# University of Delaware Disaster Research Center

# FINAL PROJECT REPORT #28

SOCIOBEHAVIORAL RESPONSE TO CHEMICAL HAZARDS: PREPARATIONS FOR AND RESPONSES TO ACUTE CHEMICAL EMERGENCIES AT THE LOCAL COMMUNITY LEVEL

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SOCIOBEHAVIORAL RESPONSES TO CHEMICAL HAZARDS: PREPARATIONS FOR AND RESPONSES TO ACUTE CHEMICAL EMERGENCIES AT THE LOCAL COMMUNITY LEVEL\*

Final Report to the

# NATIONAL SCIENCE FOUNDATION

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# This is a report summarizing a four-year project running from late 1977 through late 1981. As such, it emphasizes and highlights the general finding and major themes from our work. The report, therefore, does not pretend to give all the details or even all the findings from our study. The more specific details are given in the more specialized publications listed in an appendix to this report.

While the problem of chemical emergencies, the topic of this volume, is not peculiar to American society, our field research was confined to the Unit States and Canada. We do believe our findings and implications have broader applicability than to just our society. However, the test of that belief mus come in some future research.

What is reported was derived primarily, although not exclusively, from the field work undertaken at the Disaster Research Center (DRC). Accordingly we followed standard DRC policies in reporting any results. Thus, we do not identify particular individuals or officials, and in most cases, not even the specific organizations or localities we contacted in our research. The only exception was when the information about groups or communities was already published, and in the public domain.

The report follows the standard scholarly policy of citing references an otherwise documenting what is reported. However, many of the statistics and examples used in the report, were computed or derived from primary data in th DRC files. All unreferenced material can be presumed to have been developed by DRC from its own data.

This report is intended for many audiences. However, as a general state ment, it is primarily aimed at disaster researchers and social and behavioral scientists. While we think what is said can benefit policy makers, planners, and operational personnel concerned with chemical emergencies, our other publications other than this volume target them as the prime audience.

In the pages that follow, we set forth our research findings on organized preparedness planning and on organized responses to chemical emergencies. In this respect, the report is unique. While there is substantial literature on technical aspects of chemical emergencies, as far as we are able to ascert this is the first overall report on the sociobehavioral aspects of chemical disasters that has been derived from an extensive and systematic study. As such, we can claim that this report is a major first step in opening up a sociological perspective on chemical emergencies. Readers, of course, must ultimately judge whether the report is significant and substantively importan

## PREFACE

### ACKNOWLEDGMENTS

As with nearly all DRC publications, what is reported represents a collective product. Many staff members at DRC contributed, directly or indirectly, to the end product.

The day-to-day work was carried out by a multi-disciplinary team of advanced graduate students in sociology, political science, organizational behavior, public administration, and urban planning. In most cases, the team members particiapted in the data gathering, the data analysis, and the report writing.

Three different persons served as project manager at different points of the research. They were: Clark Lawrence, Quinten Johnson, and Jane Gray, who ably occupied the position for the longest period of time. The Graduate Research Associates and others who undertook most of the field work were: Sue Blanshan, John Bolland, Shari Carres, Lauri Dragher, Tom Gabor, Terri Griffith, John Helms, Cheryl Miller, Lori Minutilli, Todd Peterson, Robert Swisher, and Verta Taylor. Nan Baer, who joined the research project in its last phases, also helped with the data analysis and report writing. The contributions of all these staff members are reflected in this report, and we gratefully acknowledge their assistance.

A special debt is owed to Kathleen Tierney. As DRC Field Director during the first several years of this particular study, she played a very important role in the training and supervision of the field workers. The quality of the data gathered is a tribute to her skill as the Field Director. Even more important, she made many major contributions to the data analysis and report writing. Much of this volume is heavily dependent on the internal memos, preliminary papers, first drafts, and written publications produced by Tierney during, as well as after, her tenure as Field Director. We especially want to single her out and to thank her for everything she contributed to the work.

The support staff of the Center also has to be acknowledged. Elizabeth Wilson, the Center's Executive Director, contributed incalculably to solving administrative and logistic problems in the first three years of the work. Her successor under a different title, Jennifer Welch, the current DRC Administrative Director, has used her considerable editing expertise to try to have this report appear in some readable form of English. Since the final decisions were not hers, however, she had to be absolved of any deficiency along that line, but she is nonetheless thanked very much for her effort. Thanks are also due to Elizabeth Readerman for typing the first draft of this report and especially to Connie Smith, the DRC secretary, for the final typed version.

Special thanks must also be given to persons outside of the Center. Dr. William Anderson, this study's research liaison officer between the National Science Foundation and the DRC, was consistently supportive of the work from its inception to its conclusion, and did everything reasonably possible to facilitate the work. He not only gave encouragement but provided useful substantive ideas reflecting his own considerable field research experience. Our work also benefited from the suggestions, questions, and advice of the Advisory Board established for the work. Since their criticisms were not always accepted into our work, they can in no way be held responsible for the final product. Nonetheless, we are grateful for the ideas advanced by the Board members: Robert Alvarez of the Environmental Policy Center, Ludwig Benner of the National Transportation Board, Professor James Brown of the George Washington Law Center, Howard Fawcett of the American Chemical Society, Irving Gruntfest of the Environmental Protection Agency, William Harris, Jr. of the American Association of Railroads, Raymond Langlois of the Baton Rouge Mutual Aid System, Bernard Rusche from the DuPont Corporation, and Guy Watkins from the Dow Chemical Company.

Last, but not least, we must acknowledge the help of the hundreds of citizens and officials who provided data to our field team. They are too numerous to list. However, we acknowledge their cooperation and hope that the research we undertook will either directly or indirectly help them better prepare for, and respond to, chemical emergencies.

The work reported in this volume is partly based on funding provided by grant #PFR-7714445 from the Division of Problem-Focused Research of the National Science Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author and the Disaster Research Center, and do not necessarily reflect the views of the National Science Foundation.

Since mine was the final decision on research and substantive matters, any faults, shortcoming, and errors in this volume are, of course, the responsibility of the author, who was the Principal Investigator on the research project reported herein.

E. L. Quarantelli Director, Disaster Research Center

# TABLE OF CONTENTS

	Page
PREFACE	. <u>ii</u>
ACKNOWLEDGMENTS	. 111
CHAPTER I. INTRODUCTION	. 1
PART 1. STUDYING THE PROBLEM	. 5
CHAPTER II. NATURE OF ACUTE CHEMICAL HAZARDS: THE CURRENT SITUATION	
The Threat of Chemicals	. 7
The Consequences of Dangerous Chemicals	. 9
CHAPTER III. GUIDING FRAMEWORK FOR THE STUDY	
Value of a System Model	. 12
The Overall Preparedness Model	. 14
Looking at the Response Pattern	. 16
CHAPTER IV. RESEARCH PROCEDURES AND DATA	
The Research Design for Phase One	. 19
The Research Design for Phase Two	. 21
Analysis Undertaken	. 24
Quality of the Data	. 25
PART 2. FINDINGS FROM THE STUDY: PREPARATIONS FOR EMERGENCIES	. 27
	-
CHAPTER V. RISK, VULNERABILITY, AND THREAT PERCEPTIONS	
Some Conceptual Distinctions	. 29

v

# TABLE OF CONTENTS (continued)

																	Page
Findings on Perceptions of Th	reat		*	÷	۵	24 S		8	*	٠	8	٠	٠	•	*	. 8	31
Community Perceptions	* *	•	•	*	4	۲۵	٥	۰.	÷	a	*	٠	\$				32
Sector Perceptions	 	ĸ	æ	¥	5		٠	٠	ę	E	ę	3					33
Organizational Perceptions	5 2	e.	٥	G	@		đ	° a	A	a	ø	6	0		.9		34
Some Concluding Observation	8.	*	\$	8	ę	4 8	•	5	÷	*	9	a	9	•	٠	٠	35

## CHAPTER

VI.	AVAILABILITY	AND	MOBILIZATION	OF	RESOURCES

The Nature of Resources	۳.	•	•	•	٠	•.	۰.	٠	•	•	•	<b>9</b> ,	4	٠	4	¢i	Ħ		•	۴.	37
Resource Availability .	<b>9</b> -	۴	۴.	3	•		•	٩	-9	•	\$	٠	•,		÷		. 2			÷	39
Resource Mobilization .		¢	•	•	•	6 6	ŧ		*	-3	4		± '	•	G	æ ·	÷		٠	<b>D</b> .	42
Local Mutual Aid Systems	*	5	¢.	¢.		ų. V	*	8		u.	•	4	•			9	÷	ð	•	•	.43

# CHAPTER

VII.	PATTERNS OF COMMUNITY SOCIAL ORGANIZATION
	The Nature of Linkages
	The Characteristics of Typical Patterns
	Kinds of Integrated Linkages
	Local Linkages
	A Concluding Observation

# CHAPTER

VIII. SOCIAL CLIMATE

The Nature of Social	C	1 ir	nai	:e	•	÷		4	¥	<b>a</b>	٠	2. 2	•	ø	٠	\$	e	¢	e	4	*	8	58
Belief Assumptions .	6	•	ė	5 5		٠	¢	5	9	÷	*	•	•	9 9	ø	ø		÷	*	· •	*	*	5%
Value Priorities	F	¢	ş	۴		đ	8	ħ	۴.	8	u.	#	•	*	9	đ		ð	ð:	· @	÷	ŧ	61
Norm Expectations .	۰	÷	<b>*</b>	٠	•	ę	G	5	÷	2	4	s.	13	s,	р	*	÷	, e	æ	÷	•	٠	62
A Concluding Note .	ż	*	tr	•	٠	, <del>4</del>	÷	e	ø	. 69		a	•	ę	æ	÷	ø	6	•	æ	•	٠	64

# CHAPTER

IX. THE PLANNING PROCESS AND PREPAREDNESS

ſhe	Nature	of	Preparedness	÷	*	æ	φ,	5	٠	•	¥	*	6	8	e	÷	•	Ta <sup>1</sup>	*		б	6
	-																					

# TABLE OF CONTENTS

Commu	mity Chem	ical	Di	lsast	er	Pr	epa	are	edn	ess		v	•	ø	, ¥	. 9	8	*	. *	4		*	rage 67
Some	Paradoxes	<b>s</b> 4	ĸ		4	* °	•	8	÷	6 Q	8	R	7			6	*	\$	÷	e	۰	¢	73
																• :							

## CHAPTER

# X. EFFECTS OF PREPAREDNESS PLANNING ON RESPONSES

Misconceptions	About Disaster Preparedness	77
Preparedness	Is Not Formal Disaster Plans	1
Preparedness	Is Not a Product	78
Preparedness	Is Not an Extension of Everyday Operations	79·
Preparedness	Planning Is Not Aimed at Prevention	80
Preparedness	Planning Aims at Thoughtful Response	81
Preparedenss	Planning Is Realistic	81
Preparedness	Planning Is Based on Knowledge	82
Preparedness	Planning Focuses on General Principles	82
Preparedness	Planning Involves Education	82
Preparedness	Planning Overcomes Resistance	82
The Actual Sta	to of Pronarodnece	83

# CHAPTER

87.7	THAT & OTD	ABTYN	OTHILLOTANAT	CONTRACTION TEC
A.L		2112	OTTOWTTOWER'	COTAT TTACETTO PERC

Impact Contingencies	• •	5 9	۰	¥	٠	•	6		•	¢.	•	*	9	•	*	•	•	86
Situational Contingencies	<b>t</b> . (				•	3			• ,	*		•					•	89
Variations in Space	• :	8 8		\$	8		8			•)		4		æ		. 4	۵	89
Variations in Time			•	٠	*	 10	•		ą	i		÷		•	•		ø	90
Variations in Circumstances		• •		•	٠	۰.	٠	•				а		9	•	•	•	91

# CHAPTER

XII.	FIRST RESPONDERS AND INITIAL DEFINITIONS													
	Fixed Sites Versus Intransit Situations	v	•	4	•	•	٠	a	• ¢	•	4	•	•	93
	The Response Pattern ,	æ	*	*	3	¢	8	 9		٠	a	•	۰.	95
-														

## CHAPTER

	XIII.	CONVERGENCE	AND	OUTFLOW	PATTERN
--	-------	-------------	-----	---------	---------

Typical	Patterns	8	•	•	٠	•	•		•	9	•	a,	•		ŧ		8	. •	•	*			*	a	÷	100	?
Special	Problems	٠		B	٠	a	 a	•.	•		. •	а	¥	ð	۳.	٠	-	٠		, F	•	•	10	\$	<b>3</b>	105	Ì

TABLE OF CONTENTS (continued)

CHAPTER				1 - Z	Page
XIV. SIMILARITIES AND DIFFERENCE NONCHEMICAL DISASTER RESP	S BETWEEN CHI ONSES	EMICAL AND			
Comparison of Risks and Nec	essary Prepar	rations	w w z	o à e	. 107
Comparison of Responses .	• • • • • • • •	<b>6</b> F 2 3 3 3 5 7	2 % 17	~ 4 g	• 1.09
	-				
CHAPTER XV. CONCLUSIONS AND IMPLICATION	IS				
General Conclusions Findings About Disaster P Findings About Responses	reparedness to Chemical 1		ь 6 ў 3 й 4 в б	20 L G 20 A Z	
General Implications Applied Implications Research Implications .	ф с ф й с р т Ф с ф й с р т	8 U 2 8 6 9 6 9 6 8 9 0 8 8 9 4 9 9 0 8 8 8 9 4	9 6 6 9 6 6 9	0 0 0 	<ul> <li>115</li> <li>115</li> <li>123</li> </ul>
APPENDICES					. 125
REFERENCES	9 % & & & &	а с о с и 	4 m 4	9 C 4	. 128

vili

### CHAPTER I

#### INTRODUCTION

A definite sequence in the study of disasters can be observed. For centuries, such events went unexamined as generic and comparable phenomena, treated for a long time as unique expressions of the supernatural. "Acts of God," as the more common disasters were long designated, obviously could neither be fully understood, predicted, nor prevented by mere humans. With the weakening of religious beliefs and the advent of secularism in the modern world, however, attention turned towards a scientific explanation of disaster agents (see Baskum, 1974). Thus, in the late 19th Century, the physical aspects of disaster agents such as earthquakes, tornadoes, floods, and hurricanes were more and more studied, particularly as they were increasingly seen as natural rather than supernatural phenomena. Little by little the basic processes and mechanisms involved were discovered and analyzed. This line of research was so successful that varying degrees of prediction's are now possible for all the major natural agents. In this last decade, even earthquake prediction has become a scientific reality (Turner, 1976). Given this, it is not surprising that systematic efforts to prevent certain natural catastrophes from happening are also underway as, for instance, through cloud seeding.

The human or social counterpart side of the physical and engineering aspects of natural disasters has not had an equivalent scientific development, although the situation has markedly changed in recent times. Only after the end of World War II was research initiated on individual and group behavior involved in preparing for, and responding to, extreme collective stress situations. However, the volume of this work has increased dramatically in the last several decades. As one recent review of the area noted:

Three decades ago, there was not enough theoretical material or research work on response to social crisis and disaster to have warranted writing more than a footnote attesting to that fact. A paragraph could have summarized all the relevant work and activity of two decades ago. Even ten years ago, several pages might have sufficed to summarize totally the burgeoning activities in the area. The growth of the area has been exponential, not linear, and today the research efforts and theoretical advances have reached such a level as to force us to be highly selective in our coverage in this paper (Quarantelli and Dynes, 1977: 23).

Although there are still large gaps and lacunae, much is now understood about selected aspects of the human and social sides of natural disasters. The range and depth of understanding is well documented in recent reviews and summaries of the literature (Barton, 1970; Mileti, Drabek, and Haas, 1975; Quarantelli, 1978). The total knowledge of the social is not yet equivalent to that which exists about the physical side of disasters, but the gap between the two has been narrowed substantially over what it was even 20 years ago.

But the study of the so-called "man-made" or technological type of disasters has lagged behind research into both the physical and social aspects

of natural disasters. For example, very little is known about the specific hazards associated with a wide variety of chemicals, as witnessed by the frequent labeling in recent years of substances as dangerous which were once not thought to be any threat. The human and social aspects of technological disasters show even less study and absence of systematic research. Interestingly, an intensive case examination of the Halifax, Canada, ship explosion in 1917 is the first ever systematic social science study into disasters of any kind (Prince, 1920). However, this study, while a historical benchmark in the disaster literature, did not immediately generate continuous research into the area generally, much less technological disasters specifically. In fact, it was not until 1977 that some kinds of technological disasters became for the first time subject to comparative and systematic social science research. This occurred when the Disaster Research Center (DRC) at Ohio State University, with a grant from the National Science Foundation in the United States, launched a three year study of the sociobehavioral responses to chemical hazards, which of course is the subject of this report. Earlier work on technological disasters whether by the Center itself (e.g., Yutzy, 1964; Drabek, 1968; Fitzpatrick and Waxman, 1972) or others (e.g., Killian, 1956; Sagaloff, 1961; Westgate, 1975) had only looked at the problem in passing, or as a small part of a larger question. Then, too, few of the previous efforts had much of an empirical basis. If any data were obtained, they were for limited and isolated case studies, or used in anecdotal fashion for theoretical speculations (e.g., as in Barry Turner, 1978).

