically active areas, the Chinese appear to have developed something of an earthquake culture (familiarity with hazard).

(10) After a psychic predicted an earthquake in the Wilmington and Southport areas of North Carolina, a random survey of residents showed 8% of families bought earthquake insurance within the first week after prediction, two families evacuated, 40% took varied actions to protect families and 17% stockpiled supplies.

(11) Only 10% of families interviewed thought they would even consider relocating permanently, although 50% said they would consider it if their employer moved. Few employees, however, saw permanent wholesale relocation as an option.

(12) Commitment to an area at risk, if relocation (permanent evacuation) is blocked, serves to enhance actions to reduce vulnerability and increase preparedness.

Nigg, J. M. 1982. "Awareness and Behavior: Public Response to Prediction Awareness," pp. 71-96 in Perspectives on Increasing Hazard Awareness, T. F. Saarinen (ed.). Boulder, Colorado: Institute of Behavioral Science, The University of Colorado.

Earthquake Threat in Southern California, 1980) describes the relationships between earthquake predictions that South Californians remembered and the importance attributed to preparedness actions taken by themselves or by their community. In two years of study (Jan. 1977 - Dec. 1978), five sets of interviews were collected using a random sample of Los Angeles county residents. Comparisons of responses to the same questions over time indicated that there was a decline in awareness, especially of pseudoscientific prediction category. However, three out of five persons remembered Palmdale uplift throughout the two years. Announcements attributed to scientific sources were considered more credible. Earthquakes did not constitute a salient concern during the study period. There appeared to be increasing uncertainty and a decline in the belief that an impending damaging quake would occur. Findings suggest a loss of interest in earthquake matters. However, in relationship to preparedness the author finds a state of "sustained alert." No decline in personal preparedness or support for governmental planning measures, especially for hazard reduction, was noted throughout study.

Findings:

(1) The frequency of warning announcements remembered declined over the two-year period.

(2) There was decline both in the numbers of destructive quakes respondents had heard about and in the overall number of warnings they took seriously.

(3) A reduced number of persons expected a damaging quake within a year.

(4) There was decrease in both expressed fear and in the salience of earthquake events.

(5) Although the number of those who heard and took seriously forecasts, those who did take the forecasts seriously believed that government should actively take additional preparedness measures.

(6) Those people who had greater knowledge of the uplift, who believed it a precursor to a quake and who thought damage might occur in their area were most supportive of additional government preparedness actions being taken (60% of the sample were in this category).

(7) Although a lapse of active interest occurred, no similar decline in personal preparedness or in support for additional governmental preparedness planning was noted. (Author notes that this may be used as a basis for community preparedness programs.)

Panel on the Public Policy Implications of Earthquake Prediction. 1975. Earthquake Prediction and Public Policy. Washington, D.C.: National Academy of Sciences.

This report synthesizes the previous research dealing with response to earthquake prediction and makes specific recommendations for further research regarding the "social challenge of earthquake prediction." The report examines the consequences of earthquakes and earthquake predictions including the issuance of warnings and predictions, the possible economic and legal aspects emanating from predictions, the problem of equity and the political implications of earthquake prediction including confrontations between officials and the media. Earthquake prediction is divided into four main phases: (1) the release of predictions, and the issuance of warnings, (2) possible hazard-reduction measures, (3) measures to reduce post-disaster tasks of rescue and rehabilitation more effectively given advance warning and (4) steps to reduce counterproductive effects regarding the economic and social aspects of community life. The report notes that the distinction between a warning and a prediction is occasionally misinterpreted by the public. Also the infrequent occurrence of earthquakes and the absence of environmental cues create unique problems in devising suitable measures for hazard mitigation programs. Massive or general evacuation of population is seldom advocated but selective evacuation in specific locations at risk because of dams, possible fires or explosions or in the proximity of unsafe structures is feasible. The report notes the need for federal guidelines in establishing criteria for earthquake prediction. Specific strategies may be hampered by the responses of the private sector of business, the lack of legislation or laws to include such measures and/or the lack of political stability in local offices. The second main conclusion is that the possibilities for saving lives is much greater than that of reducing property losses. The report also concludes that the possibility of effective response is enhanced when a community has established a long-term policy toward earthquake prediction supported through active economic measures and political coordination and continuity. Although earthquake preparations have been concentrated in the western states the possibility of disasterous earthquake in the East and Midwest should also be considered especially in new building construction and in land management.

Findings/Comments:

(1) The report concludes that people have difficulty interpreting earthquake predictions and therefore responding to predictions and warnings.

(2) Public mitigation measures must deal with the economic and legal consequences as well as the problem of equity and political implications including confrontations between media and officials.

(3) Evacuation of specific populations at risk rather than a general evacuation is advocated.

(4) Continuing preparations by communities in land management and replacement of unsafe structures in terms of long-term policies are suggested as the the most feasible measures to ensure reduction of hazards. Federal guidelines to establish criteria for earthquake mitigation are needed to ensure coordination and continuity.

Turner, R. H., J. M. Nigg, D. H. Paz and B. S. Young. 1979. Earthquake Threat: The Human Response in Southern California. Los Angeles, California: Institute for Social Science Research, University of California, Los Angeles.

This report concerns the extent of awareness and appreciation of an earthquake precursor the Palmdale Bulge (or Southern California Uplift) and other forecasts had on southern California residents actions to take precautionary measures. From a survey of 1,450 adult Los Angeles County residents, conducted in 1977, and four subsequent telephone surveys taken at 5-6 month intervals thereafter, data was collected to detect changes in responses to earthquake threat. Neighborhoods that had suffered damage or evacuation following a 4.5 magnitute earthquake on New Year's Day, 1979, were also studied. Interviews were also conducted in neighborhoods that had suffered damage in the 1971 San Fernando - Sylmar earthquake and in predominantly minority districts to allow for better comparisons of those persons with recent earthquake experience and with those residents of minority or ethnic status. Residents were asked about their awareness and seriousness of earthquake predictions, how concerned they felt regarding the hazard, whether they felt informed and where they obtained information about earthquakes. Residents were also asked if they felt action was warranted on government's part and how much faith they placed in both scientific and non-scientific predictions. Survey instrument included.

Findings/Comments:

(1) Awareness of Uplift and possible significance increases for owner-occupied households, with age up until 50 years, with educational attainment as related to college graduates, for more males than females, for Anglos as compared to Blacks and Mex-Americans, in areas of most vulnerable buildings, to extent of community attachment and to households with greater family income but not to households with children.

(2) Awareness is not converted to more extensive preparations for earthquakes for people over 50, among college graduates, among those that fear earthquakes intensely or for people living in most vulnerable housing. In general, however, the more aware of the Uplift, the more prepared, although less aware households with minor children are more prepared.

(3) 88.5% of respondents received information on earthquakes from TV news media, 76.7% from newspapers, 70.9% from radio, 48.8% from movies but only 3.8% from organizations. "People" source distinctly associated with rumor so media found more effective than word of mouth dissemination.

(4) Most households unprepared for earthquakes and the prospect of earthquakes stimulated relatively little preparation. About one-half of 600 households have instructed children about what to do in an earthquake but only one-fourth have developed family emergency plans and only one-fifth have plans for getting family together after earthquake.

(5) Scientifically based predictions are considered more seriously than other forecasts but trust in scientific community does not extend to moral or ethical issues.

(6) Findings indicate knowledge of physical frameworks of earthquakes are "contaminated" by individual magical and moralistic beliefs.

Turner, R. H. 1983. "Waiting for Disaster: Changing Reactions to Earthquake Forecasts in Southern California," International Journal of Mass Emergencies and Disasters 1(2): 307-334.

This article analyzes the changes in response over a period of three years in the Los Angeles County to several predictions given in 1976 for an imminent great and destructive earthquake. Interviews with five waves of adult county residents over a period of two years, followed by a sixth wave immediately following a moderate but nondestructive quake provided data to measure change and stability of response to earthquake threat. Hypothesized negative effects of an extended period of waiting include (1) a declining sense of urgency and vigilance, (2) disillusionment and disbelief, (3) accumulating anxiety and defensive denial of danger, and (4) resentment and scapegoating. Hypothesized positive effects include (5) familiarization, appreciation and sensitization, and (6) the symbolic and active rehearsal of responses. Measures of fear, imminent expectation of a damaging quake, household preparedness, confidence in scientific earthquake prediction capability, suspicion that information was being withheld, attitudes toward the release of uncertain predictions, the focus on scientific versus unscientific forecasts and the preferred source of information tend to disconfirm the hypotheses regarding the negative effects of disillusionment, denial and scapegoating and to provide weak support for the positive hypothesis regarding rehearsal response.

Findings/Comments:

(1) Although lessoning of media attention, informal discussion and awareness and sense of urgency regarding earthquake threat declined, a more discriminating pattern of awareness was noted in selection and appreciation toward earthquake news (increased realism).

(2) Support for enforcement of building codes and improvement of communications concerning earthquake prediction remained unchanged.

(3) A slight though not significant statistical increase in fatalistic attitudes was noted but overall the level of fatalism remained stable.

(4) Increased faith in earthquake prediction was not matched by increased confidence that the effects of disastrous quakes can be controlled.

(5) Realization that some groups at greater risk increased slightly but fewer groups mentioned as being at risk (decline in elderly and disabled categories or residents of unsafe structures noted).

(6) Neither the disillusionment associated with "crying wolf," the defensive denial associated with accumulating anxiety, nor scapegoating of scientists and public officials occurred on a widespread basis.

(7) Relative stability of response was noted overall regarding forecasts, fatalism, confidence in ultimate earthquake prediction achievement, suspicion regarding the withholding of information, continued desire for news about earthquake topics, and the tendency to interpret smaller quakes and other events as clues to imminence of destructive earthquake. Continuance of the low salience of earthquake concern after initial drop remained relatively unchanged also.

(8) Changes did occur in the number and quality of announcements remembered and in the sense of uncertainty regarding the likelihood of an early earthquake. The number of people doubting the feasibility of releasing uncertain predictions increased as well as those considering an earthquake an abnormal event.

(9) People looked more strongly toward government for reduction of problems regarding endangered groups.

FLOODS

Clifford, R. A. 1956. "The Rio Grande Flood: A Comparative Study of Border Communities," National Research Disaster Study No. 17, Washington, D.C.: National Academy of Science.

Between June 27 and 30, 1954, the Rio Grande River flooded both U.S. and Mexican border communities. The researchers used the opportunity to compare the reactions of formal and informal groups of two different cultural and social systems to the same event from a sociological perspective using the "familistic Gemeinschaft" and "contractualistic Gesellschaft" constructs. The report describes differences between the communities of Piedres Negras, Mexico, and Eagle Pass, Texas, in types of warnings, communication, hazard belief, the operation of formal and informal groups, organizational interaction, means of evacuation, the use of kin and friendship ties and in the rehabilitative efforts. During evacuation some force was used both by the Mexican army and families to remove those unwilling to leave. Nearly one half of residents in each city had relatives in the other city which led to the lowering of border restrictions during and immediately following the emergency but not to the official acceptance of aid by Mexican authorities. The study notes the "degree and nature of informal bonds across the border, and the differentiation in structure and functions of formal organizations of the two communities" (p. 137). Sources of data include systematic interviews of residents in areas hardest hit by flood, interviews of organizational members, participant observation and analysis of files of organizations and agencies involved.

Findings/Comments:

(1) Persistence of normal social patterns including major values of system resist disturbance in emergency situation. The study supports the position that values such as honor and respect, efficiency, scientific accuracy and objectivity are important in disasters if they are important in the normal social situations of community.

(2) In communities characterized by emphasis on familistic, traditional and personalistic orientations (such as Piedras Negras) there will be extreme resistance to interfamily aid which relies on friendship or neighborliness with the resultant a lack of coordination in activities.

(3) Serious problems that occurred in social relations were predominantly on the formal level.

Cochrane, H., E. Gruntfest, M. Stokes, H. Burgess, G. Burgess and L. Steinback. 1979. "Flash Flood on the Big Thompson: A Case Study," Denver, Colorado: Western Governors' Policy Office for Policy Research.

This case study of the July 31, 1976, flash flood in the 25-mile long Big Thompson Canyon in Colorado describes the event and the losses including an estimate of the secondary commercial losses. Also discussed are options for mitigation of future flood losses, improvements to the flood warning systems, the search and rescue operations from an organizational standpoint, and the problems in recovery especially from the victim's outlook regarding issues of communication and information. Conclusions suggest flood insurance is the key to any program of loss reduction but that sales of the insurance must be mandated by some institution or agency to be effective. Since local leaders lack experience in actual disasters, the suggestion is made that a state or regional clearing house be established as well as an advocacy position adopted for disaster victims.

Findings/Comments:

(1) Expected secondary losses did not occur because the productive base of the economy was not shaken, there was a massive influx of government, especially federal aid, and tourism quickly rebounded.

(2) Structural measures were either economically, politically or environmentally not feasible.

(3) Mitigation thus depended on non-structural measures including the use of federal flood insurance and citizen awareness programs.

(4) The flood warning system was inadequate in the Big Thompson Canyon because of (1) the lack of detection devices and lack of environmental cues to predict flooding,(2) insufficient or even dangerous warnings, problems of terrain and the wide dispersal of population and (3) the failure to respond or to take appropriate actions for one's safety, such as evacuating area by climbing canyon walls.

(5) Lack of local experience in dealing with disasters is the largest problem of local leaders in the post-disaster period.

(6) Flood insurance appears to be key to any program of flood reduction but must be mandated for maximum effectiveness.

Danzig, E. R., P. W. Thayer, and L. R. Galanter. 1958. "The Effects of a Threatening Rumor on a Disaster-Stricken Community." Disaster Study #10, Disaster Research Group. Washington: National Academy of Sciences.

One quarter of the population of Port Jervis, N.Y., evacuated the city when a false rumor circulated that an upstream dam had failed on August 19, 1955. This study by a team of psychologists investigates both the official and unofficial reactions to the rumor and attempts to establish the communication patterns that emerged. A recent inundation of flood waters coupled with the long-standing dam threat appeared to sensitize the population to the threat such that many persons evacuated without verification of the dam failure. Only people at home appeared to have received the rumor which was initiated by an apparent stranger but supported by at least one fire truck operator through the sounding of a siren. No one fled alone and those that did flee reported seeing others fleeing also. No people with official duties abandoned their posts during the period of verification and no panic was evident. No variable which does not implicitly or explicity involve geographic proximity to the river was found important. The study finds no basis to support the hypothesis that people were more likely to evacuate given official sources of information as compared to other sources of information. The authors found an apparent fit of the data in post hoc analysis to a game theoretical model suggesting that residents used a predefined behavior model that was rational and homogenous. Authors suggest behavior can be predicted. The survey instrument is appended as well as the coding procedures and other methodology pertinent to the study.

Findings/Comments:

(1) No support for the hypothesis that people are more likely to believe and act upon threatening reports if they come from official sources (pg. 55). Messages from official sources carried no more weight, behaviorally, than messages from other sources (pg. 70).

(2) No relationship was found between education and age with either the source of attempted confirmation or the likelihood of seeking confirmation regarding threat.

(3) Previous evacuation experience and place of residence were the only variables related to evacuation. Authors group these under one heading, "geographical proximity to threat."

(4) Differences in content and source of threat messages had no measurable effect on people who heard them (pg. 70). Advice to evacuate was completely uncorrelated with evacuation, both within and between the previously flooded and non-flooded areas of the city (pg. 70).

(5) Mass media was found effective in calming and informing population.

(6) Authors concluded that (1) educational programs to acquaint residents with potential problems as well as for actions for survival, and (2) prompt reduction of ambiguity regarding the range of destruction while a disaster is in progress is needed to help people make appropriate decisions regarding a disaster situation.

Drabek, T. E. 1969. "Social Processes in Disaster: Family Evacuation," Social Problems 16 (Winter): 336-349.

Using a symbolic-interactionsist perspective this article examines the responses of 278 families evacuated from their homes prior to a disasterous flood in Denver, Colorado, June 16, 1965. Data from interviews indicated that families acted as units. A series of interrelated but qualitatively distinct processes occurred regarding the warning, confirmation and eventual evacuation behavior. Specific evacuation behavior followed four general patterns related to the mode of confirmation: (1) evacuation by default; (2) evacuation by invitation; (3) evacuation by compromise; and (4) evacuation by decision. Processes of confirmation also followed four patterns: (1) appeal to authority (9%); (2) appeal to peer (43%); (3) observational confirmation; or (4) through unintended or latent consequences of behavior intended for other purposes. A simplistic decision-making model was not seen as valid for characterizing the evacuation behavior.

Findings/Comments:

(1) Processes of warning, confirmation and evacuation are highly interrelated.

(2) Four processes of evacuation behavior related to mode of warning and confirmation are : (1) evacuation by default, (2) evacuation by invitation, (3) evacuation by compromise and (4) evacuation by decision.

(3) The author suggests that threat information should be divided into three dimensions for analysis: content, mode and source.

Drabek, T. E. and K. Boggs. 1968. "Families in Disaster: Reactions and Relatives," Journal of Marriage and the Family 30 (August): 443-451.

In response to a massive flood which struck the metropolitan area of Denver, Colorado, June 16, 1965, approximately 3,700 families were evacuated from their homes. Interviews with a random sample of 278 of these families indicated that the initial response to warnings was marked

disbelief regardless of warning source. Families evacuated as units, and data indicated a strong tendency for them to take refuge in the homes of relatives rather than official centers. The tendency is significantly affected by social class. Data further suggested that as interaction between relatives during the warning period increased the likelihood that relative homes would be selected as evacuation points increased.

The flood was sudden, unexpected, and localized. Five hypotheses regarding the role of relatives were tested and indicated that the role of relatives is highly important both in the warning process and in the actual evacuation behavior. Four of the hypotheses were supported. Only 3-1/2% of families stayed in official shelters with 42% staying at the homes of relatives. Role of relatives differed according to social class, by dependent groups (the very young or the very old), and by ethnic group.

Findings/Comments:

(1) Most flood evacuees will take refuge in the homes of their relatives rather than official shelters.

(2) The lower the social class of the family, the greater the tendency to evacuate to homes of relatives.

(3) The older the family members, the greater the tendency to evacuate to homes of relatives.

Drabek, T. E. and J. S. Stephenson III. 1971. "When Disaster Strikes," Journal of Applied Social Psychology 1(2): 187-203.

This article describes warning responses of 278 randomly selected families who evacuated their homes prior to a flood in Denver, Colorado, on June 16, 1965. The flood was sudden, unexpected, unfamiliar, highly localized and the social context in which warnings were received varied. Response patterns were analyzed for families who were geographically separated at the time that the initial warnings were received. Interviews revealed families responded as units, not as isolated individuals. Of those together at time of evacuation, 92% left together. If families were apart, the immediate concern was locating other members (41% were physically separated at time of evacuation). Family responses were sharply associated with initial warning source and message content. Messages from authorities were perceived as "orders to evacuate" - 70% received initial warning from authorities - whereas peer and media warnings were viewed as descriptive sources. "Regardless of warning source, the initial reaction was one of disbelief" (pg. 194). Four evacuation processes emerged from the analysis: (1) evacuation by invitation,

(2) evacuation by default, (3) evacuation by compromise and (4) evacuation by decision. No reports of disorganized behavior or panic were observed. Implications for community emergency planning are noted.

Findings/Comments:

(1) Families respond as units, not as isolated individuals.

(2) Four types of evacuation were noted: Evacuation by invitation, evacuation by default, evacuation by decision, and evacuation by compromise.

(3) Warning messages by authorities were perceived as "orders to evacuate"; warnings by media were least effective but most widespread; family and friends three times as effective as media in producing adaptive behavior to warnings.

(4) Only 3% of the families had made any type of emergency plans prior to flood; only 13% made plans following flood.

(5) Only a few families (6%) indicated that were thinking of looting indicating that routine fears were set aside when the large-scale disaster occurred.

Erickson, K. T. 1976. Everything in Its Path. New York: Simon and Schuster.

On February 28, 1972, at 8:00 a.m., the collapse of a slag dam in the Buffalo Creek area of West Virginia destroyed 16 mining communities located along a 17-mile stretch of floodplain below the dam. Of the 5000 original residents, 4000 were left homeless, 125 died and between 7-10 remain missing. Although company officials had monitored the dam earlier, no official warnings to evacuate were given. Residents close to dam had evacuated voluntarily prior to collapse. The two sheriff deputies dispatched earlier to aid in the event of an evacuation were dismissed by a mining company official. Most survivors evacuated by climbing the hillside or moving to higher ground. Data was obtained from legal documents, interviews, mail questionnaires and communications to lawyers from survivors who had instituted a lawsuit against the mining company. Erickson notes the "words of 142 persons" appear unaltered at one time or another in text. The social-psychological imprints left on survivors of tradegy as well as the circumstances leading up to the event and during recovery are discussed. The author argues that the social fabric of the community in terms of social and individual behavior patterns was destroyed by the disaster. Analysis of disaster in social-psychological terms, thus, is necessary to understand the impacts of disaster at both community and individual levels; for

some individuals, recovery from event is impossible because an entire way of life was destroyed during disaster.

Findings/Comments:

(1) No official warnings to evacuate were given although company officials apparently were aware of danger enough to open sluiceway and water behind dam had been noted at a critically high point.

(2) Most persons escaped by climbing hillside or evacuating to higher ground.

Flood Loss Reduction Associates. 1984. "Technical Guidance Manual for Local Flood Warning and Preparedness Programs," New York State: Department of Environmental Conservation.

As stated in the objectives, this technical manual provides generalized guidance on the planning procedures for assessing flood warning and preparedness plans within New York State. Included in the report are discussions of flood warning programs, coordination between state, local and private sectors, the use of volunteers for improvement of local flood warnings, the chief elements and planning of preparedness programs and steps for implementation and evaluation of such programs. Analysis of areas at risk include identifying resources available, scope of program, design of warning arrangements and identification of response actions and subtasks, especially as they relate to evacuation of special populations, or that require coordination of two or tasks simultaneously. Appendices include glossary of terms used in floodplain management, lists of available agencies useful in developing plans, criteria for evaluation, references for further information and a description of National Weather Service's system. Two companion reports are also available.

Findings/Comments:

This is a technical manual for the assessment and planning of preparedness programs designed to mitigate flood threats within New York state. Points out need for special populations to be notified prior to public warnings.

Flood Loss Reduction Associates. 1984. "Prototype Local Flood Warning Plan." New York State: Department of Environmental Conservation.

Taking the principles outlined in the companion report, the Technical Guidance Manual for Flood Warning and Preparedness Programs, this report uses the Logan River Flood Warning Program as a prototype for illustrating how the program may be implemented for a specific area in New York State. To supplement services available from the National Weather Service, a non-profit corporation was organized using members from state, federal and local agencies. To add site-specific data to the National Weather Service information on local rainfall and stream data collection, volunteers were encouraged to become observers of local conditions to help identify and determine specific flood locations. This information is then coordinated with the NWS and disseminated through warnings by the Corporation to public and local officials in the affected areas or as predetermined by the Corporation. "Flood advisories" are also issued to those with a specific need for an earlier warning or who need earlier or more detailed warnings than the general public. The plan also addresses the need for public information programs with brochures, speakers and releases for the media, specifies operational procedures for both normal and emergency operations including the establishment of an emergency operations center. Plans include implementation and maintenance of the system and descriptive initial costs involved in setting up the system. Examples are given throughout the manual. Two companion reports are available.

Findings/Comments:

This is a technical manual to be used as a prototype for setting up a local flood warning system within New York State using volunteer observers to assist in locating specific flood locations.

Flood Loss Reduction Associates. 1984. "Prototype Local Flood Warning and Preparedness Program." New York State: Department of Environmental Conservation.

Taking the principles outlined in the companion report, the Technical Guidance Manual for Flood Warning and Preparedness Programs, this publication uses the Big Rock Warning and Preparedness Program as a prototype program for New York State. As stated, it is intended to protect life and property during floods and reduce economic losses caused by or stemming from flooding. To do this, specific policies and planning procedures are outlined. Of evacuation note are policies to eliminate the need for rescues, warnings to minimize unnecessary evacuation and opportunities to give advance notice of potential flooding to special populations or interests. The public information program on flood awareness notifies residents of flood potential, warning signals, evacuation routes,

designated shelters as well as protective actions. Fifteen appendices offer detailed illustrations of specific actions of prototype program. Two companion reports are available.

Findings/Comments:

This is a technical manual designed to be illustrative of an implemented flood planning and preparedness program for New York state. The program is designed to eliminate the need for rescues, give warnings to minimize unnecessary evacuation, and to provide advance notice to special populations.

French, J., R. Ing, S. Von Allmen, and R. Wood. 1983. "Mortality from Flash Floods: A Review of National Weather Service Reports, 1969-81," Public Health Reports 98(6)(Nov.-Dec.):584-588.

This paper reviews 34 NWS reports associated with flash floods from 1969 through 1981 involving either a loss of more than 30 persons or a loss of more than $100 million in property damages. Thirty-two events took the lives of 1,185 people -- an average of 37 deaths per flash flood. Although only 18 flash floods occurred in the 1977-81 period and 14 in the 1969-71 period, the number of deaths was 2-1/2 times greater for the earlier period. More than twice as many deaths were associated with flash floods in areas where the survey team considered warnings inadequate. Twenty deaths occurred in remote recreational areas where no warning was given. Of the deaths, 93% were due to drowning with 42% of them car-related. The other drownings occurred at home, at a campsite or when persons were crossing bridges and streams. Most floods occurred in the summer with September having the most floods. The highest number of deaths per event were associated with flash floods in which dams broke after heavy rains. The Army Corps of Engineers has identified over 68,153 non-federal dams in the U.S. of which 13% or 8,818 have been inspected. Of these dams, 2,925 are considered unsafe. In Essex, Connecticut, several dams considered unsafe were monitored following heavy rains on June 4-5, 1982. On June 5, water was observed flowing over the top of one dam. Firemen evacuated people in parts of town that might be affected if dams failed. Within one hour after evacuation, five dams broke. Although the area sustained heavy damage, not one life was lost. To keep better accounts, the NWS plans to change format of survey reports so they can be systematically recorded.

Findings/Comments:

(1) The highest number of deaths per flash flood occurred when dams failed.

(2) Of the deaths associated with flash-floods, 93% were due to drowning with 42% of these car-related.

(3) Most floods occurred in summer months with September being the worst month.

(4) When five dams failed in Essex, Connecticut, prior monitoring during heavy rains resulted in not one life being lost although heavy property damage ensued.

(5) Of 8,818 non-federal dams inspected by Corps, 2,925 were found unsafe.

(6) Of 32 reports reviewed between 1969-81 in which either 30 deaths occurred or in which $100 million damages occurred, a total of 1,185 deaths occurred with an average of 37 deaths per flash flood.

(7) Between 1969-76, there were 2-1/2 times as many deaths than during the period between 1977-81 due to flash floods.

Graham, W. J. and C. A. Brown. 1983. "The Lawn Lake Dam Failure: A Description of the Major Flooding Events and an Evaluation of the Warning Process." Denver: U.S. Bureau of Reclamation.

This report describes the events following the failure of the privately owned Lawn Lake dam located approximately 60 miles northwest of Denver, Colorado, in the Rocky Mountain National Park on July 15, 1982. The dam failure triggered the failure of another dam downstream, killed three people within the park, and caused $21 million of property damage. The area is comparable to the Big Thompson and Buffalo Creek in topography. An evaluation of the warnings issued indicated that prompt and appropriate responses, i.e., evacuation were given by most people but some convergence behavior was noted as persons rushed to the river to take photographs or to watch the water rise. The death of one camper was attributed to this behavior. No official notification of the unattended dam failure was ever given. Rather the first report was given by a maintenance person who used an emergency telephone to contact the National Park Service. Park Rangers warned campers but did not order evacuation. Estes Park police warned people outside the park and, on the recommendation of National Park Service, evacuated areas within a 50-foot radius of the river. Local criticism arose about the flood warning to campers being "too gentle." The only radio station in the area provided continuous coverage and disseminated information issued by officials. Previous experience of 1979 Big Thompson flood that had precipitated the placement of safety signs along canyon roads may have made people flood-conscious. Most people received multiple warnings. Motel or resort owners were warned directly from an official source either personally or by telephone. No panic was observed.

Findings/Comments:

(1) Three deaths in National Park attributed to lack of warning severity; "dam failed" was not in ranger's warning message. "Warning must be forceful enough to move people to action" (McLuckie quote).

(2) Convergence behavior from outside danger zone put people at risk.

(3) The 100-year floodplain maps had not considered structural failure of dam and, thus, placed minimal restraints on floodplain construction and subsequently more people were at danger. Deliniation of the area that would be flooded if Lawn Lake/Cascade Dams failed was not available to officials prior to disaster.

(4) "Dam failed" message motivated most people to take immediate action and evacuate.

(5) No panic behavior observed.

Gruntfest, E., T. Downing and G. White. 1978. "Big Thompson Flood Exposes Need for Better Flood Reaction System to Save Lives," Civil Engineering (February): 72-73.

This article describes behavior just before and during the Colorado Big Thompson flood in 1976 and the implications for an effective warning system including suggestions on how to escape a flash flood. Most people responded in one of four ways to flood warnings: by ignoring warnings, climbing the canyon walls, driving out of the canyon or by evacuating and then returning prematurely. An effective warning system is only as strong as its components - weather forecasts, observation networks, reliable and speedy communication, preparedness planning and public education. Observations suggest the content of warning greatly influences how people respond. Warnings given through personal modes are more effective than those given impersonally. Rather than panic, people tend to disregard warnings that interfere with their normal activity. Personality, age, gender, group content, group attitudes and socio-economic status affect how people respond. Previous experience and information also influence individual actions but local lore can be a prelude to tragedy. Suggestions for public information program are also given.

Findings/Comments:

(1) Many ignored warnings because they did not appreciate gravity of situation or did not have any environmental cues. Rather than panic people tended to disregard warnings that required them to interrupt their normal activities. People disregarded warnings that appeared to be false rumors, could not be confirmed, lacked specific information or did not describe or encourage specific actions.

(2) Warnings delivered through personal modes were more effective than those transmitted impersonally.

(3) Previous experience and information influence actions; long-time residents of the Big Thompson canyon thought a great flood had never occurred.

(4) Personality, age, gender, group context, group attitudes and socio-economic status affected responses.

Gruntfest, E. 1977. "What People did during the Big Thompson Flood," Working Paper 32. Boulder: Institute of Behavioral Science, University of Colorado.

This study analyzes the behavior patterns of groups caught in a flash flood in the Big Thompson Canyon the night of July 31, 1976, during which 139 people died. The purpose of the report is to suggest improvements to the warning system design for the Front Range communities vulnerable to flash flooding. Comparisons are made between actions of survivors and non-survivors and those warned with those not warned. Variables examined include location at time of flood, action taken, group context and number and the kind of warning, if any, received. Results indicate that climbing the canyon walls was the most effective action that could be taken with doing nothing the worst action. Those driving alone through the canyon were at highest risk. Specific suggestions regarding warnings are recommended. An annotated bibliography of references to Big Thompson flood research is appended.

Findings/Comments:

(1) Those who took some action were more likely to survive than those who took no action.

(2) Those who climbed up canyon walls or to high ground had best chance of survival.

(3) Persons in groups of three to five either in family context or with friends were more likely to survive than those alone.

(4) Those who drove out were most likely not to have received a warning.

(5) Those who climbed or took another action were more likely not to have received a warning than those who did nothing or drove.

(6) Those who were in family groups were more likely to take no action than to climb.

(7) Those in groups of three to five were more likely to do something than those who did nothing.

(8) Those who were alone were most likely to do nothing.

(9) Those who drove were more likely to warn others than those who climbed.

(10) Location in the canyon and what action the group took were most influential in statistically separating the survivors from the non-survivors.

(11) Familiarity with the Big Thompson Canyon was the least influential in statistically separating three of the analyzed populations: the survivors/non-survivors, the warned/non-warned, and the action/no-action.

(12) The number of people in the group was most significant in distinguishing whether or not an action was taken.

(13) The location of the group in the canyon and their origin were the most significant in separating the warned from the non-warned.

(14) In statistically distinguishing the locals, the full-time and part-time residents from the tourists, those who visited the Big Thompson Canyon or other Rocky Mountain canyons infrequently, the number of people in the group, the origin of the group, and if the group survived were the most significant.

Hannigan, J. A. and R. A. Kueneman. 1978. "Anticipating Flood Emergencies: A Case Study of a Canadian Subculture," pp. 129-146 in E. L. Quarantelli (ed.) Disasters: Theory and Research. Beverly Hills, California: Sage.

This article discusses the disaster subculture which has developed in Manitoba, Canada, since the instigation of a major floodway program and its implication for future emergency management. The study focuses on the role of public organizational linkages. An emergency operations center is activated during an event consisting of three levels of government -- Provincial, Federal and municipal (Winnipeg) facilitating operations across several jurisdictions. Noted as an example is evacuation of Indian reservations which falls under Provincial responsibility while care of Indians after evacuation is Federal responsibility. Data was collected through a telephone survey of 220 Winnipeg residents conducted in March, 1976, regarding flood-related knowledge, orientation to flooding problems and attitudes toward flood-related policies. About 41% of sample had prior flood-experience. Data suggests individual sector of

disaster subcultures was decidedly weak in knowledge and generally disinterested in disaster preparations.

Findings/Comments:

(1) Data illustrates growth of disaster subculture at organizational level has weakened individual interest in flood-related matters. The trend is less evident in rural areas where flooding continues to be an annual problem and where flood mitigation measures are less effective.

(2) The sample was split regarding role of government in regulating building on floodplains and in extending relief to flood victims.

Hutton, J. H. 1976. "The Differential Distribution of Death in Disaster: A Test of Theoretical Propositions," Mass Emergencies 1 (Oct): 261-266.

Statistics on disasters indicate that older persons die in greater numbers than would be expected from their proportionate distribution in the population. Explanatory variables from the literature suggest seven relationships which were tested in an empirical study of 189 flood plain residents within the city limits of Rapid City, South Dakota. Data suggest negation of commonly held social-psychological beliefs regarding the cause of this pattern; the results indicate that disproportionate death for older persons occurs among that segment of persons who do not receive warning (pg. 265). Although older persons are as likely to receive as much warning as others, it is at the time of impact that the disproportional victimization occurs. Results support an explanation that differential distribution by age of relative strength, good health and physical capabilities account for the old age and death relationships in disasters.

Findings/Comments:

(1) The disproportionate death for older persons occurs among that segment of persons that do not receive warning even if older persons are as likely to receive warning as others.

(2) Results support explanation that differential distribution of death by age is related not to psychological factors but to diminishing physical factors of older persons such as lack of relative strength, good health and physical capabilities that influence degree of impact on older persons. Evidence suggests that elderly possess fewer resources, therefore, to evacuate from a disaster situation.

Kutak, R. I. 1938. "The Sociology of Crises: The Louisville Flood of 1937," Social Forces 17: 66-72.

This early (1938) article examines the impact of a crisis caused by a flood on the community structure. Crises are seen as potential stimuli in developing a sense of community both economically and socially. Noting that a "crisis situation represents a break in the routine of social living" and may supply the need for "(synthetic) circuses" that serve as "an escape mechanisms" (pg. 69-70) the author suggests crises produce "certain psychological changes in the inhabitants of the community" (pg. 67.). He notes the blurring of racial and status differentials when "immediate needs replace ultimate purposes" (pg. 67). Although a crisis may have value on the community structure, "the community may be stronger after the crisis than it was before" (pg. 70.), both mechanical flood protection measures and the establishment of emergency organizations with trained personnel selected in advance should be instituted. Thus, the population could respond like "that exemplified in a fire drill" (pg. 72). The postscript discusses Margaret Mary Wood's question concerning the issue of whether people respond to natural catastrophes in the same manner as man-made crises which are a result of "man's inhumanity to man" (pg. 72).

