Dennis S. Mileti. *Natural Hazard Warning Systems in the United States: A Research Assessment*. Boulder, Colorado: Institute of Behavioral Science University of Colorado, 1975. 97 pages.

This monograph is one of twenty-one produced since 1974 by staff members of the Assessment of Research on Natural Hazards Project funded by the National Science Foundation with J. Eugene Haas (a sociologist) and Gilbert F. White (a geographer) serving as co-principal investigators. The purposes of the project are to provide a means for evaluating funding alternatives for various types of research on natural hazards and to stimulate a systematic appraisal of research needs from the viewpoint of the utility of potential findings (p. v). Of the twenty-one monographs, twelve deal with assessment of research on specific

hazard types while eight others deal either with cross-hazard phenomena (such as land use management and relief/rehabilitation) or with methodological techniques (e.g., computer simulation, scenario methods). The capstone monograph is the *Assessment of Research on Natural Hazards* by White and Haas (MIT Press, 1975). Professor Mileti's personal contribution to this series is substantial; he is either sole or co-author of five of the monographs. His work under review here is noteworthy as much for its implications for future funding patterns by NSF/RANN as for its assessment of the current state of hazard warning systems.

The monograph contains six chapters plus an excellent seven-page summary located immediately following the front matter for easy access and a bibliography containing 108 references to research on the warning process. After a detailed scenario of warning activities prior to a 1972 flood in Rapid City, South Dakota and a discussion of seven characteristics of natural hazards affecting warning, Mileti presents a systems model of the warning process at the community level, discusses its components, reviews the literature on processes of hazard evaluation, warning dissemination, and individual response to disaster warnings, then presents several specific recommendations to those engaged in warning. In the longest single chapter (thirty-three pages), he reviews the state of technology for predicting and forecasting fifteen different types of hazard. The separate discussions average just under two pages each and seem to have been approached with the intent to first describe the forecast technology including sources and types of data and an assessment of forecast accuracy, then to identify agencies charged with making each type of forecast and the communication channels through which they are linked to other components of the warning system, and finally to list organizations which disseminate warning messages to the community at large. It was not always possible to replicate this outline for each of the fifteen hazards, however, due to unevenness in the development of predictive technology in some cases. A concluding section outlines federal agencies which monitor the weather, types of weather observation systems, interorganizational communication systems, and public warning systems.

Two short chapters (four pages each) follow, one commenting on the roles of risk delineation and community preparedness in the warning process, the other devoted to "large societal factors" (demographic patterns, organizational size, public fiscal policies, etc.) which act as constraints on the effectiveness of warning systems. The final chapter suggests future research studies whose findings are likely to be of benefit in improving the effectiveness of hazard warning systems. For the most part these suggestions are derived from key relationships among components in the warning system model developed earlier. Four major studies are called for; potential consequences and recommended funding levels for each are identified. Two are of the post-audit variety: a cross-hazard study of responses to warning and a cross-hazard study of warning dissemination. Also recommended are a series of laboratory experiments on psychological states occasioned by warning messages and an examination of warning systems during non-crisis periods. This chapter concludes with an assessment of potential benefits in terms of the reduction of catastrophe potential and of average annual losses due to hazards of a variety of lines of research and with a call, reflecting the current emphasis at RANN, for researchers to do more to insure the utilization of their findings by users.

Two specific points deserve comment apart from the overall evaluation of the monograph. Under close examination, one of the major dependent variables in the warning system model, response, seems to become the much narrower term "proper response." In post-audit studies (i.e., in retrospect), it is easy to see what were adaptive and what were maladaptive responses in light of past events. But

as disaster situations unfold, determining the proper course of action to take in response to a warning message is much more problematic. Mileti notes this parenthetically (p. 15), but the danger here lies in generalizing from empirical correlates of specific types of behavior which may have been proper in one context but not so in another to propositions about response at a more abstract level. And related to this is the absence of any call for potentially beneficial studies of negative cases, that is, situations in which disasters were possible but did not develop as forecast or in which their impact was less than predicted. The most obvious illustration would be studies of response to tornado watches; other examples might be studies of cities where heavy snowfall was forecast but did not materialize, or rural areas where drought during the growing season was predicted but did not occur, and of coastal areas where hurricanes turned suddenly out to sea after threatening land for several days. Examination of cases such as these could provide data on both dissemination and response qualitatively different from those in which an actual disaster occurred (in terms of Mileti's model, the bypass input into the response system from the environment, among other things, would be altered), the ex post facto luxury of knowing adaptive and maladaptive warning responses would be controlled somewhat, and patterns might be uncovered which could be used to predict responses to warning for hazards whose forecast technology will make such warning possible for the first time only in the future (e.g., earthquakes).

Overall, the work must be evaluated from the standpoint of each of its two principal components: the survey of research-based findings on the warning process and of the state of forecast technology; and the proposals for future research and for funding patterns. A better statement of research findings on social processes relevant to warning systems is provided by Mileti himself in chapter three of Mileti, Drabek and Haas' *Human Systems in Extreme Environments* (University of Colorado, Institute of Behavioral Science, 1975) which he recommends to the reader, but the present treatment does contain several specific recommendations to practitioners which this other work does not. The assessment of forecast technology for the separate hazards is somewhat better, especially as a brief introduction for someone unfamiliar with the specifics of warning systems in particular hazards, but the treatment is sometimes uneven (the discussion of earthquake hazards reads more like a research proposal, for example). In terms of its discussion of research opportunities, the monograph is more important. From a theoretical standpoint, the systems model Mileti presents is quite useful in providing a logical framework for synthesizing diverse kinds of research on phenomena encompassed by the warning process, identifying gaps in understanding of the process, and suggesting potential trouble spots in the links among system components. From a practical standpoint, the report is especially important for both practitioners in identifying key problems in the warning process and for specialists in disaster research because of its likely impact on funding decisions at NSF.

Although, as Mileti points out, portions of the material overlap with that found elsewhere in the monograph series, publication of this separate cross-hazard discussion of warning systems is justified because it provides easier access to and fosters integration of otherwise disparate materials. The report is a useful one which practitioners and researchers alike should be aware of more for where it can lead us than for what it tells us about where we have been. But this afterall is its primary purpose.

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