There would seem to be several reasons why it has taken until 1977 for the start of social science research into any kind of technological disaster. Perhaps the fact that for a long time, such disasters were not seen as having the same potential for extensive death and destruction as did such natural agents as hurricanes or earthquakes. In recent years, of course, the latent and longrum effects of chemical or nuclear hazards have come to be seen as possibly even more devastating (in a different way) than natural disasters.

The absence of any tradition of social science research into disasters generally until after World War II is also probably a factor in the lag of studies on technological disasters. Even in the post war years, there were very few students of disasters, and they could address only a limited number of questions (Quarantelli and Dynes, 1977). But the field of social science disaster research has now established itself on a world wide basis, and there is a critical mass of researchers extending out their interests in all directions (see Quarantelli, 1980b).

Finally, it may be that the lag in study is due to the widespread view that problems involving some kind of technology require primarily technological solutions. However, such a view has increasingly been recognized as too simple, and today, social scientists are more and more recognized as important in the study of the prevention of, and response to, different kinds of physical and chemical hazards. The absence of catastrophes and the relatively small number of major chemical disasters in the United States so far could be attributed to good safety measures—which may be better than many other places in the world—but studies of incidents suggest too many "near misses" and lucky combinations of circumstances to attribute too much to technical safeguards. As will be documented later in this report, field observations and studies of preparations for, and organization of, responses to actue chemical emergencies also frequently indicate confusion, uncertainty, lack of

2

coordination, and general inefficiency in the mobilization of resources in the face of a sudden chemical threat. The picture one frequently gets is similar, although on a smaller scale, to that depicted by the President's Commission on the Three Mile Island nuclear accident (see President's Commission, 1979); that is, the technological safeguards proved relatively adequate, but the human errors and organizational flaws were such as to almost turn a rather routine accident into an incredibly disasterous catastrophe. In our study we found, as others had previously observed, that many small scale dangerous chemical incidents are frequently transormed into potentially larger and more serious events by inept efforts at first response. The importance of sociobehavioral aspects has thus increasingly been recognized (see Rawls, 1980).

This recognition has not only developed in the research area. At an accelerating pace, citizens and governmental officials have come to see that the same chemicals which are beneficial in so many ways, and which are playing an ever important role in the way we live today, also present a degree of risk for all American communities. Some recent dramatic events have called considerable public attention to, and generated concern, about the problem. Thus, the crisis situation at Love Canal is simply an extreme manifestation of the hazards posed by the dumping of volatile chemical wastes near populated areas. The explosion of liquified petroleum gas as a result of a train derailment in Waverly, Tennessee, which resulted in 16 deaths, 43 injured, and \$1,800,000 in property damages (Analysis of Proceedings. 1978), likewise primarily highlighted the fact that a community need not contain chemical producers to have potential chemical problems. Newly formed groups of private citizens and public interest organizations have increasingly devoted time and attention to the dangers presented by toxic chemicals. Also, established environmental groups such as the Sierra Club and The Conservation Foundation have gotten involved.

Local officials also have begun to realize that while some localities face few or no threats from natural disaster agents, no place anywhere in the country which has a railroad and highways is invulnerable to a chemical threat. At the state level, the National Governor's Association recently argued that the problem of chemical emergencies should be given a high priority in state disaster planning (Whittaker, 1981). Notable, too, is that hazardous substances have been the target of a considerable amount of legislation in this decade, signalling increased governmental monitoring and regulation of all phases of chemical production and distribution. Due to the increase in both public and government concern with the problem, many private and community organizations are beginning to perceive a need for information about the hazardous materials area.

In line with this general interest in the problem, the focus of our research was on organizational and community preparations for, responses to, and recovery from, relatively sudden chemical emergencies. In the first phase of the work, we concentrated on planning and preparations at the local community level for acute chemical disasters. In the second phase, the emergency time activities of organizations during actual incidents involving chemical hazards were examined in detail. The third phase of the work, far more limited in scope than the other two, locked at the long-term organizational and community consequences in localities impacted by major chemical disasters. Thus, the results of this study focusing on preparations for,

3

responses to, and recovery from, serious accidents involving the sudden release of hazardous chemical substances, should be of interest to a large number of officials and organizations having policy, planning, and operational responsibilities in community wide emergencies.

In Part 1 of this report which immediately follows, we describe how the problem of sociobehavioral responses to acute chemical hazards was studied. After a chapter on the nature of acute chemical hazards in the United States at the present time, we indicate the theoretical framework guiding our work and the research procedures we used, including an assessment of the quality and quantity of the data we obtained. In Part 2 of the report, we present a general summary of our empirical findings on preparations for chemical emergencies. The material is organized around central ideas from our theoretical framework; notably, the idea of threat perceptions, availability, and mobilization of resources, social linkages or patterns of community social organizations, social climate, and the preparedness planning process. In the next section, Part 3, we set forth our other empirical findings on the organized responses to actual chemical disasters. This section discusses the effects of preparedness planning on response, situational and impact contingencies, first responders and initial definitions of the situation, the post-impact convergence and outflow patterns, and some similarities and differences between chemical and nonchemical disaster responses. The report concludes with a chapter which draws together the conclusions and derives the implications of our research. An appendix lists all publications from our study, including those being written as well as those which have already appeared in print.

# Part 1. STUDYING THE PROBLEM

Our study of the sociobehavioral aspects of chemical emergencies was partially initiated out of a growing awareness that, like other beneficial human inventions such as the airplane, the dam, and the nuclear reactor, the production and transportation of chemicals has meant a quantitative and qualitative change in the hazards communities must face. The research focused on how organizations and communities cope with the hazards presented by chemicals in their midst, both in terms of preparing for chemical emergencies and in terms of responding to such emergencies when they occur. More specifically, the study dealt with actions taken to reduce the occurrence and/or the negative effects of the kinds of threats which present immediate sudden danger to communities, rather than activities aimed at reducing chronic threats which have more subtle long range consequences, as seen in the Love Canal situation in New York. Thus, our concern was primarily with acute chemical hazard situations.

The safe handling of chemicals is an area of tremendous complexity, requiring highly specialized technical knowledge, training, and skill. But organized preparations for, and responses to, sudden chemical emergencies necessitate more than specific technical expertise. The factors and problems involved in the handling of dangerous chemicals are also social in nature. In fact, as we will show later, technical and social aspects are intricately intermixed in both planning and in disaster settings. As such, a social science perspective on organized preparedness for, and response to, sudden chemical emergencies, is both important and necessary. The fields of toxicology or chemical engineering can address certain questions; sociology and social psychology are needed for others.

One way of illustrating the importance of the social in chemical disaster planning and response is to describe another situation which illustrates the role these factors play. One aspect of natural disasters, specifically the task of issuing warnings for tornadoes, hurricanes, floods, and serious storms is such an example. Forecasting and issuing warnings of severe weather events is the job of highly trained meteorologists and hydrologists in the National Weather Service (NWS). Technological advances such as radar and satellites have made it possible to forecast the weather with increasing accuracy. However, in order to warn the public effectively, NWS has incorporated into its operations social scientific principles pertinent to reaching and communicating with relevant audiences. NWS knows, for example, that it is not the technical or scientific accuracy of a storm warning as much as the credibility of the source that motivates people to heed it; that, to be followed, warnings must include directives on appropriate actions to take; and that, contrary to widespread belief, refusal to evacuate, rather than panic flight in the face of a threat, is the biggest problem officials must face (McLuckie, 1970). Even given highly technical and accurate information, the NWS understands that eliciting appropriate public response involves using social scientific knowledge about human response to warning messages. Without the application of this kind of knowledge, even the most precise warnings, based on the most accurate forecasts, would go unheeded. Indeed, because Weather Service professionals know this, most major conferences sponsored by the National Weather Service and the National Oceanic and Atmospheric Administration (NOAA) have sessions devoted to discussions of social aspects of warning for flash floods, severe storms, and other weather-related events.

Another way of illustrating the importance of considering social factors in planning and response to community emergencies is to note the distinction made by some disaster researchers between the agent-generated and response-generated demands which result from disaster impact (for the conceptual distinction see Dynes, Quarantelli, and Kreps, 1981). The former are the kinds of disaster-related needs which are created by the disaster agent itself: if homes are destroyed by a tornado, emergency housing is necessary; if basements are flooded, basement pumps are needed; if large numbers of people inhalë toxic fumes, emergency medical services are needed on a large scale; if water supplies are polluted, decontamination or neutralization measures have to be taken; and so on. Response-generated demands, on the other hand, are those activities which must be carried out if the agent-related needs are to be met at all; these include such matters as communication, decision-making, coordination, and related functions. Response-generated demands are processes which cut across specific task areas and organizations. They are just as important as, if not more important than, agent-generated demands, and it is in the area of response-generated demands that the social factor intervenes. Thus, for example, large scale evacuation is not just the physical movement of people; it requires many decisions, much communication, considerable coordination, and so on (see Quarantelli, 1980a).

As already noted, our study was based on the well-supported premise that many problems in disaster preparedness and response are "people" problems, and the consequences of unresolved people problems can be just as serious as those resulting from unsolved technical problems. For example, a special resource such as foam may not be mobilized in a chemical fire because it does not exist in or near the stricken community. However, even if it is there, it may not be used simply because community emergency personnel are unaware of its existence or because it is not known who has the responsibility for <u>authorizing</u> its use. In short, whether resource scarcity is the result of a supply problem, or the result of a problem in the (human) delivery system, the outcome is the same: there is a failure to meet a critical need. It is in the lastmentioned area--that of organizing so as to bring needed resources to bear in community crises--that social scientific research findings can be of help.

In this part of the report we first address the question of what kinds of acute chemical hazards American communities currently face. It will be noted that the threat is pervasive, probably is increasing, and has catastrophic potentials. We then indicate the general social science perspective and sociological model we brought to bear when we undertook our study. In essence, an open social system model was used to analytically capture the demands and the capabilities present when either preparing for, or responding to, chemical emergencies. The last of the three chapters in this part of the report indicates the quality and quantity of the data we collected using our theoretical framework. Our assessment is that the data obtained, while not ideal, were more than adequate for our research purposes, and represent the first of its kind ever obtained, especially in its systematic and comparative nature.

### NATURE OF ACUTE CHEMICAL HAZARDS: THE CURRENT SITUATION

In this chapter we note the nature of the risks and dangers presented by the large scale production, distribution, and use of chemicals in American society. Statistics and brief descriptive notes (many taken out of Tierney, 1950) are used to give a picture of the kinds of possible emergencies and disasters which the mishandling of chemicals can create in the United States. We observe that threatening situations without impact can be as socially disruptive as actual, scute hazardous chemicals episodes.

#### The Threat of Chemicals

Chemicals provide considerable benefit to society but do pose some risk for the human race. Our modern lifestyle would be impossible without the chemical innovations of recent times. The contributions they have made to our high level of living, especially in urbanized and industrialized societies, seem incontestable. Yet, the production, distribution, storage, and usage of a substantial number of chemicals also create varying degrees of risk to life, property, well-being, and everyday routines. Some risks are of a chronic nature, and have an impact primarily over a long period of time, as in the recently discovered instances of asbestos fibers or the consequence of hazardous waste dumps such as at Love Canal. Still other threats of a chemical nature tend to appear suddenly, creating acute emergencies which have to be immediately responded to when they occur. It is this category of more sudden perils with which our study was concerned.

The 161 billion dollars-a-year (in 1980) chemical industry in the United States, manufactures tens of thousands of different chemicals annually, with more than 20,000 of them produced in amounts exceeding one million pounds yearly. While a large majority of chemicals are not normally dangerous, "most of the big commodities that make up the bulk of the industry's output" (Winston, 1978) are among the more than 1,600 hazardous materials listed by name for federal regulation by the Department of Transportation. Also, new chemicals are added each year to the more than four and a half million types currently registered by Chemical Abstracts. Many estimates suggest that at least several hundred of the new substances created represent potential hazards.

Apart from the dangers involved in the production and use of certain chemicals, there are risks inherent in their transportation and distribution. Virtually everything produced is ultimately transported, often more than once. The United States Department of Transportation believes that there are over 250,000 shipments of hazardous materials in the country each day (Safety Effectiveness Evaluation, 1981: 6). In 1978, it was estimated that more than four billion tons of hazardous materials were shipped 218 billion ton miles by various transportation modes in the United States (U.S. House of Representatives, 1978). At any given time, perhaps 100,000 trucks are carrying hazardous chemical bulk cargoes over roads and highways. Tank trucks may carry, sometimes under pressure, as much as 7,000 gallons of a bazardous chemical. About 35 percent of all freight trains contain dangerous material (Systems Safety Analysis Subcommittee, 1978). The hazardous materials most often transported by American railroads--such as liquified petroleum gas, chlorine, anhydrous ammonia, and vinyl chloride--are carried in rail tank cars with capacities of up to 42,000 gallons. Another estimate is that one truck in every ten and one of every twenty three railroad cars carries hazardous cargo (Rawls, 1980). The Southern Pacific Railroad alone reportedly moved over 100,000 carloads of hazardous substances in just one year--1974 (Bahme, 1978).

The heavy volume of traffic involved results in many actual and potential dangerous episodes in American society. From 1971 through 1979, 95,167 "incidents" were reported to the Department of Transportation (Safety Effectiveness Evaluation, 1981: 5). However, regulations are such that only carriers and not shippers are required to make such reports, and in any case, "only 05 air carriers, 1,272 highway carriers, 84 railroads, 56 water carriers, and 18 freight forwarders have ever submitted incident reports since they were first required in 1971" (Comptroller General, 1980: 17). That there may be underreporting of incidents is suggested by the fact that the Bureau of Motor Carrier Safety official list of hazardous material truck shippers alone, known to be incomplete, includes around 12,000 firms; its official list of hazardous materials carriers includes 11,700 companies (Safety Effectiveness Evaluation, 1981: 5).

There is also reason to suspect that actual and potential hazardous-intransit accidents may be on the increase. Department of Transportation records known to be incomplete (see Safety Effectiveness Evaluation, 1981) show that from 1977 to 1978, there was a 19 percent increase in hazardous material incidents reports, and an eightfold increase in such reports from 1971 to 1979. Likewise, indicating an upward trend, the National Governor's Association found that state emergency offices went from practically no awareness of hazardous materials incidents prior to the end of 1978, to involvement in 5,724 such incidents in the 29 ensuing months. Later figures, such as the 17,524 reports of unintentional release of hazardous materials in 1979 probably do reflect greater awareness of the problem, the addition of more chemical products classified as hazardous, and better reporting mechanisms. However, because of known underreporting, all figures are minimum ones at best, and it has to be assumed that because of the greater volume produced, increasingly greater amounts of potentially dangerous chemicals are being moved around the country. With more at risk, the probabilities of emergencies occurring are higher.

These can also be risks in the storage and disposal of chemicals. Liquified petroleum gas (LPG), one of the most serious chemical hazards, is stored at 8,000 facilities around the United States (Comptroller General, 1978). Over 10,000,000 tons of nonradioactive hazardous waste is generated yearly by American industry, and the amount is growing at the rate of five to ten percent annually (Safety Effectiveness Evaluation, 1981: 7). That state emergency offices got involved in 2,579 nontransportation hazardous materials accidents in the period from January 1978 through March 1981 hints at the emergencies which may occur at fixed facilities where dangerous chemicals are manufactured, stored, used, and in some cases, disposed of for various industrial purposes. Potantially dangerous chemicals exist in all possible forms of liquids, solids, and gases, and can bring about a variety of deleterious consequences varying with the nature of the physical or biological substance exposed to the chemical. Thus, chemicals can do damage solely, or through combinations of, indulation, ingestion, absorption, contact, and other exposures to flammable materials, compressed gases, corrosive materials, explosives, oxidusing agents (e.g., bleaches and chlorides), poisons, etiologic materials (e.g., liquified natural gas), and molten materials (see U.S. Department of Transportation, 1978). There are, in short, multiple ways in which human and other organisms, plant life and fauna, and physical and material objects can be destroyed, damaged, or otherwise directly negatively affected by a dangerous chemical. Futhermore, a number of chemicals which are benign in themselves can, as a result of a synergistic effect or the reactions resulting from mixing with other benign chemicals, become highly dangerous substances.