Findings/Comments: Conceptual article regarding impact of crises on community structure.

Mileti, D. S. and E. M. Beck. 1975. "Communication in Crisis: Explaining Evacuation Symbolically," Communication Research 2 (January): 24-49.

Taking a symbolic interactionist approach, this article examines the response to warnings issued to residents of Rapid City, South Dakota, prior to a flash flood that produced a major disaster on June 9, 1972. Response to warnings is seen as a complex social process involving the interaction between the transmitter and the subjective interpretation (meaning) by its recipient. Evacuation as a process is a function of warning content, communication mode, situational context and warning belief. In short-term warnings neither situational context, perceived warning certainty and warning content were found related to warning confirmation as postulated. It is concluded that the variable of time may be of central importance in explaining evacuation behavior. It is suggested that an additive evacuation model be developed which considers the variables of time, number of warnings given in specific circumstances and the type of disaster agent.

Findings/Comments:

(1) Situational context (whether the family was together or not) and perceived warning certainty were of no predictive value for warning confirmation for any of the warnings examined.

(2) Communication mode emerged as a moderate predictor of warning confirmation but not for warning belief. Warnings received from the media increased the probability that a person would seek confirmation. Belief is suggested to be more of a function of perceived certainty with which the warning is delivered and the confirmation of that warning rather than in how that warning is delivered.

(3) Evacuation seems to be a function of warning belief which appears, itself, to be a function of confirmation (pg. 45). Warning confirmation and warning belief (after several warnings had been received) were consistently strong predictors of evacuation. After receiving several warnings, mass-communicated warnings were a strong predictor of warning confirmation suggesting that evacuation could have been maximized in Rapid City had more warnings been issued through the media.

(4) The variable of time is concluded to be of central importance in explaining behavior elicited by warnings in predisaster settings (pg. 44).

Moore, W., E. Cook, R. Gooch and C. Nordin. 1982. "The Austin, Texas, Flood of May 24-25, 1981." Washington, D.C.: National Academy Press.

Intense thunderstorm activity in the late evening of May 24, 1981, resulted in severe flooding of the city of Austin, Texas. Thirteen lives were lost and $35.5 million in damages to private and public property was incurred. In reporting on this flood, the Committee on Natural Disasters discusses the problems of urbanization on areas prone to flooding. Contributing factors included saturation of soil prior to peak rainfall, Shoal Creek experiencing a 100-year event, homes built in floodplain prior to regulations and additional development of upper watershed. Although warned by the National Weather Service regarding the possibility of flash flooding, not until flooding had commenced were residents evacuated by Fire Department personnel. Two of the dead were adult persons who refused to leave their home with the other fatalities found in or near their flooded cars. The authors note that a community can only cope with flood threats to the extent that citizens are made aware of the hazard and understand the implications of policies related to mitigation of the threat. Suggestions that permanent markers be displayed near high-hazard areas as future reminders are similar to those recommended in studies of other flash-flood areas such as mountain canyons.

Findings/Comments:

Technical report of National Academy of Science.

National Oceanic and Atmospheric Agency. 1981. "The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980." Silver Spring, MD: National Weather Service.

Between February 13-21, 1980, a series of heavy rainstorms produced flash floods and widespread flooding in southern California and central Arizona. Persistent rains also produced mudslides in California. This report reviews the hydrological and meteorological conditions, the dissemination of warnings and forecasts through the NOAA system and the response of agencies involved. Although NWS warnings contributed significantly to reduction of loss of property and lives, 21 people died and property damage of $400 million resulted. Inability to pinpoint areas of localized heavy rainfall accurately prevented issuance of timely warnings for individual sites, mainly canyons in the Los Angeles suburbs. Evacuation varied with many residents uncertain of site warnings or remaining in homes to protect their property.

Findings/Comments:

(1) Failure of some Los Angeles residents to recognize flood danger and take appropriate action was due in part to lack of specificity in the NWS warnings.

(2) Most of the general public received warnings through the mass news media who frequently used special reports as feature material.

(3) Even after sustaining property damage and evacuating, eight residents said they would not consider leaving the area (p. 6-8).

(4) In Riverside County, California, evacuated residents were advised to return prematurely when flows appeared stabilized. Later rainfall in mountains caused substantial flooding which required reevacuation of some residents.

(5) The San Clemente fire department evacuated approximately 30 houses before flash flooding occurred based on NWS information and experience.

(6) The fatality and most of the property damage in Mandeville Canyon, California, were caused by mudslides. There was local warning via vehicles and some voluntary evacuation but some residents remained at home to protect their property.

Perry, R. W., M. K. Lindell and M. R. Greene. 1981. Evacuation Planning in Emergency Management. Lexington, Massachusetts and Toronto: Lexington Books.

This book presents the results of a multiyear study of the design and implementation of community disaster-evacuation plans. Factors affecting citizens' decisions to evacuate in response to flood warnings are developed within an empirical framework by examining four communities subject to riverine flooding. Using an emergent-norm perspective, the discussion focuses on the individual perceptions, past hazard experience and social patterns. Suggestions are then made to enhance the likelihood of citizen compliance. "Management" in this context refers to the "active intervention in the course of events that promotes outcomes that are mutually disruptive to the community" (pg. xiii). A path analysis model is discussed in the text.

Findings/Comments:

(1) The social-psychological factors shaping evacuation decision include four variables: (1) warning belief, (2) level of perceived risk, (3) possession of adaptive plan, and (4) family context in which the warning is received.

(2) Families either evacuate as units or account for missing members before leaving.

(3) Aspects of the structure and delivery of warnings that effect evacuation performance include warning source, warning contents, the effects of multiple messages, and past experience.

(4) Three major social-network variables, (1) kin interactions, (2) community involvement, and (3) age, have roles in warning response. Ethnicity also affects receipt and response.

(5) The elderly do not necessarily constitute dependent groups which hinder evacuation efforts.

(6) Minority citizens receive, interpret, and respond to warnings differently than Anglo groups.

Perry, R. W., M. K. Lindell and M. R. Greene. 1982. "Crisis Communications: Ethnic Differentials in Interpreting and Acting on Disaster Warnings," Social Behavior and Personality 10(1): 97-104.

This article discusses the relationship between the interpretation of warning messages and the subsequent response behavior between two ethnic groups, Mexican-Americans and Whites. Noting that literature has suggested minority groups suffer disproportionately greater negative

losses from natural disasters, the authors test four hypotheses: (1) specificity of warning message, (2) warning belief, (3) perceived personal risk, and (4) adaptive response taken. Data were collected following a March (1978) flood of a small western town of Fillmore with a substantial Mexican-American population. Warnings were delivered by both police and fire department personal via loudspeakers as well as door-to-door notification. (No information on media messages.) Authors conclude that ethnic differentials contribute to differences in warning response because Mexican-Americans (1) exhibit greater skepticism of warning message regardless of specificity of message, (2) perceive a lower personal risk, and (3) were less likely to evacuate regardless of risk perceived or level of warning belief. Even when Mexican-Americans agreed with Whites or were objectively at same level of danger, they were less likely to undertake officially suggested evacuation behavior.

Findings/Comments:

(1) Mexican-Americans are more skeptical than Whites about believing warning message regardless of specificity of message.

(2) Mexican-Americans interpreted the same message as Whites as indicating lower levels of personal danger.

(3) Mexican-Americans were less likely than Whites to evacuate regardless of level of warning belief and perceived personal risk.

Poulshock, S. W. and E. S Cohen. 1975. "The Elderly in the Aftermath of a Disaster," The Gerontologist 15(4): 357-361.

Survey data collected from a sample of elderly flood victims of the 1972 Hurricane Agnes indicate that the perceived needs were for "hard" services outside the home such as housing, increased income and transportation and relatively little need for "social services." The survey is based on 250 elderly white flood victims 60 years and older in Luzerne County, Pennsylvania, taken in June 1973, one year after impact. The sample reflected a victim ratio of 2 females to 1 male with a mean age of 72 years. Only 15.6% of evacuees moved initially to an evacuation center indicating that family/friends support systems emerged immediately following impact of disaster. In the one year period since the flood, 88% had moved at least once beyond the initial move, 68.2% had moved at least three times and 31.2% had been forced to move four or more times. About 38% of respondents at the time of the survey were still undecided as to housing plans. Some housing improved for evacuees over pre-flood housing conditions. The level of satisfaction with agencies was overall satisfactory, which may reflect the fact that the elderly demand less than younger counterparts and may therefore receive less.

Findings/Comments:

(1) Only 15.6% of evacuees moved initially to an evacuation center but within a year over 88% of evacuees had moved at least once more, 68.2% at least three times, and 31.2% four or more times.

(2) Utilization of income supplements, not welfare was noted. Only 2% sought cash assistance, 19.2% sought food stamps, 39% sought income supplements for housing but 55% secured low-interest loan from Small Business Administration.

(3) A low utilization of mental health services was observed even though information from respondents indicated a need for such services.

(4) Despite indications of chronic physical problems in more than half of the respondents, perceived needs for services were for those outside the home such as housing, increased income and transportation. This indicates a need for greater emphasis on supportive services that extend life-space outside the home environment.

Saarinen, T., V. Baker, R. Durrenberger and T. Maddock. 1984. "The Tucson, Arizona, Flood of October 1983." Washington, D.C.: National Academy Press.

On Monday, October 2, 1983, flood waters of the Santa Cruz River coursed through normally dry Tucson, Arizona, causing extensive erosion and incising to embankments, destroying bridges, flooding farmlands and forcing the evacuation of the entire community of Marana. Major flooding also occurred along the Rillito and the Gila River as well as two of its tributaries, the San Francisco River, and the San Pedro River. This report describes the meteorological event and the warning process, analyzes the historical and current geomorphology and hydrology of the Tucson Basin and then discusses the human response to the flood. The large and rare flood caught local emergency officials unprepared. Although the National Weather Service provided warnings, the warnings were not used effectively at local levels. No central EOC was utilized and local and state agencies worked independently using separate facilities. Large crowds converged to watch turbulent waters. The authors note the continuous problem of urban pro-growth interests, lack of floodplain regulations due to private ownership of the river and decreasing groundwater table levels leading to loss of riparian vegetation were all contributing factors to the flood disaster. The report concludes that piecemeal bank protection is inadequate but estimates by the COE for complete bank protection were about $3 million a mile, making the project not cost-effective.

Findings/Comments:

This is a technical report describing the Tucson, Arizona, flooding. The greatest flood damage in Tucson was caused by lateral erosion of arroyo walls, not by overbank flow. This damaged buildings adjacent to stream by undermining at the same time destroying many bridges.

U.S. Department of Commerce. 1977. Johnstown Pennsylvania Flash Flood of July 19-20, 1977, Natural Disaster Survey Report 77-1. Rockville, MD: National Oceanic and Atmospheric Administration.

During the night of July 19-20, concentrated torrential rains resulted in a flash flood that struck both Johnstown and the Conemaugh River Basin in Pennsylvania killing 76 people and resulting in property losses of over $200 million. Two thousand six hundred and ninety-six persons were injured or suffered illness related to the flood and five were hospitalized. One thousand four hundred and thirteen dwellings were destroyed, 1363 had major damage and 4108 suffered minor damage. One hundred and thirty-five mobile homes were destroyed and 77 more suffered major damage. Fifty-two apartments were also destroyed, 93 had major damage and 1148 incurred minor damage. This report describes the meteorological and hydrologic conditions that caused the flood, the dissemination of warnings and public preparedness for the event. Several earthern dams washed away aggravating the severe flooding. With electricity and telephone networks disabled, most communications were carried over CB radios. Firemen reported people hesitant to evacuate because no one felt the threat of flooding. The following morning, hundreds of persons converged downtown Johnstown to view waters with consequent heavy traffic jams.

Findings/Comments:

(1) As in the Big Thompson flood, the required rainfall information was not available to NWS warning office.

(2) Telephone communications were sporadic and highly unreliable for transmitting reports of rainfall and flooding.

(3) Radar operators at WSMO Pittsburgh were unable to carry out assigned duties because of heavy workloads and inadequate coordination during shift times and rapidly developing flash flood conditions.

(4) Media and public criticism of overforecasting in past caused reluctance on part of forecasters to issue flash flood watches or warnings without verification of flooding. Flash flood warnings were not disseminated until 2:40 a.m., after the flooding had started. The 4:00 a.m. zone forecast made no mention of flooding in progress.

(5) Identification of flood plains that require evacuation had either never been made or required updating.

(6) Flooding in downtown streets led Johnstown fire department personnel to warn people to move to higher levels but no official warning apparently given to evacuate. Firemen and police in neighboring communities evacuated people near waterways even though people were reluctant to leave.

Young, Michael. 1954. "The Role of the Extended Family in Disaster," Human Relations 7: 383-391.

Survey data regarding the experience of families evacuated during a 1953 flood in Britain confirms the social-psychological significance of keeping nuclear families intact during an evacuation as well as the importance of extended family ties in sheltering and recovery efforts. Three recommendations are made: (1) that evacuation be made of entire nuclear family units rather then "women and children first," (2) for maximum effectiveness materials during recovery should not be concentrated near the site but instead dispersed within the surrounding "cushion area," and (3) provision of free transport services should be made as soon as possible to carry victims to homes of relatives.

Findings/Comments:

(1) Most flood evacuees took refuge in homes of relatives rather than in official centers.

(2) The proportion of evacuees from a given district taking refuge with their relatives will vary inversely with the distance to relatives.

(3) The more scattered the extended family the less effective for purposes of mutual aid and psychological stability in the process of recovery following a major disaster.

Additional information on evacuation planning for floods is found in the following which have not been abstracted. When material is cited in Quarantelli we are referring to Evacuation Behavior and Problems: Findings and Implications from the Research Literature (Quarantelli, 1980), originally issued through the Disaster Research Center, Ohio State University, Columbus, Ohio. The Center is now located at the University of Delaware.

Anderson, W. 1964. "The Baldwin Hills, California Dam Disaster," Research Note No. 5. Columbus, Ohio: Disaster Research Center, Ohio State University (cited in Quarantelli, 1980).

Blum, R. and B. Klass. 1956. "A Study of Public Response to Disaster Warnings." Menlo Park, California: Stanford Research Institute (cited in Quarantelli, 1980).

Boek, W. and J. Boek. 1956. "An Exploratory Study of Reactions to an Impending Disaster." Albany, New York: New York State Department of Health (cited in Quarantelli, 1980).

Klausner, S. and H. Kincaid. 1956. "Social Problems of Sheltering Flood Evacuees." New York: Bureau of Applied Social Research, Columbia University (cited in Quarantelli, 1980).

Worth, M. F. and B. F. McLuckie. 1977. "Get to High Ground! The Warning Process in the Colorado Floods June 1965," Disaster Research Center Historical and Comparative Disasters Series. Columbus, Ohio: Disaster Research Center, The Ohio State University.

HURRICANES

Baker, Jay. 1986. "Hurricane Elena: Preparedness and Response in Florida." Florida Policy Review, Winter.

From August 28 through September 1, 1985, hurricane Elena threatened Florida and even though it never make landfall in Florida, it caused at least $200 million in damages. Two evacuations of panhandle residents occurred, the first since the completion of major comprehensive, quantitative hurricane evacuation studies of threatened areas in Florida. The paper reports the hurricane warning process, the threat information available to officials during Elena and the actions taken. Pinellas County was used as an example to illustrate difficulties in decision making regarding evacuation.

Findings/Comments:

(1) The driving force behind almost all decisions to advise or order evacuation was the posting of hurricane warnings by the National Hurricane Center (NHC).

(2) Warnings that called for "splitting" of county evacuation were difficult for officials who were prepared to respond on county-wide basis only.

(3) Computerized hurricane decision systems on probabilities of hurricane striking were not utilized by officials during threat.

(4) Evacuation rate from high-risk areas was estimated at 90% with 120,000 people going to Red Cross shelters. This represented 40% of evacuees and the highest incidence of public shelter use ever reported.

(5) Officials in Panhandle of Florida reported clearance times and areas of bottlenecks calculated prior to Elena were extremely close to what was observed except near Tampa Bay which cleared much more rapidly than expected through prior calculations.

Baker, E. J. 1984. "Public Response to Hurricane Probability Forecasts," NOAA TM NWS FCST 29. Washington, D.C.: National Weather Service.

The stated purpose of this study was to assess the effect probability forecasts of hurricanes will have on public response. Data was taken from an experiment conducted with two groups of respondents in Pinellas County, Florida, in the spring of 1983. Respondents in one group were presented with 16 hypothetical hurricane threat situations described in terms of storm severity, storm location and National Hurricane Center "alert" status (watch, warning or neither) as well as local officials statements regarding evacuation (advised, ordered, neither). The other group was presented the exact same situations plus the probability that the storm would hit their area and the probabilities of affecting other coastal locations. Overall probabilities were found to have little, if any, effect on public response one way or the other. The most important variable affecting response was local officials' statements, regardless of whether probability information was available or not (pg. ii).

Findings/Comments:

(1) Probability forecasts of hurricane have little if any effect on public response to evacuation.

(2) The most important variable affecting response was local officials' statements, regardless of whether probability information was available or not.

Baker, E. J. 1984. "Deciding Whether to Evacuate a Beach Community during a Hurricane Threat." Unpublished manuscript, Florida State University, Tallahasse, Florida.

(As taken verbatim from the paper presented)

"High population densities in the coastal barrier areas and limited transportation routes connecting them to areas farther inland could require 24 hours or more in some locations to safely evacuate barrier areas before arrival of a severe hurricane. Confidence in that sort of quantification of evacuation difficulties has come about only recently and is but one example of the increased information burden being borne by public officials and emergency management professionals as they face a decision whether to evacuate their jurisdiction when a hurricane threatens. This paper discusses the difficulty of that decision process and describes how 100 coastal emergency management professionals currently attempt to make their decision."

Forecasting of storm predictions is clearly explained with scenarios described using five factors (or types of threat information): severity of storm, NHC alert, NHC probabilities, relative probabilities, and trend in probabilities. Diagrams are appended to text. Concluding that decision strategies are best defined for decisions that are made most often and that emergencies are not routine, the author suggests that better instruction in the factors regarding the decisions be available to professionals.

Findings/Comments:

(1) Analysis of data indicates that many of the emergency management professionals do not have a clear idea of how to use some of the factors in making evacuation decisions or have misconceptions regarding their use. (Analysis is supported through statistical procedures.)

Baker, E. J. and T. M. Carter. 1984. "The Role of Information in Public Response to Warnings," American Meteorology Society Conference (Draft).

This paper examines the role of information sources in the individual decision making response to warnings regarding hurricane threats. Assuming a cost/benefit analysis is used by individuals in the decision to evacuate, the authors examine the kinds of information that would most likely enhance the decision to evacuate. Factors which are seen to affect the decision are perceptions regarding the likelihood of the storm hitting the resident's area including the use of probability forecasts recently instituted by the NWS, the perceived severity of consequences such as general information of hurricane hazards, the severity of the

particular storm, the uncertainty of changes in landfall location and the perceived individual vulnerability of a person's neighborhood and dwelling. Suggestions regarding the dissemination of information to enhance the likelihood of evacuation by officials is given including telling those who do not need to evacuate. Coastal residents use whatever information—faulty or correct—in their decision to evacuate. Of all possible sources, the public responds most directly to local officials. The authors state that the possibility of "crying wolf" undermining future responses to evacuation warnings has been overstated and evidence from studies suggest that the public should be credited with more sense. However, this trust places increased responsibility for providing correct and updated information by officials to their citizenry.

Findings/Comments:

(1) Decisions to evacuate during a hurricane threat are based on the perceived levels of benefits and the costs of evacuation by the coastal residents provided predominantly by the information received by the individual.

(2) By far the most important potential source of information in enhancing the decision to evacuate is advice or orders from local public officials.

(3) The "cry-wolf" problem is not substantiated by empirical evidence.

Baker, E. J. 1980. "Coping with Hurricane Evacuation Difficulties," pp. 13-18, in E. J. Baker (ed.), Hurricanes and Coastal Storms, Florida Sea Grant College Report No. 33.

The imprecision of forecasting landfall for hurricanes presents problems for both public and local officials. This article briefly describes some of the problems including the timing of warnings and the number of people that actually respond to such warnings by evacuation. Problems with evacuation route capacity are noted as well as the feasibility of using vertical evacuation as a last resort. Suggestions for preventing "the growth of impossible evacuation situations" include restrictive zoning and controlled growth policies.

Findings/Comments:

(1) Not everyone will evacuate even if given official orders.

(2) Evacuation route capacity varies from 500-800 vehicles per lane per hour in three of the evacuation studies.

(3) Vertical evacuation has problems in (1) ascertaining the structures as safe, (2) over-crowding by evacuees if option is publicized, (3) possible stranding of evacuees from food and medical services, and (4) possibilities of roof failure or window breakage leading to interior damage and threatening the safety of evacuees.

(4) The most stringent policy includes a "growth cap" (pg. 17) and restrictive zoning policies. Thus, evacuation is enhanced through (1) increasing evacuation capability (i.e., by building another causeway, elevating or widening existing roads), (2) decreasing the number of people who need to leave an area (by construction of necessary shelter facilities), or (3) limiting the population.

Baker, E. J. 1979. "Predicting Response to Hurricane Warnings: A Reanalysis of Data from Four Studies," Mass Emergencies 4: 9-24.

This study reexamines four post-hurricane sample surveys regarding human response to hurricane warnings: Moore et al. (1963) on Carla; Wilkinson and Ross (1970) on Camille; Baker et al. (1976), and Windham et al. (1977) on Eloise. After reviewing the previous studies, the analysis is extended with respect to one variable, evacuation in response to hurricane warning. All storms were major hurricanes, presented landfall forecasting problems, and had lengthy periods of monitoring. They differed in that each struck a distinctly different coastal area at a different time of day and fatalities differed widely. The 75 variables tested were grouped into 13 categories: information sources, evacuation advisements, storm watching, belief that the storm would hit, expectation of damage, confidence in weather forecasting, recall of forecast information, knowledge about hurricanes, previous hurricane experience, length of residence, site characteristics, demographics, and a miscellaneous category. The four studies failed to identify consistently strong predictors of evacuation using only measures of association: chi-square or Goodman and Kruskal's reduction in errors measure. It is suggested that a more discriminate measure of evacuation other than just leaving home should be used. The conclusion in the surveys is that those persons in the most risky areas evacuated but little was discovered that could enhance the likelihood of evacuation.

Findings/Comments:

(1) No conclusive findings that were consistent in all four studies except the fact that those in the most risky areas tend to evacuate.

(2) No conclusions regarding the future enhancement evacuation propensity are available from the studies.

Bates, F. L., C. W. Fogelman, V. J. Parenton, R. H. Pittman and G. S. Tracy. 1963. "The Social and Psychological Consequences of a Natural Disaster: A Longitudinal Study of Hurricane Audrey." National Research Council Disaster Study 18. Washington D.C.: National Academy of Sciences.

This extensive report discusses the social and psychological consequences to a coastal community from disastrous Hurricane Audrey in which 440 persons lost their lives and half the homes in the area were demolished. The longitudinal study was conducted from 1957 to 1961 in Cameron Parish, Louisiana, in an attempt to assess the social impacts of a natural disaster including the social change that followed the event. A tentative model for longitudinal study of disasters utilizing a system's approach is given. Failure to evacuate by the respondents was blamed on not believing the storm to be as serious as it was, having no prior experience with the extent and height of storm surge generated, and by being misled by media reports citing a latter time of impact than that issued by the NWS. Estimates placed the number evacuated from the water at approximately 1200 of which approximately 800 were evacuated by army and oil company helicopters. The majority of survivors left the impact zone as soon as possible after the storm due to the unsanitary conditions. Blacks suffered significantly heavier losses with deaths of 322 per 10,000 of population compared to 38 deaths of whites per 10,000 of total population.

Findings/Comments:

(1) Reasons for not evacuating as given by respondents included lack of belief in seriousness of storm, conflicting media reports regarding landfall times, and unfamiliarity with extent and height of storm surge generated by a hurricane of this magnitude.

(2) The authors conclude that Fritz's therapeutic community concept is useful only in immediate post-impact situation and not in long-term analyses.

(3) Blacks suffered significantly more deaths than whites with 38/10,000 deaths of whites per total population compared to 322/10,000 deaths of blacks per total population.

Berke, P. and C. Ruch. 1985. "Application of a Computer System for Hurricane Emergency Response and Land Use Planning," Journal of Environmental Management 21:117-134.

A computer system to simulate hurricane losses is presented that is based on two models -- exposure, as evidenced by land-use patterns and hazards, as represented by wind speed and surge patterns. The system uses a computerized geographic information system (GIS) to generate a

standardized data base for spatial oriented data. Coupled with exposure and vulnerability models and damage algorithms, the GIS identifies location and extent of losses as well as hurricane prone land. The identification of the exposed population and buildings is based on regional land development scenarios that distribute growth among census tracts based on an attractiveness rating. Zones are deliniated based on hazard vulnerability. The intent is to provide informed data on which decisions in coordinating land-use and emergency response measures (including evacuation and sheltering strategies) can be formulated. Paper uses Nueces County, Texas, that includes Corpus Christi, as a case study.

Findings/Comments: Description of computer model that calculates social and economic losses for a range of hurricane surge and wind intensity models.

Brinson, W. 1980. "Hurricane Evacuation Planning for Coastal Georgia," pp. 63-66, in E. J. Baker (ed.), Hurricanes and Coastal Storms, Florida Sea Grant College Report No. 33.

During exercises conducted at state and local levels to test the effectiveness of the new State of Georgia Natural Disaster Plan, the need for further planning of evacuation procedures became evident. Major problem areas included lack of data regarding evacuation zones along the coastal area related to rising water and high winds, lack of description concerning preplanned evacuation routes and knowledge of host and reception areas for evacuees. This report describes the organizations involved in the process of upgrading the plan as well as the coordination required between agencies. Counties with an inactive or with no civil defense organization were the most difficult from which to obtain data and it is suggested that such counties be eliminated from being host areas.

Findings/Comments:

(1) The major problems with the State of Georgia Natural Disaster Plan included the lack of data regarding evacuation zones along the coastal areas related to rising water and high winds, the lack of description of preplanned evacuation routes and the lack of knowledge concerning host and reception areas for evacuees. Corrections required extensive coordination between state, federal and local officals.

(2) Counties without an active or official civil defense unit were the most difficult to gather required data and authors suggest they be eliminated from being a host area.

Carter, T. M., S. Kendall and J. P. Clark. 1983. "Household Response to Warnings," International Journal of Mass Emergencies and Disasters 1 (March): 95-104.

This article explores the influence of family structure in responding to natural hazard warnings. Responses given by 429 residents of Mobile, Alabama, after Hurricane Frederick struck in September, 1979, are analyzed using a two-phase decision-making model. Comparisons are made between differently structured families—single persons living alone, married couples with children and married couples without children—regarding whether residents did or did not consider evacuation and, secondly, if they did consider evacuation, what factors influenced that decision. Data suggests families with children appear more likely to consider evacuation. Complete nuclear families appear to act as relatively self-contained decision-making units relying on their own interpretation of warnings while single persons and those married without children rely on their prior perceptions of risk and their social contacts with other significant persons.

Findings/Comments:

(1) Single residents living alone are less likely to respond to either official or unofficial statements irrespective of their perceptions of risk and to respond to their social contacts in considering evacuation.

(2) Married couples with or without children are equally likely to respond to official statements although those without children are equally likely to respond to unofficial ones as well.

(3) Married couples with children are much less likely to respond to social contacts and to rely more heavily on their perception of their risk of storm surge flooding, confirmation of threat as well as additional information in deciding to evacuate.

(4) Couples without children and single residents are more likely to evacuate with no additional incentives, once having considered evacuation, than couples with children.

(5) Single residents are more likely to evacuate on the basis of prior risk perception, once having considered evacuation, than couples without children.

(6) Couples with or without children are more likely to evacuate on the basis of their perception of the likelihood of flooding, once having considered evacuation than single residents.

Chiu, A., et al. 1983. "Hurricane Iwa, Hawaii, November 23, 1982." Washington, D.C.: National Academy of Sciences.

This team report discusses the effects of Hurricane Iwa which struck the Hawaiian islands of Kauai, Oahu, and Niihau, on November 23, 1982. Although not considered a major storm, the hurricane produced Hawaii's most costliest natural disaster although only one death and several minor injuries were incurred. High winds knocked out communications which left the local NWS without direct access to satellite data resulting in poor data collection of weather anomalies. Numerous problems regarding emergency preparedness and evacuation measures are discussed. Among the most significant issues affecting emergency response were the brief period of storm detection and warning; the inaccuracy of FEMA 100-year floodplain maps in determining extent of flooding; damages incurred because of poor building construction; poor design and inadequacy of building codes; inadequacy of shelters and amount of provisions in accessible locations; lack of alternative evacuation routes; late issuance of warnings particularly to tourists; understaffed and underequipped civil defense staff on Oahu; lack of understanding of various ethnic and cultural differences by disaster agencies (several different languages are spoken on the islands); and incomplete coverage of the siren warning system on Kauai. Although preparations for other types of natural disasters have occurred, the report notes that to date no attempts have been made to devise comprehensive redevelopment guidelines for wind-damaged areas.

Findings/Comments:

(1) Evacuation was hindered by numerous problems including a brief period between detection and warning, the understaffed and underequipped civil defense agency on Oahu, late issuance of warnings, lack of alternative evacuation routes, lack of information and coordination of provisions regarding shelters including jurisdictional disputes on their use, and lack of information dissemination to tourists who were also forced to use shelters.

(2) Although well equipped to handle other natural disasters the agencies involved were not prepared for a hurricane. (Authors note that no plan has been developed since the hurricane.)

(3) Lack of back-up electricity for communications hampered coordination of warning and emergency systems including media communication.

(4) Restorative attempts were hampered by cultural and ethnic diversity for which the agencies involved were unprepared.

Christensen, L. and C. E. Ruch. 1980. "The Effect of Social Influence on Response to Hurricane Warnings," Disasters 4(2): 205-210.

This paper reports the results of two experiments conducted to test the hypothesis that an individual's response to impending disaster is influenced by observing the behavior of others. Selecting subjects at random from the Galveston, Texas, telephone directory, the first experiment used individuals as subjects while the second employed couples either married or involving close friends. The first experiment tested the influence of a stranger's responses on one own's response as well as the potential influence of surrounding events and authority figures such as the NWS on individual response. The second experiment tested the influence of a spouse or friend's response on own's response. Observing the responses of others did not appear to affect responses taken at an individual level but the advisory of the NWS did produce a more extreme response. Describing surrounding events with those of prior hurricanes also increased the extremity of response. Failure to find a significant group effect in eliciting responses in the second experiment supported the overall findings that social influence is not a relevant factor in decision-making to evacuate. The authors suggest that the nature of the task may influence the degree of conformity through Allen's (1965) variables which suggest conformity decreases as importance of the task increases, as the ambiguity of the stimulus decreases and as the person's perceived competence in dealing with hurricanes increases. They account for the failure to find a social influence.

Findings/Comments:

(1) In the two experiments, advisories issued by authorities such as the NWS produced a significant impact in generating a more extreme response except for individuals with prior hurricane experience for which the knowledge of surrounding activities was a more powerful predictor.

(2) In neither of the studies did the actions of strangers, friends or spouses have any impact on an individual's response including intent to evacuate.

Christensen, L. and C. E. Ruch. 1978. "Assessment of Brochures and Radio and Television on Hurricane Awareness," Mass Emergencies 3: 209-216.

This study seeks to assess the impact of the Hurricane Awareness Program on residents of 22 Texas coastal communities regarding their knowledge and beliefs about hurricanes, and their intended responses including whether they had a pre-planned evacuation route when faced with a hurricane threat. Of the 1,350 residents, selected at random from each city's telephone directory, which were mailed a questionnaire in August, 1977,

and followed by a reminder card; the response rate was 32% (363 returned). Analysis indicates that radio presentations produced little or no effect in stimulating hurricane awareness or preparedness and may have produced a negative result. The brochure increased the accuracy of knowledge regarding hurricanes and the television spots enhanced beliefs about hurricane destructiveness. Bias may exist in the study because of the self selective process regarding the dissemination of brochures, in the media presentations or because of the low return rate.

Findings/Comments:

(1) Radio presentations produced little or no effect in stimulating hurricane awareness or preparedness and may have even produced a negative result.

(2) The brochure increased accuracy of knowledge regarding hurricanes and television spots enhanced beliefs in hurricane destructiveness.

(3) Concerning intended responses, residents who had received brochure were significantly more prone to having a pre-planned evacuation route than those who had not received a brochure (76% versus 59%).

Clark, J. and T. M. Carter. 1980. "Response to Hurricane Warnings as a Process: Determinants of Household Behavior," pp. 19-24, in E. J. Baker (ed.), Hurricanes and Coastal Storms, Florida Sea Grant College Report No. 33.

This paper presents a tentative model of individual response to natural hazard warnings in general, and evacuation behavior in particular. Using a "bounded rationality" decision-making approach the model employs sequential passes through the decision-making process to predict: (1) the range of responses that will be displayed in the population and (2) the proportions of the population that will display the predicted response. Factors that influence include the saliency of the hurricane warning and the information contained in the warning. Two factors influence source of information: (1) ease of obtaining information and (2) perceived reliability or credibilty of source. The model additionally predicts that multiple sources of information are used by the population. Since the model employs sequential passes, inconsistent information may be magnified resulting in delay in reaction to hurricane warnings. Furthermore, the model indicates that minimal experience with previous hurricanes will result in low negative utility to evacuate, thereby, increasing the threshold levels and making it more difficult to motivate people to evacuate in the future.

Findings/Comments:

(1) This theoretical article presents a model suggesting that experience with hurricanes of minimal impact will make it more difficult to evacuate individuals in the future. Increase in threshold levels results from instability of utilities regarding the decision to evacuate and, thus, result in delay in response to warnings.

Committee on Natural Disasters. 1985. "Hurricanes Iwa, Alicia, and Diana - Common Themes." Washington, D.C.: National Academy Press.

This report first briefly summarizes the Committee on Natural Disasters' various study team's activities during the calender year 1984. The report then presents a generic analysis of the several recent hurricanes - Iwa, Alicia and Diana. Included are distinctive meteorological features, coastal processes, structural damages, loss of lifelines, and response and recovery efforts. None of the hurricanes were intense but demonstrated the great vulnerability of today's coastal populations to more serious hurricane disasters due to extensive coastal development. Appendix A also lists the potential team members and their associations for 1984.

Findings/Comments:

(1) Most severe damage to lifelines caused by three hurricanes was to overhead power lines, telephone cables and poles on which they were suspended.

(2) The three hurricanes demonstrated that the greatest threat to structures are inadequate fastenings and anchoring and windborne debris.

(3) All three hurricanes revealed strengths and weaknesses of current emergency and evacuation plans but the loss of life was much less than had evacuations been less successful and timely.

(4) None of three areas had conducted surveys of buildings that would be safe from hurricane forces and could be used as shelters for evacuees remaining in affected area.

Committee on Science and Technology. 1984. "Hurricane Alicia: Prediction, Damage and Recovery Efforts." Hearings. Washington, D.C.: U. S. Government Printing Office.

Hurricane Alicia struck the Galveston-Houston areas of Texas on the night of August 17 and 18, 1983, and was possibly the second most costliest storm in the United States. In this report, the course of the storm and the accompanying meteorological conditions are reviewed as this was the first storm in which probability forecasts were issued publicly. "Downburst" phenomena were noted as well as numerous tornadoes. Lifelines dependent on electricity were most affected but media continued with aid of auxiliary power sources. Evacuation was limited and varied across areas partially attributed to officials not wishing to "cry-wolf" again after Hurricane Allen in 1980, and NHC reluctance to mention actual landfall point. When storm intensified, there was not enough time for estimated total evacuation of Galveston Island (estimated at 26 hours). The Red Cross opened 111 shelters housing 25,000 evacuees. High temperatures required "cooling-centers" to be set up following storm. Some looting was documented with arrests. Also mentioned are recovery efforts that included unprecedented amount of debris removal. Prior subsidence at Brownwood housing development along with the hurricane damage caused FEMA to offer buy-outs of all insured housing in the Brownwood area. On-site observations, secondary sources such as newspaper accounts and official records as well as some interviews with officials used as sources for committee's report. A number of recommendations are given at end of text.