#### The Consequences of Dangerous Chemicals

It is true that most acute chemical emergencies do not in the United States eventuate in severe manifest losses, although even a threat can be disruptive and costly in many ways apart from death, injury, or even property damage. In addition, there has been a continuing series of major chemical emergencies, where the deaths and injuries over the years aggregate in the hundreds and thousands, and property damage in the millions. Finally, the potential for a massive catastrophe is always present, and possibly because of an increasing number of things which can go wrong, may be more probable in the future than it ever was in the past.

Sudden hazardous materials incidents can generate massive social disruptions. Over 215,000 people had to be evacuated from the Toronto, Canada suburb of Mississauga on November 11, 1979 as a result of a train derailment threatening the release of chlorine gas (Scanlan and Padgham, 1980). While no potential chemical disaster of such magnitude has yet occurred in the United States, each day probably brings the possibility closer. The National Transportation Safety Board chairman stated that the June 1979 derailment of 20 carloads of hazardous materials including acetone, chlorine, and anhydrous ammonia, in a sparsely populated rural location near Crestview, Florida could have resulted in a "catastrophe" in a more densely populated locality (cited in Tierney, 1980: 3); in the actual incident, the ensuing explosion led to the emission of poisonous fumes requiring evacuation of 4,500 people up to almost 20 miles from the accident site. A RAND study projected that a liquified natural gas tanker collision four and a half miles off the California coast, could kill in the subsequent fire, 70,000 persons and inflict 325 million dollars of property losses (Bahme, 1978: 189).

As it is, statistics show that dangerous chemical episodes are resulting in deaths and injuries, large scale disruptions of social life, and massive financial losses. A DRC survey of articles on sudden hazardous chemical incidents reported in the <u>New York Times Index</u> for the years 1972 through mid-1978 indicates that such incidents were responsible for 111 deaths and 1,469 injuries during that period. Numerous evacuations were reportedly carried out, with the number of persons evacuated ranging from 40 to 30,000. In 1977 alone, acute community emergencies caused by dangerous chemicals claimed 32 lives and injured at least 543 persons. In 1978, during the course of the DRC study, train derailments involving hazardous materials in Waverly, Tennessee and Youngstown, Florida produced a total of 24 deaths, 159 injuries, 3 and 1/3 million dollars in property damage and 550 million dollars in legal claims. In a recent newspaper article it was noted that in the first nine months of 1978 alone, close to 20,000 people had to be evacuated from their residences during or after 783 rail accidents involving hazardous chemicals, including 178 in which toxic chemicals were released (New York Times, April 15, 1979).

Incidents such as described in the following attest to the magnitude of damage and disruption chemical products can cause when they are not properly controlled. They also illustrate that rural and metropolitan areas are both vulnerable, and that the danger may come from accidents in fixed installations or problems in the transport of chemical substances. Potential serious threats are everywhere.

The Texas City, Texas disaster in 1947 resulted when a ship being loaded with ammonium nitrate exploded in the harbor. A total of 522 persons died in the explosion, over 4,000 were injured, and property damage was in excess of 100 million dollars.

A tank car explosion of nitromethane, a flammable liquid, in 1958 near Niagara Falls, injured 180 persons, and resulted in damage of over one million dollars to buildings within a three and a half mile radius, including eight elementary schools.

The Crete, Nebraska train accident of 1969, in which a derailed freight car struck a tank car of anhydrous ammonia on a nearby siding, released an ammonia cloud which killed eight in the nearby town, and hospitalized eleven others.

The release into the air of silicon tetrachloride from a storage facility in Chicago in 1974 led to a dense and odorous toxic cloud which spread over the nearby Altgeld-Murray housing project and overcame hundreds of residents and necessitated the evacuation of thousands.

An explosion of liquified petroleum gas from an overturned tanker truck at Eagle Pass, Texas in 1975 killed 17, injured 48, and damaged a nearby trailer park and destroyed 50 automobiles.

A fire in 1976 in Chatsworth, a Los Angeles suburb, in an industrial building which contained hydrochloric acid, chlorine, and polyvinyl chloride resulted in the hospitalization of 72 persons and the evacuation of thousands.

The spill of 13,000 gallons of phosphorus trichloride, a corrosive liquid, as a result of a train accident in 1980 in Summerville, Massachusetts generated a cloud which necessitated the evacuation of over 23,000 people and required hospital treatment of 418 persons. A fire in a condemned chemical warehouse in Elizabeth, New Jersey two years ago led to ensuing explosions which injured about 30 persons. The acid cloud that billowed out over a 15 mile radius forced the closing of schools in several cities, and brought about a discussion of possible toxic alert for parts of New York City.

A damaged pipe in 1981 led to the release in South San Francisco, California, of 1,000 gallons of silicon tetrachloride which vaporized into caustic fumes when it hit the air. About 10,000 persons had to be evacuated, 28 were sent to hospitals, and ships were barred from an eight square mile area of the bay as well as 70,000 people who worked in an industrial area on the western side of the bay.

Many hazardous materials emergencies carry the potential for catastrophe. But even when the damage is relatively minor, or the hazardous materials incident is simply a threat and does not eventuate in any physical destruction, communities can still suffer both directly and indirectly. Responding to these kinds of emergencies is physically dangerous and psychologically taxing for community emergency personnel. Social dislocation, such as that which is produced by emergency or precautionary evacuations, can result in economic losses due to work stoppage and the cessation of retail trade. Overtime paid to public and corporate employees can strain budgets. Families evacuated in the middle of the night or children forced to leave schools, may undergo psychological stress. Lawsuits can also occur in the aftermath of chemical incidents especially if there is public feeling that the threat was not well handled.

Thus, by any criteria, as we have tried to illustrate in this chapter, there is a problem. There are incidents of acute chemical hazards, there is a strong possibility that such events are on the increase, and there does exist the potential for very major or catastrophic chemical disasters. The effects of such happenings are not only in the casualties and property damage they directly produce, but also in the social disruptions and economic losses they indirectly occasion.

With this as the problem we were interested in, what theoretical notions from sociology guided our study and what data did we collect? In the next chapter, we outline our research model and design. In the chapter after that, we discuss the data we obtained.

#### CHAPTER III

## GUIDING FRAMEWORK FOR THE STUDY

In the last two decades, social scientists, especially sociologists, have increasingly brought their models, concepts, hypotheses, and methodologies to bear on the question of how people and groups behave in, and react to, natural disasters such as earthquakes, floods, hurricanes, and tornadoes. The research undertaken has led to considerable understanding of human behavior and organized social action under extreme stress situations (Quarantelli and Dynes, 1977). Consequently, when we launched our study of chemical disasters, it seemed appropriate to continue to draw from the general social science literature.

Thus, for the first phase of our study, we used an open system model in our research. In the next section of this chapter, the usefulness of such a model is illustrated by showing how disaster preparedness is generally affected by social factors. In the third section of the chapter, we set forth the overall model and graphically depicted the dimensions or elements in the model.

The response pattern to acute chemical emergencies was approached through an offshoot of the open system model: namely, the notion that the pattern can be viewed as an emergent process which involves an interplay between demands and capabilities in the situation. This shift in perspective was partly dictated by the fact that while there is a relationship between disaster preparedness and disaster response, there can be a considerable discrepancy between the two. We depict how we approach the response pattern in the fourth section of this chapter.

## Value of a System Model

The model employed in the study depicts chemical disaster preparedness and response as open systems. In this model, environmental threats constitute a demand on the emergency preparedness and response subsystems of the community system. However, these subsystems are affected not only by threats but also by several other factors, including threat perceptions, the social climate, and social linkages or the interorganizational networks. Before discussing each of the elements in the model in turn, it might be useful to illustrate why such a factor as social climate is so important in understanding community preparedness, that is, why the mere existence or even the perception of a threat is not sufficient to bring about preparedness efforts.

While the example of social climate is the specific one used, perhaps the best way we can begin this discussion is to emphasize the distinction social scientists make between what people <u>say</u>-their attitudes and beliefs-and what people <u>do</u>--actual individual, group, and organizational behavior. Why is this distinction important for understanding local preparedness? When we talk about planning for a new hazard in the environment--whether a natural catastrophe like the Mount St. Helen's volcano or a technological threat like hazardous materials--we are really talking about carrying out a type of planned social change. As the history of any number of government programs shows, bringing about planned change can be extraordinarily difficult regardless of how much change is needed or wanted. Some of this difficulty is due to the common and mistaken assumption that knowledge of better ways of doing things is sufficient for people to adopt these better methods, as well as to the equally widespread ides that if a large enough number of people change their individual attitudes about social conditions -- if they have their consciousness raised--behavior will inevitably change and social conditions will be improved. On the contrary, however, it has been demonstrated time after time by social researchers--in the laboratory, in field experiments, and in the observation of the behavior of individuals and groups in everyday life--that attitudes and beliefs are at best only weak predictors of behavior (see, e.g., Deutscher, 1966; Schuman and Johnson, 1976). Any number of contingent factors can come into play in determining whether attitudes, beliefs, and intentions of individuals -- and organizational policies and plans as well -- ever get translated into action. Many factors besides the need for change, and awareness of the need, affect whether change occurs.

We stress the attitude/behavior descrepancy for several reasons. First, as we indicated above, it needs to be emphasized because many Americans have a tendency to take a sort of "hearts and minds" approach to the solution of social problems and to planned social change: to believe that it is sufficient to change attitudes about the need for things like disaster preparedness, and, that these things will automatically come. Second, we are stressing the factors which affect the relationship between what people say and what they do to try to offset the tendency to see collective or organizational solutions to problems as the result of individual motivations and intentions -- in other words, to neglect the social context which makes these motivations and intentions either harder or easier to carry out and more or less likely to succeed. It takes more than individual commitment to make preparedness happen. Third, this emphasis comes out of an awareness that there are people in the chemical industry and in public safety organizations who are working to make the environment safer through better preparedness, and who, at the same time, want to understand more about why this is so difficult to do when there is widespread public government and industry concerns with the problem. Among our overall observations, our study noted how difficult it sometimes can be to turn attitudes, awareness, and concern into practice.

To better understand the discussion that follows, it might be useful to think of disaster preparedness not as a linear process, but rather as a funnel or a value-added process in which factors such as the social climate become important once minimal conditions, e.g., awareness of chemical threats, are met in a community. According to this perspective, awareness of the need for planning is a necessary, but not a sufficient, condition for organized preparedness efforts. Awareness of the problem is something that may be present, but that may not necessarily lead to any lasting or potentially effective preparedness arrangements. Since one of the things we learned in our research was that in many of the communities we studied, there is not even attitudinal agreement on the magnitude of chemical threats, it becomes a little more understandable why carrying out preparedness is so difficult.

## The Overall Preparedness Model

Our data gathering and analytic efforts were guided by an open system model which used the local community as the basic unit of study. Buckley (1968) argues that the open system is the appropriate model for sociocultural entities such as communities. Open systems resemble homeostatic systems in that they can be impinged upon by environmental forces, and adapt by means of feedback. However, they have the additional property of "internal" openness: system elements can act upon and have interchanges occurring among components, as well as between system and environment. Open systems show considerable variation and are subject to change, structural elaboration, and self-direction. Our study, then, concerned the manner in which several analytically distinct system elements interacted with one another to produce system-wide effects.

The eight key dimensions we used to describe and organize the data are depicted graphically below. Conceptually, these dimensions are the local community, threats, resources, social linkages, social climate, preparedness, feedback, and the extra-community setting. Resources, social linkages, and social climate, respectively, are depicted as being within the context of one another. The figure below represents our effort to suggest the increasing level of generality of phenomena as one moves from resources, to social linkages, to social climate.

In our working model, we assume that for any given community there is the possibility of some kind of danger from chemical and other threat agents. Such threats may be viewed as the input, or demands, on the community system for disaster preparedness. However, within any given community, there are always offsetting capabilities for meeting such demands. These we see as the resources which can be used to meet the demands. The resulting balance between threats (demands) and resources (capabilities) is reflected in some mode of community social organization, that is, in a particular pattern or set of links among the organized elements involved in preparing for local disasters. The specific form that the <u>social linkages</u> take in a community is a matter of empirical determination. For example, linkages may exist in the form of systems, networks, clusters, or fragmented sets of social units prepared in varying degrees to respond to an actual or potential disester.



Different social, political, economic, legal, historical, or psychological factors may also affect the social linkages and resources which are present in a community. We termed factors such as these the social environment or <u>social climate</u> of the community. Finally, whatever the particular constellation of elements in a community, one outcome or output is some form of disaster preparedness. As we conceptualized it, preparedness includes meetings, rehearsals, disaster drills, and memos of understanding, as well as written disaster plans. Additionally, we view preparedness itself as producing <u>feedback</u> which in turn affects not only the demand, or threat possibilities, but also the resources, or capabilities, social linkages, and the overall social climate.

Of course, no community exists in a social vacuum; the <u>extra-community</u> setting also has to be taken into account. This setting consists of sociocultural factors outside the community which impinge upon the local system so as to affect disaster preparedness within it. These factors, for example, may range from legal norms at the federal level to the power of national headquarters of chemical corporations to influence the safety operations of their local plants, to the agenda-setting function of the mass communications system in calling attention to the transportation of hazardous materials as a social problem.

15

It is important to stress again that the different elements or dimensions stand in certain relationships to one another. Stated in propositional form, we could say we approached our study goal and gathered our data with the idea that:

- In any given space-time configuration, there is some kind of onerative community.
- 2. Any community is subject to a range and variety of threats.
- 3. Certain resources are available to cope with the threats.
- 4. These resources are handled by some kind of community social crganization or sets of social linkage.
- 5. These existing social linkages or patterns reflect the <u>social</u> <u>climate</u>.
- 6. There is a degree of <u>preparedness</u> resulting from all of the just-noted elements.
- 7. The preparedness results in <u>feedback</u> to threats as well as other elements.
- 8. All of the above are affected by the <u>extra-community</u> setting of the community.

#### Looking at the Response Pattern

Given a community's state of preparedness, what might be its organized response to an acute chemical emergency? In general, we assumed (and it was borne out empirically) that there would always be a discrepancy between preparations and response. Part of this idea was drawn from prior DRC studies. For example, in the Center's study of the delivery of emergency medical services at times of great casualties, we had found that no matter how weil the emergency medical system (EMS) or a given hospital was prepared, the organizaed response varied considerably from what had been planned and envisioned. Two elements seemed to almost always enter into the situation to change the actual response from the prepared response; one was that the EMS system could seldom control the flow or input of victims or injured into the system. There were frequently situational contingencies which made the carrying out of the planned response either impossible or very difficult. Two, there were almost always emergent aspects to what had been planned. In the process of the providing of EMS, new groups or activities very frequently appeared. The contingencies and the emergent qualities all but assured that there would be a discrepancy between the organized EMS which were provided and those which had been planned, and this was true no matter how well prepared the EMS system was before the disaster or catastrophe. It was not that preparedness did not matter, for it did, but there was always a difference between the planning and its implementation in actual situations (Quarantelli, forthcoming),

With this as background, in our study of the organized response to acute chemical emergencies, we assumed that we had to assume an emergent process

with situational contingencies. Both the demands and the capabilities in the situations were seen as involving both aspects. Thus, our model of the organized response conceptually divided the response into four major aspects or dimensions; namely, the state of planning and preparedness in the community, the disaster threat or impact contingencies, the actions of the first responders and their initial definitions of the situation, and the convergence and outflow of people, things, and information. Graphically, we saw the response situation as follows:



## Extra-community Policies and Factors

In our working model for response, we assume that for any given community, there are some latent capabilities for responding which result from the state of <u>community disaster preparedness</u>. The state of preparedness might be high or low, for chemical or other kinds of disasters, but in all cases there is a latent potential for responding in some organized fashion. In a fundamental sense, no community is ever totally unprepared. There are, for example, always some organizations that are emergency-relevant and so on.

When a chemical incident occurs, be it an explosion, spill, or release, some demands for a response are generated. However, what these demands are will vary from community to community, from one incident to another. This is because there are always variants present, among the most important of which initially are the <u>situational and impact contingencies</u>. Thus, for instance, it makes a considerable difference whether the initial accident occurs on private instead of public property, or during which sequence of social time the impact occurs (e.g., during or not during rush hour on a major highway) and so on.

Similarly, the first responders and their definitons of the situation are crucial. Different behaviors will emerge depending on who they are and what they perceive. It is in fact a characteristic of first responders that they often have the potential to turn a relatively minor traffic accident (e.g., an overturned truck) into a major chemical disaster (e.g., by throwing water on chemicals which will explode when so treated). There will usually be an outflow of people, things, and information from the accident site, which, however, typically generates a similar convergence on the accident site. The <u>outflow and convergence</u> essentially represent what we considered as the manifest capabilities brought to bear on the demands of the chemical accident. As already noted, we assume that the latent and the manifest capabilities are not necessarily equivalent.

Of course, just as community disaster planning does not take place in a social vacuum, neither does the organized response to an acute chemical emergency. The extra-community policies and factors operative at any given point in time have to be considered. For example, for some kinds of dangerous chemicals such as pesticides or chlorine, there are standby industrial teams which will start to move towards a chemical incident involving one of their products, sometimes even before any of the local community emergency forces have even become aware of a potential hazard in their locality. (While it is analytically important to distinguish the extra-community aspects, all such aspects will, for purposes of this report, be described and discussed under the topic of outflow and convergence.)

The ideas set forth in this chapter were partly derived from certain theoretical notions in sociology as well as DRC's previous empirical observations of other kinds of disasters. They were intended primarily to guide and organize our data gathering. There is no pretense that what we used was in any way a theory of disaster preparedness and/or response patterns. In the main, our work was of an inductive rather than deductive nature; we aimed at developing generalizations and propositions. In this respect, we did not test hypotheses or relationships between variables. Our goal, instead, was to arrive at a holistic picture of how local commutties prepare for, and respond to, acute chemical emergencies. As such, the guiding framework for the study presented in this chapter was not and did not have to be other than what we have called it--a guiding framework.

#### CHAPTER IV

## RESEARCH PROCEDURES AND DATA

Our research design is described in this chapter, as well as the nature of the data gathered, and the general and special analysis undertaken. We first indicate what we sought and what we obtained in the first phase of the study, where the focus was on community and organizational disaster preparedness for acute chemical emergencies. The second section of the chapter describes the objectives, field procedures, the nature of the data collected and what analytically we did with it when we turned to the second phase of our research, where our concern was with the response patterns to immediate threats of sudden chemical disasters of their actual occurrence. The general and special analyses we undertook for both phases of the research are then noted, although not all the findings so obtained are explicitly discussed in this report. We conclude the chapter with a brief assessment and evaluation of the quality of the data we obtained.

### The Research Design for Phase One

In the first phase of the study, our field work concentrated on obtaining systematic and comparative data on community preparedness for sudden disasters, especially those involving toxic releases, explosions, or other chemical agent emergencies. To meet our research objectives, we had to pick a sample of communities; decide what organizations and officials within them we wanted to contact; determine the nature of the information required by our research objectives; and design the field instruments we are going to use.

We considered many factors in selecting the 19 communities we chose to study. To achieve variation in our sample, we used the following criteria: size of community; region of the country; concentration of chemical companies; transportation facilities; previous disaster experiences; ownership pattern of local manufacturers; and types of chemical products present. Beyond this, we needed samples which would reflect different state regulations and enforcement practices with respect to the production, distribution, transportation, and storage of hazardous chemicals. To this end, we selected three communities in each of three states which had different sets of regulations and practices. Everything else being roughly equal, we chose communities in which the Center had done some prior field work, since this allowed us to draw on previously gathered community and organizational disaster preparedness data.

The specific communities studied were:

Akron, Ohio Baton Rouge, Louisiana Big Spring, Texas Buffalo, New York\*\* Charleston, West Virginia\* Chattanooga, Tennessee Cincinnati, Ohio\*\* Findlay, Ohio Galveston, Texas Houston, Texas\* Kingsport, Tennessee Linden, New Jersey Los Angeles, California\*\* Louisville, Kentucky\*\* Memphis, Tennessee\*\* Midland, Michigan\* Mobile, Alabama Niagara Falls, New York Savannah, Georgia\*\*

\*Cities in which DRC had done some field work on disasters, but not on overall disaster preparedness.

\*\*Cities in which DRC had previously amassed considerable and systematic data about overall disaster preparedness.

One of our goals was to contact six organizations within each community in order to obtain a picture of the overall disaster preparedness in the locality. Those chosen were the office of civil defense, the police department, the local Red Cross chapter, the local EPA office, the major general hospital in the area, and in localities with harbors or waterways, the Coast Guard or the port authority. Other organizations contacted -- more to get an idea of their own organizational planning, rather than to gauge overall community disaster preparedness-were the city and county fire department, the sheriff's office, the public health department, the office of mayor or city manager, the local state police post, utility companies, the National Weather Service, labor unions, mutual aid organizations, and the office in charge of railroad yards in the locality. Finally, a sample of facilities which process, manufacture, use, or transport large amounts of hazardous chemical materials was taken in each community, with the choice of particular chemical companies being made on the basis of the specific information obtained by the DRC team while it was in the field.

In the public organizations, we interviewed the officials who were most knowledgeable about, or responsible for, or who performed a key role in, community-wide disaster preparedness. In the chemical companies, an effort was made to talk to safety and disaster planning and operational personnel. Officers of industrial mutual aid organizations were also interviewed when possible, although since almost all held a work position in a specific organization, they were sometimes also contacted for information on their own groups. Personnel were interviewed from all organizational levels, but preferences were given to those with disaster policy, planning, or operational responsibilities.

In the interview, officials were asked to fill out a disaster probability scale for their area, i.e., they were asked to assess on a 0 to 5 scale the probability that their locality would be hit within ten years by each of 36 potential natural and technological disaster agents. Then, depending on the type of organization contacted, one of three different interview guides were used (see the appendix of this report for copies of all major field instruments). The guides themselves contained questions relevant to the major dimensions of the theoretical model, viz., threats, resource capabilities, social climate, social linkages, and preparedness planning. We wanted to obtain information on: 1) which organizations had responsibility for which disaster tasks; 2) the nature of the relationships and interactions among various community emergency-relevant organizations; and 3) the outlines of both organizational and community-wide disaster planning. The intra- and inter-organizational safety and disaster planning of chemical plants were a particular point of focus. Additionally, for each community studied, we collected documentary and community-level statistical data which might help us understand the community and the factors affecting disaster preparedness.

Our field operations went very well. Almost all organizations cooperated fully. Direct refusals to participate in the research were almost nonexistent, thus allowing an average of twenty groups and agencies to be studied in each community. The vast majority of officials contacted proved cooperative in providing information and documentation, although chemical company personnel were sometimes guarded in their comments. At the conclusion of this part of the field work, DRC had made contact with about 400 organizations, which resulted in our obtaining over 300 disaster probability scales, several hundred in-depth interviews, and quantities of documents such as agency disaster plans plus socio-economic statistical data from each of the communities. For purposes of obtaining quotable (although anonymous) remarks, about a fifth of the more lengthy, intensive, openended interviews were tape-recorded.

For each community or event studied, a brief field trip report was quickly prepared. Each report covered disaster threat possibilities in the community or the actual disaster event, organizational involvement in disaster preparations, the field teams' general impressions or observations relevant to our research objectives, any problems in field operations which might have affected the data collection, and a listing of the data obtained. The reports were based on field impressions and observations and were intended solely to provide some basis for the more systematic data analysis which we later initiated. The material gathered in the field was also systematically processed when it was submitted to DRC. This was to insure that any gap in information was noted so that the missing data could be obtained via phone calls or by mail and also to insure that items which were to be mailed to DRC were actually received.

#### The Research Design for Phase Two

Although our focus in phase one was on disaster preparedness, DRC also studied a few actual chemical emergencies during the first year of the research. The incidents were of such seeming research value that we could not ignore them when they occurred. Among the events examined were two of the major chemical disasters in American society in recent times, the disastrous events in Waverly, Tennessee mentioned earlier, and in Youngstown, Florida where a chlorine gas incident killed eight, sickened 116 people, destroyed one million seven hundred thousand dollars of property and led to tens of millions of dollars claims in lawsuits. In addition, we looked at threats and disasters from chemical agents in Midland, Michigan, the site of one of the largest chemical companies in the country; in Baton Rouge, Louisiana, the location of one of the largest chemical complexes in the world; in Mansfield, Ohio and in Texas City, Texas, noted for the location of one of the most famous disasters in the history of the United States, and its biggest chemical disaster by far. Although our study of these events was not conducted as systematically as were later emergencies, we were able to examine the relationship of disaster planning in the involved communities to the organized response to threats and dangers that developed in each particular event.

In the second phase of the study we did field work, as it turned out, on 20 different responses to threats or disasters resulting from toxic releases, explosions, spills, or other chemical emergencies. These on-site studies were supplemented by examination of descriptions of other chemical disasters in official government reports (e.g., in the accident reports of the National Transportation Safety Board), accounts by operational personnel from emergency agencies, and a few other sources. The supplementary descriptions were used primarily to see if DRC might be missing something of note in its own field operations; nothing of importance was ever found. Thus, our focus remained, as it originally had been, on three aspects: the degree and kind of influence and effect that disaster preparedness had on actual disaster organizational responses and community reactions; the distinctive or typical characteristics and patterns of the organized responses; and the extent to which responses in chemical emergencies differed from those in other kinds of disasters, especially in the same community.

Very early in the DRC research effort, it became clear that there were major differences in both preparedness for, and responses to, chemical hazards resulting from transportation accidents and from those occuring as a result of a production or processing difficulty of some kind. In addition, as might be expected, some chemically-generated disasters or threats were very disruptive to community life; others somewhat less so. These two dimensions--whether an incident involved an in-transit or fixed site and whether the event was more or less disruptive--were combined to produce four different kinds of possible chemical disasters DRC could study. A decision was made to study a minimum of at least four events that fell in each of the four categories. When our field research was completed, we had undertaken 20 field studies somewhat equally divided between in-transit and fixed facilities, but including less of the more serious disruptive events than those only moderately affecting community routines. Field studies were conducted in eight different states and Canada.

In each of the chemical incident studies, an effort was made to obtain information about all groups operating at the disaster site, as well as those emergency organizations undertaking major tasks with respect to the incident. In almost all cases, this meant DRC gathered data from and about fire and police departments, the sheriff and the local highway patrol, civil defense, key local executive governmental offices, mass media organizations, emergency response teams, hospitals, and the group(s) on whose property the incident occurred.

One of the field instruments used was for officials involved in on-thescene activities. The purpose of this guide was to obtain the initial "definitions of the situation," the actual behavior and tasks performed at the site of the incident, and the time sequence of events, as well as technological and interpersonal problems encountered along with lessons learned.

Another field instrument was directed toward acquiring information about the overall organizational and interorganizational response and generalcommunity disaster preparedness. This interview guide, used with knowledgeable key informants, was made up of 35 semi-structured questions organized around communication and coordination at the time of the incident, an assessment of what was done, and the possible recognized influence of prior planning and community preparedness on the actual response (see the appendix of this report for copies of all major field instruments).

For each actual disaster event studied, DRC constructed a response matrix which delineates in 15-minute intervals what tasks were carried out by which organization after the onset of the incident. Several dozen tasks were examined, ranging from identification of a chemical threat, to efforts at neutralization and stabilization of the hazard, to evacuation decisions and the establishment of command posts.

A separate field report was also written for each incident studied. This covered the socio-economic characteristics of the community; its state of disaster preparedness; the damages, destruction, and disruptions occasioned by the danger or threat; the nature of the organized response to the event ranging from the first indication of danger to termination of the emergency; and an assessment of the problems that surfaced as well as the relationship of the response to prior planning and preparedness measures. In a few cases, through mail correspondence or by long distance phone calls, missing material was obtained.

On the whole, the field studies of actual chemical incidents went well. In about a third of the cases, DRC teams were able to be on site while there was still an emergency, and therefore could make participant observations of happenings. In one instance, because of a delayed explosion which occurred, field team members by chance just missed being caught by the flying debris. If there was any problem with gathering data, it was in learning in depth about the community and organizational pre-disaster preparedness. In the effort to learn as much as possible about the actual responses, the DRC teams somewhat slighted obtaining information about the state of disaster preparedness in the community. In only three cases was DRC able to study an organized response to an actual chemical emergency, in the same locality where we already had done a preparedness study.

At the conclusion of this part of the research on phase two of our study, we had made contact with about 200 organizations. Several hundred in-depth interviews were also obtained. In addition, substantial numbers of documents such as organizational logs, disaster critiques, etc., were obtained. As in the case of phase one, for phase two analysis we also amassed socio-economic and statistical data for each locality studied. To maximize the cooperation of respondents and informants, very few tape recordings of interviews were made, unlike in phase one.

## Analysis Undertaken

A variety of quantitative and qualitative analyses were undertaken of the data collected. The outcome of the more general substantive analysis constitutes the bulk of this report. The topical foci are indicated in the chapter headings for Parts 2 and 3.

The results of the more specific analyses are only alluded to in the following pages or are presented in detail in other publications (see the appendix for a listing of all written or projected publications from this DRC study). The more important of these specific analyses was a longitudinal study made of the Waverly and the Youngstown chemical disasters. Periodically, these localities were revisited by DRC field teams to gather additional data after an in-depth study had been made of the emergency time response. The intent of the work was to trace the effects, if any, of recovery from such disasters on organizational and community preparedness for possible future chemical emergencies. This work on long-term consequences showed that the disasters had little direct effect on the impact communities, but had substantial indirect influence on national thinking about chemical disasters in general (see Helms, forthcoming).

Other special analyses undertaken, especially at the community level, included the following: A specific analysis was made of the assessment of community vulnerability to acute hazardous materials incidents (Gabor and Griffith, 1980). This led to a later analysis of how risk assessment could be made of local differences in proneness to chemical disaster (Gabor and Pelanda, 1981). In-depth case studies were made of three selected incidents of disaster preparedness for acute hazardous materials incidents (Quarantelli, 1981b), and of three selected incidents of organized responses to actual chemical disasters (Gray, 1981b). A specific analysis was also made of mutual aid systems in the United States for chemical emergencies (Gabor, 1981), some of which is presented later in this report. Another analysis was undertaken of fire department operations in acute chemical emergencies (Baer, forthcoming).

A detailed content analysis was made of the chemical disaster parts of 46 state disaster plans. DRC was not able to obtain four of the plans. An in-depth examination was made of one state plan, its actual implementation in practice, and the whole historical development of this particular state's hazardous material program (see a partial description of this in Lawrence, 1981). Also, certain legal aspects of acute chemical emergencies were examined in detail (Gabor, forthcoming).

In addition to the just indicated analysis, the data were examined for their direct practical implication for preparedness and response. This led to a primer for preparedness for acute chemical emergencies (Tierney, 1980), and to another primer for responding to chemical threats and disasters (Gray, forthcoming). Currently under preparation is a third analyticallyderived practical statement on the relationship between preparedness and response in chemical disasters.

# Quality of the Data

The DRC objective in this study was to obtain a scientifically valid picture of preparations for, and responses to, acute chemical emergencies. As is always the case in DRC research, we were not concerned with technical issues, questions of blame, or an "investigation" of the events we examined. Obviously, the objective can be no better than the data we obtained. Therefore, what of the quality of the data? How good was it?

Measured against some ideal standard, our data fell short of what could be desired. But of course no social science research, or for that matter, no scientific study of any kind is ever ideal, is ever perfect. If our data were to be matched against that obtained in prior DRC studies, this was one of the Center's better efforts. There were fewer unanswered questions than usual. However, in assessing the overall quality of our research, two points should be noted. One concerns the representativeness of the findings: the preparedness patterns discussed, for example, are based on material from interviews with key personnel in more than 400 different chemical producing, chemical transporting, and emergency-relevant organizations in nineteen communities around the United States. The findings are, of course, directly représentative only of these communities and organizations--rather than all U.S. communities and organizations--but there are reasons to believe many of the patterns seen in the preparedness study are broadly reflective of what is being done to plan for chemical threats in the society at large. Based on global risk assessments and emergency experience, the communities chosen were all known to have a moderate-to-high risk of serious community emergencies involving hazardous materials. Because the sample was skewed in the direction of more severe risks, it seems reasonable to expect awareness and preparedness efforts in the sample communities would be as good as, or better than, those in other less vulnerable cities.

The response data, likewise, are skewed in a particular direction. Most of the actual incidents studied in the field by DRC took place in relatively small communities. On the whole, such localities are least prepared for disasters and can locally mobilize the fewest relevant resources when an organized response is required. Thus, our range of observations might be a little less applicable in chemically dangerous incidents in large cities and metropolitan areas. However, while this logically would seem a valid extrapolation, our actual field studies did not observe very much difference among responses in small, moderate, and large size communities. There were far more similarities than there were differences.