Findings/Comments:

(1) "Cry-wolf" syndrome affected evacuation warnings as well as original predictions as to storm's path and intensity.

(2) Structural damage to buildings was caused by lack of hurricane resistant construction rather than by storm.

(3) Media effectively worked with NWS in disseminating messages as media continued to operate with auxiliary power sources.

(4) Problem with warnings and prediction times in that Alicia intensified after critical period of 26 hour lead-time had passed suggesting need for further evaluation of on-island structures for use in emergency.

(5) Debris removal unprecedented with over 2 million cubic yards of debris removed.

Davenport, S. 1978. "Human Response to Hurricanes in Texas: Two Studies," Working Paper No. 34. Boulder: Institute of Behavioral Science, University of Colorado.

These studies attempt to determine the attitude and awareness of residents to hurricanes and the types of adjustments communities have taken in response to hurricane threats. The Galveston study uses secondary sources and interviews with state officials while the second study uses information gathered from a telephone survey conducted in three communities. Awareness of hurricanes in both studies is high for residents and public officials. On the barrier island of Galveston, the data suggests that a distinct "disaster culture" has evolved indicating that island residents are much less likely to evacuate prior to a hurricane than those people in equally vulnerable lower Texas coast locations. Prior to Hurricane Carla, research suggests that 20-30% of Galveston Island residents evacuated to the mainland with 30% remaining in their homes and the rest going to Island shelters or other buildings. In the Port Aransas and South Padre/Port Isabel study conducted six weeks after Hurricane Anita struck in September 1977, 84% of the residents evacuated and indicated they would do so again if another threat occurred. A high level of awareness and preparedness exists with three-fourths of the residents having some sort of hurricane survival checklist. The presence of a large seawall in Galveston and not in other locations is viewed as contributing to the tendency of Galveston residents to defy storms and to have a feeling of false security. Also the length of settlement on Galveston Island (since the mid-1800's) as compared to the recent settlement of Port Aransas and South Padre within the last 50 years is seen as a contributing factor to lack of motivation for Galveston residents to evacuate.

Findings/Comments:

(1) A literature search and interviews with state officials indicates that a "disaster subculture" may exist in Galveston suggesting that residents will fail to evacuate and have a false sense of security during a hurricane threat. Authors suggest presence of seawall and length of settlement of the island contribute to complacency regarding hurricane threat.

(2) In contrast, the coastal communities of Port Aransas, South Padre and Port Isabel exhibited a high level of awareness and preparedness regarding hurricanes. Prior to Hurricane Anita, 84% evacuated and indicated they would do so again during a hurricane threat. Also perception of vulnerability to hurricane hazard appears realistic but the extent of potential damage may not be realistic.

Forrest, T. R. 1979. "Hurricane Betsy, 1965; A Selective Analysis of Organizational Response in the New Orleans Area," The Disaster Research Center Historical and Comparative Disaster Series, No. 5. Columbus, Ohio: Disaster Research Center, The Ohio State University.

This report details the responses of established and expanding organizations to Hurricane Betsy which struck New Orleans in September of 1965 and which was immediately followed by an unexpected flood caused by tidal surge. The organizations studied are Civil Defense, Salvation Army, Red Cross, Public Works including utility and transit divisions and the Southern Bell and Telephone Company. Noting that New Orleans has developed a "disaster subculture" through repeated threats and impacts, community organizations have adapted their behavior to efficiently mobilize resources when the disaster occurs. Three time periods are used in discussing the disaster: pre-impact, impact and post-impact. Data were collected from 147 personal interviews with organizational officials and staff, official reports and newspaper accounts. Predisaster procedures as well as those used during the stress situation are described for comparing the organization's responses. That "disasters can act as an impetus prodding organizations to set into motions a new pattern of response" (pg. 125) is apparent from impacts on long-term operational adjustments made by these organizations from Hurricane Betsy.

Findings/Comments:

(1) Disasters can act as impetus prodding organizations to initiate long-term operational adjustments to patterns of response. These included new equipment, facilitating better communication links between organizations and with the public and new operational plans and programs directly reflecting problems encountered during the emergencies.

(2) The Red Cross initiated changes regarding shelter operation. These included adding shelters, establishing training programs, instituting a liquid diet feeding system for first 24 hours to avoid cooking, and opening shelters 12 hours prior to expected impact.

(3) The power failure which had left many organizations helpless and the problem of communication impeding coordinated efforts illustrated sharply the technical problems that must be faced even when a set of detailed plans exist for emergencies.

(4) Disasters do not precipitate chaotic random behavior. In disasters, organizations and individuals adapt resources to meet with new demands.

(5) The importance of an effective coordinating body to direct human and material resources is necessary to coordinate activities. This also illustrates the importance of an interdependent and national network system that can mobilize resources when normal systems are disrupted.

Louisiana Department of Public Safety. 1984. "Southeast Louisiana Hurricane Study, Evacuation Behavioral Survey, Final Report." Baton Rouge: Office of Emergency Preparedness.

A survey of citizen evacuation-related responses to hurricane threat was administered in nine parishes in Southeast Louisiana in January, 1984. The survey was 93% mailout and 7% phone. The response rate was 31%. Analyses point to a high degree of potential evacuation by respondents. Residents will depend upon local government for advice and aid in the event of hurricane evacuation scenario. Suggested factors affecting evacuation behavior include evacuation experience, vulnerability of home structure to storms, number of vehicles owned and the self-reported past evacuation experience. A discrepancy exists between the high degree of potential evacuation and the self-reported past evacuation experience. The survey instrument is included.

Findings/Comments:

(1) The majority of respondents in all parishes indicate they would evacuate if order was issued by local government or civil defense; for the entire region 91% indicated they would evacuate. This contrasts sharply to the reported historical predominance in all parishes to not evacuate. In two parishes estimated non-evacuation rates based on reported hurricane experiences are between 68% and 72%. Data suggests the estimate of 60% potential evacuation with an order in light of historical data available. Those with hurricane experience are less likely to evacuate than those without but those with previous evacuation experience or who are novices are more likely to leave than those who never evacuated.

(2) The concept of vertical refuge received mixed responses ranging from a low negation by 18.5% in one parish to a high of almost 50% in another parish. Reasons for rejection included fear of high winds, entrapment, crowds in confined quarters, structure collapse, lack of utilities and water, and a general mistrust of idea.

(3) The majority of respondents will be ready to evacuate within 4 hours of the decision to leave. (Impact on transportation network diagram included for four possible scenarios.)

(4) The majority of evacuees will go to friend's or relative's followed by evacuation to Red Cross Shelters and then motel/hotel destination. About 25% estimated using shelters. There is lesser likelihood that those who remained in a hurricane in the past will use shelters while former evacuees or novices will be more likely to seek public shelter.

(5) The average "decision threshold" has a quadratic relationship with "home risk", i.e., the vulnerability of home (personal vulnerability) contributes significantly to decision-making process to evacuate.

(6) The proportion of owned vehicles used by a household for evacuation has positive relationship with the decision threshold.

(7) Evidence of a disaster subculture is found in all but one parish.

Moore, H. E., F. L. Bates, M. V. Layman and V. J. Parenton. 1963. "Before the Wind: A Study of Hurricane Carla," National Academy of Sciences/National Research Council Disaster Study #19. Washington, D.C.: National Academy of Sciences.

On Monday, September 11, 1961, Hurricane Carla caused the evacuation of over one-half million residents from coastal Louisiana and Texas. This report (with the companion report, "And the Winds Blew") presents the results of the first major study of the mass evacuations and the events preceding and following it. The study using five sampled areas is divided into two parts (1) the storm threat as perceived by the people and (2) the actions taken on the basis of the perceptions. The major objectives were to determine the effectiveness of the warning systems, to study evacuation including the decision-making process of individuals and officials to take action, the coordination and effectiveness of disaster-oriented agencies including the voluntary ones. Theoretical implications of results in terms of possible applications to nuclear and/or future natural disasters are also discussed. Warning viewed as a process. Hypotheses are presented and tested regarding the relationship between warning and evacuation behavior even though no effective official order was issued to evacuate except in one sampled area, Cameron Parish. Noted especially are several hypotheses advanced by Mack-Baker (1961).

Findings/Comments:

(1) About 9/10 of those sampled reported receiving the first warning two days prior to impact; usually first by radio or TV (91%).

(2) Rural residents paid closer attention to warnings than urbanites.

(3) Women were more affected by warnings than men; SES and ethnicity also associated with reaction to warnings.

(4) NWS cited as authority almost universally on warnings; 75% did not verify warning received from media; 91% considered the mass media a reliable source; evidence was clear that people do not base actions on advice of personal or trusted friends.

(5) When specific advice or orders issued, a larger proportion of people evacuated.

(6) When an evacuation plan was used, more evacuation was likely to occur; three-fourths believed if in a similar situation the people should be ordered to evacuate probably by civil defense agency.

(7) Distance travelled from home to refuge associated with stage in family cycle; modal distance travelled was less than 25 miles.

(8) Percentage of people staying in home increased with age (56% that were 61 or over did not want to leave).

(9) Females were more likely to evacuate that males.

(10) There was a direct effect between extent of evacuation and discussion outside family; "snowball" effect as neighbors conform to evacuation roughly coincided with ecological patterns in "naturally" hazardous areas.

(11) Families with incomes of less than $4500 were more likely to evacuate homes but not hometowns.

(12) People evacuated as members of families or other groups not as individuals and decisions to evacuate made by family not as individuals. Previous disaster experience associated with evacuation.

(13) Role conflict existed between volunteer and paid workers. Data is unclear although some evidence suggests that people remained only if they felt obligation to stay; those with no perceived responsibilities most likely to leave town.

(14) Red Cross estimated that 206,103 persons stayed in 540 shelters; order of priority for shelters were private homes, commercial shelters and lastly, public shelters.

(15) Rumors, especially from media, were a problem following storm and resulted in increased anxiety causing premature return attempts.

(16) No evidence of widespread panic were found.

Moore, H. E. with collaboration of F. L. Bates, J. P. Alston, M. M. Fuller, M. V. Layman, D. L. Mischer and M. M. White. 1964. And the Winds Blew. Austin, Texas: The Hogg Foundation for Mental Health, University of Texas.

This report describes the response to warnings and evacuation advisories as well as the impacts generated from Hurricane Carla which hit the Gulf coast of Louisiana and Texas in September of 1961 forcing the evacuation of an estimated 750,000 people. The study examines the course of the hurricane from its origin in the Carribean and the response by media,

officials and organizations as they prepared for the threat of the storm and later in the rehabilitation and recovery efforts necessitated by the storm. Comparisons are made between Cameron Parish in Texas and Chambers County in Louisiana in their mode of operations in evacuations, in inter-organizational coordination and in the handling of clean-up and return of the evacuees. Previous recent experience is seen as the important variable. In both cases evacuation and sheltering of the evacuees was accomplished with considerable success unlike the problems encountered when evacuees wanted to return before health conditions warranted and which caused considerable consternation among evacuees. Content analysis of newspapers is included in their role of surveillance of the environment, correlation of information, translation of cultural transition and as entertainment to boost morale and provide release from tensions. Problems with organizations such as the Red Cross and insurance agencies are also scrutinized from behavioral standpoint. The report concludes with a section on disaster culture. Basic to disaster culture is the attempt residents make to deny or minimize danger faced and loss incurred. The question arises as to whether rationalistic aspects of disaster culture such as expectation to remain on one's job allows persons to recover more quickly emotionally following the event.

Findings/Comments:

(1) Recent experience is the most important variable in accounting for differences in response to hurricane threat.

(2) Media plays several important roles in disseminating information regarding threat, with TV the most important source, radio second, and newspapers third. However, from a recovery standpoint, newspapers provide a correlation of information and in role of entertainment boost morale and provide release of tension.

(3) Evacuee re-entry was a problem as sewage and potable water was unavailable after storm.

(4) Telephone calls increased substantially prior to evacuation; the telephone company brought in 300 extra operators to handle emergency operations.

(5) Using a hospital as an evacuation site was not feasible in this emergency situation as sterile conditions and accommodations were difficult to maintain.

(6) Insurance was not adequate for recovery as distinction between water- and wind-related damages was often indeterminable causing some mortgage foreclosures and much consternation among victims; the state has since worked to close the gap.

(7) Disaster culture hindered evacuation efforts and may prove lethal to residents who do not appreciate the intensity of storms such as Hurricane Carla. The prevailing cultural norms of community

resistance to evacuation, especially among elderly, are difficult to change and may be exaggerated as time passes, leading to further problems.

(8) Tornados spawned by hurricane were not anticipated, resulting in more devastation.

Perry, R. and M. Lindell. 1980. "Predisaster Planning to Promote Compliance with Evacuation Warnings," pp. 44-49 in E. J. Baker (ed.), Hurricanes and Coastal Storms, Florida Sea Grant College Report No. 33.

Successful pre-impact evacuation programs not only directly save lives but serve to reduce loss of property and disruption of social networks as well as allowing equilibrium to be more quickly regained. By developing voluntary incentives, evacuation can be more easily implemented. These include provision of an adaptive plan, in systematizing and publicizing transportation information, by developing warning confirmation centers or another strategy for effective confirmation of messages, by establishing "family communication centers" in shelter planning and in communicating the general nature of official security measures. Other tactics include the establishment of "shelter checkpoints" and publication in advance of safe areas and safe routes so that residents of hazardous areas could make advance plans with family or friends.

Findings/Comments:

(1) A review of empirical literature on individual's responses to warnings of disaster indicates adaptive plans, warning continuation behavior, the role of the family, security and property protection, and sheltering have been found associated with degree of success of evacuation programs.

(2) Evacuation incentives depend critically on conditions present during event such as speed of onset and scope of impact that affect ability of threatened population to evacuate.

Pinellas County Department of Civil Emergency Services. 1986. "Hurricane Elena Critique." Pinellas County, Florida.

This in-depth critique examines and evaluates the major response activities including evacuation actions taken by officials of Pinellas County, Florida, in response to a threat posed by hurricane Elena. At 1:00 a.m. on August 31, 1985, an evacuation order was issued by Pinellas

County officials to all county residents. Although the hurricane eventually made landfall 80 miles outside of Pinellas County the resulting storm damages included four deaths, 76 hospitalized, 395 injuries not requiring hospitalization, 256 homes made uninhabitable with another 79,707 homes destroyed, and 252 businesses damaged or destroyed. An estimated 300,000 persons evacuated with 38% or 113,727 people using 70 Red Cross shelters. Nineteen nursing homes with 1,860 patients and three hospitals with 211 patients were evacuated. Discussions and recommendations center on decision-making of officials, legal issues, warnings, emergency center operations, problems of communication and public information, transportation and traffic control. Additionally, closure of evacuated areas meant critical workers and equipment could not move through roadblocks. Also discussed are the problems associated with evacuation of nursing homes, hospitals and the "special needs" population. The biggest delay in the nursing home evacuations centered on the late arrival of buses. Later return to hospitals and nursing homes was completed over an extended period of time as buses became available. Concise and innovative recommendations follow problems outlined in text.

Findings/Comments:

(1) The trend by the National Hurricane Center (NHC) to limit use of hurricane watches directly impacts local emergency preparedness plans.

(2) Local programs based on regional planning are impacted by the NHC which does not consider local or regional plans when issuing warnings.

(3) A major problem for emergency managers was the governor's call for voluntary evacuation without coordination or knowledge of the County in opening shelters.

(4) The large membership of advisory committee hampered notification of members and subsequent decision-making.

(5) Media present at executive meetings issued premature statements even when asked to wait by officials.

(6) Nursing homes, hospitals and barrier islands were not apprised of the on-going decision-making actions although long-lead times are needed for evacuation of facilities.

(7) Law enforcement agencies felt that the sale of alcoholic beverages contributed to problems in bars and shelters during hurricane.

(8) Lack of coordination between contiguous municipalities at checkpoints at causeways hampered orderly re-entry by citizens.

(9) Hard copies of Executive Orders were not available to all concerned counties and hampered coordination between state and local officials.

(10) Only two of the three major cable systems were linked to the Emergency Broadcasting System (EBS) leaving some cable viewers unnotified of threat. The information when supplied did not give the evacuation zones.

(11) In some cases, police and fire personnel evacuated zones not at risk.

(12) Several television stations provided the public with wrong evacuation zone information after the evacuation order was issued.

(13) Local television stations did not use script to notify the hearing-impaired.

(14) No written procedures nor pre-prepared agenda were on hand for use with cable television over-ride system.

(15) Lack of use of forms by Emergency Operations Center (EOC) staff hampered later retrieval of information regarding actions during emergency.

(16) Telephones were used as a primary source of communication which automatically reduced radio traffic and kept other agencies from remaining informed when tie-ups occurred in the system.

(17) Lack of representation from Red Cross prevented EOC staff from being informed about shelter problems for first 30 hours.

(18) The EOC was poorly organized with no food, cots or shift designation of staff members.

(19) Minimum staffing of EOC hampered coordination of re-entry.

(20) Communication support was provided by 123 amateur radio operators at shelters, local government and other disaster agencies, handling over 700 emergency messages although some shelters remained without radio communication.

(21) No planned phone numbers for citizens concerning evacuation information was available.

(22) The majority of all telephone calls related to citizen's inability to determine if they resided in an evacuation zone.

(23) At times conflicting information was being provided to public through media especially regarding bridge and road closings and openings.

(24) Transportation for evacuees from nursing homes was uncoordinated both during evacuation and on return.

(25) Response to Governor's advisory evacuation order resulted in up to 2000 evacuees congregating outside shelters prior to opening which restricted access later by emergency vehicles.

(26) Sheltering and feeding of 30,000 more evacuees than planned for (84,500) resulted in major feeding problems for Red Cross.

(27) The larger number of elderly evacuees caused unforeseen medical problems beyond capability of Red Cross and EMS personnel.

(28) The largest number of special needs evacuee requests came as a result of 911 calls or as direct requests to agencies rather than as part of Voluntary Registration Program.

(29) Lists were not maintained of where special needs evacuees were taken to shelters.

(30) Special needs evacuees not participating in Voluntary Registration Program called multiple agencies for evacuation assistance contributing to ambulance cancellations on arrival at destination sites.

(31) Most nursing homes evacuated with their own supplies, food and mattresses, utilizing pre-arranged transport or their own vehicles.

(32) Some buses dispatched to municipalities or nursing homes did not arrive or were delayed when local police commandeered buses for own use.

(33) Although National Guard personnel were prepared to assist evacuation of Pinellas County Jail, no facility was available in Pinellas County to secure prisoners.

(34) Interorganizational problems regarding control of National Guard personnel resulted in delays in Guard response to local requests for help during evacuation.

(35) Critical workers and equipment could not move through road blocks when Governor's Order sealed Pinellas County during emergency.

(36) Treasure Island reported four residences burned after forced entry but looting did not appear a county-wide problem during evacuation.

(37) Persons evacuating did not always go to assigned shelters, causing overcrowding in many shelters.

Ramani, S. 1985. "Design and Development of a Computerized Cyclone Disaster Simulator," pp. 143-148 in Emergency Planning, Vol. 15, No. 1, John Carroll (ed.). La Jolla, CA: Society for Computer Simulation.

This paper describes the SIMCLONE Game, a computerized cyclone disaster simulation which provides the basics for training disaster relief managers especially in developing countries. In a series of modules, the exercise examines three phases: phase 1 which incorporates the two-month period prior to the event including the allocation of resources and long-term planning decisions, phase 2 describes the cyclone warning phase in which decisions to evacuate, shelter, etc. are made, and phase 3 includes the post-disaster period when damage reports are given and further allocation of resources must be made. The computer program's flexibility provides a variety of scenarios to expose problems and practices of rescue and relief management, the management of resources during pre- and post-disaster periods and to illustrate the value of disaster preparedness.

Findings/Comments: This paper describes the SIMCLONE computer simulation game designed to teach emergency managers in developing countries the management problems associated with cyclones.

Ruch, C. 1983. "Hurricane Relocation Planning for Hardin, Jasper, Jefferson, Newton and Orange Counties." College Station, Texas: Sea Grant Program, Texas A&M University.

This technical report was prepared to assist emergency managers in deciding when to institute evacuation of Texas coastal areas during hurricane threats. Using the storm surge model labeled SLOSH (Sea, Lake and Overland Surges from Hurricanes), information regarding possible surge penetration, critical road cutoff times, delineation of evacuation zones according to storm intensity, and hours needed for partial and complete evacuation times are given. Data used to estimate number of vehicles and place of refuge were taken from telephone surveys conducted by Red Cross volunteers asking residents about plans during future threat. Estimated evacuation times are based on 20% reduction in ordinary road capacity as well as the time needed to reach a "safe" area beyond the evacuation and contingency zones. Adjustments for warning and preparation times need to be included. Additional data is supplied for Freeport and Texas City levee systems and Galveston Island. Data on shelter needs and appendices also are included.

Findings/Comments:

This is a technical manual describing use of the SLOSH model for evacuation times of Brazoria, Galveston, Harris, Fort Bend, and Chambers Counties, Texas. However, data for estimating number of vehicles and place of refuge were taken from telephone surveys asking residents' intentions

during a hurricane threat. Number of vehicles ranged from 1.08 to 1.62 for anticipated use during evacuating per household.

Ruch, C. 1981. "Hurricane Relocation Planning for Brazovia, Galveston, Harris, Fort Bend and Chambers Counties, Texas." College Station, Texas: Sea Grant College Program, Texas A&M University.

This technical report was prepared to assist those responsible for evacuation of Texas coastal areas in the timing and execution of evacuation procedures. Certain hurricane characteristics (wind speed, movement speed, location and direction of storm) from the storm surge model called SLOSH (Sea, Lake and Overland Surges from Hurricanes) are utilized in estimating evacuation times. The model does not include predictions of wind generated wave height, rainfall generated from storm, astronomical effects, or river flooding. Minimum evacuation times do not assume full utilization of roadway capacity over entire evacuation time, use of vehicles other than evacuation ones, nor adjustments for tourists. Concern also centers on delimiting contingency areas adjacent to actual evacuation zones so that areas not subject to threat will be evacuated unnecessarily. A three-hour warning delay (one hour to warn, one hour for people to prepare and one hour to prepare monitoring systems to maximize utilization of evacuation routes) is suggested before actual evacuation occurs. Shelter needs are also noted including concerns of Red Cross personnel. Information for media include suggestions on how media can help in monitoring traffic conditions and in publicizing shelter locations. A glossary of hurricane terms is appendixed along with detailed coordinates of specific locations for the use of the SLOSH model.

Findings/Comments:

(1) As indicated in surveys, vehicle estimates per household ranged from 1.26 to 1.62 for Brazoria County, 0.94 to 1.54 for Galveston County, 1.10 to 1.57 for Harris County and 1.3 to 1.4 for Chambers County.

(2) As indicated in surveys, the percent of households indicating intention to evacuate in a hurricane ranged from 85% to 97% for Brazoria County, 71% to 90% for Galveston County, 62% to 89% for Harris County, and 80% to 89% for Chambers County.

Ruch, C. and L. Christensen. 1981. "Hurricane Message Enhancement." College Station, Texas: Sea Grant College Program, Texas A&M University.

This report describes the results of three experimental studies conducted with randomly selected samples to determine what best stimulates people to respond to hurricane information. The information was then used to develop a hurricane response model with both Galveston as well as national applicability. Items to be stressed in enhancing pre-warning messages include hurricane awareness programs that indicate specific actions to be taken related to "watch" and "warning" and to distinguishing between damage caused by wind speeds and that accompanying storm surge. For Galveston, people need to be informed about tidal rise that blocks the island's evacuation route, about the length of time it takes to evacuate, and on the function of the city's emergency management system. When a threatening condition exists, the mass media can enhance a warning message by portraying satellite images, by using authority figures, by notification of surrounding events like plant closings, by using fear tactics when threats are imminent, and by describing the destructive consequences of hurricanes including the possibility of hurrricane spawned tornadoes. The survey instrument with tabulated results are appendixed.

Findings/Comments:

(1) The distance of the hurricane from land and evacuation notices were the most effective factors in stimulating safety response patterns.

(2) In using films on television regarding possible damage, the media should emphasize the linkage between hurricanes and tornadoes. In Galveston, 72% of residents sampled indicated that they feared hurricane spawned tornadoes more than hurricanes themselves.

(3) Nearly 89% of Galveston residents indicated that in cases of conflicting information they would believe the local National Weather Service messages.

(4) The most effective method for maximizing increased safety response patterns is a combination of hurricane related material that includes themes of testimony, information and fear. When used independently, the most effective is fear, followed by information, with testimony being last.

(5) For individuals with prior hurricane experience, knowledge of activities of surrounding businesses and organizations is an effective variable in stimulating action.

(6) Actions of strangers or friends did not have any significant impact on individual's responses in these experiments.

Savage, R. P., J. Baker, J. H. Golden, A. Kareem and B. R. Manning. 1984. "Hurricane Alicia: Galveston and Houston, Texas, August 17-18, 1983." Washington, D. C.: National Academy of Sciences.

This comprehensive technical report describes the meteorological and topographical conditions existing during Hurricane Alicia and the responses to them. The storm came ashore near Galveston, Texas, the night of August 17-18, 1984, causing property damages estimated at $1 billion dollars, 3,243 injuries and 17 deaths (Interagency Mitigation Team, 1983). An estimated 2,000 homes or apartments were totally destroyed with another 16,000 affected. Alicia was the first storm in which the National Weather Service used the "probability" system of forecasting landfall. Data indicates that the system functioned well with most people understanding the system. The wind-induced damage was generally caused by a lack of adequate hurricane-resistant construction rather than the storm. Evacuation rates differed throughout Galveston Island mainly as a function of vulnerability of location and actions taken by officials. Belief of "cry-wolf" syndrome (not supported) was also feared by officials. No provision for sheltering Galveston island evacuees off the island had been made prior to the storm. The unique effect of the storm was the concentrated damage to glass windows of a cluster of high-rise buildings in downtown Houston. Thus vertical evacuation or refuge is questioned in such circumstances. Shore processes are also explicated and recommendations for mitigation of future events given. Text includes numerous photos, graphs, and tables.

Findings/Comments:

(1) Most people appeared to understand the concept of probabilities in forecasting storm landfall issued by the National Weather Service.

(2) Vertical evacuation or refuge questioned for high-rise buildings with large expanses of glass and subject to specific wind conditions.

(3) Unsupported fear of "cry-wolf" syndrome and uncoordination among various localities and officials hindered warning efforts and messages. Lack of shelters off Galveston island appeared to discourage evacuation for those without resources off the island.

Simpson, R. H., B. Hayden, M. Garstang and H. Massie. 1985. "Timing of Hurricane Emergency Actions," Environmental Management 9(1): 61-70.

This report explains the rationale and concept of the decision system developed for use in Florida for determining when to recommend actions to prepare for a hurricane emergency. The system is founded upon individual hurricane climatologies and decision procedures that are tailored for use

at each community. The system reformulates the hurricane tracking forecast prepared by the National Hurricane Center in Miami to specify the probability of a strike at each of 12 vulnerable coastal communities and then normalizes the value in terms of probabilities computed for historic hurricanes that have struck the particular community. The authors suggest that risk analyses with a 93% level of confidence relieves officials of the need to make meteorological decisions in timing evacuations and other critical measures that must be taken even before an official hurricane warning is received.

Findings/Comments:

Theoretical article dealing with concepts of determining probability of hurricane strike in a particular community via computer analysis. Arrives at level of risk within a given 93% level of confidence for an area that can be compared with other sites. To feed the input into the computer requires the services of trained tropical meteorologist.

Simpson, R. H. and H. Riehl. 1981. The Hurricane and Its Impact. Baton Rouge, Louisiana: Lousiana State University Press.

This detailed book describes the physical nature and development of hurricanes and the impact such storms have on coastal zones. The authors note that the public response to hurricanes is usually one of fascination rather than fear, which present a hierarchy of problems, responsibilities and challenges to governmental officials, professionals and residents of coastal areas. Populations vulnerable to hurricane impact have greatly increased as coastal lands have been developed. This has resulted in exceptionally low hurricane experience levels of coastal residents. To develop viable plans for planning, a fundamental knowledge and methodology for understanding and analyzing the threat of hurricanes is given, often using detailed meteorological and scientific methodology. References to evacuation problems are interspersed throughout, but are formally noted in 2-1/2 pages of text in which problems of timing and in situ evacuation are discussed. Hypothetical and actual case studies of hurricanes are used. Numerous illustrations are included throughout the text. Appendices include Saffir/Simpson Damage-Potential Scales, chronological list of all hurricanes in the U.S. from 1900-1974, and a glossary of terms.

Findings/Comments:

(1) Migration of population to coastal area increases the potential for problems from hurricanes.

(2) Impact from storm surge greatest (9 out of 10 people who die in hurricanes are drowned), winds next and rains least. "Old" hurricanes can produce rains and therefore the potential for flooding.

(3) Threat assessment estimates depend on wind velocity peaks, height of tidal surge peaks (generally 4 meters above mean sea level) and the farthest point inland subject to possible inundation. Steps are given to develop plans.

(4) Editing of lengthy warnings from NWS by media in Hurricane Audrey in 1957 left out explicit messages to coastal residents to evacuate.

(5) Massive relocations of populations are not always possible especially in locations where existing is limited by (1) long expanses of two-lane highways, (2) highways subject to early flooding, (3) bridges and causeways, and (4) residential development that doubles or triples population on holiday weekends due to tourism.

(6) In situ evacuation procedures almost always contorted with political opposition having a wide range of motivations.

Simpson, R. H. 1980. "Will coastal residents reach safe shelter in time?" pp. 25-27 in E. J. Baker (ed.), Hurricanes and Coastal Storms. Florida Sea Grant College Report No. 33.

This paper draws attention to the problem of timing in evacuation planning. This includes the time available after warnings are received, reaction time of residents in decision-making, and the travel time involved in reaching a safe shelter. The author suggests that some provision must be made for in situ relocation including vertical evacuation. Advantages to vertical evacuation include reducing the time to reach shelter, reduction of highway problems and elimination of need for automobile transport. Disadvantages include certification of structures used for shelters, problems of security and liability, and the legal rights of individuals to refuse shelter to evacuees. The Miami proposal for in situ evacuation is given as an example.

Findings/Comments:

(1) The availability of time is crucial in determining the types of evacuation measures that can be taken by a community. Few communities have provided for the possibility of in situ accommodations including vertical evacuation.

(2) Vertical evacuation reduces evacuation time, eliminates the need for automobile transportation for evacuation and reduces highway problems.

(3) Vertical evacuation requires certification of structures and has problems of security, liability and the right of individuals to refuse shelter to potential evacuees.

Urbanik, T. 1980. "Hurricane evacuation demand and capacity estimation," pp. 32-37 in E. J. Baker (ed.), Hurricanes and Coastal Storms, Florida Sea Grant College Report No. 33.

This paper analyzes the problems of estimating the vehicular demand for hurricane evacuation and the factors for adjustment due to special conditions generated by hurricanes. The approach suggests that when available capacity is known, estimates can be made as to how soon evacuation must start to ensure that everyone has the opportunity to evacuate. Factors include demographic characteristics of the area (demographic factors), estimation of the number and types of vehicles used in evacuation (vehicle factors) and the estimation of number of residents who would leave (response factors). Capacity estimates of routes for evacuation are affected by roadway factors, traffic factors and ambient conditions including those special to hurricanes such as high winds and rain. The procedures are then applied to Galveston, Texas.

Findings/Comments:

(1) Highway capacity for hurricane evacuation planning can be estimated using the demographic characteristics of the area, the estimated number and types of vehicles per-capita in the area, and then adjusting by estimated response rate.

(2) Capacity estimates for highways must include ambient conditions of rain and high winds often associated with hurricanes prior to landfall.

USFEMA (U.S. Federal Emergency Management Agency). 1983. Preparing for Hurricanes and Coastal Flooding, A Handbook for Local Officials, Publication 50. Washington, D.C.: Federal Emergency Management Agency.

This handbook was designed to reduce impacts from hurricanes and coastal flooding. Part 1 provides overview and identifies preparedness actions including the methods involved in collecting information and evaluating appropriate measures regarding the potential hazards associated with hurricanes. Part II focuses on appropriate measures for coastal flooding with specific preparedness measures needed for hurricanes. These include keeping development from hazardous areas, promoting safe construction, protecting natural systems, protective structures and measures, relocation and pre-disaster planning from post-disaster action. Chapter 6 within this section is devoted to forecasting and warning systems, evacuation planning and promoting public awareness. Throughout the manual are examples of how specific communities have used measures. Assistance available from federal and state programs is described in Part III. Appendices provide additional information on useful information contacts from state and federal agencies.

Findings/Comments:

This is a handbook produced by FEMA to assist communities in developing actions for lessening impacts caused by hurricanes and coastal flooding. Chapter 6 focuses on forecasting and warning system, evacuation planning, and promoting public awareness.

USFEMA (U.S. Federal Emergency Management Agency). 1984. "A Guide to Hurricane Preparedness Planning for State and Local Officials," CPG 2-16. Washington, D.C.: FEMA.

This Civil Preparedness Guide (CPG) describes the scope of FEMA's Hurricane Preparedness (HP) Program and provides guidance and specific procedures to state and local governments on conducting hurricane preparedness activities. CPG 2-16 provides information to supplement (not replace) CPG 1-32, Financial Assistance Guidelines. HP is FEMA's program to foster hurricane preparedness in high-risk, high-population areas by providing financial and technical assistance to state and local officials to conduct quantitative hurricane preparedness studies. The studies are composed of two projects: (1) a population preparedness project and subsequently, (2) a property protection project, both of which are to be intergrated into the state and local Emergency Operation Plans (EOP) for natural and technological hazards as well as for nuclear attack. Projects are to be based on SLOSH models for local sites. Detailed and extensive coverage of strategies and expectations by FEMA as well as the consequences of non-preparedness in future hurricane disasters are also given.

Findings/Comments:

This publication presents strategies and reviews FEMA's guidelines for hurricane preparedness programs.

(1) An effective evacuation implementation element identifies the areas-at-risk, population-at-risk, evacuation time, the hurricane evacuation decision system, and mutual aid agreements for implementing inter-jurisdictional evacuation assistance and coordination.

Wendall, M. 1980. "Legal aspects of flood warning and evacuation," pp. 28-31 in E. J. Baker (ed.), Hurricanes and Coastal Storms, Florida Sea Grant College Report No. 33.

This paper analyzes some of the legal aspects including liability resulting from warning and evacuation procedures. To date there have been few

litigation measures resulting from disaster operations even though the government has gradually removed or limited the defense of sovereign immunity. The point of departure regarding liability is the existence of responsibility to have a program or to take action. The author notes that the public may come to justifiably rely on them as an established means of response to flood danger which may change the issues of liability.

Findings/Comments: Conceptual paper on legal aspects of warnings and evacuation procedures.

Wilkinson, K. and P. Ross. 1970. Citizens Response to Warnings of Hurricane Camille, Report No. 35. College Station, Mississippi: Mississippi State University, Social Science Research Center.

This study prepared for the National Weather Service examines citizen reactions to warnings of Hurricane Camille which hit the Mississippi coast on August 17, 1969. Although the warning system was judged effective by 84% of respondents surveyed, the major factor that influenced the decision to evacuate was how dangerously the situation was defined. Although no differences were found in demographic variables between stayers and evacuees, stayers generally underestimated the potential destructiveness of the storm. The authors posit situational and personal factors include misunderstanding warning, an erroneous idea of land elevation of homesite and past experience of less dangerous storms. "Hurricane parties" reported but not supported although there is evidence of disaster culture in "spirit of defiance" displayed by respondents. Survey instrument appended to text.

Findings/Comments:

(1) Although nearly all respondents reported knowing of storm, variations in warning message content and in persuasiveness received from media sources presented communication problems.

(2) There was serious underestimation, especially of stayers, of storm's potential danger due to situational and personal factors.

(3) Among residents is evidence of the "spirit of defiance" characteristic of disaster culture.

(4) The major difference between stayers and evacuees was how dangerously the personal situation was defined.

Windham, G. O., E. I. Posey, P. J. Ross and B. Spencer. 1977. Reactions to Storm Threat During Hurricane Eloise, Report 5. Mississippi State University, Social Science Research Center.

This study sponsored jointly by the National Weather Service and the Social Science Research Center at Mississippi State University concerns the perceptions and reactions of persons to a hurricane threat and to warnings given prior to Hurricane Eloise. The storm occurred in September 1975, in the Florida Panhandle causing extensive damage and the loss of four lives. Drawing upon data collected from Hurricane Camille and other research, the concept of the "Experience Adjustment Paradox" was formulated suggesting that hurricane experience or pseudo-experience of residents tends to discourage evacuation. Also found was a lack of understanding regarding the nature of hurricanes, particularly regarding winds and storm surge. Authors state that 90% of all hurricane deaths are from drowning. As residents' apprehension increased so did desire for information especially on an hourly basis as storm reached land even if there were no change to report. Data was collected through sample and purposive surveys. The survey instrument is appended to report.

Findings/Comments:

(1) Authors state data supports Williams (1964) conclusion that behavior of persons under threat of disaster is directly related to information received and to individual interpretation.

(2) Authors state data confirms findings of Williams (1964), Moore (1964), and Wilkinson and Ross (1970) indicating that background experience interacts with interpretations of current situation, i.e., newcomers (less than 5 years) are more likely to evacuate than those of longer residence who have adjusted through "local hurricane culture or philosophy." Stayers tended to discount threat or to stay because of concern for property or business interests.

(3) Early errors in official advisories regarding landfall of storm and conflicting messages of local business and actions groups in Panama City may have affected credibility of warnings.

(4) Definite misconceptions regarding potential damage from hurricane winds and storm surge suggest the need for the National Weather Service to continue efforts to inform residents about realities and dangers of hurricane. Knowledge about hurricane safety "rules" were not associated with evacuation behavior.

Additional information on evacuation planning for hurricanes is found in the following which have not been abstracted. When material is cited in Quarantelli, we are referring to Evacuation Behavior and Problems: Findings and Implications from the Research Literature (Quarantelli, 1980), originally issued through the Disaster Research Center, Ohio State University, Columbus, Ohio. The Center is now located at the University of Delaware.

Killian, L. 1954. "Evacuation of Panama City for Hurricane Florence." Washington, D.C.: National Academy of Science (cited in Quarantelli, 1980).

Rayner, J. 1953. "Hurricane Barbara: A Study of the Evacuation at Ocean City, Maryland, August, 1953." Washington, D.C.: Committee on Disaster Studies, National Academy of Science (cited in Quarantelli, 1980).

Ruch, C. 1965. "ESTED - A Decision Aid," paper presented at the National Hurricane Conference, New Orleans, Louisiana, April, 1985.

Schaffer, R. and E. Cook. 1972. "Human Response to Hurricane Celia" (p. 50). College Station, Texas: Environmental Quality Program, Texas A&M University (cited in Quarantelli, 1980).

Stone, J. 1983. "Hurricane Emergency Planning Estimating Evacuation Times for Non-Metropolitan Coastal Communities," UNC-SG-83-2. Raleigh, North Carolina: North Carolina State University Sea Grant College Program.

Treadwell, N. 1962. "Hurricane Carla - September 3-14, 1961" (p. 97). Office of Civil Defense Region 5. Denton, Texas: U.S. Government Printing Office (cited in Quarantelli, 1980).

TSUNAMI

Anderson, W. 1970. "Tsunami Warning in Crescent City, California and Hilo, Hawaii," in The Great Alaska Earthquake of 1964: Human Ecology, Committee on the Alaska Earthquake of the National Research Council (ed.). Washington, D.C.: National Academy of Sciences.

This study examines the response and compares the warning systems of two communities, Crescent City, California, and Hilo, Hawaii, to the tsunami threat generated by the Alaskan earthquake of 1964. Disaster warning is considered a process consisting of interrelated activities and patterns. Both communities had experienced previous tsunamis accompanied by loss of life and substantial property damages. With the aid of scientific experts, Hilo officials subsequently developed a more formalized and sophisticated routine for warning citizens including the use of public sirens, a 24-hour broadcast media capability for transmitting warnings

and a predetermined written evacuation plan. An up to date census of disabled persons is maintained with the local fire department responsible for evacuating those people during an emergency. Crescent City relies on previous warning patterns without a formalized or predetermined plan. Officials in Crescent City are highly sensitive to issuing a false alarm to citizens regarding the information available to them as ambiguous and fearing that a number of false alerts will hamper warning efforts when a real threat occurs.

Findings/Comments:

(1) Comparisons between Hilo, Hawaii, and Crescent City, California, indicate that feedback, especially from the scientific or expert community, constitutes an important factor in modifying warning systems for future tsunami threats.

(2) Tsunami warning seems more routinized in Hilo, Hawaii, than Crescent City, California, because officials in Hilo received and acted on information from several sources on methods for improving warning and evacuation procedures.

(3) The use of sirens to alert Hilo citizens to a possible tsunami emergency needs identification for exact response including when evacuation is appropriate.

Anderson, W. 1969. "Disaster Warning and Communication Processes in Two Communities," The Journal of Communication 19 (June): 92-104.

This paper examines the warning systems of two communities, Hilo, Hawaii, and Crescent City, California, which have a history of false tsunami threats and actual tsunami disasters. Disaster warning is conceived as a communicative process consisting of a number of interrelated activities and procedures in which a variety of groups, organizations and individuals become involved. Comparisons indicate that both communities rely on local officials to issue warnings and to order evacuations. Problems include lack of inadequate or ambiguous information, reliance on sources outside the community, previous experience with false alarms, and anticipating local public reaction. Once a disaster has struck, however, people are more cooperative in responding to evacuation notices. The communities differ in preparedness planning. Hilo has a written plan delegating roles and duties in an event and delimiting areas for evacuation, public sirens for evacuation notification and a 24-hour radio communication system to which citizens can turn to for information. Crescent City has none of these and relies on personal contact for evacuation. The author credits the difference in preparedness plans in Hilo to the feedback obtained from the scientific experts and others regarding the kinds of improvements needed in a tsunami disaster warning system. No such feedback occurred in Crescent City so less change was made.

Findings/Comments:

(1) People are more cooperative and respond more quickly to warnings following an actual tsunami event than when false alarms have been generated. It is easier for officials to call for another evacuation.

(2) Officials are hampered by lack of information, lack of environmental cues and consequential reliance on outside sources of information, past experience and fear of public repercussions.

(3) Hilo benefited from scientific experts and others in improving the warning system. The city now has a written plan delegating duties and identifying dangerous areas, public sirens and a 24-hour radio broadcasting system.

Bonk, W., R. Lachman and M. Tatsuoka. 1960. "A Report of Human Behavior During the Tsunami of May 23, 1960." Hilo, Hawaii: Hawaiian Academy of Science.

This report describes the response to a tsunami which struck Hilo, Hawaii, on May 22-23, 1960. Millions of dollars of damage occurred and 61 people died. A prepared questionnaire was presented to 327 adults in the affected area by interviewers with similar background and ethnicity to the subjects. About 95% of the sample reported hearing the siren warnings earlier in the evening at 8:35 p.m. but interpreted the warning differently (even the instructions in the local telephone book indicated that the siren was only an alert and did not describe expected behavioral response). On hearing the siren, 32% evacuated their homes immediately, 45% waited for further information including another warning, and 15% continued normal routines. Ambiguous communication appeared to force each person to draw their own conclusions. Of the 34 interviewees who did not understand English, 21% evacuated whereas 42% of those who spoke English evacuated. The third wave, the most destructive, struck at 1:05 a.m. on May 23 while 35% of the "waiters" slept and 64% of "waiters" were awake. Fourteen people reported that they were "sightseeing" at the wave impact. Of the 197 people in sample who did not evacuate, 57% people were pinned inside wreckage and 25% were injured, pointing to the necessity of complete evacuation following a tsunami warning. Recommendations for improvement of tsunami warnings include vigorous sustained public education programs that are also presented at time of emergency through media, delineation of danger zones and the adoption of emergency vehicles to evacuate those incapable of leaving themselves.

Findings/Comments:

(1) The public must have continued exposure to the meaning of sirens and that appropriate behavioral response is evacuation to high ground.

If response is small, officals have the responsibility to vigorously warn all those in designated tsunami danger zones.

(2) Ambiguous communication through media including insensitivity to language barriers suggests that sources of information should be centralized and given in several languages if appropriate.

Haas, J. and P. Trainer. 1974. "Effectiveness of the tsunami warning system in selected coastal towns in Alaska." Rome: Proceedings of the Fifth World Conference on Earthquake Engineering.

A tragic earthquake and the resulting tsunami in March, 1964, prompted the formation of the Alaska Regional Tsunami Warning System. This paper discusses the problems associated with the prediction and dissemination of warnings and the difficulty in educating coastal residents about the tsunami hazard and the warning system. A typology of tsunami events is suggested using a combination of the speed of onset and the physical cues. Problems with transmission of tsunami messages including timing, initial validation and linkages are discussed in connection with evacuation. Three different tsunami pilot education programs in Kodiak, Homer, and Seward with the community of Sitka used as control were tested for their effectiveness. The response to a tsunami evacuation in Sitka occurring on Sunday, July 30, 1972, is also reported.

Findings from educational pilot studies:

(1) Evidence from the pilot studies suggests that intensive short-term public education efforts offer little hope in reducing potential losses of life and property in tsunamis.

(2) None of the programs had any significant effect on residents' knowledge of tsunamis, how they felt regarding the reliability of the warning system, or in their expressed intended behavior. The only significant increase occurred in the perceptions regarding the severity of the tsunami hazard within the two educational programs using the personal contact approach and the media.

Findings from the Sitka evacuation study:

(1) About 58% of respondents thought of a possibility of tsunami after feeling the earthquake, 18% learned of threat via radio, 14% through face-to-face contact, only two through loudspeakers on cruising police vehicles.

(2) After learning of the possibility of a tsunami (first actions taken) 23% evacuated promptly, 26% continued their normal activities, others sought additional information, waited to contact family members, or began preparing for possibility of evacuation.

(3) About 82% of households contained families of which half were separated at some time before their evacuation was completed.

(4) About 50% of respondents recalled verbal message calling for immediate evacuation, 50% remembered safe areas as being identified. Only a few recalled other types of basic information as being given.

(5) About 82% reported they did not check on accuracy of initial warning.

(6) Within families either immediate or eventual consensus regarding evacuation was reached. In only 5% of cases were families divided at onset.

(7) About two-thirds of those evacuating took time to collect items including pets. These included clothing, blankets, food, water, and personal possessions.

(8) Of those evacuating, 61% left directly and stayed until all clear message received. The rest engaged in such actions such as leaving from some other place but stopping by home before final evacuation, leaving a safe place to check on relatives or returning home and then going back to a safe place.

(9) About 50% of leavers indicated one or more things they would do differently next time in the event of a tsunami warning. Intention to act faster was given by 66% of the evacuees.

(10) Comparisons to "what would you do if" question previously asked in pilot program indicated that fewer Sitkans took time to collect items than said they would (80% to 68%) and separated families did attempt to contact each other as had been predicted by intentions.

Lachman, R., M. Tatsuoka and W. Bonk. 1961. "Human Behavior During the Tsunami of May, 1960," Science 133 (May 5): 1405-1409.

This study reports the results of a quasi-random study examining the consequences of an ambiguous warning system to the residents of Hilo, Hawaii, during a tsunami threat in May, 1960. Although warned by sirens more than four hours prior to impact as well as by the media, 61 people were killed, several hundred injured and an estimated 500 homes destroyed. Adaptive behavior in form of evacuating was not related to amount of education and only slightly related to other disaster experience.

Findings/Comments:

(1) Formal education is not a determinant of whether or not an individual shows adaptive behavior in the form of evacuating or staying awake during a tsunami emergency situation.

(2) Prior disaster experience has a minor role and only increases slightly the probability of adaptive behavior in subsequent emergencies.

(3) The tidal-wave warning siren sounded for a 20-minute period more than four hours prior to impact but only 40% of sample reported evacuating.

(4) Fourteen individuals or 4.3% of sample reported they were at shoreline at time of impact waiting to see wave.

(5) Among group who did not evacuate, 57% were trapped in wreckage and 23% were injured. Six of individuals trapped in wreckage and three who were injured had returned to homes after evacuating or who evacuated to unsafe area.

Yutzy, D. 1964. "Aesop 1964: Contingencies affecting the issuing of public disaster warnings at Crescent City, California." Research Note #4. Columbus, Ohio: Disaster Research Center, Ohio State University.

This paper describes the behavior of official organizations after notification that a possible tsunami threatened their community. Actions taken were similar to those in previous alerts in which no tsunami was generated. Following a second bulletin that a tsunami could be expected to hit, deputies were sent door-to-door warning people that a seismic wave was expected but no formal evacuation was ordered. Not until three waves had hit the town was a general public alarm sounded. Eleven people died and 15-20 were reported missing. Extensive damage affected 29 city blocks. The decision not to order an evacuation sooner was credited to ambiguity of information. This suggested that the tidal wave was only probable and limited the release of information regarding the size of wave and prompted seemingly contradictory information regarding the wave passage. Less tangible factors include prior experiences of false evacuation that resulted in ridicule and repercussions from the public. The author notes that "implementation does not occur in a social vacuum but in context of past, present and future social relationships" (pg. 7).

Findings/Comments:

(1) Limited, ambiguous, and contradictory information led to reticence to issue evacuation orders.

(2) Drastic action taken too many times limits effectiveness and leads to repercussions from public.

Additional information on evacuation planning for a tsunami is found in the following which have not been abstracted. When material is cited in Quarantelli, we are referring to Evacuation Behavior and Problems: Findings and Implications from the Research Literature (Quarantelli, 1980), originally issued through the Disaster Research Center, Ohio State University, Columbus, Ohio. The Center is now located at the University of Delaware.

Anderson, W. 1966. "Seismic Sea Wave Warning in Crescent City, California and Hilo, Hawaii," Working Paper No. 11. Columbus, Ohio: Disaster Research Center, Ohio State University (cited in Quarantelli, 1980).

Anderson, W. 1965. "Crescent City revisited: a comparison of public warning procedures used in the 1964 and 1965 emergencies," Research Note No. 11. Columbus, Ohio: Disaster Research Center, Ohio State University (cited in Quarantelli, 1980).

Weller, J. 1967. "Response to Tsunami Warnings: The March, 1964 Prince Williams Sound Earthquake," Working Paper No. 15. Columbus, Ohio: Disaster Research Center, Ohio State University (cited by Quarantelli, 1980).

VOLCANOES

Foxworthy, B. and M. Hill. 1982. "Volcanic Eruptions of 1980 at Mt. St. Helens, The First 100 Days," Geological Survey Professional Paper 1249. Washington: United State Government Printing Office.

This report details in chronological order the seismic activities of Mt. St. Helens from March 20 to June 27 including the awesome May 18 eruption. Noted are the geologic studies of Crandell and Mullineaux that led to deliniation of the hazard zones. Also detailed are the number and types of people that were evacuated after the March 27th eruption plus the additional and frustrating problems of keeping people out of the evacuated areas until the May 18th eruption occurred. Convincing the public including the loggers of the potential hazard as the volcano continued to simmer was almost impossible for officials. Written like an evening journal, the report contains personal accounts and numerous photographs, making the technical information highly

readable. A fascinating account for those interested in volcanoes especially the problems associated with the public and media convergence for such a rare event.

Findings/Comments:

This is a descriptive report of the Mt. St. Helens events recording both geologic events and personal observations.

(1) In spite of earthquakes and news reports, some residents refused to believe eruption possible, some with fatal results later.

(2) Sightseerers jammed possible evacuation routes with their vehicles and tried to evade road blocks to a get closer view of volcano.

(3) Although USFS officials closed off areas above 4,400 feet, both press and public continued to penetrate evacuated areas.

Greene, M., R. Perry and M. Lindell. 1981. "The March 1980 Eruptions of Mt. St. Helens: Citizen Perceptions of Volcano Threat," Disasters 5 (1): 49-66.

This report explores the role of warning belief, perceived personal risk, sources of information, and individuals' adaptive plans (including evacuation) following detection of seismic activity of Mt. St. Helens in March, 1981. Six communities within a 40-mile radius of Mt. St. Helens were divided into three subsamples according to geographic proximity to the volcano. Sampling via telephone, a survey was used to determine citizen's perception of risk and willingness to evacuate. Citizen awareness of threat appeared variable and not many fully appreciated danger prior to the eruption. When awareness increased, people experienced difficulty in identifying specific threats often specifying risks they were familiar with, i.e., floods. Data suggest that dissemination of information during a short period of imminent threat (generally via media) sensitized people even though many claimed not to have taken any protective action against the threat.

Findings/Comments:

(1) Before the eruption, the public viewed an eruption as a low probability event. After the eruption, determination of specific threats was related to known threats.

(2) Data suggests that intensive dissemination of information by media sensitized the population, but did not result in protective actions other than preparation for evacuation.

(3) Ninety percent of respondents in each sample received information on volcano activities at Mt. St. Helen twice a day or more frequently.

(4) The greater the distance from the volcano the less likely respondents were to make plans for a safe place to evacuate.

Hodge, D., V. Sharp and M. Marts. 1979. "Contemporary Responses to Volcanism: Case Studies from the Cascades and Hawaii," pp. 221-248 in P. D. Sheets and D. K. Grayson (eds.), Volcanic Activity and Human Ecology. New York, New York: Academic Press.

This study examines the attitudes and perceptions of people in two areas affected by volcanoes: Hawaii and the Cascades. Data suggests that age and experience resulted in a greater skepticism of occurrence of volcanoes in the Cascades. Protective steps taken by the Forest Service were unpopular. Ethnicity and inadequacy of communication affected were responses of some segments of the Hawaiian population. Decisions varied with ethnic group as to fatalism or belief in governmental actions. Organizations responsible for land management in either area have not developed operating procedures for volcanic threats. The authors suggest that hazards should be viewed as both a community and official problem with educational programs designed to elicit community support when evacuation or closure is necessary. Otherwise, stimulating people to respond to next ambiguous threat will be even more difficult.

Findings/Comments:

(1) Ethnicity affects response to volcanic threat probably through inadequacy of communication, degree of fatalism or belief in governmental actions.

(2) Experience and/or age results in skepticism of occurrence of volcanic threat.

(3) Amount of tolerance for official actions may be less in future evacuations or closures because of ambiguity regarding potential volcanic threat (Note: This is 1979 article prior to Mt. St. Helens eruption).

(4) In the Cascades, people prefer individual coping not governmental actions which are not feasible given current legal arguments regarding protection of individuals on federal lands.

Lachman, R. and W. Bonk. 1960. "Behavior and Beliefs During the Recent Volcanic Eruption at Kapoho," Science 133: 1405-09.

The volcanic eruption on January 13, 1960, after a five-year hiatus, resulted in 250 people evacuating the village of Kapoho on the Big Island

of Hawaii, prior to and during the first night of eruption. Observations were made concerning "security seeking" behavior and the relationship to other variables such as ethnicity, degree of acculturation, education level, and previous experience under stress. Belief in the volcanic goddess Pele was openly acknowledged by many of evacuees. Rituals and offerings were made to volcanic goddess Pele regardless of ethnic group, creed, age level or educational attainment.

Findings/Comments:

(1) "Security-seeking" behavior was not related to ethnicity, age, creed or education in behavior observed during eruption of Hawaiian volcano.

Leik, R. K., S. A. Leik, K. Ekker and G. A. Gifford. 1982. Under the Threat of Mt. St. Helens: A Study of Chronic Family Stress. Minneapolis, Minnesota: Family Study Center, University of Minnesota.

This report presents the results of a study of individual and family stress due to the Mt. St. Helens volcanic eruptions. Sampling was conducted in three sites and one control site in Washington State using telephone surveys and in-depth family interviews. Only one site, Longview-Kelso was examined in detail. Following family interviews, members participated in a simulation experiment involving a worsening condition of Mt. St. Helens. Although data indicated considerable stress, few families evacuated during eruption and almost none seriously considered moving away from volcano's threat. Effects show consistent relationship with distance from volcano. Seven policy recommendations are made.

Findings/Comments:

(1) The May 18 volcanic eruption created considerable stress especially for those near the mountain. Stress levels and coping behaviors change consistently given distance gradient from volcano.

(2) Data indicates few families interviewed evacuated and few if none considered seriously moving from volcano threat. Thus residents will continue to live there and remain apprehensive about mountain.

(3) Experimental simulations appeared correlated with actual family decisions and actions regarding Mt. St. Helens. The simulations and interviews appeared to have opened up discussion among family members and friends.

(4) Caseloads at mental health clinics did not show additional increase but hospital emergency room visits showed notable increase following eruption. The authors suggest public mental health clinics not geared to viewing stress as a collective problem and therefore cannot be handled by the usual structure.

Perry, R. W. and M. R. Greene. 1983. Citizen Response to Volcanic Eruptions: The Case of Mount St. Helens. New York: Irvington Publishers, Inc.

This book presents the results of a year-long study of citizen response to the volcanic action of Mt. St. Helens. Two separate studies are described. The first study, conducted in April, 1980, analyzed citizen perceptions of volcanic risk after the volcano had resumed activity in March. The second is a large-scale study after the May 19 eruption. In this case, three towns comprising two communities differing in proximity to the volcano, Toutle/Silverlake and the Woodland, are analyzed. Data indicates that most of the citizens perceived no threat from Mt. St. Helens prior to its eruption nor had they taken any protective action other than arranging for evacuation. Evacuation is discussed in terms of adaptive response decision-making, focusing on warning belief, perceived personal risk, adaptive plan and family context in warning response. Evacuee destinations and mode of transportation data support prior findings of going to kin (46.2%) or friends (29.5%) and using the family vehicle (95%) in Toutle/Silverlake communities where 87.8% of respondents evacuated. In Woodland, 16.9% evacuated of whom 80% (or 12 of the 15) reported that they were called by friend or relative offering shelter to where they subsequently evacuated. Suggestions for enhancing protective actions via dissemination of specific information are included in the policy analysis.

Findings for Toutle/Silverlake:

(1) A high level of warning belief probably occurs because of environmental cues. About 34% respondents made no attempt to confirm the warning. Of those who did not, 77.4% rated warning belief as high and 16.1% as moderate.

(2) Data supports the argument that as level of personal risk increases so does likelihood of evacuation with 87.8% of respondents evacuating in the Toutle/Silverlake communities.

(3) The most frequently cited reason for evacuating was seeing eruption (29.1%), next, by officials urging departure (26.6%), followed by relatives urging departure (20.3%).

(4) Destinations were to kin (46.2%) or friends (29.5%) using a family vehicle (95%).

Findings for Woodland:

(1) When warning belief was high, 46.4% evacuated compared to 22.3% of those whose warning belief was low or moderate. Only 16.9% evacuated of whom 80% (or 12 of the 15) reported being offered shelter by kin or friend which they accepted.

(2) When risk is perceived to be low virtually no one made preparations to evacuate (pg. 100) but protective actions were undertaken by half of those who perceived risk as low. When personal risk was perceived as high, no matter what the level of warning belief, almost everyone made preparations to evacuate (pg. 101).

Findings for both Toutle/Silverlake and Woodland:

(1) Level of warning belief is positively correlated with level of perceived personal risk (pg. 101).

(2) Taken alone, both personal risk and warning belief are positively correlated with warning response (pg. 101).

(3) Personal risk bears a stronger positive relationship to warning response, because when the effects of risk are controlled, the magnitude of the relationship between belief and response declines (pg. 101).

Perry, R. W., M. K. Lindell and M. R. Greene. 1983. "Threat Perception and Public Response to Volcano Threat," The Journal of Social Psychology 116: 199-204.

This paper examines perceptions of threat posed by Mt. St. Helens volcano in Washington State prior to eruption after 123-year dormancy and before the governor's emergency declaration. Level of perceived risk, sources and frequency of receipt of information and degree of confidence regarding information are examined. Janis and Mann's (1977) conflict model of decision making is used for analysis of response to warnings of impending danger. Data were collected during week of April 5-7, 1980. Authors conclude it is not possible to determine if continued monitoring of information instead of evacuations or taking other protective action was a form of defensive avoidance.

Findings/Comments:

(1) Although three sampled sites were of varying distance from the volcano, relatively uniform effects were found resident in terms of perception of threat, in frequency and sources of information, and in the level of confidence about protective actions.

(2) High levels of perceived threat were associated with similarly high frequency of information receipt and with confidence in information received; only 10% of total sample reported hearing information on volcano as infrequently as once a day.

(3) Mass media dominated as source of information: 98% mentioned TV, 91% cited newspapers and 87% cited radio. 70% reported getting information from friends or relatives and only 21% had received information through direct contact with state, local, or county officials).

(4) Results indicate a "vigilance dominant decision pattern" consistent with the Janis/Mann model. The high level of perceived threat indicates that residents considered consequences would be serious if the volcanic eruption occurred.

Saarinen, T. and J. Sell. 1985. Warning and Response to the Mt. St. Helens Eruption. Albany, New York: SUNY Press.

The 123-year dormancy period for Mt. St. Helens when it erupted on March 28, 1980. Continuing seismic activity, the largest and most destructive eruption occurred on May 18 when a cubic mile of the mountain summit was blown away. Based on interviews with 130 officials of government, private industry and volunteer organizations, this book examines the initial response to warnings about the volcanic eruption by the various actors as well as the mitigative measures taken in planning for and dealing with this major disaster. The discussions in each chapter reveal the problems encountered from the scientific aspect of the United States Geological Survey (USGS) viewpoint, the United States Forest Service's (USFS) and the conflicts engendered between federal, military, state and local officials assigned to cope with the unexpected problem. Attention by the media and the public remained high with many attempts to circumvent roadblocks and enter restricted zones. Although the interpretation and flow of information regarding the hazard and the secondary threats such as mudslides, ash and floods appeared adequate, people remained unconvinced of the potential threats and did not evacuate. As a result, 60 lives were lost in the May 18 eruption including some media representatives and loggers. Recommendations for planning of future threats are given. The appendices contain a list of agencies interviewed and the survey instrument.

Findings/Comments:

(1) Those agencies with considerable hazard experience were more likely to have acted in response to warnings and were more active in emergency plan development.

(2) 45% of respondents received first warning through official channels with the rest hearing through news and other informational sources.

(3) Those receiving information through official channels were more likely to be involved in pre-May 18 activity and plan development.

(4) News media were documented as first warning source (42%); 59% of local government officials received news reports as first warning.

(5) Nearly three-fourths of organizations first notified by USGS did something, while most of those whose information came through other channels did nothing.

(6) Both the USGS hazard watch and the Blue Book were significantly associated with action in warning period and pre-eruption planning prior to the May 18 eruption.

(7) Problems with news media particularly at the national level included interference with emergency activities, violation of the Red Zone, distortion of information in news reports and transmission of rumors without verification.

(8) The most beneficial action in reducing casualties taken during the warning period was felt to be the USFS establishment of permanently evacuated areas and restriction of access to other districts even if closure was difficult to enforce.

Sorensen, J. H. 1981. "Emergency Response to Mt. St. Helens' Eruption: March 20 to April 10, 1980," Working Paper 43. Boulder, Colorado: Institute of Behavioral Science, University of Colorado.

This paper reports the behavior and methods of officials and individuals regarding the estimation of risks of the eruption and potential damages from Mt. St. Helens' volcano in Washington. The paper identifies the key actors and organizations in the response to the threat, traces the information flow among actors and from them to the public. The analysis indicates persistent problems faced by emergency personnel and how affected parties perceived and estimated the risks from a future eruption.

Findings/Comments:

(1) The U.S. Forest Service's strong response to impending eruption facilitated a coordinated response due to their previous organizational experience with fighting fires.

(2) Most state and local agencies poorly prepared for eruption.

(3) Distinct segregation between federal and state/local organizations was observed.

(4) As eruption progressed organizations better prepared to handle effects. Had the most serious eruption occurred at beginning of seismic activities many more disruptive effects and deaths would probably have occurred.

(5) Rumor was a minor problem but media was seen by officials as a fairly major problem.

(6) Local efforts hampered by lack of definitive and understandable information regarding volcanic risks. Information seen as "pacifier" (pg. 33) as little expertise existed among officials regarding the interpretation of data.

(7) Most officials did not perceive eruption as likely or possible.

Sorensen, J. H. and P. J. Gersmehl. 1980. "Volcano Hazard Warning System: Persistence and Transferability," Environmental Management 4(2): 125-36.

This study examines the normative functioning of the volcano warning system on the island of Hawaii. Noting the strong social ties that exist among the residents living under the active threat of the volcanoes, the research seeks to identify the combination of factors both socially and environmentally that have contributed to the efficiently run warning system. Conditions that have contributed include an off-limits emergency operations center using a single spokesperson for each subsystem, a card file system for all community associations which aids evacuation and emergency efforts, and careful post-event analysis of emergency plans after every performance. Authors note that transfer of warning system to another hazard would probably only work in a low-populated rural area with a slow moving hazard. With frequent experience, the credibility of key personnel rather than organizational infrastructure and structure of existing community social networks apparently play key roles in shaping an efficient response in Hawaii. Thus, implementation in other areas would need policies that fit local social structures to be transferable.

Findings/Comments:

(1) An off-limits EMO reduces confusion and helps eliminate conflict.

(2) A single spokesperson for each subsystem reduces conflicting information, gives greater credibilty to subsystem information flows and reduces rumors.

(3) Card file system of community association members aids evacuation and emergency efforts.

(4) Careful post-analysis of warning system results in plans and procedures to ameliorate problems every time system used.

(5) Thus experience with hazard, credibilty of key personnel rather than organizational infrastructure, and knowledge of social structure play key roles in environmental management procedures in Hawaii.

OTHER HAZARDS

Diggory, J. C. 1956. "Some Consequences of Proximity to a Disease Threat," Sociometry 19 (March): 47-53.

In March 1952, an outbreak of rabies among wild foxes occurred in a large but well circumscribed area in Eastern Pennsylvania presented the opportunity to study the effects of proximity to threat. On the assumption that threat situations depends on the value of threatened objects and their loss, 3000 interviews were conducted at varying distances from the focus of outbreak. The results show that the greater the proximity to the threat: (a) the larger the number of sources of information used, (b) the higher the incidence of word-of-mouth communication, (c) the smaller the tendency to overestimate the magnitude of threat, (d) the more frequent the reports of anxiety, and (e) the more frequent the changes in behavior occasioned by the threat. Behavior changes were significantly correlated to anxiety level regardless of proximity. In low proximity areas, behavior was associated with sources of information. In remote areas, notions of exaggerated threat was associated with a false idea of nearness of threat. No evacuation occurred no matter how high the threat was perceived.

Findings/Comments:

(1) Increasing with proximity to threat were: (a) number of sources of information used, (b) incidence of word-of-mouth communication, (c) anxiety, and (d) threat-oriented behavior.

(2) Decreasing proximity to threat was associated with (a) overestimation of threat to humans, (b) correlation between overestimation of danger and of its proximity, and (c) correlation between number of sources of information and behavior.

Hart, G., L. Escalante, W. Petak, C. Pinkham, E. Schwartz, M. Wurtele. 1985. "The Los Angeles, California Tornado of March 1, 1983." Washington, D.C.: National Academy Press.

On March 1, 1983, between 7:40 and 8:05, a surprise tornado caused damage of intensity F2 on the Fujita scale in Los Angeles, California. Due to lack of historical records in the area regarding tornadoes and the absence of the typical meteorological events preceding a midwestern tornado the National Weather Service never issued either a tornado watch or a warning. This report summarizes the meteorological circumstances and the observed structural damage to buildings and lifelines in the 3-3/4 mile by 1/3 mile area affected by the tornado. The emergency preparations in the City of Los Angeles to cope with other types of

expected disasters enhanced the city's ability to handle problems associated with the tornado. The city had activated an EOC at 5:00 p.m. as standard procedure the previous day in anticipation of storm-related problems from predicted heavy rainfall. Fifty homes and seven businesses were destroyed, 58 homes and 82 businesses damaged, 100 people made homeless and 32 people were injured. Estimated damages to public sector were $4 million with another estimated $11 million in damaged homes and private businesses. The Red Cross sheltered 188 evacuees. The broadcast media continued to report looting even when informed to the contrary by police that no looting had occurred. Disaster assistance was immediately made available through Community Redevelopment Agency (CRA) and the Community Development Department (CDD) by the Mayor and the City Council thus permitting interiors of buildings to be protected from further water damage and decreasing overall losses.

Findings/Comments:

This technical report of the Los Angeles tornado incorporates a discussion of emergency response to the event in addition to describing the meteorological and assessing the structural damage to buildings and lifelines.

(1) The emergency preparations undertaken by the City of Los Angeles to mitigate against expected disasters significantly enhanced the city's abililty to handle a tornado, a completely unexpected event in California.

(2) Immediate provision of disaster funds by Mayor and City Council permitted interiors of buildings to be protected from further damage and decreased overall property losses.

Neal, D. M., J. B. Perry and R. Hawkins. 1982. "Getting Ready for Blizzards-Preparation Levels for Winter of 1977-1978," Sociological Focus 15 (January): 67-76.

This article discusses preparations for blizzard conditions by respondents of Wood County, Ohio, in 1977-78 based on a mailed questionnaire. Preparations were higher than expected; 53.3% of those who received warnings (72.2% heard about blizzard before it began) responded by obtaining additional food and extra water supplies but did not plan any additional preparation for the winter of 1978-79. The respondents had a reasonably clear understanding of their actual situations of preparedness; those that felt unprepared were realistic concerning their situation. Further examination of the theory of "bounded rationality" to determine conditions under which it is most useful is suggested. No intention to evacuate were expressed.

Findings/Comments:

(1) Only 72.2% of respondents heard about the blizzard before it struck with 53.3% of those making additional preparations for the storm. Evacuation was not a precautionary action.

(2) Data suggests respondents were better prepared than might be expected and that they had a clear understanding of what their condition of preparedness actually was. Preparation plans for approaching winter were modest with only low-cost supplies being considered.

Sims, J. H. and D. D. Baumann. 1972. "The Tornado Threat: Coping Styles of the North and South," Science 176: 1386-92.

The authors argue that tornado death rates in Illinois and Alabama may be related to the psychology of individual residents. Compared nationally, the disproportionately higher frequency of tornado-caused deaths in the south cannot be explained by intensity or frequency of events, by a larger population at risk, by time of occurrence, or by environmental variation such as housing-type, or by variance in quality of warning systems. Rather it appears that the psychological dimension of internal versus external locus of control is responsible for the variation to response to tornado threat. Data was gained through a 15-sentence completion test administered to 57 respondents (white females between the ages of 31 and 60) in eight counties of the two states. Statistically significant differences were found in completions to eight of the tests that deal with autonomy. This implies that people with external locus-of-control are less likely to take protective action such as evacuation.

Findings/Comments:

(1) Three of eight questions dealing with internal/external locus of control are significantly different between Illinoisans and Alabamans; Southerners place more weight than Northerners on a force external to themselves (e.g., God) as causal agent. Northerners view themselves as responsible for directing own lives and more confident in their own efficaciousness.