The second point to be made is that whatever the quelity of our research and observations, the data was not self explanatory, but required interpretation. The interpretation we brought to bear necessarily reflected the experience and understanding of the Center about preparedness and response in non-chemical types of disasters. To the extent that chemical emergencies differ from other kinds of disasters, the interpretation may not all be equally valid. However, as we discuss in chapter XIV of this report, there are both similarities and differences between chemical and non-chemical disasters. On the whole, we think there are far more similarities than there are differences, so to that extent, our interpretations are more likely to be valid. On balance the data does seem quite adequate given our research objectives. We were able to develop a general picture of the conditions and characteristics associated with community and organizational efforts to prepare for, and respond to, acute chemical emergencies. We were, as we indicate at the end of this report, able to draw practical, research, and theoretical implications from our work. Certainly, it was possible for us to amass a body of data far more systematic and comparative than ever gathered before for an examination of the problem, and as such, our conclusions have a far more solid base of research findings than had ever been previously available.

### Part 2. FINDINGS FROM THE STUDY: PREPARATIONS FOR EMERGENCIES

The threat of chemical disaster presents significant challenges for planners--perhaps even greater challenges than do natural disaster threats. Given past experiences, many communities have some idea of the nature, magnitude, and variety of the natural disaster threats they face. Because of this knowledge, there is some degree of preparedness in such localities. In contrast, however, chemical threats are much less understood, for several reasons. First, while hazardous materials are not entirely new in our society, their widespread production and use, as well as their damageproducing potential, have increased dramatically only in the last few years; and this increase is not yet universally recognized. Second, with literally hundreds of potentially dangerous substances present in, or passing through, our communities daily, and with thousands of potentially dangerous combinations possible, chemical threats display tremendous variety, compared with natural disaster threats. Third, compared to most natural disaster agents, hazardous materials are relatively unstable, complex, and capable of alteration, with the later threat possibly being of a different nature or much greater magnitude than the initial danger. Fourth, taking technical and social precautions against these kinds of agents necessitates sophisticated protective measures which in general are not well understood by nonspecialists. Finally, as we shall see later, chemical threats tend to involve some rather atypical organizational ties and jurisdictional arrangements, at least compared with those involved in natural disasters.

Nevertheless, despite the differences between natural and chemical disaster agents, many of the tasks that need to be performed in a serious chemical emergency are not markedly different from those needed in a major natural disaster. Care of the sick and injured, establishment of security at the disaster site, provision of information to the public, overall co-ordination of the response, assumption of organizational responsibility, and a number of similar tasks all must be performed in any community emergency. Moreover, many of the same community emergency organizations--the police and fire departments, the civil defense office--become involved in any disaster response, regardless of the type of agent. Thus, it seems both efficient and cost effective to incorporate community preparedness for chemical emergencies into more comprehensive preparedness measures for the entire range of threats a community faces. By and large, however, this has not been the approach taken in most communities. This part of the report describes the kinds of preparedness measures that have been developed for dealing with chemical threats in the communities studied by the Disaster Research Center. It also attempts to advance some explanations why such rather limited preparedness arrangements for chemical emergencies exist.

How prepared are American communities for acute chemical disasters? To answer this question requires examining five subsidiary questions. First, there is the question of how American communities are threatened by dangerous chemicals. We shall see that examining this matter requires making a distinction between risk, vulnerability, and perceived threat (and it is the last to which we paid greatest attention to in our study). Second, there is the question of what resources communities can bring to bear in hazardous chemical emergencies. In particular we shall note the importance of the presence or absence of mutual aid systems as a major factor in resource availability and mobilization. Third, there is the question of how communities are organized
to deal with a possible chemical disaster. Important to this issue are the social linkages which exist among the more relevant social organizations in the area. Fourth, there is the question of the social climate as to disaster preparedness which prevails in the community. There are certain beliefs, values, and norms which can encourage or discourage preparations for chemical emergencies. Fifth, and last, there is the question of how threats, resources, social linkages, and social climate interrelate to affect planning for disasters. To be effective, preparedness planning must be a process, and not simply something which results in a product, such as a written disaster plan.

The next five chapters of this part of the report consecutively and individually address each of the five questions posed above.

#### CHAPTER V

# RISK, VULNERABILITY, AND THREAT PERCEPTIONS

What is seen as endangering a community is not as self evident as might be thought. Three major views on this matter are initially discussed in this chapter under the concepts of "risk," "vulnerability," and "threat." Thus, we conceptually distinguish as well as note the relationships between Thus, we conceptually distinguish as well as note the relationships between perception of risk, perception of vulnerability, and perception of threat. Focusing primarily on the last kind of perception, we then report our findings on community, sector, and organizational perceptions of threat. Some possible reasons for the observed findings are noted.

## Some Conceptual Distinctions

The first step necessary for disaster preparedness is some recognition, especially at the community level, of some kind of danger or hazard. But such a recognition is differentially portrayed by such terms as "risk," vulnerability," and "threat." For us, as well as for other students of the "vulnerability, " and "threat." For us, as well as for other students of the problem, these terms have different referents, although all three involve some kind of perceptual evaluation or assessment of a particular situation as dangerous (for general discussion of this issue see Gabor and Griffith, 1980; Gabor and Pelanda, 1981).

Risk perception involves an external assessment possibly of what threats face a community. This kind of perceived threat is sometimes called "objective," because, for example, geophysical data can be used to indicate "that a particular community is in a flood plain, or is traversed by many that a particular community is in a flood plain, or is traversed by many that a particular community is in a flood plain, or is traversed by many that a particular community of the situation. However, in pendent of awareness within the community of the situation. However, in another sense, so-called objective threat or risk also involves perceptions by some individual, agency, or group, although made independent of the community for which the assessment is being made.

There is also a relationship between risk and the degree of preparedness in a community. It is thus obviously possible to have two communities with the same risk, but because they have differing degrees of disaster preparedthe same risk, but because they have differing degrees of disaster preparedthe united States are both in zone three (highest risk) insofar as earthin the United States are both in zone three (highest risk) insofar as earthquake risk is concerned, but as a DRC study found, the latter city is far more aware and prepared for an earthquake than the former community (Dynes more qually vulnerable. In fact, there are four major possibilities as to not equally vulnerable. In fact, there are four major possibilities as to rulnerability when community risk and disaster preparedness are crossclassified (see Gabor and Griffith, 1980: 325-326), as illustrated in the following figure:

29

#### PREPAREDNESS

		High	Low
a di seconda da second	High	Moderately High Vulnerability (Wide Range)	High Vulnerability
an finn an Anna an Anna Anna Anna Anna Anna	Low	Low Vulnerability	Moderately Low Vulnerability (Wide Range)

RISK

But disaster preparedness is itself an evaluative matter, and as such, depends on the perception of the evaluator. Thus, since at bottom, disaster preparedness is also a perceptual matter, so vulnerability involves perceptual evaluations as does risk.

Finally, there is the internal or community perception of threat, sometimes called subjective perception, which may or may not correspond to risk or vulnerability perception. For example, as we found in our study, local officials may not see the railroad running through their community as being a risk threat because they are not aware of the toxic chemicals carried daily by tank cars on the tracks. Thus, threat perception may be higher, lower, or the same as risk perception and vulnerability perception, although in reality the three perceptions very seldom correspond. Of course, so-called subjective perception is no less perception than is risk or so-called objective perception, or other perceptions such as assessments of community vulnerability.

In our study, we did use all three perceptions of threat. We used risk perception, as already indicated, in choosing the communities we selected for examination of disaster preparedness. All the localities we studied had "moderately high" to "high" risk from chemical hazards as measured by concentration of chemical plants, heavy traffic of hazardous cargoes, and the other selection criteria used as noted in Chapter IV. We also did study disaster preparedness and as such, did assess the vulnerability of different communities to acute chemical emergencies. Findings about such vulnerabilities are discussed later in this report, especially in Part 3 on community response to chemical disasters.

Nowever, our prime focus, and the subject of this chapter, is threat perception. While for different purposes we conceptualized threats in all three ways in our study, the greatest attention was paid to threat perception. In part, this reflects our social science perspective on the question. It is a fundamental axiom in social psychology that if a person defines a situation as real, it is real insofar as consequences are concerned. Thus, if community officials do not perceive their locality as being subject to chemical risks or threats, they will not prepare to deal with such kinds of possible dangers.

We measured threat perception primarily by our administration of the already mentioned disaster probability scale. All key officials in all communities were asked to assess, on a scale of 0 to 5, the probability of 36 different natural and technological disasters occurring in their localities within a ten year period. A rating of 0 represented non-applicability or no chance of occurence, while a 5 indicated a perception of almost total certainty. (The scale is reproduced in the appendix to this report.) All respondents were asked to rate three chemically-related disaster agents: namely, a sudden toxic release, a chemical substantive spill, and a major chemical plant explosion. The rest of this chapter describes our findings about threat perceptions.

#### Findings on Perceptions of Threat

The table below displays the mean probability scores of our respondents for all disaster agents. We found that when the probability for each agent was calculated and rank ordered from highest to lowest, the three chemical agent situations rank rather high. In fact, as the table indicates, "chemical spills" and "major chemical plant explosion" rank first and third respectively. Sudden toxic release was tied for fourth ranking with a plane crash.

#### TABLE I

Mean Probabilities for All Disaster Agents

			N = 300
	AG	ENT	
	*1.	Chemical Contamination or Spill	3.78
	2.	Massive Wreck of Automobiles	3.56
	*3.	Major Plant Explosion-Chemical	3.31
-	*4.	Sudden Toxic Substance Release	3.13
	5.	Plane Crash in Community	3.13
	6.	Major Plant Explosion-Other	3.12
	7.	Major Frost and Freeze	3.01
	8.	Major Water Main Break	3.01
•	9.	Water Pollution	2.99
·	10.	Electrical Power Blackout	2.97
	11.	Tornado	2.96
•	12.	Flash Flood	2.84
	13.	Severe Fog Episode	2.84
	14.	Major Gas Main Break	2.84
	15.	Freezing Ice Storm	2.72
	16.	Oil Spill	2.67
,	17.	Major Hailstorm	2.57
	18.	River Flood	2.56
	19.	Pipeline Explosion	2.52
	20.	Smog Episode	2.38
	21.	Blizzard or Massive Snowstorm	2.16
	22.	Forest or Brush Fire	2.13
	23.	Water Shortage	2.06
	24.	Ship Disaster in Harbor/Coast	2.02
	25.	Epidemic	1.96
	26.	Hurricane	1.93
	27.	Drought	1.83
	28.	Radiation Fallout	1.73

A	<u>JENT</u>	X	
29	. Earthquake		1.51
30	. Dam Break		1.14
31	. Mud or Landslide		1.11
32.	. Sand/Dust Storm	~	.93
33.	, Tsunami or Tidal Wave	•	.53
34	Mine Disaster	te de la companya de	.51
35	. Avalanche	· · · · ·	.19
36	. Volcanic Eruption/Fallout		. 07

We noted several interesting patterns when we separated out community, sector, and organizational level perceptions of chemical threats or views about the probability of chemical incidents in the localities studied. Among the more important findings were the following, starting with our most general level, the community:

#### Community perceptions.

Clearly, chemical disasters are among the most frequently mentioned threats in the communities we studied. When individual mean probabilities are calculated for each of the 19 cities, the data show that in twelve of the communities, mean probabilities for all three chemically-related agents are greater than or equal to 3.00, or moderately probable. Of all the other 33 disaster agents, only a massive wreck of automobiles obtained as high a ranking. We also found that only in one city was a chemical spill perceived as less than moderately possible. In nine of the nineteen cities, all three chemical disaster agents were among the seven disasters seen as most likely to occur. In all but two communities, at least one of the chemical agents is among the first five disaster threats that our respondents feared.

We did note that perception of threat was affected by community size. The smallest communities were significantly less likely than medium size and large cities to rate the probability of chemical incidents as high. This is of particular interest because as later discussed, smaller communities have the least disaster preparedness and the fewest resources available for coping with chemical emergencies. However, there are no significant differences between medium and large cities in their rankings of the three chemicallyrelated disaster agents.

We also found that concern with chemical hazards is increasing. Six years before this study, representatives of comparable organizations in about one-third of our sample cities had been asked about their perceptions of the probability of a number of natural and technological hazards (see Dynes and Quarantelli, 1977, for a discussion of this study). When 1972 and 1978 figures were compared, it was clear that the perceived risk of chemical emergencies had increased, and this was especially true in the case of transportation mishaps. This sensitivity may, however, also reflect the fact that two highly publicized chemical transportation emergencies, namely at Waverly and Youngstown, occurred just before our field research on preparedness began. It is a fact that communities with recent disaster experience of a major kind also tended to rate the probability of future chemical disasters as high. It should also be noted the increase in awareness or experience does not necessarily mean people understood the technical or social aspects of chemical disasters, or that they were actively engaged in preparedness planning.

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Awareness of chemical threats is not necessarily associated with awareness of, and planning for, other environmental hazards. Communities we studied could be aware of weather-related threats without necessarily being concerned with hazardous materials. This is consistent with other findings in the disaster research literature, which suggest sensitivity to, and experience with, a particular disaster agent does not inevitably generalize to others (Quarantelli, 1977). In fact, an existing disaster subculture for one kind of disaster agent might actually make a community less sensitive to other kinds of disaster threats (Wenger, 1978).

While transportation accidents involving hazardous materials were seen as an increasing threat, there was not a high degree of agreement among communities about which oragnizations or governmental entities should be preparing for, and responding to, these kinds of emergencies. In any given community, different organizational representatives told our field teams that such incidents should be the responsibility of various groups and agencies: the manufacturer; the transporter; the state Environmental Protection Agency; the state police; the local fire department; the military; or some other organization. Of course, any or all of these organizations might have a role to play in a transportation emergency, so the respondents were not wholly incorrect in their answers. The problem is that there appeared to be an informational void regarding what each organization was really empowered and able to do, i.e., what the community could reasonably expect from each organization in the event of a major transportation accident involving chemicals.

### Sector Perceptions

To simply report general figures on community beliefs about the likelihood of chemical disasters glosses over important differences in threat perception which exist among different community sectors. Ratings of the perceived likelihood of a toxic spill, plant explosion, and sudden toxic substance release made by representatives of chemical manufacturing and transporting concerns were compared with those of public organizations. We found the last two groups were significantly more likely to see chemical threats as a problem for the community than were industry representatives.

This finding is understandable, given the different frames of reference of private industry and public and emergency organizations. In our field work, we observed that private chemical concerns tended to equate chemical safety with their own efforts to protect the health, safety, and well-being of their employees and to make the work environment safe. For these companies, stating chemical incidents were highly likely would be tantamount to saying their own safety efforts were not working. This would scarcely enhance industry prestige. In contrast, public organizations are charged with considering the safety of the entire community; they are expected to take a public service stance and to concern themselves with all possible threats.

To do otherwise-to say chemical threats are not a problem-could seem to reflect a lack of vigilance or possibly even abdication of responsibility. In effect, personnel in these organizations are "doing their job" when they expect the worst, while industry people are "doing their job" when they say they have taken all possible precautions to make the job environment safe. Thus, the public and private sectors tend to use different criteria in determining what constitutes a threat. The differences in approach make for difficulty between private companies and public agencies in trying to develop cooperative interactions about disaster planning and preparedness measures.

#### Organizational Perceptions

Perceptual differences were also noted by us at the organizational level. Awareness among community emergency organizations about hazardous chemicals manufactured or processed in their community ranged from virtually non-existent to very high, but generally tended to be low. In many localities, the key safety organizations and their personnel (with the possible exception of fire departments) simply do not know the degree and kinds of chemical risks which are present in their areas. Even in localities which have done good hazard or risk assessments of natural disaster agents and some types of technological disaster agents, the absence of concrete knowledge about local chemical risks is often conspicuous. However, the matter of knowledge is only one factor in organizational perceptions of chemical threats, and is probably not the most important factor.

Organizational differences in perceptions of the threat can be seen, as were sector differences, as partially reflecting differences in organizational frames of reference. Findings analyzed by organization type show these patterns clearly. For example, among public and emergency organizations, our analysis showed there is diversity in perceptions about the risk of chemical hazards. We found that fire department representatives were by far the most likely of all public organization personnel to be aware of these threats. Police departments ranked second. In the chemical industry, respondents from larger chemical manufacturing facilities, especially those linked with large, multi-site manufactures tended to manifest more awareness than personnel in smaller facilities. In fact, small size chemical companies not part of a large chemical corporation did not see themselves as being a significant threat or source of potential disaster for the local community no matter how risky the products they handle.

Like the findings regarding different community sectors, these findings contain more general implications for the way organizational perspectives influence perceptions of threat. They illustrate the point made by other students of organizations (Thompson, 1967; Haas and Drabek, 1973; Pfeffer and Salancik, 1978) that organizations take positions on issues which help bolster their own autonomy and prestige. That is, they seek to maintain freedom from outside constraints and to be viewed as doing important and effective work. Since the fire department is commonly charged with responding to chemical threats—that is, since hazardous materials incidents are within the fire department's regular task domain—and since good performance on tasks within its domain is essential to any organization's community image, chemical threats are more salient to fire department personnel and tend to be highlighted. Chemical companies, on the other hand, can better maintain their prestige and freedom from interference and outside regulation by minimizing the threat their operation represents to the community. The differences between large and small chemical companies in their beliefs about the probability of chemical mishaps might possibly be explained by the fact that larger companies--thinking about the chance of losing important resources and prestige, and of receiving outside intervention should an incident occur--make safety more salient. They know they have a great deal to lose if they do not. Single-site and small chemical concerns, lacking such a perspective, are highly reluctant to undertake any disaster preparedness or to get involved in planning with other community groups.

In the case of both local fire departments and large chemical companies, what we observed was perhaps more a case of organizational learning than anything else. Not only were chemical threats seen as very much within the domain of these organizations, making such threats very salient, but the price paid for mistakes, either by these particular organizations in the past or by similar organizations whose experience is known to respondents, may make the risk seem more real and pressing. Some respondents from such organizations made such explicit admissions in comments obtained by the DRC field teams.

#### Some Concluding Observations

We might make four concluding observations. The cities, organizations, and respondents we had selected for our study were not chosen by any probability sampling technique. The samples were purposely selected from cities known to be subject to a relatively high degree of risk from chemical hazards, and also from organizations that should be and usually are involved in community-wide planning for disaster preparedness. As such, the conclusions drawn from the results of the analysis might be seen as descriptive only of the 19 communities studied and not typical of other American towns and cities. However, any bias in the sample is likely to be in the direction of overstating threat perceptions of acute chemical disasters, since known communities and persons within them who would be sensitive to disaster planning were studied. Therefore, if there are any significant differences between the sample of cities, organizations, and respondents used and the universe of all American communities groups and officials, the findings reported may indicate greater perceptions of threat than are generally true.

Moreover, it is only in one sense that our respondents can be said to have assigned a high degree of probability to the occurrence of the three chemically related disaster agents. We can see from the table presented earlier that three chemically-related agents are ranked among the four most probable disasters. However, this ranking may just as well reflect a relatively low perception of all disaster threats as a high absolute perception of chemical disasters. In actual fact, the perceived threat of most of the 36 disaster agents was ranked lower than "moderately possible." Even taking into account the very low scores for some of the more geographicallybound agents such as avalanches, tsunamis, and volcanoes, the perception of disaster threats was low in general. The highest mean probability for any agent was 3.78, which was for a chemical spill incident. On a scale of 0 to 5 this is not that high a probability. Stated another way, perceptions of chemically-related disasters rate high only relative to the low rating given almost all other disasters. Also, it has to be remembered that the communities we had selected could all be considered at the very least as moderately high risk localities as measured by magnitude of production and/or transportation of hazardous chemicals.

Nonetheless, we did find that the three chemically-related agents were all near the top of the rankings. Perhaps perceptions of chemical disasters were only moderate, but they were seen as more likely than almost any other kind of disaster. In addition, there is some evidence that chemical emergencies are increasingly seen, although somewhat unevenly, as potentially important community problems.

Finally, our findings suggest that virtually all communities are likely to contain at least a minimal core group of organizations which are concerned about the problem. To be sure, there is not agreement among different organizations on the nature and severity of the problem. This lack of consensus has its basis in differences in organizational frames of reference, interests, and priorities. While not an insurmountable obstacle, this lack of agreement on the risk of chemical threats does handicap preparedness efforts. Without agreement on the need for preparedness and without highly visible hazards or recent chemical emergencies or near misses which might act as a spur for local planners, it can be difficult to create interest in preparedness in communities. Nonetheless, nearly all communities contain a certain number of organizations whose latent interest in chemical emergenices might be mobilized under appropriate circumstances.

Overall, what can we generally conclude about threat perceptions of chemical emergencies? It does appear that there is some degree of perception of threats from chemical agents, but it is a selective perception along the different lines indicated. If perception of threat were all that were necessary for disaster preparedness, we might expect to find relatively adequate disaster planning in a number of American communities, although far from all. As we shall document in more detail in a later chapter, this adequacy is not the general state of preparedness we encountered in our study. This observation suggests that more must be involved in generating preparedness planning than just the perception of a threat--in itself not a surprising finding, but nonetheless a conclusion, which for the first time, is well-grounded in our empirical data.

#### CHAPTER VI

#### AVAILABILITY AND MOBILIZATION OF RESOURCES

Even if there is the perception of the possibility of acute chemical emergencies in a community, it will contribute little to disaster preparedness if resources are not available or have not been collectively mobilized. In this chapter, we first note that the term resources has a broader meaning than just physical and material objects such as equipment. Then, we indicate what our study found about the availability of local resources for chemical emergencies. However, the usefulness of even available resources is limited if they are not collectively mobilized. At the end of the chapter, therefore, we discuss in particular, organized resources in the form of local mutual aid systems. Throughout, attention is paid to the social factors which underlie the presence of resources and their collective mobilization.

#### The Nature of Resources

Human and material resources are a necessary element for community disaster preparedness. Without them, there can be no effort to prepare for disasters, either generally or specifically. Furthermore, resources affect the kind, types, and extensiveness of chemically-relevant local planning attempts.

Resources include more than physical elements such as sand and material objects such as foam. Thus, trained personnel, specialized information, active leadership, and other obvious (and less obvious) matters can also be resources. But the simple availability of such things is not enough. The maximization of resources necessitates their collective mobilization. Put another way, resources are most available when they are an integrated part of an organized effort, such as a local mutual aid system.

The following are among the major kinds of direct resources of manifest importance for developing an adequate response capability for hazardous materials incidents:

- 1. <u>Trained and knowledgeable personnel</u> from both the public and the private sector;
- Substances for suppressing or neutralizing hazardous chemical agents (foams, sand, water, etc.);
- 3. <u>Information</u> on the nature and properties of chemical risks existing in the community, whether chronic or acute, and on ways of responding to specific hazardous agents; and
- 4. Equipment to neutralize substances, and, communications hardware providing the capability to mobilize personnel as well as transmit information efficiently and effectively in the event of a threat to the community arising from a chemical agent.

Besides these kinds of resources, there are other less obvious elements which, if present in a community, may also be seen as indirect resources affecting local disaster planning. Leadership, or initiative, especially of an organizational sort, is an important resource, and one which can definitely make a difference how well communities prepare for chemical mishaps. Although not commonly thought of as a resource, the formal designation of <u>authority</u> to initiate and direct planning and response activities is another factor which can affect the state of local disaster preparedness. There must also be <u>facilities</u> (i.e., buildings and equipment) which can be used to support response-related activities such as site security and evacuation. The number and variety of <u>civic-oriented organi-</u> zations in the community also makes a difference.

To the extent there is organizational initiative, authority for responsibility, support facilities, and a richness of public-minded private organizations--all can serve as indirect resources determining the level of disaster preparedness communities can achieve. These are not the only, but are among the most important, organizationally-rooted indirect resources significant to a community's efforts in readying itself for large-scale emergencies.

But availability of direct and indirect resources is not enough to insure an adequate standby program for coping with disasters. These resources must be collectively mobilized. This is particularly true if the resource, for its use, requires the actions of multiple groups. If it is not known how a resource can be mobilized, if the resource is separately held by different agencies, or if the resource is known only to a few of the relevant parties, it will be difficult if not impossible for collective mobilization to occur. For example, we found in our study that there is widespread recognition that evacuation is a central question to be addressed if there is to be preparedness for chemical disasters. However, there is considerable uncertainty and lack of knowledge of what resources need to be available and who should organize them to handle the problem. Thus, awareness of the importance of evacuation is not matched by planning for the collective mobilization of the needed resources.

The potential for collective mobilization is most clearly indicated when there is some kind of mutual assistance or help system for chemical emergencies in the community. The presence of such a system usually indicates a pre-disaster effort to ascertain what resources might be needed, where they can be found, and how they could be brought to bear in a chemical threat or danger. Mutual aid systems can, of course, vary considerably in their capabilities to deal with chemical problems, so the availability of such systems does not insure either their effective use or that they will even be used in emergencies. Nonetheless, a minimum amount of collective mobilization is indicated by the existence of a mutual aid system or some other community organized effort to pool and otherwise integrate resources.

38

#### Resource Availability

Communities around the United States show variation along all the resource dimensions noted above, i.e.: skilled personnel; substances for suppression of chemical agents; specialized information; special equipment; leadership initiative; authorized responsibility; support facilities; and organizational richness of a particular kind. Any given community may rate high on some of these resources and moderate or low on others. Moreover, while communities in the United States can be classed together by type, e.g., those rich in all resources--those high is some and low in others and those low in most resources--each community is unique in some sense. Notwithstanding unique aspects we were able in our study to draw several general overall conclusions about resources availability, and to make some observations about each of the specific dimensions. We now turn to a discussion of these matters.

One general point which stands out is that a resource that is not identified and widely understood by responsbile community officials and incorporated formally into local preparedness activities is, for all practical purposes, not a resource at all. Examples can be cited to illustrate this point. The Chemical Manufacturers Association (formerly the Manufacturing Chemists Association) maintains a 24-hour toll-free telephone information service called the Chemical Transportation Emergency Center (CHEMTREC). This service provides information on the properties of various hazardous chemical substances and is an important potential informational resource. However, CHEMIREC cannot be used by local communities unless local public safety personnel are first aware of its existence, how to use it, and what to expect from it. In the communities DRC studied in 1978-1980, most (but not all) fire departments were aware of CHEMTREC, but the majority of other disaster-related organizations were not. In less than one-ninth of the communities we studied, did all three major emergency organizations (i.e., police, fire, and civil defense) indicate an awareness of even the existence of CHEMTREC. Very, very few local community disaster plans noted the existence of the service or listed its number. Community public safety organizations which do not know of the service, or which know, but do not have such information readily available, would thus be unable to utilize an existing informational resource should the need arise.

Another general observation we made in our study is that resources for chemical emergencies are not well integrated with the amassing and the collective mobilization of resources for other kinds of disasters, It is extremely rare to find communities having totally separate collection of resources for most different kinds of disaster agents, especially natural ones. Thus, one does not find in the same community, different emergency personnel or statutory authority, for instance, for dealing with tornadoes and with hurricanes. To be sure, some relevant resources are specific to particular agents, such as the need for boats for riverine floods, but most of the resources are disaster general, not disaster specific. However, our study found that resources for chemical emergenices are sometimes treated as separate from resources for other kinds of disasters. Thus, there are sometimes special hazardous materials emergency units attached to fire departments (and occasionally police organizations) which are totally segregated from the rest of the disaster planning and preparation of those organizations. As in the instance of nuclear threats, there is a tendency for the chemical area

to be treated independently and separably from any other kind of potential community danger, and this is reflected in the matter of resources for chemical emergencies. This is neither a very efficient nor a cost-effective way of preparing for community disasters, even granting there are some disaster specific resources needed for any given disaster agent.

At a more specific level, many American communities, although not all, have trained some local personnel from the public sector to handle chemical hazards; five departments in particular tend to have autonomous units (see Barr, forthcoming). However, our study found such training is lacking in fire departments from smaller communities, and in almost all volunteer fire units. Unfortunately, the latter kind of organization constitutes by far the most prevalent kind of fire department in the country of the nearly 30,000 that exist. We found very few instances in our research of police personnel with any trained skill for handling chemical emergenices, even though they are more likely than anyone else to be the first responders in a chemical incident, especially if it stems from a transportation accident.

There is even less local availability of special substances which can be used to suppress chemical agents. Our study found that only in a few large metropolitan areas did public emergency organizations have, at hand, foam or other special substances sometimes needed to neutralize certain hazardous chemicals (and almost none had readily-available supplies necessary for decontamination of cleanup in the recovery period after the emergency). While water is always available, our study found this, at times, could be dangerously dysfunctional, for water sometimes reacts with certain other chemicals to produce a toxic gas or an explosion. Sand, surprisingly, is not as readily available in large enough quantities for immediate use as might be thought, and its storage simply is not part of research disaster preparedness in the over 40 communities in which we did research.

Specialized information (e.g., manuals, Chemcards) and equipment (e.g., masks, acid suits) are also very much in short supply in the American communities we studied. There is a definite relationship to community size; the smaller the locality, the less likely available are the specialized knowledge and equipment in the public sector. Actually, in most cities and even many smaller areas, there are likely to be numerous people with understanding about chemical hazards, such as teachers of chemistry, but they are not a readily-available source, either because they are in the private sector and educational institutions, or are simply unknown as a resource to local emergency personnel. We have already noted the lack of knowledge of a resource such as CHEMTREC, and later we shall further indicate how the publicprivate sector divisions in American society contribute to keeping the public emergency organizations in the dark about specialized information and equipment which actually often is present in the local area. But as found in countless disaster studies, the presence of something in a locality does not make it part of the resources utilized for community disaster preparedness, unless that something is known to exist, its location is known; and arrangements have been made for its possible use in an actual disaster.

If we turn to indirect resources, the picture is also uneven. As a whole, our study found little initiative or leadership in preparing communities for chemical mishaps. We noted that in particular, public organizations, such as the emergency agencies of a locality, very seldom took a lead in chemical disaster planning. This was particularly notable in communities where local chemical companies were seen as undertaking some kind of chemical disaster program. Activity by the private sector seems to discourage initiatives by the public sector. Unfortunately, in most cases, the chemical sector initiative in chemical disaster preparedness was limited to in-plant planning and seldom extended to larger community disaster problems.

Almost no community has special facilities for chemical disaster operations; however, most communities do have some facilities (e.g., an emergency operating center) which can be used to support response related activities in chemical emergencies. To the extent a community has such resources for general disaster responses, to that extent it will have indirect resources for chemical emergencies.

Explicit authority for dealing with chemical emergencies is not a problem, since most public emergency organizations have a general mandate. which implicitly, at least, covers all kinds of emergencies. The problem, rather, is that the authority is seldom used. In other words, responsibility for chemical disasters is frequently not assumed by the local community agencies. Our study in particular, found that chemical disasters resulting from transportation accidents were not uniformly seen as the responsibility of any given local organization. Responsibility tends to be attributed to a variety of groups, including local fire departments or civil defense offices, the manufacturers of the product, and/or the transportation company. In fact, until the occurrence of recent dramatic transportationbased chemical disasters, extremely little attention was paid to the possibility of such events by almost any community group or agency. Even now, the problem is usually defined by local organizations as primarily other than a local community responsibility insofar as preparedness is concerned and, to some extent, even insofar as response is concerned.

Finally, the number and kinds of civic oriented private organizations in a community can affect planning for acute chemical emergencies. This is a particularly relevant factor for localities which have chemical plants within or around their boundaries. Some chemical companies, although not all the larger national ones, are especially sensitive to and oriented toward, good plant/community relations. In some of those cases, the local plant of the national corporation might work very closely with the community emergency organizations in disaster preparedness. On the other hand, we also found in our study a stand-off attitude by one or both sides. While this kind of situation tended to be truer of smaller chemical concerns or those with only one plant, our research discovered several national, if not international chemical corporations who did not encourage their local units to cooperate in any way with the community emergency organizations insofar as preparing for chemical disasters.

Our perception of the general picture of direct and indirect resources for chemical emergencies suggests that both kinds of resources are unevenly present and weak in most American communities. The direct resources are especially lacking in smaller localities. The indirect resources, while in principle available in many American cities, are not so in actual fact. In particular, preparedness activities by the private sector, especially local chemical concerns, are unintentionally prone to undermine efforts by the public sector to prepare resources for chemical emergencies.

#### Resource Mobilization

As already observed, some communities are richer in resources than others. Communities which contain vast chemical manufacturing complexes naturally have a greater potential supply of trained personnel familiar with the handling of hazardous chemicals than do communities which are primarily on transportation routes or which have only a handful of smaller manufacturing concerns. Along other lines, communities endowed with a generous tax base and abundant funds for public safety services are at an advantage when it comes to devising preparedness measures for chemical hazards. Yet most, if not all, communities possess some sorts of resources which, if wellorganized and handled by competent groups, could be used to ameliorate the effects of a chemical threat. Similarly, local chemical companies might possess large supplies of foam or other material for neutralizing, say, chemical fires. However, unless prior arrangements are made among local organizations, and unless prior authorization is given for obtaining the foam in an emergency situation, slip-ups can be expected to occur should there be an urgent need for the substance. In summary, the availability of resources may be a necessary, but is not a sufficient, condition for good chemical disaster preparedness. The resources must be mobilized in some collective way,

The presence or absence of disaster-relevant social linkages can be expected to influence the utilization of community emergency resources. Regular contact and communication among those who must plan for chemical incidents--including manufacturers and transporters; local police, fire, and civil defense organizations; city and county officials; hospitals and ambulance services; health department and EPA personnel; the state police; and others--help insure that needed resources are identified and incorporated into interorganizational agreements. When this occurs, resources can be available when and where they are needed, without relying on either inspiration or improvisation at the time of a hazardous chemical incident.