(2) Illinoisan and Alabaman respondents differ in preferred mode of informing themselves, i.e., Northerners place more trust in technological expertise than Southerners who favor using own senses to inform themselves on how crisis is progressing.

Taylor, J. B., L. A. Zurcher and W. H. Key. 1970. Tornado: A Community Responds to Disaster. Seattle: University of Washington Press.

On June 8, 1966, at 7:12 p.m., a tornado touched down in Topeka, Kansas, leaving 17 dead, 500 injured, 1600 homeless and causing $100 million worth of damage. The tornado left a four-block wide by 8-mile long swath of destruction. Taking a pyscho-scoiological approach, this book describes the events and behavior of victims and non-victims for a period of eight days following the disaster by looking at the disaster response as a particular kind of collective behavior. The authors were a team of professionals on the staff of the Menninger Foundation who themselves witnessed the storm. The book provides a systemic, interdisciplinary and multilevel analysis of individual and group reactions under stress as taken from observations, interviews, diaries, and medical records. The research is, thus, personalistic and case oriented. Included are influences of and to the social agencies and institutions involved in recovery including the city government. A series of sirens sounded warnings along with radio messages. People took shelter in spite of their disbelief. This was first tornado to hit the city although watches had been issued frequently. Panic was rare. Noise of approaching storm was tremendous with the sky reported as being dull yellow grey and raining. After the storm passed, a period of unhealthy calm was noted. Mass convergence of help and tourists to the area resulted in fish-bowl effect for residents. Some looting was reported. Authors suggest that spectators are tourists of disaster. Red Cross was severely criticized for bureaucratic actions and general ineffectiveness. Description of social change that occurred is also given.

Findings:

(1) No panic, although some looting and long-term psychological effects from the disaster were recorded.

(2) Enormous amount of convergence behavior was noted following event.

(3) People took refuge and evacuated temporarily when warned by sirens and radio "in spite of disbelief" that the storm would hit Topeka.

Wallace, A. F. 1956. "Tornado in Worcester," National Academy of Sciences/National Research Council Disaster Study #3. Washington, D.C.: National Academy of Sciences.

This early report of an unexpected tornado which struck Worcester, Massachusetts, shortly after 5:00 p.m. on June 9, 1953, describes behavior during and following impact. Wallace notes that the disaster-syndrome affected persons in the impact area whether they were injured or

not. This caused them to act differently than other victims, with infantile obedience and docility followed by altruistic behavior. The counter-disaster syndrome was exhibited by those in the filter areas from which most of the initial manpower for rescue and evacuation arrived. Evacuation of people following the disaster was effective. Although hospitals were unprepared for the mass of injured, the influx of hospital personnel was more than enough to cope with problems. Of 2000 families evacuated, only 57 used Red Cross shelters initially, with 6000 people being fed the first night. From then on mobile units catered to emergency workers. Wallace posits that the "cornucopia theory" was responsible for the fact that a year later almost complete rehabilitation had taken place. Had a warning been given prior to impact, he suggests that many of the 66 lives would not have been lost. Most of credit should be given to emergency personnel of police, fire and utility units.

Findings/Comments:

(1) Disaster-syndrome affected those in the impact area whether injured or not; counter-disaster syndrome exhibited by those in filter areas following period of "isolation."

(2) Evacuation following disaster was effective but hospitals were unprepared and massive traffic jams occurred in filter areas and around hospital entrances.

(3) Cornucopia-theory assumes outside help is available and made possible successful rehabilitation of the community; Wallace questions whether this aid would be available following an atomic attack.

HUMAN INDUCED HAZARDS

HAZARDOUS MATERIALS

Burton, I. 1981. The Mississauga Evacuation Final Report. Toronto: Institute for Environmental Studies, University of Toronto.

This detailed report describes the December 10, 1979, train derailment and events following the accident, the response of government, organizations and the public, and the social and economic impacts of the evacuation. In addition, it analyzes the implications for emergency planning and hazard management. It is based on six surveys of the public and businesses, semi-structured interviews with key actors and members of the public representing a special group of responders (e.g., handicapped), and reports and transcripts concerning the accident. Overall the report presents a very detailed and concise account of the evacuation.

Major Findings

(1) The average cost of the evacuation to households was $220 plus $90 in lost wages (total $16.5 million).

(2) Businesses lost about $50 million.

(3) People experienced both negative and positive impacts from the evacuation experience.

(4) The major negative impact cited was inconvenience (28%) expressed in long-term anxiety due to the accident (11%).

(5) Organizational response was successful despite minor problems of communications, lack of timely technical information, and difficulty in establishing shelters.

(6) Perimeter control of evacuated areas was difficult to maintain.

(7) Warning instructions concerning expected duration of evacuation and what necessary personal items to take with evacuees were lacking.

(8) Health care provisions for evacuees was subject to problems including locating personal physicians, and gaining access to medical records.

(9) Compensation for evacuation costs was somewhat confused and inequitable.

(10) Reentry guidelines following evacuation were deficient.

(11) People evacuated rapidly (50% < 30 min.; 80% < 60 min. and 60% < 15 min.) from high risk areas following personal notification.

(12) People voluntarily evacuated outside official areas.

(13) Lack of guidelines and plans to deal with the evacuation of pets was a problem in that people attempted to return to feed or recover animals.

Cashman, J. 1983. Hazardous Materials Emergencies, Response and Control. Lancaster, PA: Technomic Publishing Company

This comprehensive book covers the response efforts of both private and public sectors to hazardous material emergencies. The material is oriented to team personnel that are involved in the clean-up and disposal of materials from accidents. Saturated with antedotes and case histories the chapters present a wealth of data for the control, containment and clean-up as well as discussing the problems involved in the disposal of spilled materials ranging from chemical mixtures to radioactive contaminations. Information regarding crowd control, actions and equipment needed to protect both individuals involved as well as the public at large, and the alleviation of public concern are interspersed throughout the volume. Evacuation issues are illustrated with a detailed account of the Mississauga, Ontario, incident in which the Peel Regional Police Force evacuated 217,000 persons for six days. The last chapter is devoted to a listing of specific publications used for reference and training of personnel involved in hazardous materials response.

Findings/Comments:

This book containing much descriptive information can be used as a reference work regarding hazardous materials ranging from chemical spills to radioactive emergencies.

DePol, D. and P. Chercmisinoff. 1984. Emergency Response to Hazardous Materials Incidents. Lancaster, Pennsylvania: Technomic, Inc.

This book is intended as a guide to those involved in handling emergency responses to hazardous materials incidents. In particular, the problems which occur when a hazardous material is accidentally released either through a transportation accident, process upset, fire or explosion. Topics covered include legal responsibility and liability, contingency planning and the response process. Methods for identifying and evaluating hazardous materials and the potential consequences are included with a separate section on evacuation procedures - when, where and for how long. Appendices include the EPA list of hazardous materials, reportable quantities and definitions of terms as abstracted from the Code of Federal Regulations.

Findings/Comments:

This book is intended as a reference for handling accidents due to hazardous materials but is appropriate for all emergency management personnel.

Fowlkes, M. and P. Miller. 1982. "Love Canal: The Social Construction of Disaster." Washington, D.C.: Federal Emergency Management Agency.

This study examines the behavioral response to the toxic waste disaster at Love Canal, Niagara Falls, New York. Data was obtained from 63 in-depth interviews of a primarily random sample of homeowners both permanently evacuated (relocated) and remaining in the Love Canal area. Analysis centers on the relevance of the self-reported family health experiences and demographic factors for shaping resident perceptions of "what happened" at Love Canal. The ambiguity and uncertainty of the seriousness of the chemical migration is discussed with reference to their contributions to the general resident distrust toward officials and expert actors in their unwillingness to afford legitimacy to the problem. Recommendations for future emergency management of such incidents conclude the text.

Findings/Comments:

(1) Beliefs concerning the magnitude of chemical migration were highly correlated with age and the presence of dependent children.

(2) Social structural factors and the desire for evidence influenced both the access and attentiveness to information and perceptions of the relevance of that information.

(3) The quality of the family health experience and the degree to which that was accommodated within the traditional medical paradigms relate to differing beliefs regarding chemical migration and the attendant risks.

(4) Problems of competence, credibility and communications led to mistrust of the government during relocation process.

Gray, Jane. 1981. "Characteristic Patterns of and Variations in Community Response to Acute Chemical Emergencies," Journal of Hazardous Materials 4:357-365.

This paper presents initial findings from the Ohio State Disaster Research Center's investigation of community response to chemical emergencies. Overall it discusses issues associated with first responders and problems in defining the threat, and the issues of convergence and, finally, outflow. General conclusions are that communication linkages need to be improved, initial responders need training, better coordination of responding agencies is weak, warnings require better information, and medical treatment needs to be improved. The article also addresses several specific conclusions about evacuation.

Findings/Comments:

(1) Evacuation usually results from word-of-mouth communications from first responders or neighbors.

(2) Mass media rarely play a role in evacuation warning dissemination.

(3) Evacuation warning messages are often incomplete and vague.

(4) Notices to evacuees to return are generally not well handled.

Gray, Jane. 1981. "Three Case Studies of Organized Response to Chemical Disasters," Misc. Report No. 29. Columbus: Disaster Research Center, Ohio State University.

This report systematically describes and analyzes emergency response to three chemical disasters. The first was an explosion and fire in a truck carrying phosphorous in an urban area. The second involved an explosion in a chemical plant in a metropolitan area which released methyl parathion fumes. The third involved a derailment of train cars carrying dangerous chemicals including chlorine in an industrial/suburban area. Each event is described as to the nature of the event, the community characteristics, type of disaster preparedness, emergency resources, organized response, and an evaluation of response. Evacuation occurred at each site and varied as to scope and timing. Relevant information by case include:

Case 1: Few problems were encountered in evacuating people within one block of the accident (total of 100). This was done door-by-door by police.

Case 2: One and one-half hours after an explosion, a public announcement for evacuation was made. After several more decisions to evacuate additional areas, a total of about 3,000 people left a five-square mile area. People were initially warned to evacuate by speakers on helicopter and police cars, and by friends and neighbors.

Case 3: This was the "Mississauga Evacuation" involving 217,000 evacuated in 13 "waves" as well as the evacuation of four hospitals and six nursing homes.

Findings

Case 1:
1. The small evacuation did not pose any difficulties.

Case 2:
1. Confusion about how many and how far to evacuate led to delays.
2. Evacuation orders broadcast from helicopters and patrol cars did not reach people.
3. Warning messages were not clearly understood or were incomplete.
4. Warning messages did not tell people where to go.
5. There was little sense of urgency to leave.
6. There was no system to tell evacuees when to return.
7. Lack of pre-emergency planning created confusion about evacuation response.

Case 3:
1. Uncertainty about the size of evacuation was constantly present.
2. Some people refused to leave, particularly as distance increased from accident site.
3. Pre-planning facilitated smooth evacuation of people and institutions.

Kelty, J. 1984. "Calculation of Evacuation Distances During Toxic Air Pollution Incidents," pp. 311-314 in 1984 Hazardous Material Spills Conference Proceedings. Rockville, Maryland: Government Institutes, Inc.

This paper describes a system for calculating safe evacuation distances following a toxic air pollution incident. It is designed to prevent needless "overevacuation." Following the development of reasonable safety factors for two classes of toxic materials: severely and moderately toxic, a simple Gaussian dispersion model is used to determine evacuation distances. Model data requirements include source terms, wind speed and acute exposure safe level values.

Findings/Comments:

Description of model for calculating safe evacuation distances in event it is a toxic air incident.

Killian, L. 1956. "A Study of Response to the Houston, Texas, Fireworks Explosion," National Academy of Sciences/NRC Disaster Study 2. Washington, D.C.: National Research Council.

This study reports on a survey of 139 people residing near a fireworks factory in Houston, Texas, which exploded and burned causing a mushroom-shaped cloud to rise above the site. Around 100 people were injured and four killed in a 0.25-mile radius of the plant. Following the explosion, the Civil Defense received calls for information including many that inquired about an "A-bomb." Seven days after the blast interviews were begun with a random sample of subjects stratified for distance from the plant to ascertain their interpretations and response. Only 13% thought it was an A-bomb and the rest dispensed with this possible perception with information or logic.

Findings/Comments:

(1) Most people relied on interpersonal communications for information or explosion.

(2) People have no good means by which they would recognize an atomic explosion.

(3) People give meaning to this type of event within a situational context.

(4) No subject reported sheltering or evacuation as a response to the incident, but instead respondents went about normal activities.

Liverman, D. M. and J. P. Wilson. 1981. "The Mississauga Train Derailment and Evacuation, 10-16 November, 1979," The Canadian Geographer 25: 365-375.

This paper highlights results of a survey conducted following the Mississauga train derailment which involved a tank car of dangerous chlorine. Within 24 hours, a total of about 225,000 people evacuated from 15 sequentially declared zones. Using both mail and telephone surveys, 581 of 953 households responded to the survey. Of those surveyed, 6.0% were already gone at the time of the accident, 2.2% did not evacuate and the remaining 91.7% evacuated. The article details the results of the survey concerning evacuation messages, reasons for leaving, level of spontaneous evacuation, destinations, and individual impacts and attitudes. The success of the evacuation is attributed to unique institutional, social, and environmental factors which may differ in other evacuation settings.

Findings/Comments:

(1) 95% received evacuation warning before leaving.

(2) The two main stimuli for evacuation were media warnings (45%) and police requests (38%).

(3) Voluntary evacuation took place before official orders (18% in zones 1-7; 8% in 8-11, and 22% in 12-15).

(4) Overall the cummulative evacuation/time pattern was S-shaped.

(5) Most people (85%) went to friends and relatives and a few went to official shelters.

(6) Many made more than one move during their evacuation: 24.3% made two moves, 7.7% made three, and 2.5% made four or more. Twelve percent made a second evacuation because of later evacuation notices to leave which was regarded as safe at first.

(7) About 22% were stressed by the situation.

(8) Fifteen percent felt they were ill-prepared for the evacuation.

(9) Only 3% who evacuated said they would not do so again in similar event.

Quarantelli, E. 1983. "Evacuation Behavior: Case Study of the Taft, Louisiana Chemical Tank Explosion Incident." Columbus: Disaster Research Center, The Ohio State University.

This report summarizes the findings of a post-emergency study of evacuation following an explosion at the Union Carbide plant at Taft, Louisiana. It is based primarily on interviews with representatives of 17 organizations involved with the emergency. The report details the chronology of events surrounding the evacuation of an estimated 17,000 people. While evacuation was recommended out to a five mile radius, it was only rigorously implemented out to a three- to four-mile radius. The major thrust of the report is to link planning and implementation. The report concludes that plans per se were of little practical use in carrying out the evacuation, although, the planning and disaster experience of those involved were helpful in the operations. The major problem in the evacuation was communication with the chemical plant; Union Carbide representatives were not effective in disseminating information and the evacuation was not as timely as it could have been. Had a more serious situation developed, it is possible that the evacuation would not have been judged as being effective. The report also downplays the use of the Waterford Nuclear Power Plan in assisting response albeit the process of preparing it likely increased response ability.

Findings:

(1) The situation demanded adaptation to unplanned situations not covered by other written plans on evaluation.

(2) The local officials were not adequately notified of the development of the accident and subsequent risk, consequences, and need for evacuation from Union Carbide plant officials.

(3) The presence of a disaster subculture was credited for the ability to successfully implement the evacuation.

(4) Most evacuees went to friends and relatives and not to official shelters.

(5) Despite darkness and rain, the 17,000 people were evacuated in two hours without traffic congestion or accidents.

Quarantelli, E. L. 1982. "Transportation Accidents Involving Hazardous Chemicals Versus Those Involving Dangerous Nuclear Materials," Misc. Report No. 30. Columbus: Disaster Research Center, The Ohio State University.

This report compares and contrasts emergency planning considerations for nuclear and chemical transportation accidents. Chapters address (1) the general risks from and possible scenarios of nuclear material accidents; (2) the range of possible chemical hazard incidents; (3) a comparison of common and unique response capacities needed for both types of accidents; and (4) policy implications for emergency management derived from the comparison. The general conclusion is that despite dissimilarities, the two threats have been treated as technical problems and little attention has been given to social and organizational weaknesses in preparing for and responding to accidents during transport. Some general observations about evacuation planning are offered by the report.

Findings/Comments:

(1) It is noted that evacuation would likely be the primary protective action for both threats.

(2) On the average, chemical incidents would require larger areas to be evacuated.

(3) A chemical incident would present much more uncertainty regarding how large of an area would require evacuation.

(4) Warnings to support evacuation are not dependable due to identification and communication problems.

(5) Mass media plays little role in an evacuation due to the rapid response needed.

Quarantelli, E. 1981. "Sociobehavioral Responses to Chemical Hazards: Preparation for and Responses to Acute Chemical Emergencies at the Local Community Level," Final Report to National Science Foundation. Columbus: Disaster Research Center, Ohio State University.

This report summarizes a four-year study into the problems of chemical emergencies from a behavioral perspective. The study used a system model linking the local community with its social climate, social linkages, and resources on one hand, and with the extra-community setting on the other hand to analyze preparedness and response to threats. The study involved two major tasks. The first concerned field study of 19 community response organizations. The second was an

investigation of response in 20 chemical incidents. A four-celled typology divided according to fixed versus transport accident and disruptive versus nondisruptive was used to select the accidents that were investigated.

Overall the study of the preparedness organizations produced a set of findings that are applicable to evacuation planning in a general sense only. The studies of actual incidents provided some evacuation-specific observations. The general finding linking the two phases of the research is that due to unclear and undefined planning and preparedness roles, that when an emergency occurs, no group attempts to organize and control an evacuation.

Findings/Comments:

(1) Often when a transportation accident occurs, spontaneous or informal evacuations take place. People become aware of an emergency and use word of mouth communications to tell others about the situation. When perceived as dangerous, evacuation ensues as word is spread throughout primary groups.

(2) When formal evacuations do occur, they are not based on any formal plans and are usually delayed until first responders establish the nature of the danger.

(3) People respond to warnings quickly based on a widespread perception of danger.

(4) Warnings are frequently inadequate in that they rarely tell people where and how far to go.

(5) Warnings rarely give alternatives to evacuation.

(6) Little attention is given to keeping people informed of a developing situation and giving guidance on reentry of evacuees.

(7) The lack of an organization in charge of evacuations creates delays and confusion.

Scanlon, J., M. Padgham, and W. Star. 1980. "The Peel Regional Police Force and the Mississauga Evacuation: How a Police Force Reacted to a Major Chemical Emergency." Canada: Canadian Police College.

This report details the week-long response in chronological order of the Peel Regional Police Force to a derailed train carrying hazardous chemicals in the town of Mississauga, Ontario, Canada. Considered one of the most effective evacuations to occur in North America, over one quarter

of a million people were evacuated in several increments without incident or injuries. This document is a case study of police operations and organizational response from the police perspective. The appendix includes excerpts of the disaster plan as it existed at the time of the derailment. It is a requirement that all officers know the disaster plan in order to pass promotional examinations. "Success for the evacuation was attributable to the pre-planning, training, experience and nature of the Peel Regional Police Force, the availability of assistance from close at hand and the characteristics of Mississauga, its people, and the surrounding area" (p. 102).

Findings/Comments: This comprehensive and factual document presents data taken from Peel Regional Police Force reports about evacuation procedures and problems.

Terrien, E. 1984. Hazardous Materials and Natural Disaster Emergencies: Incident Action Guidebook. Lancaster, PA: Technomic Publishing Co.

This technical manual describes and recommends emergency actions and operations for hazardous incidents requiring evacuations that may include a radiation accident. Sample charts, diagrams, lists, and worksheets provide information for setting up and operating an emergency command structure as well as for writing reports. Under radiation accidents is information for identifying victims and procedures for decontamination. A glossary of hazardous materials and detailed descriptions of tank trucks and railroad cars are included at the end of the manual for identification purposes.

Findings/Comments:

This technical manual describes steps to be taken when a hazardous accident occurs that requires evacuation and/or decontamination of radioactive materials.

Thomsen, T. 1984. "Evacuation Distances for Spills of Hazardous Chemicals," pp. 315-321 in 1984 Hazardous Materials Spills Conference. Rockville, Maryland: Government Institutes, Inc.

Using standardized assumptions, basic evacuation data for spills of hazardous chemicals are calculated. The results are put into tabular formats to aid emergency response officials in making evacuation decisions. A method is provided to calculate the evacuation distance and width based on the variables of spill size, wind velocity temperature,

and stability class. Examples of the standardized tables and sample calculations are provided.

Findings/Comments: Technical manual on how to calculate the evacuation distance given a hazardous chemical spill.

Additional information on evacuation planning for hazardous materials is found in the following which have not been abstracted. When material is cited in Quarantelli, we are referring to Evacuation Behavior and Problems: Findings and Implications from the Research Literature (Quarantelli, 1980), originally issued through the Disaster Research Center, Ohio State University, Columbus, Ohio. The Center is now located at the University of Delaware.

Alhert, M. B. and L. Sagaloff. 1962. "Task Silence: The Post-midnight Alarm and Evacuation of Four Communities Affected by Ammonia Gas Release" (p. 37). Philadelphia: Institute for Cooperative Research, University of Pittsburgh (unpublished report cited in Quarantelli, 1980).

Fitzpatrick, J. and J. Waxman. 1982. "The March, 1972, Louisville, Kentucky, Chlorine Leak Threat and Evacuation," Working Paper No. 44. Columbus, Ohio: Disaster Research Center, Ohio State University (cited in Quarantelli, 1980).

Quarantelli, E. L. 1984. "Chemical Disaster Preparedness at the Local Community Level," Journal of Hazardous Materials 8: 239:249.

Segaloff, L. 1961. "Task Sirocco: Community Reaction to an Accidental Chlorine Exposure" (p. 42). Philadelphia: Institute for Cooperative Research, University of Pennsylvania (cited in Quarantelli, 1980).

Sheldon, R. 1983. "Evacuation Overlay for Haz Mats Incident Map," The International Fire Chiefs (May 2).

Tierney, K. 1980. "A Primer for Preparedness for Acute Chemical Emergencies," Mono. No. 14. Columbus: Disaster Research Center, Ohio State University.

U.S. Department of Transportation. 1984. Hazardous Materials Emergency Response Guidebook. Washington, D.C.: U.S. Department of Transportation.

NUCLEAR POWER

Aldrich, D., et al. 1982. "Recent Developments in Reactor Accident Offsite Consequence Modeling," Nuclear Safety 23: 643-652.

This article reviews the suite of models used to analyze offsite consequences of accidents. After reviewing the development of the alternative versions of the model (CRAC, CRACIT, NUCRAC), various uses are described. These include evacuation feasibility, emergency planning regulatory analysis, reactor siting criteria evaluation, and probabilistic risk analyses. The article concludes with a statement on the need to develop improved modeling capabilities with respect to source terms, plume dispersion, wind trajectories, and emergency response capabilities.

Findings/Comments: Current reactor consequence models require improvement to be useful in evacuation planning studies.

Bartlett, G. S., P. S. Houts, L. K. Byrnes and R. W. Miller. 1983. "The Near Disaster at Three Mile Island," International Journal of Mass Emergencies and Disasters 1 (March): 19-42.

This article discusses the results of three telephone surveys with people in the TMI vicinity, and a survey of 7, 9, and 11th grade students in Lower Dauphin School District. The article reports differences and similarities in the responses of students and adults as well as their perceptions and distress. This is framed around four-stages or phases of disaster response. Detailed information on departure and return dates and the reasons for evacuation are provided.

Findings/Comments:

(1) Students were strongly affected by the accident. Those who evacuated were upset and worried although these feelings declined over time.

(2) The pattern of response at TMI was similar to disasters where real damage occurs.

Belardo, S., et al. 1983. "A Microcomputer-Based Emergency Response System," Disasters 7: 215-220.

This article describes a computerized system to assist local emergency officials in responding to nuclear power plant emergencies as well as

other hazards. The system displays data on evacuation routes and models radioactive dispersion in both graphic and tabular forms. In addition, the system employs heuristic models designed to assist with emergency decisions. Such decisions include when and where to evacuate, sheltering needs and deployment of emergency response resources. The model runs on an Apple II Plus computer with 48K of RAM. The results of using the system at Ginna Power Plant is presented.

Findings/Comments:

(1) The technology for microcomputer decision aids in emergency is documented.

(2) Public officials at Ginna accepted the technology for use in their evacuation planning process.

Brunn, S., J. Johnson and D. Ziegler. 1980. Final Report on a Social Survey of Three Mile Island Residents. East Lansing: Michigan State University, Department of Geography.

This report describes the methodology and presents the results of a survey conducted following the TMI accident. The survey was mailed to 300 households; 178 were selected from city phone directories for communities within 15 miles of TMI, and the remainder from three communities beyond 15 miles using the same sampling technique. A total of 150 questionnaires were completed out of 267 reaching their destinations. In the report are the descriptive findings from the 22 item questionnaire along with numerous charts, graphs, and diagrams of the data. Discussions of the data are made in the context of the decision to evacuate, attitudes toward nuclear power, attitudes towards the accident, and personal and environmental impacts. Recommendations concerning understanding nuclear accidents, evacuation plans, reporting, public relations, and research funding are offered.

Findings/Comments: See Zigler et al. 1981 for a summary of the findings.

Chenault, W., G. Hibert and S. Reichlin. 1979. "Evacuation Planning in the TMI Accident," PCPA01-78-C-01-93. McLean, Virginia: Human Sciences Research Corporation.

This report reviews evacuation planning in conjunction with the accident at TMI. Reviewed are various local, state, and federal activities at both pre- and post-accident time frames. The efforts to adapt and

revise existing plans during the accident are reviewed. Implications for evacuation planning are derived from the reviews.

Findings/Comments:

(1) Evacuation plans should be based on pre-emergency risk delineations.

(2) Plans are necessary for complex emergencies.

(3) Redundant communication links are needed for multiple jurisdictional involvement.

(4) Volunteer effectiveness breaks down over extended periods of threat.

Cutter, S. 1984. "Emergency Preparedness and Planning for Nuclear Power Plant Accidents," Applied Geography 4: 235-245.

This paper reviews planning assumptions for fixed-site radiological emergency preparedness in the U.S. Four of the five deficiencies in these assumptions concern evacuation. These include assumptions about evacuation behavior, problems of evacuating high density areas, lack of attention to other means of protective evacuation, and use of selective evacuation. The paper concludes that social science research has been underutilized in developing the planning basis for nuclear power emergency programs.

Findings/Comments:

(1) People do not always comply with evacuation orders.

(2) Evacuating high density populated areas is difficult.

(3) Evacuation may place people at greater risks.

(4) Selective evacuation may not work.

(5) Interstate coordination of response efforts is not well established.

Cutter, S. and K. Barnes. 1982. "Evacuation Behavior at Three Mile Island," Disasters 6: 116-124.

This journal article reports the correlates of evacuation behavior at TMI. Data were collected by the authors using a mail survey sent to 1000 households within 20 miles of the reactor. A response rate modified for undelivered questionnaires of 40% was achieved.

The survey indicated that 39% of the sample evacuated one or more persons. Most (74%) stayed with friends or relatives and no one used an official shelter. Further details on destination and durations of evacuation are given as well as reasons for evacuating. Major reasons were the Government's advisory, anticipated consequences, and confusion.

In addition, the study examined the role of distance, social status, and social influence in response.

Findings/Comments:

(1) Evacuation rates decreased with distance from the plant.

(2) Households with children were more likely to evacuate.

(3) Older persons were less likely to evacuate.

(4) People with neighbors who evacuated were more likely to evacuate.

(5) Educational levels were not consistently related to evacuation behavior.

(6) Single-member households were less likely to evacuate.

Desrosiers, A. E., M. Moeller, M. McLean and T. Urbanik. 1984. "Sensitivity and Benchmark Study of the CLEAR Evacuation Time Estimate Code," Transactions of the American Nuclear Society 46: 325.

This study compares evacuation time estimates from the CLEAR code to observed data from an interstate highway subject to daily queuing. Results showed that the code worked well for the periods of traffic buildup and peak flow. During periods of decreasing volumes, the code overestimated evacuation times.

Findings/Comments:

(1) Accurate estimates of vehicle populations and flow rates are needed for evacuation time estimates.

(2) Preparation time assumptions in the model are important when the network is subcritical.

(3) CLEAR reasonably estimated the observed traffic flow for interstate highway travel data.

(4) The CLEAR model overestimated evacuation times during low-flow periods.

Dynes, R. et al. 1979. Report of the Emergency Preparedness and Response Task Force, Staff Report to the President's Commission on the Accident at Three Mile Island. Washington, D.C.: U.S. Government Printing Office.

This report analyzes emergency planning for and response to the TMI accident. It involves an analysis of planning efforts made by local county, state and federal organizations and their activities in response to the accident including the recommended precautionary evacuation. Detailed chronology of key events and communication patterns are provided.

Findings/Comments:

(1) The quest for certainty regarding reactor conditions by the state delayed evacuation decisions.

(2) The NRC provided information that was confused and inconsistent.

(3) Public officials (State and NRC) had inaccurate beliefs about the response of the public.

(4) Local officials were isolated from information from state and federal agencies.

Fischer, D. 1981. "Planning for Large Scale Accidents: Learning from the Three Mile Island Accident," Energy 6: 93-108.

Decision-making issues at TMI are examined from an interorganizational perspective. Following an overview of accident management in general, a descriptive account of organization involved with TMI, their interactions and decisions is given. A brief account of evacuation decision-making is included. The lack of pre-accident planning is identified as a major problem in the accident. The need for a more integrated planning approach is identified.

Findings/Comments:

(1) A dialectical planning process is needed for large scale accidents in order to improve emergency response.

(2) The uniqueness of the accident is not a useful concept for explaining the inadequacies in evacuation decision making.

(3) Lack of planning complicated evacuation decisions.

Flynn, C. 1979. Three Mile Island Telephone Survey: A Preliminary Report. Washington, D.C.: U.S. Nuclear Regulatory Commission.

This report describes the methodology and results of the NRC telephone survey after the TMI accident. General categories of information collected by the survey include evacuation behavior, information and communications, accident effects, TMI and nuclear power attitudes and demographies. A total of 1454 respondents were interviewed. Data were collected for respondents and family members (selected variables). The randomized quota sample was stratified for distance and direction from the reactor site. Data from the survey is summarized in 28 tables.

Findings/Comments:

(1) Sixty percent of the five-mile zone evacuated and a total of 39% within 15 miles evacuated.

(2) The median length of stay during evacuation was five days.

(3) The average distance travelled was 100 miles.

(4) Most evacuees went to friends and relatives (78%) or motels (15%).

(5) The major reasons given for evacuations were perceived danger and confusing information.

(6) People mainly relied on media (TV, radio) for information.

(7) Evacuation costs were estimated to be $18 million (to families).

(8) Females were more likely than males to evacuate.

(9) Seventy-one percent of pregnant women evacuated.

Flynn, C. 1982. "Reaction of Local Residents to the Accident at Three Mile Island," pp. 49-63 in Accident at Three Mile Island, edited by D. Sills and others. Boulder: Westview Press.

In this article the reasons for the extreme variation in response of individuals to the TMI accident that began at 4:00 a.m. on Wednesday, March 28, are examined. Using data collected from seven 1979 surveys, Flynn concludes that part of the population experienced considerable stress because of the lack of information and ambiguity surrounding the event. However, a significant minority of residents were not worried then or now regarding emissions and that the accident made little difference in their lives. Out-migration because of the accident appears modest even within the five-mile radius of the plant among families with children.

Findings/Comments:

(1) Data suggests over half of population within five-mile radius left and one-third within the 5-15 radius vacated.

(2) Reasons given for evacuating were (1) that the situation seemed dangerous, (2) information was confusing, (3) a related desire to avoid the danger, and (4) avoiding the confusion of forced evacuation.

(3) Reasons for not evacuating included inability to leave jobs and the lack of an evacuation order. Forty-five percent felt whatever happened was in God's hands and one-third were concerned about looters.

(4) NRC survey found two-thirds of children five and under and 70% of pregnant women departed. Both surveys and personal interviews found older persons less likely to have left because not included in advisory.

(5) Estimates of the number evacuating ranged from 50 to 60% within 5 miles and 33 to 54% within 10 miles, depending on the survey used.

(6) Median date of return was Wednesday, April 4, although governor's advisory not lifted until April 9, and schools were not reopened until April 11.

Flynn, C. B. and J. A. Chalmers. 1980. The Social and Economic Effects of the Accident at Three Mile Island. Tempe, Arizona: Mountain West Research, Inc. with Social Impacts Research, Inc.

The report covers the social and economic effects of the accident at Three Mile Island during the first six months following the accident.

A variety of data sources were utilized including published documents and statistics, household surveys, newspaper files, interviews, and other research about the accident. The findings can be grouped into effects on (1) the regional economy, (2) institutions, and (3) individuals. Direct economic effects during the emergency period following the accident were interrupted local production and reduced local income and employment. Losses were conspicuous during the first week of April but subsequently very minor. There is no evidence of any continuing interruption of activity because of the accident. However, there is concern within the business community about the effects of the accident on the continued growth and development of the area. Major institutional effects were a strain on the emergency preparedness network in the area and an increased focus on the issue of the TMI plant by the local populace. Major effects on individuals were the evacuation itself and increased stress during the accident period. For most people, the effects of the accident were short-lived, but for others, the accident has caused a more permanent change in the day-to-day activities.

Findings/Comments:

(1) Evacuations cost each household about $300.

(2) Evacuation disrupted local businesses but did not produce long-term hardships.

(3) For most the effects of evacuation were short-lived; a small number of respondents remained stressed, or continue to feel economic effects, six months after the disaster.

Gant, K. and M. Schweitzer. 1984. "Protective Actions as a Factor in Power Reactor Siting," ORNL-5941. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

This report examines the relationship between a power reactor site and the ease of implementing protective actions (emergency measures to reduce the radiation exposure to the public in the unlikely event of a serious accident). Limiting population density around a reactor lowers the number of people at risk but cannot assure that all protective actions are possible for those who reside near the reactor. While some protective measures can always be taken (i.e., expedient respiratory protection, sheltering), the ability to evacuate the area or find adequate shelter may depend on the characteristics of the area near the reactor site. Generic siting restrictions designed to identify and eliminate these site-specific constraints would be difficult to formulate. The authors suggest identifying possible impediments to protective actions at a proposed reactor site and addressing these problems in the emergency plans.

Findings/Comments:

(1) Generic siting restrictions designed to identify and eliminate site-specific constraints would be difficult to formulate.

Goldsteen, R. and J. K. Schorr. 1982. "The Long-Term Impact of a Man-Made Disaster: An Examination of a Small Town in the Aftermath of the Three Mile Island Nuclear Reactor Accident," Disaster 6(1): 50-59.

In this article, the long-term effects of the TMI incident are explored regarding residents' perceptions of vulnerability to future nuclear incidents, their physical and mental health, and their trust in public officials. In the sample's reported behavior during the accident period, 71% evacuated with 85% traveling to points more than 25 miles from the power plant. The reasons in rank order were stated as (1) needing to remove the family from danger, (2) fear of the unknown and (3) being told to leave by authorities. From the constant or increasing levels of stress reported by residents in the period following the accident, the authors conclude that effects of a technical disaster may be more enduring than those from natural disasters. Appendix includes the single measures used to determine levels of anxiety and the 26 items used to measure demoralization.

Findings/Comments:

(1) Seventy-one percent of persons interviewed reported evacuating during the accident with 85% traveling to points outside the plant's 25 mile radius.

(2) Reported reasons for leaving include: (1) the need to remove family from danger; (2) the fear of the unknown; and (3) being told to evacuate by authorities.

Houts, P. et al. 1984. "The Protective Action Decision Model Applied to Evacuation During the TMI Crisis," Mass Emergencies 2(1): 27-39.