However, such a collective mobilization of resources was not a dominant characteristic of the communities we studied. For example, in less than a third of the cities where we did a preparedness study was there a comprehensive industrial mutual aid system for chemical emergencies. Now while an arrangement of comprehensive mutual aid systems and/or mutual assistance pacts is only one way in which resources can be collectively mobilized, it is certainly a major way. As such, we want to note what our research found about how local mutual aid systems (see Gabor, 1981) can collectively mobilize resources, although this topic will be discussed again later in our examination of patterns of community social organization.

42

#### Local Mutual Aid Systems

What did our study disclose about comprehensive mutual aid systems (MAS) other than they were a relatively small minority in the communities in which we did our work? We noted that comprehensive MAS included extensive representation from the local chemical industry, as well as diverse elements of public sector emergency-relevant groups (civil defense, fire, police, and public health departments, hospitals and ambulance services, National Weather Service (NWS) offices); welfare organizations (Red Cross, Salvation Army, etc.); and private organizations (local radio and television stations and the press). Some of these organizations such as NWS offices, the social welfare agencies, and the mass media are represented less frequently in such systems than are the primary emergency-relevant groups such as fire and police departments and, of course, chemical companies.

In half the cases we studied, these groups were formally linked together by a legally-binding agreement. The decision not to charter MAS in the remaining cities seemed to be based on two factors -- liability and safety. With respect to the former, we found companies wished to avoid situations wherein they are unable to discharge tasks which they have agreed to perform. Such obligations could require that they provide additional funds to ensure that equipment and other forms of aid would be available as required. Companies might also wish to avoid being trapped by previously agreed-upon emergency help. For example, in the event of a major chemical emergency, the prospective lender of equipment might think it better to retain such equipment in case its own facilities were threatened, In such cases, an agreement to lease equipment or lend personnel could jeopardize the safety and security of the lessor. In the absence of legally binding agreements, a company could elect in an emergency to refrain from providing assistance altogether, or at least to provide only such help as would be consistent with its own interests.

The typical MAS charter is similar to most other organizational charters. The documents usually contain a preamble indicating the general goals of the system; specify the procedures to be followed in the election of executive members and committees; outline their duties, and note how and what agendas are to be followed.

Planning sessions for MAS often occur monthly, although we found commitment to regular attendance and the extent of active participation differed drastically in the communities studied. Our research noted that in most cases, the industrial sector, which always played the predominant role in the development and subsidization of the system, also dominated the meetings, due to its superior expertise in the technical aspects of chemical hazards and its numerical majority. We noted that within the private sector, a handful of representatives of the major local corporations typically assumed leadership. A notable exception was found in one city where public sector representatives played a more dominant role in the MAS than did industry and, in fact, had spearheaded the formation of a county-wide MAS to integrate and supplement functions carried out by a more narrowly focused MAS previously existing in the area.

We observed that multiple functions were undertaken by the most comprehensive of the MAS we studied. Typical functions singled out for planning attention were resource inventorying, the activation of the MAS system, the problems associated with communications, information and traffic control in a chemical emergency, and what preparations could be taken for operational activities in fighting chemically-related fires. But while certain obvious functions were given high priority in the preparedness planning of MAS, other seemingly important functions we found were either ignored or paid only limited attention.

All MAS involved actual resource sharing. Resource inventories, usually of material items, were typically assembled by member groups. The lists of resources (and from whom they could be obtained) were almost always circulated. Commitment of resources could be made by all or only several members; although this latter situation held only for non-chartered MAS. Planning sessions were frequently devoted to familiarizing members with new types of equipment, and training in their use.

Our research found that all MAS undertook contingency planning in regard to procedures involved in the activation of the system. Typically included were directives on the recommended chain of command, and the tasks which the system would perform in a chemical emergency.

We observed that communications and public information were stressed by MAS planners. Communications systems have been developed to activate MAS, to provide two-way communications between emergency-relevant personnel, and to inform the public of the ongoing crisis situation. Two basic procedures usually exist for activation. The predominent one is a centralized switchboard housed in the local fire or police station, which is to be notified (generally through an unlisted telephone line) of a plant's problems. The switchboard operator then would dispatch emergency personnel to the scene and make the appropriate calls for other required resources. A hotline connecting MAS members is also used. In this system, the activation of the line by any member company immediately sounds alarms at all facilities involved in the network, as well as at local fire departments.

MAS planners were cognizant of the fact that land-based lines, such as those just mentioned, could be vulnerable to power outages during a major disaster. For such eventualities, radio communications networks of various kinds had been formed. Some MAS had received certification to operate radios on a separate frequency. Efforts had also been made to enlist the use of amateur radio networks as possible backup systems.

As far as public information is concerned, MAS often disignated officers who would be responsible for releasing information regarding the progress of an emergency. All persons functioning at the emergency scene were to be instructed to refer inquiries to that individual. These officers were supposed to carefully screen all information released to the press and to provide regular updates to the public in order to avoid the potential adverse effects of incorrect stories which might circulate. One MAS we studied maintained a communications network whereby individual plants could release information by using NWS equipment which enable them to record a statement via telephone. This recording could then be replayed on local radio in the same manner as weather reports.

Another crucial set of functions considered by all MAS we examined dealt with securing the impacted site and controlling traffic. Most of these functions were to be performed by law enforcement agencies. The maintenance of site security and the manning of roadblocks around the emergency site were occasionally delegated to plant security personnel so local police could focus upon the sometimes complex task of community traffic control. We found traffic control plans involving MAS ranged from those that were extremely specific, with contingency plans existing for incidents occurring at any point in a city, to those that provided more generalized guidelines, to those which merely identified the police agencies responsible for traffic control. The establishment of roadblocks surrounding a stricken plant is seen as preventing non-essential personnel from entering the blocked off area and allowing emergency-related personnel and equipment to move in and out of the endangered zone more easily. Most of the MAS we studied have developed identification or pass systems so that implementation can immediately follow the establishment of roadblocks. Interestingly, when considering security and traffic-related functions, MAS plans placed little emphasis upon evacuation procedures and the maintenance of law and order in evacuated areas, which is at variance with what is often found in much other community disaster preparedness planning.

Although numerous forms of hazards are posed by dangerous chemicals-fires, explosions, toxicity (contamination of the soil, water, air, and endangerment of living organisms), corrosion, and exposure to various forms of vapors--the MAS we studied were primarily concerned with the threat of fire. Presumably this was because fires cause the most extensive property damage, precipitate most explosions, and frequently occasion the accidental releases of noxious chemicals. Also, fire was the agent which most MAS members thought has the greatest yield in terms of mitigation efforts. Very litte, it was felt, could be done once a texic plume was floating over a city, other than evacuating the threatened population. Similarly, we were told explosions initiating emergencies cannot be anticipated, but that ensuing fires can be contained. On the other hand, it was pointed out that the proper containment of fires can prevent explosions and atmospheric releases of toxic, volatile, and irritating vapors. Because of the importance of the fire threat, it was not surprising that the closest liaisons of chemical companies, in the public sector, are local fire departments. Various forms of fire-fighting technology are exchanged at planning sessions, and fire departments are kept abreast of some details relating to fire hazards in member chemical plants. Where there was a local fire department MAS, a liaison committee in the comprehensive MAS usually existed to provide close cooperation and coordination between the two systems during an actual chemical emergency.

A general requisite to membership in most MAS was the establishment of contingency plans within the individual organizations and the demonstrated possession of resources which were adequate and sufficient to counteract any on-site incident. Such preparedness by each member organization supposedly precluded the necessity of activating the MAS for routine incidents. In principle, it also obviated the need for detailed involvement of other MAS members in the affected plant's affairs during a major emergency. The general emphasis was one of maximal self-sufficiency and minimal involvement in the affairs of other MAS members. However, this does not explain weaknesses, if not gaps, in almost all the MAS. For example, the medical sector (i.e., hospitals, ambulance services) would seem to be of considerable importance in chemical emergencies for the treatment of the injured and the stricken (e.g., from gas poisonings). However, although medical groups were involved in all of the comprehensive MAS we looked at, we found a marked difference in their role in terms of leadership, initiative, and in the importance with which they were regarded by chemical company representatives. Medical committees of MAS sometime focused on anticipating needs for personnel, equipment, and facilities for emergency situations and on planning for coordination of medical activities during chemical disasters, but sometimes their role was much more limited.

The most fundamental prerequisite to emergency planning is risk and vulnerability assessment. Yet even the most comprehensive MAS we studied showed virtually a total disregard for this task. Only one of the systems we examined undertook periodic inspections of plants to ascertain potential hazards; this, of course, was in addition to routine fire inspections. In another community, a committee designated to assess hazards was dissolved a few years before we did our study. It appeared to us that the void in this area was the result of plant officials' resistance to intrusions into their organizational property and their concern about the disclosure of company secrets. Furthermore, it is possible that the periodic identification of hazards in chemical facilities was incompatible with plant officials' efforts to keep a low profile insofar as publically portraying themselves as risks to the larger community.

Just as the extent of formal contingency planning varied substantially, so did the evaluation of these plans. We observed that for the most part, MAS undertook only one large-scale disaster drill annually. These varied from paper and communication drills to actual simulations of project emergencies. The extent to which procedures were elaborated upon and tested did, however, vary considerably, depending largely upon the existence or absence of an organizational charter for the MAS. Activation of the system in a drill was invariably carried out by the designated plant, but the mode of communication used and the agencies contacted depended upon the communication systems established. In some such exercises, loaners of equipment and personnel presented requested resources at the front gate of the designated plant and awaited instructions from the officials of that plant. The executive members of the MAS, most frequently in collaboration with civil defense officials, usually oversee the total response training effort and act as liaisons between the lending organizations and the company. But in our experience, only in varying degrees were performances of participants fully evaluated and the feasibility of the implemented plans fully assessed.

Our discussion thus far in this chapter, as was our emphasis in the research we undertook, has been on local resources. There are, of course, many extra-community sources which potentially can collectively mobilize resources. Unfortunately, and as we will discuss in more detail later, extra-community sources of information and aid for chemical disasters are not widely known. Only a few local organizations are aware of where they can turn, and even within these groups, the knowledge is often of a personal rather than official nature. Thus, groups and agencies which might need such information in a threat or disaster situation of a chemical nature are likely to learn about it by happenstance rather than by design. Our study found a surprising lack of knowledge about extra-community resources, given the wide variety of sources for aid which exist. The great range of state agencies; regional and federal entities; private response organizations; and information, clearinghouses, training, and educational institutes (see Tierney, 1980) is usually known only to a very few local emergency organizations and a handful of officials in a typical community. These groups are a part of a national network, but are generally unknown and invisible to local communities. As such, the resources they have available and how they have been collectively mobilized are not viable factors at the local level. Some linking of local personnel and agencies (particularly fire departments) with networks outside the local community has started to develop in recent years, but the process is still in a very early state of development. As far as most communities are concerned, the locally-based resources noted earlier in the chapter are what they perceive as having available.

Overall, there is relatively little by way of direct or indirect resources available in most communities, although much in principle exists either in latent or unknown form. Amassing of resources by any element in a community, in fact, appears to discourage other efforts to find and develop available resources. Only where there are the relatively rare local mutual aid systems can it be said that there is any collective mobilization of resources for chemical emergencies. But even these systems share with most local community efforts an isolation from the extra-community resources which do exist.

This disjunction between the local situations and the nationwide network of extra-community resources does indicate the importance of social linkages. Thus, there is empirical support for what was initially suggested by the theoretical framework we used in the study. We therefore turn in the next chapter to depicting what our research uncovered about the patterns of community social organization with respect to chemical disaster preparedness.

#### PATTERNS OF COMMUNITY SOCIAL ORGANIZATION

Even though there may be agreement in the community on the chemical threats faced by a local area, and even if resources are available and collectively mobilized, preparedness cannot be achieved in the absence of social linkages. Such linkages, or nerworks of relationships among disaster-relevant community sectors, are needed to further the goal of preparedness. Thus, in this chapter, we describe what our study found about patterns of community social organization with respect to chemical emergencies. We first very briefly discuss the nature of, or what we mean by, social linkages or patterns of social organization. Then our findings about the dominant characteristics of typical linkages are noted. We conclude the chapter with a discussion of the degree of integrated linkages displayed by the communities we studied, in the process noting again the fully comprehensive mutual aid systems already discussed in the previous chapter. Throughout our whole depiction of the patterns of community social organization for chemical emergencies. we try to indicate some of the dynamics at play and try to suggest a few of the conditions which may facilitate or inhibit the growth of relevant social linkages.

#### The Nature of Linkages

Both natural and chemical disaster agents normally have a potential for creating demands which exceed the response capability of any one community organization. Thus, adequate community preparedness must include mechanisms by which a number of relevant emergency organizations can share resources, allocate tasks, and delegate authority in crisis situations. Planning for disasters is made easier by the existence of informal, or, (preferably) formalized and regularized contacts between personnel in disaster relevant organizations during nondisaster periods. Regular contacts, meetings, seminars, training sessions, and similar linking activities are invaluable for carrying out such activities as:

--sharing information on local risks

--discussing the availability of equipment and other resources --assessing the need for additional resources

--identifying and eliminating conflicting or duplicative organizational preparedness efforts

--passing on information on how communities are handling preparedness problems.

As indicated in the last chapter, mutual aid systems, such as those found in a small minority of American communities, are an example of social linkages which contribute to disaster preparedness. Local inter-agency disaster preparedness councils, made up of representatives from a variety of emergency relevant organizations, are another example of networks which facilitate planning. But linkages need not take such formal forms. The informal contacts which exist between local fire departments and local chemical plants or complexes, are part of the different patterns of social organizations which we found in our study. Put another way, social linkages are the contacts, working ties, or agreements among groups and organizations which are oriented toward preparedness planning of some kind.

#### The Characteristics of Typical Patterns

Community social Linkages in the disaster preparedness area can come about in a number of ways (see Dynes and Quarantelli, 1977). Sometimes, particularly in communities which have seen many disasters, they exist as a matter of tradition; community agencies with a history of cooperation in actual disasters are likely to develop ways of working together to avoid future problems in coordination. At other times, preparedness networks form because of the way local public services are organized: the police department, the fire department, and the local civil defense office are often strongly linked because they are housed in the same department of the city government. Networks can also be formed around shared or complementary functions. In communities which have ambulance services operated by the fire department, close informal ties develop among the paramedics and EMTs and the local hospitals. Consequently, these groups are likely to engage in joint preparedness activities.

Our research found that in the area of chemical hazards, the most frequent and strongest industry-community links appear to exist between safety officials in chemical manufacturing firms and local fire department personnel. This linkage is due both to in-plant safety concerns and to the mandate given to fire departments to protect life and property. Industryfire service linkages frequently result in considerable mutual understanding and coordination between these two organizations, as well as in the swift control of many chemical mishaps.

However, the fact that local fire departments are usually the major (and often the only) pre-disaster point of contact between local community emergency organizations and chemical companies in an area, can be dysfunctional in certain respects; our study observed that because the local fire company is frequently the sole link, local chemical concerns commonly have very little knowledge of general community disaster planning and resources. Conversely, most public safety agencies also have little understanding and appreciation of what the companies can and could do in a major emergency.

This is another way of saying the typical pattern of relationship involves a comparatively narrow linkage. Absent are linkages between the chemical plants and the range of organizations whose resources would be needed in the event of a major chemical episode, especially one having effects external to the company property. Neutralization of the chemical threat is but one task which must be performed in most chemical incidents. Many other tasks, including evacuation and the sheltering of evacuees; warning; control of curiosity seekers and other convergers; restriction of access to the site; provision of public information and responding to mass media inquiries; and care of the injured, must also be undertaken as part of the response to a hazardous materials crisis. Good planning not also goes beyond a concern for suppression of the agent, but also incorporates organizations which are capable of performing these and other functions as well. Thus, there must be more linkages than just between the local fire department and the local plant, but this is the typical relationship in most communities we studied.