The authors reanalyzed the NRC survey data to test whether the protective action decision model predicts evacuation behavior at TMI. The results suggested that severity, susceptibility, and barrier cost were as predicted by the models related to evacuation. The study concludes that more research on the role that conflicting information plays in evacuation decision is needed.

Findings/Comments:

(1) People who evacuated were more susceptible to damage with susceptibility measured by distance, children under six in household, and pregnant women in household, than those who did not evacuate.

(2) People who evacuated were more upset and threatened than those who did not evacuate.

(3) People who stayed because of barriers are more susceptible and upset/threatened than those who stayed for other reasons except for children under six or pregnant women families where no differences were observed.

Hull, A. P. 1981. "Emergency Planning for What?," Nuclear News (April) 61-67.

This article reviews the technical basis for emergency planning at nuclear power plants. The authors' theory is that the TMI accident did not warrant the changes in emergency planning regulations. It argues that it is undesirable to place an emphasis on planning for low-probability emergencies rather than more likely events. In doing so it challenges the emphasis placed on evacuation as a protective-action strategy. Instead, a rule is called for which incorporates pre-established responses graded to both probability and consequences.

Findings/Comments: This is an editorial article questioning the need for detailed evacuation planning around nuclear power plants.

Hull, A. P. 1981. "Critical Evaluation of Radiological Measurements and of the Need for Evacuation of the Nearby Public During the Three Mile Island Incident," Current Nuclear Power Plant Safety Issues, Vol. 2, Vienna: IAEA.

This paper analyzes the need for evacuation at TMI and concludes that it was unnecessary. Only under worst-case developments would evacuation have been necessary and then only in a zone 3.5-5.3 km from the plant. Controlled venting could reduce the possibility of a worst-case situation. The author concludes by stating that evacuation is not the only protective action strategy and calls for a broader based approach to emergency management.

Findings/Comments:

(1) Evacuation at TMI was unnecessary.

(2) Radiological planning emphasizes evacuation in an uneven way.

Jaske, R. T. 1983. "Emergency Preparedness: Status and Outlook," Nuclear Safety 24(1): 1-11.

This paper reviews the origins and development of FEMA's radiological emergency preparedness program since the presidential directive creating that agency. Generic problems from exercises and more general planning issues are discussed. Issues include accident source term, uniformity and standardization of plan/exercise evaluation, exercise frequency, public education, evaluation of alert/notification systems, and role of the federal agencies. The paper concludes that despite weaknesses radiological emergency planning has improved greatly since 1979 and its integration into an integrated management system will further improve planning.

Findings/Comments:

(1) Radiological planning has improved evacuation planning in general.

(2) Warning and public education pose problems for effective evacuations.

Johnson, J. 1984. "Planning for Spontaneous Evacuation During a Radiological Emergency," Nuclear Safety 25(2): 186-193.

This journal article states that FEMA ignores the problem of spontaneous evacuation in a nuclear power plant emergency. Based on a survey in Long Island, N.Y., it is estimated that people will evacuate up to 25 miles away. On an average, it is estimated that 39% of Long Island will leave.

Findings/Comments:

(1) Evacuation will decline with distance and direction from the plant.

(2) FEMA should revise planning guidelines to reflect spontaneous evacuation.

Johnson, J. and D. Ziegler. 1984. "Distinguishing Human Responses to Radiological Emergencies," Economic Geography 59: 386-402.

This journal article reports the result of a discriminate analysis of factors related to behavioral intents to evacuate in a hypothetical nuclear power plant emergency. Using data collected by Social Data Analysis on Long Island regarding Shoreham Nuclear Power Plant, the authors divided their sample into three constructed groups: (1) responses consistent with scenario advice, (2) responses that indicate taking a protective action when not advised, and (3) responses that indicate not taking protective action when advised. Using a step-wise discriminate analysis, a list of 16 variables were used to differentiate the three groups. A second analysis was performed using four variables. Results show that the model is a fair prediction of who will follow orders (72% correctly classified), who will go beyond recommendations (77%) but not of who will not take action (1%) when the variables of perceived distance, direction, nuclear risk and age are used in the discriminant function.

Findings/Comments:

(1) People who expressed evacuation and sheltering intents similar to recommended actions and evacuate are younger and concerned with nuclear risk.

(2) People who intend to go beyond the recommended action and evacuate are middle aged, perceive greater dangers and live farther away.

(3) People who intend not to take protective actions that are recommended are older, perceive nuclear power to be less dangerous, and live closer to the plant.

Lindell, M., P. Moeller and M. Renner. 1984. "Off-Site Response Considerations for Appropriate Protective Actions," Transactions of the American Nuclear Society 46: 322-323.

This paper reviews a project to develop decision-aids to integrate off-site response considerations into evacuation decisions. The approach attempts to incorporate response time and evacuation time parameters into the decision process. Explicit consideration is given to size and distribution of population, seasonal factors, evacuation processes, roadway constraints, and diurnal variation in human activities.

Findings/Comments: This describes a project to establish planning guidance for evacuation decisions.

Lindell, M. and R. Perry. 1983. "Nuclear Power Plant Emergency Warning: How Would the Public Respond," Nuclear News (February): 49-57.

This article reviews the issue of predicting response to a future accident at a nuclear power plant. The body of the article describes a flow model of human response to an emergency and discusses the relationship between nuclear power attitudes and behavior. The paper concludes that in the absence of clear and credible information that people will likely evacuate regardless of what is recommended.

Findings/Comments:

(1) People will evacuate in a radiological emergency unless a credible warning source is used.

(2) A slow developing accident presents fewer problems for spontaneous evacuation than a rapid one.

Moeller, M., T. Urbanik and A. Desrosiers. 1982. CLEAR: A Generic Transportation Network Model for Calculation of Evacuation Time Estimates, NUREG/CR-2504. Washington, D.C.: U.S. Nuclear Regulatory Commission.

This paper describes the methodology and application of the computer model CLEAR (Calculates Logical Evacuation And Response) which estimates the time required for a specific population density and distribution to evacuate an area using a specific transportation network. The CLEAR model simulates vehicle departure and movement on a transportation network according to the conditions and consequences of traffic flow. These include handling vehicles at intersecting road segments, calculating the velocity of travel on a road segment as a function of its vehicle density, and accounting for the delay of vehicles in traffic queues. The program also models the distribution of times required by individuals to prepare for an evacuation. In order to test its accuracy, the CLEAR model was used to estimate evacuation times for the emergency planning zone surrounding the Beaver Valley Nuclear Power Plant. The Beaver Valley site was selected because evacuation time estimates had previously been prepared by the licensee, Duquesne Light, as well as by the Federal Emergency Management Agency and the Pennsylvania Emergency Management Agency. A lack of documentation prevented a detailed comparison of the estimates based on the CLEAR model and those obtained by Duquesne Light. However, the CLEAR model results compared favorably with the estimates prepared by the other two agencies.

Findings/Comments: This is a description of an evacuation time estimation model and its application.

Olds, F. C. 1981. "Emergency Planning for Nuclear Power Plants," Power Engineering (August) 48-56.

This paper reviews the requirements for nuclear power plant emergency planning following the TMI accident and presents a detailed history of how those requirements have involved. The basic premise of the paper is that there is no technical basis for the post-TMI regulations because an accident will have negligible consequences. In conclusion, the author calls for more streamlined and less complex emergency management systems.

Findings/Comments:

(1) Too much emphasis and detail are given to evacuation planning for an accident.

Sheffi, Y., H. Mahmassani, and W. Powell. 1982. "A Transportation Network Evacuation Model," Transportation Research 16(3): 209-218.

This paper describes a computer model, NETVACI, for simulating traffic patterns during emergency evacuation of areas surrounding a nuclear power plant. NETVACI is a fixed time macro-traffic simulation model, using established traffic flow models and relationships to simulate the flow of vehicles through a network. Sensitive to network typology, intersection design and control and implementation of various management strategies, this macro model focuses on total network clearance time. The paper includes a critical review of other approaches used in simulating evacuations and estimating clearance times, a description of the structure and logic as well as the assumptions used in the NETVACI and some computational experience. The authors note the model with minor modifications may be applied to test other management schemes for simulating evacuation plans whether for natural or man-made hazards or for regulatory and licensing purposes.

Findings/Comments:

This paper provides a description of a computer simulation model, NETVACI, used for simulating traffic flows during a emergency evacuation of areas surrounding a nuclear power site.

Sorensen, J. and B. Richardson. 1984. "Risk and Uncertainty as Determinants of Human Response in Emergencies: Evacuation at TMI Reexamined," in Proceedings of the Society for Risk Analysis Annual Meeting, Knoxville, Tennessee.

Research on evacuation during the accident at Three Mile Island Nuclear Power Plant has not sought to explain the causes of behavior and has limited generality due to inadequate research designs. A causal model of the human impacts of technological disaster is developed to explain evacuation behavior. Using a probability sample of approximately 1500 families in the TMI vicinity (NRC Telephone Survey), an empirical formulation of the model is tested using path analysis. Results demonstrate seven constructs that are significant in explaining evacuation: sensitivity towards risk, concern over other risks, information, demographic characteristics, social ties, attitudes toward risk and risk managers, and perceived risk. Furthermore the research shows that distance from the plant is not only strongly associated with evacuation but has systematic indirect effects through other causes of evacuation.

Findings/Comments:

(1) Response to TMI accident is similar to response to natural disasters.

(2) Pre-accident attitudes did not directly affect evacuation decisions but were related to elevated levels of perceived threat.

(3) Perceived threat and distance were strong influences on evacuation behavior.

Sorensen, J., 1984. "Public Confidence in Local Management Officials: Organizational Credibility and Emergency Behavior," Proceedings of a Conference on Evacuation Risks in Nuclear Power Plant Emergencies. Penn State University.

This paper discusses the effect of organizational credibility on evacuation behavior by reviewing research on attitude change and response to emergency warnings. It is concluded that attitudes will not likely influence behavior including those concerning organizational credibility. In emergencies, many factors will influence warning belief. Even if organizations lack public confidence, steps can be taken to maximize public compliance with evacuation recommendations.

Findings/Comments:

(1) Evacuation planning should assume an informational warning source with low credibility.

(2) People perceive the credibility of individuals to be different than their organizations.

Sorensen, J. 1984. "Evaluating the Effectiveness of Warning Systems for Nuclear Power Plant Emergencies: Criteria and Application," pp. 259-277 in M. Pasqualetti and K. Pijawka (eds.) Nuclear Power: Assessing and Managing Hazardous Technologies. Boulder: Westview Press.

This paper reviews regulatory requirements for warning systems and evacuation around nuclear power plants. An alternative set of criteria based on social science research is proposed. The warning/response system around the Ft. St. Vrain plant is reviewed using the criteria. The paper concludes with a discussion of evacuation planning in light of TMI.

Findings/Comments:

(1) No major flaws were found in the warning system at Ft. St. Vrain Nuclear Power Station.

(2) The Ft. St. Vrain warning response system can be improved with little investment of money by incorporating social science knowledge into its design and implementation.

Stallings, R. 1984. "Evacuation Behavior at Three Mile Island," International Journal of Mass Emergencies and Disasters 2: 11-26.

This review article addresses the issue of whether evacuation behavior at TMI was a unique process, or rather whether it conformed to the patterns found in other emergencies. The TMI evacuation is analyzed as to the timing and scope of evacuation, social aspects of the evacuation and warning response. On all three grounds, the study concludes that TMI evacuation did not differ significantly from that taking place in natural disasters.

Findings/Comments:

(1) Evacuation behavior at TMI was not unique, conforming to patterns exhibited in other emergencies.

(2) No special plans or policies should be developed for nuclear power plant evacuations based on unique public response.

(3) Situations like TMI place added burdens on public officials because they are faced with conflicting information and uncertainty about an "ordered" evacuation.

Sullivan, J. D. and R. L. Sullivan. 1985. "A Feasibility Study for Simulating Nuclear Power Plant Urban Evacuation Plans," pp. 61-65 in Emergency Planning, Vol. 15, No. 1, John Carroll (ed.). La. Jolla, CA: Society for Computer Simulation.

This paper describes a plan for carrying out a feasibility study for developing and implementing the software necessary to evaluate, via simulation, evacuation plans for nuclear power plant accidents for urban areas. The study proposes to develop a computer simulation software to integrate the analysis process of risk assessment. Among the technical objectives is listed the integration of the evacuation plan simulation and the evaluation into the model.

Findings/Comments: This paper proposes a feasibility study yet unfunded to coordinate the computer software for simulating evacuation plans for nuclear power plants in urban areas.

Tawil, J. et al. 1984. "Socioeconomic Consequences of Nuclear Reactor Accidents, NUREG/CR-3566. Washington, D.C.: U.S. Nuclear Regulatory Commission.

This report identifies and characterizes the off-site socioeconomic consequences that would likely result from a severe radiological accident at a nuclear power plant. Economic, health, social/psychological and institutional impacts are addressed. These impacts are identified for each of several phases of a reactor accident--from the warning and evacuation phase through the post-resettlement phase. The relative importance of the impact during each accident phase and the degree to which the impact can be predicted are indicated. A brief overview of expected evacuation behavior is provided. The report also examines the currently used methods for assessing nuclear reactor accidents, including development of accident scenarios and the estimating of socioeconomic accident consequences with various models. A final critical evaluation is made regarding the use of impact analyses in estimating the contribution of socioeconomic consequences to nuclear reactor accident risk.

Findings/Comments: This is a review document with no empirical findings.

Urbanik, T. 1981. "An Analysis of Evacuation Times Estimates Around 52 Nuclear Power Plant Sites," NUREG/CR-1856, Vols. 1 and 2. Washington, D.C.: U.S. Nuclear Regulatory Commission.

This report summarizes evacuation time estimates from 49 nuclear power plant sites as of November 29, 1979. The estimates for each site are evaluated on 11 specific criteria including assumptions and methodology, traffic demand parameters, traffic routing and analysis. Various summaries are made in the context of population densities, weather conditions, warning time, response time and confirmation time.

Findings/Comments:

(1) A variety of approaches and methods were used to estimate times.

(2) Further refinement of analysis techniques is needed to produce consistent results and to ascertain limiting factors.

USGAO (U.S. General Accounting Office). 1984. "Further Action Needed to Improve Emergency Preparedness Around Nuclear Power Plants," GAO/RCED-84-43. Washington, D.C.: Government Printing Office.

This report assesses the adequacy of federal state and local off-site emergency planning for nuclear power plant accidents. It is a synthesis of a discussion held with emergency planners at those governmental levels as well as utilities, scientists, and interest groups. The report states that considerable progress in off-site preparedness has been made since TMI, however, further improvements can be made in several ways.

Findings/Comments:

(1) Improvements in exercises to test plans can be made by establishing minimum requirements, broadening their scope and establishing a tracking system on deficiencies.

(2) Better federal planning guidance is needed.

(3) Federal response plans need improvement.

USFEMA (U.S. Federal Emergency Management Agency). 1984. "Application of the I-DYNEV System," FEMA-REP-8. Washington, D.C.: FEMA.

This report describes the I-DYNEV software system for estimating evacuation times around nuclear power plants and demonstrates its use at five locations. These locations are Millstone, Catawba, TMI, Oyster Creek and Davis Beese. Populations at these sites range from 17,000 to 170,000. The report breaks down the process into definition of data needs, developing the transport network configuration, specifying the traffic demand, coding the input data, and setting up basic analyses, sensitivity studies, and special condition analyses. Special considerations are given to estimating trip generation, distribution, and assignment and traffic control. The report presents detailed descriptions of each case study and its results.

Findings/Comments: This is a description of a model to estimate evacuation times in a nuclear power plant accident.

U.S. Nuclear Regulatory Commission and U.S. Environmental Protection Agency. 1978. "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," NUREG-0396, EPA 520/1-78-016. Washington, D.C.: Government Printing Office.

This report suggests a planning basis for state and local government emergency organizations to determine the scope of planning efforts for nuclear power plants. The Task Force determined that a specific single accident could not be identified as the planning basis. Instead, the Task Force recommended establishing two generic Emergency Planning Zones (EPZs) around light-water nuclear power plants. The inner zone of about 10 miles would be established for the plume exposure pathways and an outer zone of about 50 miles would be established for the ingestion exposure pathways. The precise size and shape of the EPZs would be based on the judgement of the emergency planner after considering local conditions. The Task Force concluded that planning for predetermined protective actions, such as sheltering in the plume exposure zone, is warranted within these zones in the event of a serious accident at a power plant. The Task Force also recommended time frames and radiological characteristics of the accidents for use in determining the appropriate emergency actions which could be taken to reduce the accident consequences. The Task Force concluded that if the basic planning elements in existing emergency planning guidance documents are already being considered, the establishment of EPZs should not result in large increases in state and local government emergency planning and preparedness costs.

Findings/Comments:

(1) The areal definition of an EPZ should be based on judgements of the emergency planner based on local conditions and geography.

(2) Two reference zones are the 10 miles radius evacuation zone for exposure and 50 miles for ingestion.

Walsh, S. et al. 1983. "Applications of Population Projections and Remote Sensing for Nuclear Power Plant Licensing," The Social Science Journal 20: 89-102.

This paper describes the use of aerial photographs and landsat images in developing population projections for use in nuclear power plant licensings, including evacuation time estimates. The procedures for estimating population for incorporation into a geographic information system are described. A model to calculate evacuation times is discussed. Using the population estimates, evacuation times are estimated for a plant outside of Tulsa, Oklahoma.

Findings/Comments: This article describes one approach to calculating population at risk for evacuation planning.

Ziegler, D., S. Brunn and J. Johnson. 1981. "Evacuation from a Nuclear Technological Disaster," Geographical Review 71: 472.

This paper presents the results of the Michigan State survey on the TMI accident (see Bunn et al.). Results are based on a mail-out questionnaire returned by 150 persons out of the sample of 300. Findings include a listing of reasons for evacuating or staying, a description of the timing and spatial pattern of evacuation, evacuation destinations, and evacuation duration. The paper concludes with a hypothetical model of evacuation behavior.

Findings/Comments:

(1) People who evacuated did so because they were concerned about safety (91%) and/or they heard conflicting information (48%).

(2) People who stayed did so because no evacuation order was given (62%), they heard conflicting information (42%), or they had no reason to evacuate (31%).

(3) Fewer people evacuated as distance from the plant increased.

(4) The median distance traveled was 85 miles.

(5) No one used official shelters.

(6) People evacuated longer distances as distance from the plant increased.

(7) People evacuated for shorter time periods as distance from the plant increased.

Ziegler, D. and J. Johnson. 1984. "Evacuation Behavior in Response to Nuclear Power Plant Accidents," Professional Geographer 36: 207-215.

This journal article describes the intention to evacuate if an accident occurred at the Shoreham Nuclear Power Plant on Long Island, N.Y. Data was collected from 2,595 respondents living within 50 miles of the uncompleted reactor, using random-dialed telephone survey. Details of the data set are not provided but available elsewhere.

Respondents were given three hypothetical scenarios indicative of differing protective action recommendations: 5-mile sheltering; 5-mile selective evacuation/10-mile sheltering, and 10-mile total evacuation. Given the scenarios, respondents were asked whether they would evacuate, shelter, or go about business as usual.

Findings/Comments (Authors):

(1) A high degree of spontaneous evacuation was expressed in response intentions.

(2) Behavioral intentions to evacuate on Long Island are similar to actual evacuation rates at TMI.

(3) People living east of the plant were less likely to say they would evacuate.

(4) Expressed intention to evacuate decreased with distance from the plant.

Additional information on evacuation planning for nuclear power incidents including research conducted on the Three Mile Island (TMI) incident is found in the following which have not been abstracted. When material is cited in Quarantelli, we are referring to Evacuation Behavior and Problems: Findings and Implications from the Research Literature (Quarantelli, 1980), originally issued through the Disaster Research Center, Ohio State University, Columbus, Ohio. The Center is now located at the University of Delaware.

Aldrich, D., R. Blond and R. Jones. 1978. "A Model of Public Evacuation for Atmospheric Radiological Release," DOE Report SAND-78-0092. Albuquerque, New Mexico: Sandia National Laboratory.

Aldrich, D., L. Ritchie and J. Sprung. 1979. "Effects of Revised Evacuation Model on Reactor Safety Study Accident Consequences," DOE Report SAND-78-0095. Albuquerque, New Mexico: Sandia National Laboratory.

Johnson, J. and D. Ziegler. 1984. "A Spatial Analysis of Evacuation Intentions at the Shoreham Nuclear Power Station" (pp. 279-301) in M. Pasqualetti and K. Pijawka (eds.), Nuclear Power: Assessing and Managing Hazardous Technology. Boulder: Westview Press.

Lindell, M., P. Bolton, R. Perry, G. Stoetzel, J. Martin and C. Flynn. 1985. "Planning Concepts and Decision Criteria for Sheltering and Evacuation in a Nuclear Power Plant Emergency," Bethesda, Maryland: Atomic Industrial Forum, Inc.

Smith, M. 1979. "The Three Mile Island evacuation: voluntary withdrawal from a nuclear power plant threat," unpublished paper. Greenvale, New York: Department of Sociology and Anthropology, Long Island University (cited in Quarantelli, 1980).

Sorensen, J. 1982. Evaluation of the Emergency Warning System at Ft. St. Vrain Nuclear Power Plant, ORNL/TM-8171. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

Urbanik, T., A. Desrosiers, M. Lindell and C. Schuller. 1980. "Analysis of Techniques for Estimating Evacuation Times for Emergency Planning Zones," NUREG/CR-1745. Washington, D.C.: U.S. Nuclear Regulatory Commission.

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USNRC. 1981. "Report to Congress on Status of Emergency Response Planning for Nuclear Power Plants," NUREG-0755. Washington, D.C.: Government Printing Office.

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CRISIS (WAR/ATTACK)

Baffin, R. and K. Kilpatrick. 1982. "Crisis Relocation Planning: Pro and Con," Journal of Civil Defense 15(1):14-15.

Baffin presents an argument for Crisis Relocation Planning (CRP) and Kilpatrick one against CRP. Essentially, Baffin argues that CRP was based on sound policy and that we risk "losing the whole ball game" of preparedness for nuclear war if we change tactics regarding civil defense. U.S. CRP works better than the Soviet's CRP because we have a better transportation system, and a blast-shelter system is too costly Baffin argues. Kilpatrick notes that plans to evacuate the President are based on minutes but that CRP for citizens are based on four to seven days. The Soviets have the choice of urban shelters or CRP which is "vulnerable to applications of Murphy's Law." In-place shelters are practical solutions that cost less, minimize problems, make targets obscure and, thus, make CRP obsolete.

Findings/Comments: Conceptual article focusing on both sides of argument regarding CRP.

Bernard, E. H. and F. C. Ikle. 1952. "Evacuation and Cohesion of Urban Groups," The American Journal of Sociology 58 (September): 133-138.

Data from World War II unpublished military papers on evacuation of urban populations during wartime reveals the cohesion of family units and the preference for dislocated evacuees to return to cities as soon as possible. Density of unimpaired urban residences increased as a result. Little loss of production force observed during evacuations. Postwar census indicated not only same number of inhabitants resettled in damaged cities but actually included same individuals who had lived originally in urban residences.

Findings/Comments:

(1) Urbanites dislocated by bombing of residences during wartime returned as quickly as possible to same neighborhoods.

(2) Ties to place of employment and location of family and friends provide significant bonds to evacuated urbanites.

(3) Separation from family members and places of employment met with great resistance during wartime evacuations.

Brand, R. 1984. "Outward Bound: The Transportation Assumptions of Crisis Relocation Planning," pp. 79-117 in J. Leaning and L. Keyes (eds), The Counterfeit Ark: Crisis Relocation for Nuclear War. Cambridge, MA: Ballinger.

This article examines the assumptions of transporting large numbers of people from urban areas under national crisis conditions. Brand states that it is erroneous to assume that people will regulate evacuation times to ease traffic flow, that vehicles will rarely break down, and that all required personnel will remain at their duties. Furthermore, Brand sees quantitative errors in six of the assumptions. At issue is FEMA's six to twelve hour evacuation preparatory time. He argues that 24 hours is a more reasonable minimum estimate of system preparation time particularly if dependents of key personnel are to be relocated. The basic highway capacity estimates should be revised downwards 20% with 16 hour/day operations, not 24. The New York plan to reverse lanes further reduces capacity on those roads 25% while another 20% should be deducted for "crudity of cordon methods" and non-access controlled highways. Lastly challenged is the assumption that other modes of travel will all fulfill their functions and this suggests that 75% of second and third cars with unfamiliar drivers will further reduce capacity. In all this reduces evacuation flows by 40% which makes evacuation a two-week event rather than the three days estimated in the plans. Thus, the population may well be in places of greater danger, i.e., roads, when the threat of attack is the greatest.

Findings/Comments:

Conceptual article with "findings" based on the assumptions made by author.

Corbett, J. 1984. "Nuclear War and Crisis Relocation Planning: A View from the Grassroots," Impact Assessment Bulletin 2: 23-33.

This article examines the impacts of crisis relocation on a single host community "to develop a grassroots perspective on the operational considerations" regarding the plan. The Texas Disaster Act of 1975 and subsequent executive orders place responsibility for planning and implementation of crisis relocation on Texas local authorities. Using the Annex E portions of the Hays County Emergency Operations Plan which deals with crisis relocation, the author notes that local officials are neither familiar with nor have the organizational capabilities to implement the plan in times of emergencies. Using the obsolete 90,000 number of evacuees from Austin, Texas, who are intended for relocation in San Marcos, the plan is analyzed from the standpoints of plausibility, robustness and coherence regarding transportation, shelter, food supplies and public security. Data was gathered from interviews, secondary analysis, direct observation, and review of public documents. FEMA's belief that planning for "generic" disasters is a technical process to be undertaken by professionals is criticized as inadequate for nuclear war. Also challenged are the assumptions of a single case scenario, i.e., 72 hours to evacuate Austin, and sheltering times not designed to accommodate nuclear exchange or escalation which could lead to a permanent refugee situation. Treating relocation as a transient or limited phenomenon without public input does not take into account local citizens interests which may, in the event of war, be opposite that of FEMA. Thus, plans must be subjected to more critical review by the public.

Findings/Comments:

(1) Analysis of the Hays County, Texas, crisis relocation plan suggests that the assumptions of transiency regarding relocation of evacuees from Austin, Texas, to San Marcos in the event of war are inadequate because circumstances may vary as to length of event and, therefore, sheltering and feeding needs.

(2) Using "generic" disasters to develop plans for a nuclear disaster does not work because the assumption of a single scenario from which to draw conclusions will vary in the event of nuclear war.

(3) Some people in host areas more interested in keeping people away in event of war rather than in allowing them refuge.

Geiger, H. J. 1984. "Dulce et Decorum Est: Medical and Health Problems of Crisis Relocation," pp. 159-182 in J. Leaning and L. Keyes (eds.), The Counterfeit Ark: Crisis Relocation for Nuclear War. Cambridge, MA: Ballinger.

FEMA's estimate that 80% of the population can survive a nuclear attack is not supported by empirical evidence because of the medical problems arising during and after attack. This raises some bioethical considerations in the concept of civil defense. "The paradox is as follows: the more survivors there are, in relation to the depleted resources and devastated economic and social structure of a nation after nuclear war, the less likely is national recovery" (pg. 179). FEMA has based survival assumptions on "guesses" because there is no data base that includes the enormity of a nuclear event. Medical and public health problems "do not take a holiday" in any of the CRP stages. In the evacuation phase, estimates that 9.5 to 10% of the hospital population as dischargeable (and, therefore, relocatable) are based on a 1963 and a 1976 consultant assessments without analysis of actual medical populations and without empirical data taken from physicians or other medical personnel or institutions. During the evacuation, medical personnel and supplies would also be migrating, leaving medical care ambiguous. For those "hard-core" patients left behind in the cities, the expectation that a skeleton staff would provide care is a questionable assumption with legal complications. Also discussed are problems during the relocation phase when only primary ambulatory care (no inpatient care) is offered. During the shelter phase, other problems such as epidemics and radiation injuries arise. Strategies for the allocation of medical care or other supplies are also questioned from both moral and planning standpoints.

Findings/Comments:

Conceptual article regarding medical care in event of crisis relocation.

Herr, P. 1984. "Alarms of Struggle and Flight: Citizen Response to Crisis Relocation," pp. 63-78 in J. Leaning and L. Keyes (eds.), The Counterfeit Ark: Crisis Relocation for Nuclear War. Cambridge, MA: Ballinger.

For a person to take protective action, that person must be convinced that a risk exists. In this article, Herr takes issue with Perry in the assumptions Perry makes regarding the necessary preconditions for successful CRP. Herr argues that if people don't believe that participating in CRP is not in their self-interest, then they are not likely to cooperate (pg. 66). He argues that Perry's work and FEMA's survey fail to achieve requisites for cooperation so that strategic relocation cannot take place. Evidence from current literature suggests that necessary support for CRP does not exist.

Findings/Comments: Conceptual article regarding personal motivations for crisis relocation.

Hilburn, S. and R. Parker. 1983. "Crisis Relocation: America's Halfway Plan for Survival," Journal of Civil Defense 16(6): 14-16.

This article argues that current federal and state planning offers only "half-way" plans for host communities to cope with extended survival of population because current planning is both underfunded and inadequate. Without federal or state resources, few communities can handle immediate and long-term survival of present populations and evacuees due to inadequate pre-attack planning pertaining to management, stocking and fortification of host community shelters. Furthermore, FEMA makes little allowance for enormous police personnel requirements. FEMA also ignores the problems of the post-attack recovery period when food supplies will be critical. To deal with this problem, the authors suggest food from farm surplus should be stockpiled in host communities rather than sold to the "enemy at bargain prices."

Findings/Comments: Conceptual article dealing with recovery plans following a relocation of population in event of enemy attack.

Ikle, F. C. and H. V. Kincaid. 1956. "Social Aspects of Wartime Evacuation of American Cities." Washington, D.C.: National Academy of Sciences/National Research Council.

This publication discusses three types of evacuation dispersal of urban populations in the event of war within the United States. Dispersal is discussed in relationship to warning time, extent of destruction and likelihood of repeated attacks. The authors argue there are two basic principles motivating the populace to evacuate: (1) the perception of personal danger and (2) lack of alternative courses of action forcing people to pursue action they could not be persuaded to do otherwise. Experience (i.e., of bombing) causes people to react differently than they had previously. Examination of regional dispersal indicates that non-whites probably would be housed at a higher rate of density than whites (New York City and counties within 100 miles are used for analysis). Data is otherwise taken from Holland floods of 1953 and wartime evacuation of children in England. Reaccommodation usually occurs in two stages: (1) first in collection centers or shelters (usually a temporary action) and (2) then in private quarters (most preferable when found voluntarily). Perception of the emergency affects degree of hospitality of homeowners. The authors use C. J. Lammers'

study of evacuation following Dutch floods to note significant factors regarding interfamily tensions over time, particularly when evacuation is of a long-term nature.

Findings/Comments:

(1) Three things emerged from British and Dutch experience: (1) billeting inevitably leads to interrelational personal problems, (2) problems increase over time and (3) billeting between persons of different subcultures more often results in tensions.

(2) A modified probability survey of 1000 persons in N.Y.-N.J. target area showed that 27.5% of persons interviewed could make their own accommodations in case of a threat of attack.

(3) Perception of emergency affects degree of hospitality of homeowner.

(4) Reaccommodation occurs in two steps; first, in collection centers or shelters and then in private quarters.

Hypothetical mathematical models of evacuation routes of N.Y.-N.J. target are not realistic at this time. Other problems in evacuation include conflicts in administrative jurisdiction and/or between existing private and governmental agencies.

Findings/Comments:

(1) Housing will include use of existing buildings; mass shelters will be used only as collection or rest centers.

(2) Increases in housing density in reception areas are not expected to have serious repercussions relating to hostility or health hazards but will inevitably result in interpersonal tensions.

(3) Survey of N.Y.-N.J target area showed that 27.5% of persons could provide own accommodations if needed.

(4) Probable re-employment of evacuees is most likely in existing facilities by introducing additional shifts, etc. Exchange between target cities as to re-integration of evacuated workers would therefore require federal agency involvement because of its national nature.

(5) Long-range distribution of evacuees, therefore, depends on (a) location of workers near employment opportunities, (b) housing potential, (c) where housing creates minimal of friction and (d) where total transportation for moving evacuees to respective areas is minimized.

(6) Panic is not a problem unless routes are blocked: "freedom to escape has calming effect on population," (pg. 8).

Katz, A. 1982. Life after Nuclear War, Chapter 9. Cambridge, Massachusetts: Ballinger.

This chapter questions the assumptions regarding evacuation as crisis relocation strategy. If the goals are to avoid attack or to circumvent attack, the government needs to meet more than the simple demands of feeding and sheltering the population. Evacuation will severely disrupt the economy nationally and worldwide which will take at least one to two years of recovery using strident selective controls by government even if no war occurs. In an evacuation, two-thirds of all non-governmental workers will be taken out of employment. The author notes that panic buying and hoarding as well as later scarcity of goods will further strain governmental units. The social disruption will be even greater as the conflicting desires of government and evacuees create disorganization in both the host and urban areas. Ethical issues regarding the problems of those who cannot be evacuated are also raised. The author notes that the start of evacuation may be regarded as a provocative act and rather than avoid attack create one.

Findings/Comments: Conceptual analysis regarding evacuation as national strategy in event of international crisis.

Kerr, T. 1983. Civil Defense in the U.S., Chapters 5 and 6. Boulder, Colorado: Westview Press.

This book traces the continuing efforts in the United States to develop a means of protecting Americans from the effects of nuclear war. The resulting policies have been as much the result of the political process as of weapons technology marked by non-commitment by Congress and the executive branch, general apathy of the public and hostility on the part of articulate groups. In chapter 5, the author discusses the re-emergence of civil defense plans in the early 1970's for planning of crisis relocation instead of sheltering as a means of protection. Noting the current American public's uneasiness about the escalation of nuclear weaponry, the Reagan administration's proposals on civil defense have met with enough protest to dissuade any further efforts for such planning. In Chapter 6, Kerr summarizes the major criticisms levied against civil defense planning. The author notes that critics, unlike the indifferent American majority, have expressed their opinions forcefully enough to persuade many decision makers as well as opinion leaders. The two major areas of criticism concern (1) the fundamental rational of civil defense in the face of nuclear destruction and (2) the adverse effects of specific programs on the social and economic aspects of society. Because neither side can prove its own position nor disprove the other, the issue remains, in Kerr's terms, "hanging in the air, incapable of resolution" (pg. 193). Without organized support, empirical validity and lack of saliency coupled with lack of public discussion, the issue of civil defense is likely to be relegated to obscurity.

Findings/Comments:

Conceptual analysis of civil defense policies in the United States. This provocative and detailed book finds lack of saliency by an apathetic general public, articulate and forceful criticisms of a minority of critics, non-commitment by Congress and the executive branch over time, and lack of empirical evidence supporting civil defense as obstacles relegating civil defense to continuous obscurity.

Leaning, J. and L. Keyes. 1982. The Counterfeit Ark: Crisis Relocation for Nuclear War. Cambridge, MA: Ballinger.

In this edited book the various authors argue conceptually, theoretically and sometimes empirically that nuclear war is a singular event for which there can be no adequate preparation especially in the area of Crisis Relocation Planning (CRP). No civil defense program can enable a population to rebuild a society devastated by nuclear war. The fundamental difference in which nuclear war differs from all other disasters is that there will be no outside source of resources from which to draw on in the event of a nuclear war. The analogies and data which FEMA and others have used to defend CRP are unrealistic, inadequate and illogical - the only strategy for surviving nuclear war is avoidance. Contributions by 16 authors plus Leaning and Keyes examine various areas of CRP and a nuclear catastrophe including the psychological and social consequences as well as the physical and environmental impacts of nuclear war.

Findings/Comments:

Most chapters are conceptual or theoretical with some documentation for results of analyses.

Leaning, J. and L. Keyes. 1984. "The Singularity of Nuclear War: Paradigms of Disaster Planning," pp. 3-21 in J. Leaning and L. Keyes (eds), The Counterfeit Ark: Crisis Relocation for Nuclear War. Cambridge, MA: Ballinger.

Immediately quoting Quarentelli, Dynes and Perry regarding the conceptualization of disaster analysis and mitigation strategies, the authors argue that the only mitigation strategy for nuclear war is prevention. Perception of risk assessment depends on past experience, the probability of occurrence, perception of impact, capacity to intervene and availability of outside resources. Instead of trying to change people's perceptions of nuclear war, the political climate needs changing. CRP is an

unworkable and dishonest approach from their viewpoint because CRP cannot reduce the risk of nuclear war. As a doctrine of deterrence, the benefit of nuclear weapons exists in their ownership and potential threat, not in their use. However, the deterrence approach has now eroded and nuclear weapons are used just as any other technology - one which is not "safe" in any sense to use. Therefore, the only option that exists in the geopolitical arena is to reduce the number of weapons and eliminate their use; CRP only distracts us from the real issues.

Findings/Comments: Conceptual article regarding the singularity of nuclear war as a disaster.

Lipsky, M. 1984. "Things Fall Apart: Problems of Governance and Social Control, pp. 144-158 in J. Leaning and L. Keyes (eds), The Counterfeit Ark: Crisis Relocation for Nuclear War. Cambridge, MA: Ballinger.

Arguing that 95% of society's social control is maintained by the people themselves, the author questions whether in time of acute crisis such as nuclear war people would accept the current political authority as legitimate. Lipsky focuses on the nature of legitimate authority noting that it rests in the social construction of the population and the attendant social structures. FEMA has not addressed the issue of political authority in the various stages of CRP, i.e., in the relocation, the reception areas, the "holding period," and the "post-shelter" period. Thus, whether people would consent to massive evacuation and subsequent hardship as well as remain away from previous locations is questionable. Basing assumptions on research from natural crises and other wars or using analogies only provides "symbolic reassurance" not a material basis on which that reassurance rests.

Findings/Comments: Conceptual article regarding government and authority during crisis relocation.

Mack, R. W. and G. W. Baker. 1961. The Occasion Instant, National Academy of Sciences/National Research Council Disaster Study #15. Washington, D.C.: National Academy of Sciences.

This report describes the results of three studies of attitudes and behavior following the sounding of civil defense sirens which did not signal an imminent attack but differed from ordinary practice warnings. Studies conducted in Washington, D.C., in Oakland, California, and Chicago, Illinois, were used to compare reactions to the same phenomenon. They

point up the urgent need to develop an adequate warning system because few people interpreted the signal correctly or took any measures to protect themselves.

Findings/Comments: Few people interpreted unusual sounding of civil defense site sirens correctly or took any measures to protect themselves.

Nehnevajsa, J. 1983. "Some Ecological Contexts of Attitudes Concerning Issues of Civil Defense." Pittsburgh: Center for Social and Urban Research, University of Pittsburgh.

This report focuses on the public acceptance and credibility of six clusters of major issues concerning civil defense preparedness. The data is derived from a 1978 national survey involving 1,620 respondents, 77% living in documented high risk areas and the rest in lower risk areas. Questions were asked related to perception of threat, survivability, civil defense costs, the implementation of crisis relocation programs, general attitudes toward crisis relocation and claims regarding willingness to act. The research contextualizes responses within the geo-ecological characteristics available from census data at the county level for comparability between counties. These included the global characteristics, population composition, population dynamics, occupational structure as well as the county's average socioeconomic status. Noting that the threat of war is a real one to respondents, data indicates the meaning of "relocation" is often unclear and frequently equated with "movement to shelter." A summary is provided for national sample as a whole, for differences between those in high-risk and those in low-risk areas, and by implication according to socio-demographic factors of counties.

Findings/Comments: (Aggregate)

(1) Two-thirds support the need for crisis relocation planning but in-place fallout sheltering and blast protection are seen performing better than crisis relocation.

(2) Two-thirds of the respondents also did not believe there would be sufficient time to evacuate but more than half indicated they intended to evacuate spontaneously in deteriorating world situation.

(3) Seven out of 10 respondents felt a situation could exist in which the President recommended or urged evacuation from high risk to low risk areas. In a directed relocation most would prefer to "follow directions" rather than to decide to relocate to a place of their "own choosing."

(4) People were convinced the nation was spending more on civil defense than it does and that even more "ought" to be spent on civil defense.

Perry, Ronald W. 1982. The Social Psychology of Civil Defense. Lexington, Mass.: Lexington Books.

Civil defense including Crisis Relocation Plans (CRP) can be interpreted within the context of emergent norm theory of collective behavior. The objective of CRP is to move citizens out of an area before an attack begins. Thus warning response behavior in the event of nuclear attack situations does not differ from that behavior elicited in natural disasters. Perry argues that every disaster agent has some unique characteristics with nuclear events having as much within-category variation as between-category variation. Thus the focus should be on developing generic functions of coping with hazard. There are four essential conditions that ensure a decision to relocate: (1) the individual must have an adaptive plan; (2) the individual must perceive that personal risk involved in not relocating is high; (3) the threat must be perceived as real, and (4) the individual must have either the family (household) assembled to evacuate or have all members accounted for and not in danger. Emergency managers must address two activities (1) identifying appropriate adaptive behaviors and strategies for implementing protective action and (2) educating the relevant population with regard to the particular plan. Incentives recommended include information on safe destinations and plausible safety routes given in advance or as part of warning message, developing warning-confirmation centers based on telephone contacts, establishment of family message centers and development of some form of security measures for areas evacuated.

Findings/Comments:

Review of literature as applied to potential problems associated with CRP reiterates findings from natural hazards, i.e.:

(1) Compliance with request to relocate is enhanced if individual has adaptive plan.

(2) Compliance with request to relocate is increased if level of personal risk is believed high or that threat is real.

(3) Compliance with request to relocate is more likely if family members are together or accounted for during relocation.

(4) The closer one's relationship to extended kinsmen, the more likely additional information will be received by individual.

(5) The greater an individual's involvement in community, the more likely the exposure to civil-defense or emerging training programs.

(6) The greater the individual's involvement in community, the greater the number of potential credible sources of warning information.

(7) Individuals characterized by external locus of control are less likely to comply with a warning to relocate or to engage in any type of protective action.

Perry, R. W., M. Lindell, and M. Greene. 1980. The Implications of Natural Hazard Evacuation Studies for Crisis Relocation Planning, Seattle, Washington: Battelle Human Affairs Research Centers.

This study, prepared for FEMA, develops the rationale for using empirical findings of natural hazard evacuation literature as a framework for Crisis Relocation Planning (CRP). Using the emergent norm as a theoretical approach for a basis for their generalizations, the authors argue that CRP can act as a standby mechanism by serving as a substitute normative system in times of threat from nuclear war. Furthermore, the authors argue that the same analytical and conceptual frameworks can be used for any type of disaster analysis using the three important variables found in evacuation response behavioral studies: (1) a definition by respondent that the threat is real (warning belief), (2) a clear perception of personal risk, and (3) the presence of an adaptive plan. They argue further that without CRP the time needed to recover and the lives lost would be so great as to make resistance infeasible.

Findings/Comments:

Conceptual study prepared for FEMA on the use of findings from natural hazard research for Crisis Relocation Planning.

Platt, R. H. 1983. "Nuclear Crisis Relocation: Issues for a Host Community," (unpublished report). Amherst, Massachusetts: Department of Geology and Geography.

This conceptual article examines the implications of the plan to use Greenfield, Massachusetts, as a host community during a nuclear crisis as part of the Crisis Relocation Plan (CRP). The report was prepared in a geography teaching seminar at the University of Massachusetts between March and May, 1983. The report concludes that the CRP plan for Greenfield is a "hopeless travesty" and is worthless as it imperils the prospects of survival for the town's own residents.

Findings/Comments:

Conceptual analysis drawing on hypothetical assumptions regarding implications of crisis relocation on a Massachusetts host community.

Redlener, I. 1984. "Knowing the Worst Too Young: Children and Crisis Relocation," pp. 118-128 in J. Leaning and L. Keyes (eds.), The Counterfeit Ark: Crisis Relocation for Nuclear War, Cambridge, MA: Ballinger.

In this chapter, the author argues that we must protect our children in a nuclear war to guarantee survival as a society. In FEMA's relocation plans, children receive only incidental attention. For the children, the loss of health care delivery system would severely decimate the child population. Arguing that only about 20% of the hospitalized children could be safely released to their parents at any one time, the question then arises as to who and how the children that need special care will be adequately treated. Furthermore, none of the plans advocated by FEMA recognize the magnitude of behavioral, social and psychiatric problems that situations of extreme stress, i.e., nuclear war, occurs in children, "the most vulnerable members of our society" (pg. 127). Thus, CRP is only a promise of survival which "serves to foster a dangerous illusion that could cause great harm, especially to our young" (pg. 128).

Findings/Comments: Conceptual article regarding effects of crisis relocation on children, particularly those requiring special care.

Rudolf, R. 1983. "Study Investigating the Feasibility of Large-Scale Evacuation in Washington State." Olympia, Washington: Washington State Department of Emergency Services.

The feasibility of evacuating large numbers of people of Washington State to places of safety in event of a major disaster or in anticipation of such an event is the focus of this study. The major areas addressed are statutory governmental responsibilities for protection of the public, recent experiences involving large-scale evacuations, public attitudes toward disaster preparations including that during nuclear crisis and what specific preparedness measures can be taken to feasibly promote orderly large-scale evacuation within Washington State. Data for analysis was taken from the 1982 Gallop survey of national opinion towards large-scale evacuations and a survey using the same subject sent to all Washington officials. Noted are both spontaneous and official evacuations. Survey instruments and results are included in appendices along with other information regarding the Washington State population, traffic routes and capacities.

Findings/Comments:

(1) Eighty-four percent of local elected officials did not agree that civil defense preparations would increase nuclear war.

(2) Seventy percent of elected officials agreed with idea that well prepared civil defense would be helpful in coping with other disasters.

Schon, D. A. 1984. "Faith in the Rational Leap: Social Science Research and Crisis Relocation for Nuclear War" pp. 24-47 in J. Leaning and L. Keyes (eds.), The Counterfeit Ark. Cambridge, MA: Ballinger.

The author states his purpose is to develop a "frame reflective" analysis over the impacts of nuclear war. Arguing that the premises and assertions of applying current research methods to a nuclear war crisis are doubtful and even may be "articles of faith," Schon takes to task three "survivalist" writings, the Hanunian report for Rand Corporation, Dimensions of Survival: Postattack Survival Disparities and National Viability, the Hans and Sell Evacuation Risks - an Evaluation, and Perry's The Social Psychology of Civil Defense. Schon views these "survivalists" as "systems analysts and applied social researchers" usually financed through government organs who see nuclear war as another form of disaster for which one can be prepared, referred to here as "the mystique of Technical Rationality." Although highly critical of the approaches used, no new or different method is advanced for studying the problem. Rather Schon chooses to end with a different conception of "reasonableness" and "morality" which "begins by accepting our inability to predict, plan, or control our responses to phenomenon that lie beyond analysis" (pg. 47).

Findings/Comments: Conceptual article regarding use of current research network in disasters to nuclear war crisis relocation.

Schroeder, P. 1984. "The Value of Crisis Relocation," Impact Assessment Bulletin 2: 21-22.

In this brief article, Schroeder, current democratic U.S. Representative from Colorado, argues that FEMA's CRP to evacuate 250 high-risk population centers will not deter Russian attack. The issue is that state and local officials fear that crisis relocation funding is tied to other civil defense funds such as natural disaster clean-up and that refusing CRP would jeopardize these other funds. Among the 100 communities who

have formally rejected their CRP's are Boulder, Colorado, and the state of Maryland.

Findings/Comments: Conceptual article regarding use of CRP as political deterrent to Soviet attack.

Susskind, L. 1984. "A Home in That Rock: Sheltering the Relocated Population," pp. 131-143 in J. Leaning and L. Keyes (eds.), The Counterfeit Ark: Crisis Relocation for Nuclear War. Cambridge, MA: Ballinger.

This chapter criticizes FEMA's plans for sheltering approximately 145 million people in the event of nuclear war. Of particular concern is the system of shelters currently proposed, the exorbitant cost of financing the civil defense program, and the logic of crisis relocation that appears to diminish rather than enhance the chances of survival in a nuclear war. Assuming that the temporary shelters will become post-attack dwelling places for a lengthy period of time, the author questions whether shelter managers will be able to maintain social control, begin the process of replenishing supplies, and rebuilding or reestablishing local government and a semblance of order after emergence from the shelters. The author claims that the system of civil defense has lulled the public into a greater acceptance of the prospect of nuclear war while the current civil defense system would probably result in destruction of half the population. This public willingness to contemplate a shelter system "only encourages the construction of more weapons by the Soviet Union" (pg. 143).

Findings/Comments: Conceptual article regarding sheltering and recovery of evacuees after nuclear attack.

Zelinsky, W. 1985. "The Emergency Evacuation of Cities: A Comparative, Crossnational Study," paper presented at the Association of American Geographers Annual Meeting, Detroit, Michigan, April 1985.

This conceptual paper examines the 20 emergency evacuations of urban populations within 16 countries because of actual, potential or imagined, and man-made disasters including that of war since 1930. Although several cases conformed to the classic gravity pattern of dispersal during evacuation, the mobility patterns of evacuees suggest that the propensity to move is highest in young females with offspring and those who are aged, physically ill or disabled. Able-bodied working age males

are those left behind. In addition, elements of hysteria and panic were noted when evacuations involved nuclear accidents, war or rumors -- non-routine disasters. The author concludes that history and current military technology renders obsolete any plan for saving urban inhabitants through mass evacuations.

Findings/Comments:

(1) In many instances, entire populations remain in place despite devastating storms or earthquakes; examples are Chilean earthquakes, March, 1965; Tangshan, China, earthquake, July, 1976; Belize, destroyed by Hurricane Hattie in October, 1961; Pozzuoli, Italy, earthquakes since September, 1983; and Rabaul, New Britain, nested in caldera of volcano, giving evidence of activity since 1983.

(2) Gravity model of dispersion of evacuees observed in several situations: Three-Mile Island nuclear accident, March, 1979; Managua earthquake, December, 1972; Skopje, Yugoslvania, earthquake, July, 1963; Popayan, Colunbia, earthquake, April, 1983; La Soutriere, Guadeloupe, volvano showing activity, January, 1937; and similarly in populations along Gulf of South Atlantic during hurricanes since 1950's.

(3) Exceptions to gravity model of dispersion of evacuees include Darwin, Australia, by administrative fiat, evacuation of urban areas of England and Scotland during summer of 1939 onward by British government, evacuation of school children during war in Japan, Germany, and German-occupied territories and other war-induced evacuation of cities.

(4) Mobility patterns of evacuees in peace-time and wartime cases violate normal patterns in that the aged, physically ill or disabled are disproportionately numerous among streams of evacuees.

(5) Panic is seen in those fleeing from results of military activity, for example, the L'Exode and those fleeing from German and Japanese cities during later days of World War II.

Zukerman, E. 1984. The Day After World War III, Chapter 5. New York: Viking.

This chapter describes FEMA's CRP civil defense program including the instructions printed in brochures and filmstrips already prepared by the agency. The New York evacuation plan, surveying of possible shelters, preparation of shelters including those just for the size of one family,

and instructions regarding the management of public shelters including the problems of radiation and keeping spirits high are discussed.

Findings/Comments: Conceptual chapter clearly infers that CRP policies will have problems in relocation and evacuation.

Additional information on evacuation planning for war and attack is found in the following FEMA publications on crisis relocation which have not been abstracted.

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MULTIPLE HAZARDS

MULTI-HAZARD

Anderson, L., J. Keaton, T. Saarinen and W. Wells II. 1984. "The Utah Landslides, Debris Flows and Floods of May and June 1983." Washington, D.C.: National Academy Press.

This report discusses the numerous and widespread damages sustained by Utah during nearly three months in 1983, from flooding, landslides, and debris flows. Although prepared for above-normal stream flows and some flooding neither the scientific community nor the state emergency agencies could foresee or prepare for the widespread landsliding and debris and mud flows that left 22 of Utah's 29 counties declared national disaster areas. Ninety-two landslides occurred along a 15-mile stretch of the highly populated Wasach Front. The types of events that occurred are discussed in general terms with selected examples described in detail. These include (1) the Salt Lake County flooding that resulted in diversion of flood waters at one point through a main street of Salt Lake City and in the Great Salt Lake rising 1.1 ft., (2) the Thistle Landslide which was reactivated on April 9, 1983, and resulted in a 220-ft high dam across Spanish Fork Canyon creating Thistle Lake, closed two major highways and forced the relocation of one railroad line and (3) the Farmington debris flow which destroyed five homes. Public response to the extended hazards included active volunteer participation especially by members of the Mormon Church both in mitigating the threats and in the clean-up and reconstruction phases.

Findings/Comments:

This report was prepared for the Committee on Natural Disasters and includes technical geological and hydographical material as well as some description of the public participation during the extended and widespread events.

Aquirre, B. O. 1983. "Evacuation as Population Mobility," International Journal of Mass Emergencies and Disasters 1: 415-3

An analytical perspective is used to argue the relationship of human evacuation and migration share important characteristics and that evacuation is a part of geographical mobility. Focusing first on the variables of distance, permanence and voluntarism, which are used to distinguish evacuation from migration, the author notes that the assumed clear-cut distinctions often made are unwarranted. Three models are then developed which provide a basis for a synthesis of the two types of geographical mobility: evacuations and migrations as residential displacements, as the result of subjective decision-making processes triggered by stressors, and as instances of collective behavior.

Findings/Comments:

Synthesis of literature provides three models of geographical mobility involving evacuations and migrations.

Drabek, T. E. 1983. "Shall We Leave? A Study of Family Reactions When Disaster Strikes," Emergency Management Review 1 (Fall): 25-29.

This article summarizes the behavioral dynamics of response to warnings to evacuate that should be taken into account in developing workable emergency plans. Eight behavioral principles are listed: (1) typical initial response is disbelief, not panic, (2) sirens do not constitute a public warning, (3) the warning message must include both information about the threat and directions about adaptive behavior, (4) the greater the specificity of information the more people will believe the message, (5) community warning systems must perform the functions of detection, measurement, collation and interpretation of threat as well as the decision to warn including message content and dissemination, (6) patterned variations occur in response between sexes, and age and ethnic groups, (7) warnings from authority figures are perceived as more credible and (8) the individual acts as group member in receiving and processing warnings. After seeking confirmation, Drabek found people evacuated through four patterns - by default, by invitation of friends or relatives, by compromise and by decision, usually a collective one. The need for public shelters is overestimated as most people typically seek refuge with friends or relatives except when an entire community is evacuated or evacuation is perceived as being for a long period. To facilitate evacuation, Drabek urges planners to (1) encourage family plans for evacuation including the distribution of phamplets at appropriate times when threat is imminent, (2) have media reports consistent, (3) allay fears of looting perhaps through citizen task forces, and (4) establish family message centers, perhaps using citizens for this task.

Findings/Comments:

Orientational article outlining eight behavioral principles found on people's responses to warnings to evacuate. Article is directed toward personnel involved in emergency management planning.

Drabek, T. E., H. L. Tamminga, T. S. Kilijanek and C. R. Adams. 1981. Managing Multiorganizational Emergency Responses: Emergent Search and Rescue Networks in Natural Disasters and Remote Area Settings. Boulder, Colorado: Institute of Behavioral Science, The University of Colorado.

This book focuses on Search and Rescue (SAR) activities of emergency management organizations. Through interviews of officials and survivors conducted over a three-year period, SAR response was studied in six different types of disasters. Using a technique called social mapping, a series of diagrams for each incident was developed that analyzed the previous year's relationships between the organizations and groups involved, the operational communications and leadership patterns and the attitudes toward the effectiveness of the organizations. Included in some of the events are descriptions of rescues that occurred because people did not evacuate in time or who choose an unsafe location. Liability issues are also discussed as a recurrent concern in rescue operations. Survey instrument and blockmodeling technique for examining network structures are included in appendices.

Findings/Comments:

This book deals with the problems and policy issues encountered by those involved in Search and Rescue (SAR) activities in natural disasters and in remote area settings. Implicit throughout the book are the issues involved in evacuation of victims following a disastrous event by both emergent groups and institutionalized organizations.

Fritz, C. 1957. "Disasters Compared in Six American Communities," Human Organization 16 (Summer):6-9.

This paper reports the findings mainly from interviews conducted during eight field trips to six disaster-stricken communities from September, 1951, to March, 1952. Fritz argues that disasters tend to individuate behavior because persons are initially confronted with unpredictable and highly divergent situations. Persons assimilate cues using a normal frame of reference but the cues are spatially limited because of their immediate surroundings. Comparisons of disasters should include (1) speed of precipitating agent and length of forewarning, (2) nature of destructive agent, (3) physical scope and destructiveness of disaster, and (4) length of threat. Maximum social and psychological disruption occurs when disasters are instantaneous, a large number of people are killed or injured, large amount of property is damaged, or when primary groups are separated at time of impact. If threat is over quickly or nature of destructive agent is clearly perceivable or well known to population, the social disorganization is likely to be less intense and briefer in duration. The nature of the social situation at time of impact or previous degree of solidarity must also be considered.

Emergent leaders are generally those with previous "disaster role" experience or those with no ego involvement. Panic, defined as an acute fear reaction followed by flight behavior (evacuation), is a relatively infrequent form of behavior, tending to occur under fairly specific conditions. Controlled withdrawal oriented not in terms of escape from danger but movement toward a goal is much more common behavior. Nor does data support concept of "scape-goating" by victims even among those with the most intense losses or deprivation. Resentment may arise later in stages of relief and rehabilitation when discrimination is perceived as to who gets what and why.

Findings/Comments:

(1) Individuals interpret disaster events differently depending on the immediate spatial cues but within a normal frame of reference.

(2) Initial behavior in disasters lacks coordination but is not maladaptive or irrational. Substitution of collective or common definition of situation through communication channels is effective in coordinating behavior.

(3) Panic defined as an acute fear reaction followed by flight behavior (evacuation), is a relatively infrequent form of behavior, tending to occur under fairly specific conditions.

(4) Maximum social and psychological disruption occurs when disaster is instantaneous or when families or primary groups are separated at time of event.

(5) Emergent leaders in disaster often those with previous "disaster role" experience.

Fritz, C. E. and E. S. Marks. 1954. "The NORC Studies of Human Behavior in Disaster," Journal of Social Issues 10: 26-41.

This paper analyzes data collected by the National Opinion Research Center (NORC) regarding reactions to disaster as evidenced from studies involving over 70 major and minor disasters (majority are from eight field trips to disaster sites). Although reactions to disasters vary considerably both with the individual and with the nature of the disaster, certain general "modes" of reaction can be distinguished according to the activity level varying from the agitated to the depressive. Panic reactions of flight or uncontrolled evacuation are generally rare occurring only when (1) an individual believes the situation is personally threatening and (2) that escape is possible at the moment but may become impossible in immediate future. Other salient factors in NORC studies (particularly the Arkansas tornado) are the

extent of forewarning of impending disaster and evidence of emotional reactions aggravated by separation of family members or with intimate contact with dead and injured.

Findings/Comments:

(1) Panic flight, or uncontrolled evacuation, appears to occur under restricted conditions present in some disasters and only for some people involved in event. It is not the irrationality or uncontrolled nature of individual behavior but the lack of coordination among large number of persons acting on basis of different personal definitions of the situation which can present problems.

(2) Amount of forewarning has effect on actions taken and losses sustained. Evidence indicates that inadequate warning may actually increase loss rather than no warning at all.

(3) Emotional reactions appear aggravated by experiences of separation from family members as well as with contact with injured and dead.

Fritz, C. E. and H. B. Williams. 1957. "Human Being in Disasters: A Research Perspective," The Annals of the American Academy of Political and Social Science 309 (January): 42-51.

Analyses of 40 disaster studies indicate that disaster warnings need to be as clear and specific as possible and transmitted through appropriate channels to entire public to be successful. Lack of prior experience with the disaster agent and delusion of personal invulnerability interferes with an individual's ability to adopt a new frame of reference when coping with disaster. With no prior warning or environmental cues, recognition of danger is delayed. When danger is imminent, panic only occurs when people perceive (a) there is immediate personal danger, (b) only one or a limited number of escape routes exist, (c) that these escape avenues are closing (not closed at present), and (d) there is little communication to keep people informed of the situation. Generally control of convergence of outsiders needed, not control of victims. Coordination of rescue and relief (likened to mass assault) are often key problems after event. Social solidarity increases during emergency and post-emergency phases decreasing as threat subsides and influences both personal and social recuperation. Hostility and blame not problems of victims who are essentially "future-oriented" in searching for amelioration of future threat. "Issue-makers" may use mass media to foster "scapegoats" for their own purposes. Behavior during post-impact phase refutes notion that psychological disturbances caused by disaster agent renders population dependent and helpless. It is a lack of uniformity of action (i.e., social disorganization) that

has led outsiders to form erroneous conclusions. Problems of disaster management result as a lack of fit between perceptions of needs of victims and organized relief agencies.

Findings/Comments:

(1) Fear by officials that people will panic when given warnings is not supported in studies of disasters.

(2) An effective warning message must be clear and specific transmitted accurately through channels which will reach the entire public without additional contradictory information.

(3) People are reluctant to accept and act on warnings which are not perceived as immediate and personal.

(4) Reluctance to abandon property and personal possessions are common factors weighing against evacuation of threatened areas.

(5) Authors found studies support the idea that belief and reluctance to act upon flood warnings stem from lack of past experience, delusion of personal invulnerability, inability to adopt a new frame of reference, dependency on officials and denial or disregard of impending threat communications.

(6) When people have no prior warning, recognition of danger is frequently delayed.

(7) When danger is recognized as immiment and personal, people seek safety by flight (evacuating), sheltering or combating the disaster agent.

(8) Actual behavior during impact is largely determined by nature of situation as an individual assessment.

(9) People in impact zone, if isolated for an hour or more, will accomplish many of the immediate and pressing rescue and relief tasks, including evacuation of casualties, before outside help arrives.

(10) Contrary to popular image, movement toward disaster is both quantitatively and qualitatively more significant than evacuation from the impact area.

Fritz, C. E. and J. H. Mathewson. 1957. "Convergence Behavior in Disasters." National Research Council Disaster Study #9. Washington: National Academy of Sciences.

This seminal study focuses attention on convergence behavior as a basic element of crowd formation and in the generation of social movements and social institutions and not as phenomena limited to disasters. Three forms of convergence behavior are recognized: personal, informational and material. A typology of convergers is also delineated by types of roles (that include initial motives) people play: the returnees, the anxious, the helpers, the curious, and the exploiters. Interviews indicate that shifting and changing of role behavior and motivation occurs during a disaster. Previous plans to control convergence have not dealt with the problem in a positive sense but with negative restraint techniques. Thus, alternatives to convergence problem encountered after disasters include preplanning with emphasis on developing greater precision and coordination of information gathering including monitoring of media, organizing and training of population to assume responsibilities, orienting organizations dealing with disaster about convergence problems, and training personnel in specific techniques. A spatial model of convergence behavior is included in text. Data is derived from secondary sources.

Findings/Comments:

(1) Convergence action, movement of people, messages and supplies toward a disaster-struck area, has been verified in almost every study of disaster.

(2) The volume of external informational convergence is largely a function of: (1) the accuracy and specificity of information regarding the geographic scope of disaster, and (2) the degree with which information is gathered, evaluated and disseminated to appropriate receivers. Dissemination of erroneous or ambiguous reports therefore aggravates problems.

(3) Mass media is not well adapted to the dissemination of supply appeals because no control can be exercised over donors once appeals are made.

(4) Data indicates that the magnitude of convergence often hinders organized rescue and relief operations and otherwise impedes restoration of normal life.

(5) Return of permanent residents is selective in nature and dependent on the extent and type of losses suffered in a disaster.

(6) Evidence suggests a class and age differential in the speed with which residents return.

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(7) Legitimate collection of articles by friends and relatives may be mistaken for looting. Regardless of objective nature of threat from looting, victims hold belief that considerable looting follows disaster and they expect authorities to protect their property (pg. 54).

(8) Separation of primary and extended family members and friendship groups is perhaps the most significant single fact to comprehend in understanding the large amount of anxiety-motivated convergence that occurs in disasters (pg. 37).

(9) Disaster victims prefer to "double-up" in homes of relatives and friends than take advantage of available public shelters or make formal requests for housing (pg. 42).

(10) "Cornucopia theory" suggests a tendency to think in terms of repair instead of prevention and may produce disaster organizations which are better adapted to excess supply than to inadequate supply (pg. 46). The result is that formal relief and control agencies frequently overestimate the proportional extent of their own efforts and grossly underestimate the extent of informal assistance. (pg. 41).

(11) Spatial distance appears to be a greater determinant of personal curiosity convergence than of personal anxiety or help convergence (pg. 48).

(12) Although disasters increase the opportunities for exploitation, they often reduce the motivation to engage in that form of behavior, at least among the population which experiences the disaster (pg. 51). Exploitation involves ego-detachment rather than ego-involvement in a situation (pg. 52).

(13) The search for "tokens" or "souveniers" must be recognized as a prevalent tendency, especially among the external convergers who are motivated predominantly by curiosity. The frequency with which merchants and vendors capitalize on this tendency following disasters by the sale of photographs and surviving disaster-scarred objects suggests both a universality of this type of behavior and one of the means by which it can be channeled into non-disruptive forms (pg. 56).

Hans, J. and T. Sell. 1974. Evacuation Risks--An Evaluation. Las Vegas: U.S. Environmental Protection Agency, National Environmental Research Center.

After examining approximately 500 evacuations between January 1960, and February 1973, regardless of cause, 54 evacuations were selected for investigation of risks involved in an evacuation. From this data, the objective was to assess the risk of death, major injury and cost associated with an evacuation in the event of an accident at a fixed nuclear facility. Both questionnaires and personal interviews were used for analysis. Events were selected to cover a wide range of population sizes but all transportation accidents involving hazardous materials and an evacuation of more than 500 people were included. The number of people evacuated in the 54 events totaled 1,142,336 persons. Only ten deaths and two injuries were reported in all the evacuations making valid statistical comparisons inappropriate. The authors suggest using the U.S. rates compiled for motor vehicle accidents per person-mile as an alternative risk measure although this may lead to an overestimation of expected injuries and deaths when miles evacuated are large or when only a single event is analyzed. In determining costs, four categories were used for estimates: (1) expenses involving evacuees, (2) costs involving evacuators, (3) financial losses of farm areas, and (4) financial losses of urban and industrial areas. The authors note that the cost of an evacuation would be minor in ordering an evacuation especially if there were any risk at all from the disaster agent. In addition parameters in an evacuation that affect risk and how those parameters can be used to prognosticate risk were explored. Also explored were times needed to evacuate rural, urban and suburban populations (but no mixtures) depending on population density, road capacity or existing withdrawal plans. The authors further note that even when presented with a grave threat people refuse to evacuate and that there is no reason to believe that radiation rather than some other agent will provide sufficient motivation to evacuate. Some problems associated with evacuations including premature childbirths, convergence behavior and evacuations of institutions whether public or private are also discussed. No panic or looting was reported.

Findings/Warnings:

(1) The risk of injury or death to evacuees does not change as a function of the numbers of people involved.

(2) The risk of injury or death to evacuees can be approximated using the National Highway Safety Council statistics for motor vehicle accidents, although subjective information suggests that the risks will be much lower.

(3) Most evacuees utilize their personal vehicles in an evacuation.

(4) Most evacuees assume the responsibility of acquiring food and shelter for themselves.

(5) No panic or hysteria has been observed in evacuations.

(6) Evacuation costs are highly area-dependent and should be computed.

Janis, I. L. and L. Mann. 1977. "Emergency Decision Making: A Theoretical Analysis of Responses to Disaster Warnings," Journal of Human Stress 3 (June): 35-48.

Focusing on the cognitive aspect of decision-making, this article presents a theoretical model for the analysis for human response to warnings or signs of danger. The conflict-theory model of emergency decision-making suggests that effective emergency decisions are most likely when a vigilant coping pattern as opposed to hypervigilant pattern is dominant. The pattern of vigilance requires that four mediating conditions be met: (1) the awareness of serious risks if no protective action is taken; (2) the appraisal of expected effectiveness of protective action; (3) the moderate or high degree of hope that a better means of escape is realistically feasible; and (4) that sufficient time is available to search and evaluate information and advice. Hypervigilance and even panic may occur when people fear entrapment and feel little time is left to make a safe exit from the situation. When accompanied by sensory deprivation, restriction of activity or lack of contact with supportive persons feelings of helplessness increase. The authors argue that the uniqueness of the model lies in the specification of conditions relating to conflict, hope and time pressure which mediate the distinctive coping patterns.

Findings/Comments:

This is a theoretical analysis of psychological conditions involved in human reactions to warnings or signs of danger.

Jaske, R. 1984. "FEMA's Integrated Emergency Management Information System," (draft report). Washington, D.C.: Federal Emergency Management Agency.

The Integrated Emergency Management Information System (IEMIS), developed from FEMA's Radiological Emergency Preparedness Program is designed to assist emergency managers in planning, exercising and evaluating emergency response in hurricane evacuation. Four simulation models are included: (1) the dispersion model, (2) the dose model using the dispersion model and population density, (3) the evacuation model which will "calculate population levels and evacuation time in response

to evacuation instructions, transportation networks and any obstacles" producing "measures of effectiveness: measures of travel time, vehicle queues and delays and person throughput" (pg. 9), and (4) a sound propagation model determining the extent of siren warning. The application programs include scenario generation for (1) emergency response exercises, (2) exercise evaluation regarding timeliness of response by officials through evaluation of productive actions of evacuation and sheltering during a hypothetical emergency, (3) a data base accessible for other application models, and (4) an evacuation plan evaluation constructed in the emergency response by calculating time needed to evacuate population of interest.

Findings/Comments:

Orientational article dealing with software program available to emergency managers using simulation models.

Mileti, D. 1985. "Role Conflict and Abandonment in Emergency Workers," Emergency Management/Review 2: 20-22.

Concern over role conflict or strain and role abandonment is particularly acute when it references behavior of emergency workers during emergencies. This article examines Killian's original concept (1952: 309-314), as well as other accounts of role abandonment in emergency workers. Evidence from White (1952) notes that although role conflict exists in emergencies, role certainty in emergency work roles yields performing work roles over family roles and family roles over emergency roles when emergency roles are not clear and certain. Mileti concludes that the abandonment of emergency work roles by emergency workers is not a problem in disasters if emergencies are prefaced by emergency worker training. Thus, it is essential that emergency plans and emergency worker training programs are adopted.

Findings/Comments:

(1) When emergency roles are "certain" for emergency workers, role conflict in emergencies does not result in the abandonment of emergency work roles (pg. 22).

(2) When emergency work roles are not clear or "certain" - perhaps through lack of training or planning - for emergency workers, role conflict in emergencies can result in seeing would-be workers play more certain roles toward intimates before attending to emergency work (pg. 22).

(3) Role conflict for emergency workers can elicit psychological stress about safety of intimates and workers can improvise ways or emergency plans can formalize methods for workers to check on intimates.

Motz, Annabelle Bender. 1983. "Relocation as Process: A Social Psychological Perspective." Research Report 81-R01. Ft. Belvoir, VA: Institute for Water Resources, Water Resources Support Center.

This report examines the relocation process from a social psychological perspective using past studies for data. Three sets of actors are identified: the potential relocatees including their immediate community associations, the larger community, and those who define and implement relocation. Phases of relocation includes the planning and preparation stage, the actual move and the post-movement adjustments. Attention is directed towards the ways people respond to relocation according to their cosmopolitan/local orientation and their self-identity regarding the symbolic aspects of home and community. Possible reactions after the move are also examined. Implications for facilitating relocation as a nonstructural alternative of Army Corps of Engineers policies as well as a possible means for assessment of relocation process are suggested.

Findings/Comments:

(1) The extent to which an individual's self-identity is dependent upon the space of his or her home and neighborhood is likely to significantly affect his/her reactions to relocation.

(2) One's orientation toward life (local/cosmopolitan) is likely to be associated with the facility with which one adapts to new situations including relocation.

(3) Satisfaction with relocation increases over time.

Perry, Ronald W. 1979. "Evacuation Decision-Making in Natural Disasters," Mass Emergencies 4(1): 25-38.

This paper reviews and summarizes empirical studies of warning responses focusing on voluntary pre-impact evacuation behavior. While earlier studies lacked analytic models identifying variables and specifying patterns, the later systems models were useful only if analyzed at the community level. Not very useful at looking at individual behavior, systems models were usually supplemented by some form of social-psychological model to enhance the framework and allow analysis of both the individual and community levels at the same time. The adaptation of the integrated systems/emergent norm approach further permitted the "temporal ordering of factors" in personal reactions to warnings. Six variables are described: (1) presence of adaptive plan, (2) individual definition that threat is real, (3) level of perceived risk, (4) family context in which warning is received, (5) patterns of kin relationships, and (6) level of community development. A flow diagram of systems-emergent norm issues in individual response to natural hazard warning and a model using variables in individual decision to evacuate are presented in paper.

Hypotheses: (verbatim)

(1) The more precise the individual's adaptive plan, the higher the probability of evacuation.

(2) The greater the individual's perception of real threat (warning belief), the greater the probability of evacuation (data as reported is conflicting regarding this hypothesis).

(3) The higher the level of perceived personal risk, the greater the probability of evacuation.

(4) To the extent that family (household) members are together or accounted for, the probability of evacuation is increased.

(5) The closer one's relationship to extended kinsmen, the more likely one is to evacuate.

(6) The greater one's participation in the community, the more likely he/she will evacuate.

(7) Families headed by aged persons, or extended family households containing aged, are less likely to evacuate in response to hazard warnings.

(8) Cultural factors (race/ethnicity) influence the extent to which a family is likely to evacuate.

Perry, R. W. and M. R. Greene. 1982. "The Role of Ethnicity in Emergency Decision-Making Process," Sociological Inquiry 52(4): 309-334.

The authors state the purpose of the paper is to review and expand existing models of warning response behavior to include the generally overlooked minority groups. They propose the emergent norm perspective combined with the bounded rationality approach provides better understanding of the process which operates between message receipt and action. Four general tasks are addressed: (1) the personal decision regarding risk based on warning processes, (2) delimiting social factors which impinge on the warning process, (3) assembling a conventional model of warning response behavior and (4) integrating minority status variables into a comprehensive model. Their model includes twelve hypotheses; an extensive bibliography is also given.

Hypotheses: (Nine most relevant to evacuation, pg. 326-327)

(1) The more precise the individual adaptive plan, the greater the probability of evacuation.

(2) The greater the individual perception of risk, the greater the probability of evacuation.

(3) The higher the level of perceived personal risk, the greater the probability of evacuation.

(4) The greater the extent that family members are together, the greater the probability of evacuation.

(5) Individual characterized by external locus of control are less likely to evacuate or to take protective action.

(6) The greater the frequency of contacts with kin, the more warnings received.

(7) The greater the level of community involvement, the more warnings received.

(8) Membership in ethnic minority groups is related to nature of contacts with kin.

(9) Membership in ethnic minority groups is positively correlated with lower perceived credibilty of authorities.

Perry , R. W., M. R. Greene and M. K. Lindell. 1980. "Enhancing Evacuation Warning Compliance: Suggestions for Emergency Planning," Disasters 4(4): 433-449.

The authors argue that warnings are relatively useless without a community evacuation plan. Warning messages given by local authorities to threatened populations should be as specific as possible regarding the description of the threat, probable time of impact as well as suggestions for appropriate adaptive behavior. Disaster preparedness programs should include (1) a strategy for action, and (2) programs for educating the public about plans. Incentives to evacuate include four issue areas: (1) sheltering, (2) transportation, (3) family and security precautions, and (4) property protection. Empirical evidence to support the conclusions comes from studies of four flood stricken communities.

Findings/Comments:

(1) Evacuees prefer the homes of relatives or friends as shelter.

(2) As forewarning shortens and community preparation is low, persons first seek known protection (not always to their advantage).

(3) Use of public shelters increases when community preparation is high, when entire community evacuates and when evacuees anticipate the necessary time period of absence from residences as long; in general, public shelters attract one-fourth of evacuees at a given site.

(4) When flooding is recurrent and disaster subculture exists use of public shelter tends to be low.

(5) Warning messages are not necessarily the place evacuees hear about the availability of shelter.

(6) Data indicates that the public is receptive to the concept of officially provided transportation which would probably be used by potential evacuees.

(7) Families tend to evacuate as units (from Drabek and Boggs, 1968). Data indicates that most potential evacuees would support the concept of "family message center."

(8) Data basically supports Dynes et al. (1972, pg. 33) concept of "symbolic security" measures regarding evacuees perceptions of security problem. As an incentive to evacuation the suggestion is made to use individuals from neighborhoods for security purposes thus freeing police personnel for other work.

Quarantelli, E. L. 1980. Evacuation Behavior and Problems: Findings and Implications from the Research Literature. Columbus, Ohio: Disaster Research Center.

This extensive study summarizes the issues and findings from both the empirical research studies and theoretical aspects of disaster literature through 1979. Emphasis is on relatively focalized and sudden types of disasters using English-speaking sources from the social and behavioral sciences. The author questions the often implicit assumptions include the rubric that evacuation is always functionally good and follows a stimulus-response linear model. Evacuation is not always seen as a round-trip involving quite heterogenous behavior by evacuees. The model at the community level involves five components: community context, threat conditions, social processes, patterns of behavior and the consequences for preparedness (evacuation). These major themes are further elaborated on using the empirical evidence from evacuation studies and noting issues which are overlooked, assumed or missing. The tendency to observe idiosyncratic factors rather than generalized or generic aspects in disaster research studies is also emphasized. The author recommends that evacuation be viewed as a proactive rather than reactive response, that planning be viewed as a flow process with different stages involving various kinds of contingencies and that evacuation be viewed in totality

from warning to withdrawal to shelter and then return. An annotated bibliography divided into empirical and theoretical studies on evacuation follows the text. This is must reading for anyone interested in behavior of individuals or organizations during emergencies.

Findings/Comments:

This comprehensive report synthesizes research material on evacuations while noting the lack of evidence or erroneous assumptions made by both laymen and researchers in the field. Findings and implications are methodically evaluated, making this study a "must" reading for those interested in behavior of individuals or organizations during emergencies.

Quarantelli, E. L. 1957. "The Behavior of Panic Participants," Sociology and Social Research 41: 187-194.

The emerging image of panic participant suggests that a person under extreme stress does not regress to the "brute level" but rather shifts to an individualistic solution in a crisis. Using tape recorders approximately 1000 people involved in a variety of disasters were interviewed regarding behavior in crisis situations. Aspects of panic behavior include (1) perception by the participant to a specific threat regarding one's personal physical survival, (2) a future orientation in which the person feels possible future entrapment, (3) an acute self-consciousness marked by unchecked fear and focusing on escape, (4) awareness of one's activities, not blind or random behavior, (5) non-rational rather than irrational behavior, (6) aspects which are not necessarily non-functional nor maladaptive, and (7) acting in a non-social manner disregarding normal social relationships and interactions and which may be short-lived. However it is social interaction that is basic in defining the crisis situation as a threatening one and in reinforcing the definition of the situation where only flight is possible. Thus panic behavior does not represent a primitivation of response but an attempt to adjust to an unexpected and action-demanding circumstance by non-rational and non-social individualistic solution.

Findings/Comments:

(1) Aspects of panic behavior include (1) personal vulnerability, (2) feeling of possible future entrapment, and (3) individualistic focusing on escape marked by unchecked fear.

(2) Social interaction is basic to defining crisis situation as threatening and one in which correct response is flight.

Quarantelli, E. L. 1954. "The Nature and Conditions of Panic," The American Journal of Sociology 60: 267-275.

Noting that the frequency of panic has been overexaggerated in the disaster literature, this article presents the social-psychological conditions which precipitate panic reactions. Using data gathered by the Disaster Team of the National Opinion Research Center and other documentary sources, a comparative and analytic examination of specific instances of panic behavior is made. The most frequently noted form of panic is physical running or evacuation in a direction which normally follows a habitual pattern or one that is defined through interaction with others when alternative routes are possible. Panic is conceived as a non-social (but not antisocial) short-lived action in which ordinary social relationships and patterns are disregarded. Such behavior arises upon a definition of possible entrapment, a perception of collective powerlessness, and a feeling of individual isolation in a crisis. In addition, pre-existing panic conditions may exist as part of the social or group's predefinition of a crisis as one that is likely to eventuate in panic flight. Another contributory condition may involve a previous crisis that left the individual highly sensitized. Important in the generation and emergency of panic factors is social interaction.

Findings/Comments:

(1) Panic or the physical running or evacuation from a crisis situation develops as a result of a feeling of possible entrapment, a perception of collective powerlessness and a feeling of possible entrapment.

(2) Compared with other reactions to crisis situations, panic is a relatively uncommon phenomenon.

Rogers, G. and J. Nehnevajsa. 1984. "Behavior and Attitudes Under Crisis Conditions." Washington, D.C.: Federal Emergency Management Agency.

As stated, this study examines previous research regarding the nature and extent of changes in behavior and attitudes which are triggered by the actual and/or potential occurrence of crisis occasioned by hazards. Adaptive behavior and attitude changes are those that help alleviate or decrease the threat of danger while those maladaptive attitudes or behavior changes do not even when intended to do otherwise. Regarding the behavioral response to official warnings the authors note that evacuation may not always be the most adaptive action, i.e., tornadoes, and that policy makers must exercise care not to develop too rigid an emergency response system. They also note that the social nature of people must be anticipated in emergency preparedness policies: "Rather

than fleeing in individual panic, public response to official warnings is better characterized in terms of response in primary groups. Such groups tend to enhance preparedness measures by bringing to the emergency situation a relatively known set of capabilities, resources and perhaps most importantly, a set of existing roles which provide an authority structure for social response to disaster" (pg. 181). Also noted was "the spontaneous evacuation around Three Mile Island suggests ..... that emergency preparedness will have to deal with the movement of people, whether that evacuation is officially part of preparedness or not" (pg. 181). Appendices include text on the key behavioral and attitudinal issues used in literature search and documentation, a glossary, the individual form used for coding and FEMA crisis response conclusion retrieval system.

Findings:

Orientational work focusing on research dealing with changes in behavior and attitudes as reflected under crisis conditions.

Seagle, J. P., P. Duchessi, and S. Belado. 1985. "Simulation Using Geographic Data Bases: An Application in Emergency Management," pp. 66-68 in Emergency Planning, Vol. 15, No. 1, John Carroll (ed.). La Jolla, CA: Society for Computer Simulation.

This paper discusses the role of geographic data bases in assessing the decision to evacuate an area. Utilizing an IBM-XT microcomputer and software, the Disaster Management System provides flexible access to data bases through various graphics routines and is easily transported to a field operation site. The system portrays disaster scenarios and models effects of evacuation plans. Changes in parameters such as changes in road conditions can be easily incorporated.

Findings/Comments: Description of a simulation system to be used on a microcomputer that utilizes geographic data bases to effectively model and assess decisions to evacuate.

Strope, W., J. Devaney and J. Nehnevajsa. 1977. "Importance of Preparatory Measures in Disaster Evacuations," Mass Emergencies 2: 1-17.

This article synthesizes results from scholarly studies, emergency organization records and related information regarding emergency operations with respect to existing emergency plans and pre-disaster public information activities that may include prior tests and/or

exercises involving either or both disaster organizations and the public. Data included 56 evacuations in the U.S. Evidence suggests that drills or tests differ substantially from real events as to make them neither economic nor representative of population's ability to cope with disaster. Public drills do not enhance capacity to improve planning and some evidence indicates that they may be counterproductive.

Findings:

(1) Records of disasters are often incomplete and introduce uncertainty into analysis.

(2) Evacuations have routinely been successful even when no specific plan was made in advance.

(3) Commonly after disasters recommendations are made for improved plans noting equipment and infrastructure changes but not suggesting public drills.

(4) Familiarity of officials with emergency plans appears most important in preparing for evacuation when such plans are utilized in actual disasters.

(5) Public participation in evacuation drills appears difficult to achieve and may be counter-productive in a subsequent disaster by introducing misinformation and ambiguity, limiting response flexibility, and degrading information source credibilty.

(6) Information efforts to educate the public prior to the event have had limited effects. Efforts should be made to enhance organizational infrastructure and effectiveness including advance preparation of messages and means of dissemination; public pre-disaster information should be limited to enhancing source credibility in emergency.

U.S. Department of Commerce. 1978. Northeast Blizzard of '78 February 5-7, 1978, Natural Disaster Survey Report 78-1. Rockville, MD: National Oceanic and Atmospheric Administration.

This report describes the meteorological conditions causing the Northeast blizzard of February 5-7, 1978, the dissemination of warnings and the public preparedness for the event. The Red Cross reported 99 deaths and 4,587 injuries or illness due to the storm. The report documents only two deaths. More than 1,700 dwellings were destroyed or suffered major damage. Thirty-nine thousand people were stranded or forced from their homes. Losses from storm is estimated at over $648 million in five states. Specific findings and recommendations made of the NWS

system by the survey team note (1) the effectiveness of advance warnings, and (2) the need for beach erosion and tidal forecasts to allow sufficient time for local officials to order evacuation of coastal areas. Information via media was continuous, unambiguous and timely. In New Jersey, plans to evacuate from Cape May County are intact but no provision for sheltering inland has been made, a problem the Civil Defense director feels will increase should a hurricane arrive in summer during tourist season. In Hartford, Connecticut, 70 school children were unable to return home and were sheltered in school buildings. NWS warnings allowed evacuation of 100 people from Old Orchard Beach in Maine.

Findings/Comments:

(1) Adequate advance warnings and continuous coverage by media television stations were effective in preparing people for storm.

(2) One hundred people evacuated from Old Orchard Beach.

U.S. Federal Emergency Management Agency (USFEMA). 1984. "Integrated Emergency Management System: State and Local Population Protection Planning" (Review Draft). Washington, D.C.: FEMA.

As stated in this Civil Preparedness Guide (CPG) - this guide is intended to provide state population protection planners and local officials responsible for emergency planning with information on preparing emergency operations plans (EOPs) reflective of the integrated emergency management system (IEMs). Planning as a process is covered from the conceptual point of view with suggestions included on plan content. EOPs under IEMs are multi-hazard plans that treat emergency activities generically as well as hazard specific, thus, reducing redundancy, promoting uniformity and improving operational utility of emergency plans by placing emphasis on organizational response. Evacuation plans should include procedures for both partial and complete evacuations of populations, definition of both areas to be evacuated and destination points, control of traffic and return movements. Text appendices contain portions of a sample EOP that may be used as a model. Annex E (pages B-2 through B-8) provides a sample of evacuation from hazardous areas while Annex E.1 (pages B-9 through B-160) details plans for evacuation in response to a nuclear attack. Appendix E-2 (pages B-27 through B-30) suggests a plan for evacuation in response to an incident/accident at a nuclear power plant.

Findings/Comments: This is a guide for officials responsible for establishing emergency planning operations plans that include evacuations.

Berke, P., C. Ruch, K. LeMay, and D. Rials. 1985. "A Computer Simulation System for Assessment of Hurricane Hazard Impacts on Land Development," pp. 149-154 in Emergency Planning, Vol. 15, No. 1, John Carroll (ed.). La Jolla, CA: Society for Computer Simulation.

This paper describes a computer simulation system that models the losses associated with a hurricane along the Texas Gulf Coast. The losses are classified as social, including homelessness and casualties, and economic, including the dollar value of property damages and that of unemployment. The system uses two types of computer based models based on hazards and exposure developed from the computerized geographic information system (GIS). The hazard model identifies the location and severity of wind speed and surge depths while the exposure model provides inventories of land development including buildings and population at risk. The aim of the model is to identify the particular hurricane hazards within a specific area and the types and numbers of structures and people exposed to the threat. Thus, appropriate plans including evacuation measures can be designed and coordinated with planning for land use.

Findings/Comments: A description of a computer-based system based on hazards and exposure that models simulated losses from hurricanes along the Texas Gulf Coast.

Bolin, Robert. 1985. "Disaster Characteristics and Psychological Impacts," pp. 3-28 in Disasters and Mental Health: Selected Contemporary Perspectives, Barbara J. Sowder (ed.). Rockville, MD.: National Institute of Mental Health, U.S. Department of Health and Human Services.

This paper focuses on the characteristics of natural and man-made disasters and their linkages to psychosocial effects on disaster victims. After reviewing the literature on characteristics that have "trauma potential," disasters with the following factors were found to impact individuals mental health: where many survivors were exposed to death or injury, when dead bodies were exposed, where the disaster agent overwhelmed victims in life-threatening situations or was unexpected or marked by threat of recurrence. In addition, man-made disasters that were prolonged or resulted in prolonged stress or were unexpected and had a high-impact ratio on the community may instigate mental health problems. Disaster effects may result in a sense of loss of control from extended exposure to stress, from threat of recurrence, evacuation, relocation or from the inability to obtain recovery resources or to deal with bureaucratic structures of those structures which severely disrupt neighborhood patterns or community services. When there are two or more characteristics present the in same disaster, the risk of mental health problems appear to be increased for disaster victims.

Findings/Comments:

(1) Trauma-potential increased when many survivors were exposed to death or injury of primary group member.

(2) When dead bodies were exposed to survivors, the psychological impairment was likely to increase among victims.

(3) When disaster agent created high-terror and/or horror in which victim felt life was threatened, psychological impairment was likely to increase.

(4) Trauma-potential increases when victims had no previous experience with the disaster or disaster was unexpected.

(5) Disasters characterized by threat of recurrence generated mental health problems.

(6) Man-made disasters producing long periods of threat resulted in prolonged mental stress.

(7) Disasters with high-impact ratio in conjunction with an intense impact resulted in mental health problems.

(8) Intense disasters that were unexpected and had high-impact ratios were likely to provoke sense of loss of control among survivors.

(9) Disasters that result in continued exposure to stress either through evacuation, threat of recurrence, relocation, temporary housing, dependency on others, intrusion of agency personnel, legal procedures or the disruption of neighborhood or community patterns or services can be expected to have psychological impacts on the victims.

(10) When two or more of the above factors were present, the risks for mental health problems appear to increase.

Carroll, J. M. (ed.). 1985. Emergency Planning, Vol. 15, No. 1, La Jolla, CA: Society for Computer Simulation.

This edited book, the proceedings of a conference on emergency planning, contains a number of computer simulation models dealing with a variety of emergencies caused by earthquakes, windstorms, fires, floods, chemical spills, nuclear war, and radioactive fallout. A geographical data base is a feature of many of the simulations. Noting that simulation can play a key role in risk and crisis management in assessing alternative plans, the major benefit of simulation in emergency planning is

the actual management of crises which allows the decision-maker a chance to visualize the impacts of decision before actual implementation. Models in a number of articles permit real-time data to be included in simulation programs while directing or planning evacuation strategies.

Findings/Comments: Edited book from proceedings of conference on emergency planning which includes models for evacuation planning and direction.

Dangermond, J. 1985. "Network Allocation Modeling for Emergency Planning," pp. 101-106 in Emergency Planning, Vol. 15, No. 1, John Carroll (ed.). La Jolla, CA: Society for Computer Simulation.

This paper describes how network allocation modeling can be used in emergency planning using a system called NETWORK which is associated with the ARC/INFO geographic information system. A network is defined as a "fabric" implying the many interconnected features of the system. Applicable to the allocation of resources and a variety of other uses in the emergency planning, NETWORK can analyze possible evacuation routes, optimal routing and use of emergency response vehicles, etc. Since the costs for setting up the system are significant, the author suggests expanding NETWORK to work in similar capacities with other agencies.

Findings/Comments: This paper describes the possibilities for emergency management planning, including the development of evacuation routes, using a network allocation system called NETWORK.

Hobeika, A. G. and B. Jamei. 1985. "MASSVAC: A Model for Calculating Evacuation Times Under Natural Disasters," in Emergency Planning, Vol. 15, No. 1, John Carroll (ed.). La Jolla, CA: Society for Computer Simulation.

This paper describes the MASSVAC simulation computer model designed to analyze and evaluate traffic evacuation plans given a natural disaster in an urban area. Data computed in the estimations include community type, disaster type, hazard boundaries, population distributions (divided into transient and permanent), types of highway networks and traffic simulation strategy. The nature of the disaster dictates the time period within which the transportation network has to be evacuated. The control and management strategies are directly correlated within that time frame. Model applied to Virginia Beach City under simulated flood/hurricane situations providing generally sensitive results.

Findings/Comments: Description of computer model for use in determining evacuation times under natural disasters in urban areas.

Kisko, T. M. and R. L. Francis. 1983. "EVACNET: A Network Model of Building Evacuation," pp. 71-74 in Computer Simulation in Emergency Planning, Vol. 11, No. 2, January, John M. Carroll (ed.). La Jolla, CA: Society of Computer Simulation (Simulation Councils, Inc.).

This paper describes the EVACNET+ user friendly interactive computer program that allows the modeling of emergency building evacuations. The model gives a time-dependent plan to evacuate the building in a minimum time and identifies bottlenecks which may occur during an evacuation. Designed originally for fire safety engineers to determine a building's evacuability, the model allows evacuation planners more insight into developing evacuation procedures.

Findings/Comments: Description of EVACNET+, a computer simulation model that identifies the minimum time to evacuate a building while identifying bottlenecks during evacuation.

Leik, R. K., T. M. Carter, J. P. Clark et al. 1981. "Community Response to Natural Hazard Warnings: Final Report." Minneapolis, Minnesota: University of Minnesoto.

This volume is the final report of a three-year study focusing on the processes that determine the nature and effectiveness of the dissemination of warnings to natural hazards and the responses to these warnings within the local community. The objectives included (1) the response of community emergency agencies to warnings, (2) the process of dissemination of warnings by community agencies to other organizations and to the public, and (3) the process of response by the general public to those warnings. Data was collected through field research in 31 cities subject to tornadoes, flashfloods and hurricanes in the United States. Nine sites provided both pre and post data on the organizational and household level so a quasi-experimental "pre-post" test design could be developed. A typology of indices includes 22 types for organizational operation and five for household receipt and response. The concept of an integrated warning system is frequently fragmented at the local level with communication problems made worse by overlapping, sometimes contradictory and often unorganized civil defense structures. From the household data, it was found that even when warnings were issued an average of one-third of the general public did not receive warnings. A majority of

households interviewed did not take protective actions after warnings were issued especially if there was no prior perception of risk. The study concludes that the entire warning system must be improved if adequate numbers of those in threatened areas are to take protective actions. Specific recommendations are then given to improve local response capabilities. Appendices include details of sampled sites including the responses from models used.

Findings/Comments:

(1) The integrated response concept was not found at local levels with large gaps in communication systems linking National Weather Service, local civil defense offices, local law enforcement and emergency service agencies, and local broadcast media, especially when two-way communication was examined.

(2) Communication problems were worsened by overlapping, sometimes contradictory and often uncoordinated civil defense structures.

(3) In those sites where warnings were issued, an average of one-third of the general public did not receive warnings.

(4) A majority of households did not take protective action after warnings were issued. For tornado warnings, a majority did not seek shelter; in hurricanes and flash floods, a majority did not evacuate.

(5) Receiving warnings only initiates process of confirming evidence before deciding to act but given confirming evidence, protective action is likely.

(6) If there is no prior perception of risk and if warnings are unable to convince residents of impending risk, then protective action is unlikely.

(7) Local validating evidence is particularly helpful in inducing response especially if personal contact is made with police or other local authorities.

(8) If residents have a prior plan for emergency action, they are more likely to heed warnings.

(9) From experimental data, it is clear that those with experience respond differently to warnings from those inexperienced. Without experience, residents respond sooner especially when official recommendations accompany frequent warnings of good quality.

(10 Data from research indicates a general lack of reliable communication facilities by which National Weather Service can disseminate warnings both to media and local emergency service.

(11) There is a general lack of shared communication facilities among a wide variety of emergency services at the state, county and municipal levels of government and with relay of information to broadcast media.

(12) Warning messages are not formulated to motivate response but to encourage confirmation behavior.

McLean, M. A., M. P. Moeller, A. E. Desrosiers, and T. Urbanik II. 1983. "CLEAR: A Model for Calculation of Evacuation Time Estimates in Emergency Planning Zones," pp. 58-63 in Computer Simulation in Emergency Planning, Vol. 11, No. 2, January, John M. Carroll (ed). La Jolla, CA: Society of Computer Simulation (Simulation Councils, Inc.).

This paper describes the assumptions, methodology, and application of the CLEAR (Calculates Logical Evacuation And Response) model developed by Pacific Northwest Laboratories to simulate emergency evacuation times of an area following an accident at a nuclear power plant. The computer model simulates vehicle departure and movement on a specific transportation network in order to determine time estimates according to the conditions and consequences of traffic flow. These include the handling of vehicles at intersecting road segments, calculating the velocity of travel on a road segment and accounting for delays while vehicles queue. The distribution of times for individuals to prepare for evacuating the EPZ is a summation of the notification, preparation and response times plus the decision time. The rate and distribution at which individuals begin to leave is then arbitrarily divided into segments. Potential use for the model includes ability to model site-specific components of evacuation time and to identify troublesome areas in EPZ that would aid in planning and zoning decisions.

Findings/Comments: Description of CLEAR (Calculates Logical Evacuation And Response) computer simulation model for estimating evacuation times during emergency following a nuclear power plant accident.

Perry, R. 1983. "Population Evacuation in Volcanic Eruptions, Floods and Nuclear Power Plant Accidents: Some Elementary Comparisons," Journal of Community Psychology 11: 36-47.

The author argues that comparative analysis of generic "functions" of disasters will permit researchers to distinguish the commonalities as well as the differences in evacuation responses. Suggesting that

researchers need to look at empirical studies to broaden the field, the article looks at evacuation response associated with three different environmental threats: the eruption of Mt. St. Helens volcano, a riverine flood in Fillmore, Washington, and the TMI nuclear reactor accident. The TMI results are taken secondarily from three other studies: the Michigan State study, the Flynn study, and the Rutgers study. The other two are from Perry's own research. The argument is made that three elements make a nuclear related accident different from natural disasters: (1) both the public and emergency managers are unfamiliar with threat, (2) that conflicting reports were given regarding the nuclear threat at TMI, and (3) that safety was correctly perceived to be correlated with distance from the power plant at TMI. Perry argues that at TMI there was a cumulation of additive events that led to spontaneous evacuation unlike natural disasters in which persons seek evidence (environmental cues) before evacuating.

Findings/Comments:

(1) In both the natural and the nuclear related accident the most cited reason for evacuation was the belief that real situational danger existed for citizens. Conversely those that chose not to evacuate reported that they did not believe a real danger existed.

(2) Mass media warnings were infrequently cited as reasons for evacuating and social networks were relatively more important to evacuation decision making in natural disasters.

(3) Level of "spontaneous" evacuation at TMI appears related to public perception of high personal risk regarding nuclear threat, i.e., that any dose of radiation is "lethal" and is, therefore, relatively different from natural disaster evacuation response when environmental cues are sought before evacuating.

Perry, R. W. and A. Mushkatel. 1984. Disaster Management: Response and Community Relocation. Westport, Connecticut: Quorum Books.

Two aspects of human response to disasters are examined: (1) citizen reaction to warnings and (2) management techniques for relocation (permanent evacuation). Response by minority groups, i.e., Blacks and Mexican-American, are compared to Anglos in three case studies involving (1) a riverine flood in Texas, (2) a train derailment near Puget Sound, and (3) a permanent relocation of an entire Black community in Arizona subject to periodic flooding from upstream dam releases. A systems approach employing both emergent norm and the concept of bounded rationality are utilized. Methodology includes interviewing via questionnaire a sample of residents from two adjoining districts evacuated from tan urban flood areas in Westville, Texas, and then using a similar format to

sample residents evacuated from an area in Railtown near Puget Sound after a propane tank car derailed. An intensive study of residents involved in the permanent relocation of a fifty family Black community originally located in Allenville, Arizona, to another site christened Hopeville approximately nine miles away is also described. Four variables employed in models include (1) perceived personal risk, (2) development of warning belief, (3) possession of adaptive plan, and (4) family context. Findings ascertain ethnicity affects response to warnings of evacuation messages and subsequent evacuation. Mexican-Americans least likely to evacuate and Blacks place highest confidence in official sources for confirmation. Relocation efforts of minority groups are most successful when organized community group acts as official coordinator throughout entire process. Management strategies and policy implications are suggested using seven detailed principles. Questionnaire similar to interview instrument is appended to text..

Findings/Comments:

Riverine Flood Warning Response - Not Supported

Successful warning confirmation increases the level of warnings belief.

To the extent that family members are together at the time of warning or otherwise accounted for, the probability of evacuation increased.

The nature and frequency of kin relationship is related to the definition of family members who need to be accounted for in emergencies.

Membership in an ethnic minority group is related to the nature and frequency of contacts with kin.

Riverine Flood Response - Supported

The more precise the individual's adaptive plan, the higher the likelihood of evacuation.

Individuals characterized by an internal locus of control are more likely to develop adaptive plans.

The higher the level of warning belief the greater the probability of evacuation.

The more specific the warning message content, the greater the level of warning belief.

Receipt of warning from a credible source increases the level of warning belief.

The higher the perceived level of perceived personal risk, the greater the probability of evacuation.

Membership in ethnic minority group is positively related to the perceived level of personal risk.

Socioeconomic status (income) is inversely related to the level of perceived personal risk.

Receipt of warning from a credible source increases the level of perceived personal risk.

The more specific the warning message, the higher the level of perceived personal risk.

Membership in an ethnic minority group increases the chance that an individual will have an external locus of control.

The greater the level of community involvement, the more likely one is to receive warning relevant information through these contacts.

Membership in an ethnic minority group is inversely related to the level of community involvement.

The lower the individual socioeconomic status (income), the lower the level of community involvement.

Membership in an ethnic minority group is inversely correlated with socioeconomic status (income).

Socioeconomic status (income) is positively related to possession of an internal locus of control.

Train Derailment - Not Supported

The presence of environmental cues associated with disaster increases the level of warning belief.

To the extent that family members are together at the time of warning or otherwise accounted for, the probability of evacuation increase.

The nature and frequency of kin relationships is related to the definition of family members who need to be accounted for in emergencies.

Membership in an ethnic minority group is related to the nature and frequency of contacts with kin.

The greater the level of community involvement, the more likely one is to receive warning through these sources.

The lower the level of individual's socioeconomic status (income) the lower the level of community involvement.

Train Derailment - Supported

Individuals characterized by an internal locus of control are more likely to develop adaptive plans.

Membership in an ethnic minority group increases the chance that an individual will have an external locus of control.

Socioeconomic status (income) is positively related to the possession of an internal locus of control.

The higher the perceived personal risk, the greater the probability of evacuation.

Membership in an ethnic minority group is positively related to the level of perceived personal risk.

The more specific the warning message, the higher the level of perceived personal risk.

The higher the level of warning belief, the greater the probability of evacuation.

The more specific the warning message content, the greater the level of warning belief.

Successful confirmation of a warning message increases the extent to which the threat is perceived as real (warning belief).

Principles of Positive Relocation:

(1) The community to be relocated should be organized.

(2) All potential relocatees should be involved in the relocation decision-making process as quickly as possible.

(3) Citizens must understand the nature of multiorganizational context in which the relocation is to be conducted.

(4) Special attention should be given to the social and personal needs of relocatees, including that of preserving social networks.

(5) In terms of policy, recognition should be given that conflicts in the rules and operating procedures of the agencies involved will exist in the relocation effort.

(6) In terms of policy, managers should determine as early as possible the conflicts that might exist in the rules and operating procedures of agencies and determine mechanisms to alleviate future conflicts.

7. In terms of policy, hazards managers should realize that the support of key political actors is probably necessary but insufficient to ensure the implementation of a successful relocation.

8. In terms of policy, hazards managers need to have established political support and contact prior to the disaster.

9. In terms of policy, hazards managers should recognize that multiple decision points will exist in the implementation of policy and work as closely as feasible with those agencies involved.

10. In terms of policy, race should be recognized as likely to become an issue when relocating minority communities.

11. In terms of policy, the importance of a well-organized community group through which agencies can rely on for political support is important.

12. In terms of policy, it is important to have the best staff of an agency assigned to the implementation of relocation efforts.

Sowder, B. J. (ed.). 1985. Disasters and Mental Health: Selected Contemporary Perspectives. Rockville, MD: National Institute of Mental Health, U.S. Department of Health and Human Services.

This edited book contains a collection of papers prepared for a 1984 conference on post-disaster needs and issues critical to mental health. Sponsored by the National Institute of Mental Health (NIMH) and the Federal Emergency Management Agency (FEMA) the contributors include researchers and clinicians. Papers are divided among three sections: disaster characteristics, community effects, and research issues. the first section focuses on the disaster event and how various characteristics affect mental health, the second section focuses on the impact of the disaster on the community and social networks and the last section examines research issues of special concern. Contributors include Robert Bolin, Andrew Baum and Laura Davidson, E. L. Quarantelli, Barbara Sowder, Susan Solomon, Jacob Lindy, Mary Grace, Russell Dynes, Bonnie Green and George Warheit. Of evacuation interest are articles by Bolin and Quarantelli.

Findings/Comments: This edited book provides an overview of mental health problems associated with disasters including evacuation and sheltering experiences.

LIST OF ACRONYMNS USED IN TEXT

CLEAR: Calculated Logical Evacuation and Response

CPG: Civil Preparedness Guide

CRP: Crisis Relocation Planning

DOE: Department of Energy

DRC: Disaster Research Center

EBS: Emergency Broadcasting System

EOC: Emergency Operations Center

EOP: Emergency Operations Plan

EPG: Emergency Planning Guide

EPZ: Emergency Planning Zone

FEMA: Federal Emergency Management Agency

GIS: Geographic Information System

HP: Hurricane Preparedness

IEMIS: Integrated Emergency Management Information System

IEMS: Integrated Emergency Management System

NAS: National Academy of Sciences

NHC: National Hurricane Center

NOAA: National Oceanographic and Atmospheric Administration

NORC: National Opinion Research Center

NRC: Nuclear Regulatory Commission

NWS: National Weather Service

TMI: Three Mile Island

SAR: Search and Rescue

SLOSH: Sea, Lake and Overland Surges for Hurricanes

USFEMA: United States Federal Emergency Management Agency

USFS: United States Forest Service

USGA: United States Geological Survey

USGAO: United States General Accounting Office

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AN ANNOTATED GUIDE TO RESEARCH

Unclassified
December 1986
190 pages

by Barbara M. Vogt, University of Tennessee,
Knoxville, TN 37996
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Oak Ridge, TN 37831
Interagency Agreement: FEMA No. EMW-84-E-1737; DOE No. 40-1457-84

The purpose of this literature review was to explore the relevant sources of knowledge regarding evacuation related issues among recent work published in the social sciences and emergency planning fields. In organizing the material, we looked primarily for articles that included either a theoretical or empirical basis for the findings. The material was divided as to the emphasis placed on the individual or the organizational level of behavior. The annotations of the literature as well as the specific key findings from each study, where appropriate, are organized by hazard type including floods, hurricanes, tornadoes, volcanoes, tsunamis, nuclear power accidents, hazardous material accidents, and nuclear crises.

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