It is a commonplace observation in the disaster area that before comprehensive community planning can occur, organizations must be aware of each other's roles, resources, and responsibilities—in short, they must have contact and communication via social networks. The existence of broad community networks makes it easier to assess local risks; identify and collect the resources for performing a range of tasks associated with combating chemical disasters; devise and rehearse comprehensive plans for use in disasters, and perform the entire range of necessary preparedness activities.

One very important attribute of social linkages in the chemical disaster planning and response area is that links tend to be what social scientists call "vertical" as well as "horizontal." Most formal detailed local planning, we found, was vertical in nature (i.e., within an organization or task area) rather than horizontal (i.e., across organizations or task area). This often leads key people to be knowledgeable about the task functions of their own organization, but to be unaware of the task functions of other relevant parties. Crucial information on how to prepare for and respond to a chemical threat or disaster, therefore, often flows within rather than across relevant community groups and agencies.

Studies have shown that good disaster preparedness requires both kinds of linkages (Dynes, Quarantelli, and Kreps, 1981). For example, while Tocal organizations may have links to one another at the local level, they can also be vertically linked to other groups operating at state, regional, national, or even international levels. Thus, emergency-relevant contacts. should exist not only among organizations in the local community, but also between these organizations and agencies and units from outside the local area such as industry and railroad response crews, government hazardous materials spill teams, and private environmental clean-up groups. These links constitute an important means for bringing needed resources such as experienced personnel, specialized equipment, and technical knowledge into the community should the need arise. We observed that well-prepared communities generally did not leave the provision of this type of assistance to chance. Instead, officials on the local level ensured that the capabilities and functions of these kinds of organizations were well-known and widely understood among relevant groups before the occurrence of any chemical threat. Incorporating information about extra-community organizations that can offer assistance into local disaster plans can help buy much-needed time for local responders and can shorten the period it takes to restore the community to full functioning should a major chemical incident occur.

Our research found that different aspects of interorganizational linkages or relationships can facilitate or inhibit disaster preparedness. One important factor is the <u>quality</u> of the relationships among community organizations, i.e., the nature and extensiveness of intergroup contacts. The relative ease with which coordination is achieved in a cluster of organizations depends in large measure on the degree of knowledge the organizations possess about each others' structure and functions, as well as the history of their contacts and joint activities. We found that in communities characterized by a history of communication and cooperation among local organizations on disaster preparedness, cooperation in planning for chemical emergencies was more likely. When organizations have some mutual knowledge of one another and have worked together successfully, preparedness for chemical emergencies does not have to start from scratch. On the other hand, a lack of interorganizational contact or a long history of intergroup conflict, competition, or rivalry can also carry over into the emergency planning sphere, inhibiting if not blocking planning efforts. Conflict is normal; it is characteristic of all social relationships and is widespread in many communities (Quarantelli and Dynes, 1976). However, it can and does hamper preparedness for chemical emergencies--particularly since, as we have noted several times, a type of conflict of interest already exists in the chemical area between public and private sectors of the community.

We also noted that in addition to the quality of interorganizational relationships, the forms of interorganizational ties dictated by the enticipated division of labor in a chemical emergency can further complicate preparedness efforts. In the chemical emergency area, there are many disaster-related tasks which can be performed by the same groups and organizations which typically perform them in other types of community disasters: crowd control, site security, and evacuation are examples of these kinds of tasks. In the case of some tasks--traffic routing and medical treatment, for example--there is also considerable continuity in task specialization from normal, non-emergency practice, through collective crises of all types, including chemical emergencies. These continuities can usually be expected to simplify both planning and response for chemical disasters. At the same time, however, by their very nature, chemical emergencies also necessitate kinds of interorganizational coordination and cooperation which are out of the ordinary in terms of both normal group operations and usual disaster operations, and which additionally have an element of verticality which makes coordination particularly problematical for local organizations. Because of the nature of the disaster agent, planning for and responding to chemical emergencies entails the participation of additional extra-community groups and involves the establishing complex relationships which are typical neither of everyday operations nor of more general community disaster planning. Corporate headquarters, industry-wide response teams, and federal agency regulators are only a few of the non-local entities likely to become participants in the response to a major chemical threat.

Now vertical linkages are extremely advantageous in terms of the resources they can mobilize for emergencies, and extra-community ties can undoubtedly stimulate local planning efforts. However, from the standpoint of local community organizations, instituting and maintaing these linkages for preparedness purposes can be costly in both time and effort. We observed that extra resources and expertise are paid for at the cost of increased efforts in learning about, and coordinating with, so many outside groups. Moreover, keeping in mind that point we made earlier about the tendency for organizations to wish to maintain autonomy and control, the prospect of losing it to some outside entity at the time of a serious chemical incident is not welcomed by many local organizations--who will in fact be the ones to bear the brunt of public indignation and blame assignment if an incident is mishandled. As a result, despite the existence of outside resources, there is a tendency for organizational personnel to hope rather

51

than to plan for such an eventuality. That is, community emergency personnel often assume outside help will be forthcoming from somewhere in that one chance in a thousand it will be needed. They will do that in preference to making the effort needed on a day-to-day basis to determine what forms of emergency assistance are available and where and how they might be obtained. Thus, the existence of complex vertical links is a mixed blessing insofar as community-wide planning is concerned. Where other factors conducive to preparedness exist--where the need is seen and where groups have a history of cooperative disaster planning efforts, for example--verticality may encourage preparedness efforts. Nevertheless, it can also create tremendous ambiguity and produce considerable pressure for interorganizational coordination, which not all organizations welcome because it is costly. This, of course, assumes local disaster-related organizations know about the existence of outside agencies which could be called upon--and as we have noted, they often do not.

#### Kinds of Integrated Linkages

As just indicated, there are relevant resources and networks outside of local communities. Some of these are nationwide or regional in scope. They provide a context for, or in some cases, are interwoven with, local preparedness systems. Thus, we will briefly note the extra-community systems before describing the three different kinds of patterns of local community social organization for chemical emergencies discovered by our research. As already noted, although the extra-community systems are mostly unknown at the local level, they are not completely unfamiliar, especially to chemical companies and transporters, and do represent a degree of disaster preparedness even if not recognized as such by local agencies and officials.

#### Extra-Community Linkages

The most extensive nationwide information service is offered by the Washington-based Chemical Transportation Emergency Center (CHEMTREC). This Center, privately funded by the Chemical Manufacturers Association, provides certain kinds of advice to responding personnel at the scene of transportation-related emergencies. CHEMTREC maintains an around-the-clock, everyday, toll-free telephone line. Through the use of a data bank which lists more than 35,000 chemical products, CHEMTREC attempts to answer inquiries on how to treat a dangerous chemical. It also tries to assist first responders and the manufacturer of the chemical involved in the chemical emergency to get in contact with one another. We found it undoubtedly the best known of all extra-community sources.

Another potential for nationwide interorganizational cooperation can be seen in the network established to facilitate emergency response to accidents involving specific chemicals. The Chlorine Institute, representing chlorine producers in the United States and Canada, has developed CHLOREP, the Chlorine Emergency Plan. The plan calls for pre-designated teams of specialists located at plants near the scene of an accident to respond, regardless of the producer of the chlorine or the cargo's point of origin. Along similar lines, the National Agricultural Chemists Association operates a Pesticide Safety Team Network which includes some 40 emergency teams which can be mobilized throughout the country. Producers of hydrogen cyanide and vinyl chloride have similar, although more loosely formulated, agreements to provide resources to meet an emergency. Our research found that most local community personnel were rarely aware of these specialized resources.

However, in our study, we found that on the whole, most of the initiative relating to the establishment of nationwide chemical emergency programs has been taken at branches of individual corporations, rather than at corporate headquarters. Most of the large chemical manufacturers in the United States possess regional teams ready to provide information and operational assistance in relation to accidents involving their products whether they are in unrefined, intermediary, or final states. For example, the Union Carbide Corporation operates a centralized toll-free switchboard similar to that of CHEMTREC. At the request of practically any responsible source--transporters, public officials, or even individual consumers--the system, which involves 34 plants and 31 specialists (chemists, engineers, physicians, etc.) can dispatch via an elaborate nationwide communications network, a task force to any part of the country. In addition, several informal arrangements exist at the highest levels of the major corporations to provide mutual assistance when it is expeditious for them to do so. Our study observed that these kinds of arrangements and linkages, even when they involved a local chemical company, were seldom known to community. emergency organizations.

In the realm of transportation, the most notable interorganizational network in the United States is provided by the Coast Guard. It offers both information and operational assistance in the event of chemical spills on marine or inland waters; it also has developed sophisticated mathematical models to forecast expected ecological damage in the event of oil or chemical releases and to indicate the area requiring clean-up crews and evacuation, if necessary. In addition, the Coast Guard has plans for moblizing in major emergencies, Strike Forces which could operate as needed on the Atlantic, Pacific, or Gulf coasts. However, our study indicated that except in a few major port areas, there was little knowledge and even less contact by local groups with this federal agency.

We also found the development of extra-community resources for road or rail transportation accidents. At least some individual trucking companies and railroad lines have become more active in developing emergency procedures to counteract accidents involving dangerous chemicals which may arise along routes traveled by their vehicles. For example, Coastal Tank Lines has a plan whereby the truck terminal nearest to an accident responds to a spill involving its own trucks. The company has also designated specific knowledgeable personnel from its corporate headquarters to respond to and oversee operations at an emergency scene. Railroad companies such as Seaboard Coastline have developed highly centralized systems which would dispatch single multidisciplinary teams to hazardous incidents involving the railroad regardless of the location of the accident. Even some insurance firms have assisted client companies in emergency chemical situations by providing personnel or consultants with expertise in the realm of hazardous materials. This concern on their part can be understood in light of the serious economic costs they could incur as a result of many casualties and/or property damage from major chemical incidents. Several consulting

companies have also come into existence to provide nationwide service in the neutralization of hazardous chemical situations and the subsequent clean-up and disposal of the products involved.

However, almost all these extra-community resources we have mentioned are invisible at the community level. Our research revealed almost total absence of knowledge of these systems, networks, organizations, and groups. As such, there are therefore almost no links between local organizations and these sources which could be rather helpful for chemical disaster planning if they were known in the communities.

### Local Linkages

What is there by way of linkages at the local community level? We previously indicated the existence in some cases of comprehensive mutual aid systems. But less complex and comprehensive linkages also exist.

In the course of our study, we were able to identify two major types at the local level. The first one we call task-oriented linkages. This is where certain sets of specialized, and in some cases, related functions are carried out within the context of an emergency situation. For example, fire departments in a locality frequently share equipment and personnel during disasters as well as routine emergency situations. Similarly, medical communications systems, comprising hospitals and ambulance companies, exist in many parts of the country. Their responsibilities have included the reduction in response time of paramedical personnel to the scene of an accident, the optimal distribution of medical personnel and facilities in a community according to local needs, the logistics of placing accident victims in appropriate facilities based on the nature and volume of casualties, and the expedition of resource sharing among hospitals. Thus, medical linkages also serve the community in a variety of emergency situations during routine and non-routine emergencies (however, for their limits in disasters, see Quarantelli, forthcoming.)

The second major kind of linkages can be referred to as agent-oriented. They involve a network of organizations performing complementary tasks to counteract a particular disaster agent in all of its dimensions. The comprehensiveness of such linkages is highly variable, sometimes taking the form of a system. With respect to chemical agents, this type of MAS must necessarily concern itself with the performance of tasks relating to the identification, neutralization, and disposal of chemical substances involved in an accident. Then, depending on its scope, such a system will be involved in conventional emergency-related tasks such as those of public information and notification regarding the emergency; the care of casualties and the deceased; the maintenance of law and order and traffic control, both vehicular and pedestrian; evacuation; the feeding, clothing, and housing of victims; and so on. The aforementioned comprehensive MAS may themselves be linked by agreements with other regional systems.

We noted another kind of system that contains elements of both the task and agent-oriented systems. These are assistance pacts and other arrangements among chemical companies alone which exist to fulfill only those tasks within their area of expertise for disasters of a chemical nature. We found it would be inaccurate to compare communities possessing MAS with those lacking such systems, since virtually all communities have some agreements, on at least an informal level, with reference to resource sharing. It is, therefore, more realistic to look at these communities in terms of the degree of their linkages or system development.

There are those cities which have undertaken no initiative in the hazardous chemical sphere with respect to mutual aid or whose actions are based on legal requirements of a most rudimentary sort. For example, fire regulations in most communities require that fire departments periodically inspect certain kinds of facilities in a community. Because this normally involves chemical facilities within a community, such regulations inevitably result in some working relationship between officials from the local fire department and those of the local chemical installations. In the course of such contacts, it would be unusual if the two parties did not inform one another of their respective fire-fighting capabilities and did not at least informally agree to complement or supplement the resources of the other in the event of a major chemical emergency. Such conversations, relative to the comprehensive mutual aid agreements existing in some communities, which we have already discussed, are tantamount to no agreements at all, as they involve no contingency planning or commitment of resources, no risk assessment of a technical nature, and no systematic inventorying of resources.

We also observed that there are localities in which community organizations have initiated planning efforts, relating to hazardous materials incidents, beyond those legally mandated. In addition to undertaking disaster planning and reaching mutual aid agreements between the industrial sector and public emergency-relevant groups such as fire departments, we found most of the cities in this category to be characterized by mutual aid pacts among the local chemical producers themselves. For most of these cities pacts are informal, although a third of the cities we studied in this category had formal agreements regarding the transfer of equipment in emergency situations. In addition to these links among the private sector, some of the cities had private-public sector cooperation which extended beyond the mere legally-ordained contacts observed in the communities discussed above. Such cooperation exists in the form of chemical industry representation and input at local disaster council meetings, mutual aid agreements with public sector MAS such as those of local fire departments, and mutual aid pacts with local governments.

Finally, there are those communities, already mentioned in the previous chapter, where there are comprehensive MAS's. These systems incorporate a large segment of the local chemical industry and representation from public sector organizations most relevant to chemical incident mitigation--civil defense offices, fire and police departments, hospitals and ambulance companies, and the mass media. One-half of these MAS we studied were charted. Those remaining did not involve legally binding agreements but are virtually as organized as the former. The decision not to charter such organizations is generally based on fear of litigation for unanticipated problems, rather than for the purpose of avoiding commitment to the objectives of the MAS involved. These MAS contain numerous committees and programs and maintain separate funds and equipment not possessed by some of the individual members. In addition to these comprehensive MAS, some of these communities contained separate pacts among contiguous chemical plants, as well as among these plants and local fire stations.

MAS do not merely involve an amalgamation of diverse community groups. We found that often they also have links with other related systems. We have already noted that some systems are interconnected with specialized fire and police MAS. In one city we studied, an intersectional mutual aid agreement had been established between the city's industrial MAS, the industrial MAS of a nearby metropolis, as well as an area refinery. In another community, several intercompany linkages (among contiguous facilities) had been superimposed upon the comprehensive MAS. We also found in still another community in which three MAS exist in different sections of the city, that the county government had initiated a system that would function throughout the county and draw upon the resources of existing MAS and the expertise of several persons in the public sector.

There are some major consequences for communities in which comprehensive MAS for chemical emergencies have been established. Among the more important ones we noted, and already alluded to, are the following. As indicated in Gabor (1981) the most obvious consequence of MAS is an improvement in the capabilities of localities to respond to hazardous materials incidents. This is accomplished through planning and the coordination of emergency response in a climate of increased cooperation both within the industrial sector and between the industrial and public sector emergencyrelevant organizations. Aside from the formal aspects of emergency preparedness to which these systems have contributed, the regular contacts among members have resulted in informal relationships that enhance the planning process. Also, MAS, in attempting to optimize the use of local resources in contingency planning, have been able to identify gaps in the capabilities of both private and public agencies and have also uncovered duplication of services efforts. Finally, as one of the preconditions of membership in most MAS is the development of emergency procedures for the individual plants and the acquisition of resources to counteract anticipated incidents therein, MAS have encouraged the pursuit of self-sufficiency of these plants in terms of risk mitigation. The mutual education and training. of members during planning sessions also futher the attainment of this objective.

Nonetheless, even where MAS existed, the question of how linkages between organizations can lead to integrated planning was not completely solved in the communities we studied. Among the problems we noted were the following.

Much planning exists on paper and active participation is sporadic stimulated only in response to crises. Meetings are generally poorly attended, with certain groups having a consistently higher rate of absenteeism than others. Those most frequently absent are public sector or human service organization representatives who become apathetic as a result of industrial domination and are unable to develop the informal relationships established among industrial personnel.

Operationalization of planning through disaster drills lags in some cities. Either drills are undertaken too infrequently (less than once per

year) or they do not involve simulations of incidents and are inadequately evaluated. In other words, exercises are more talked about than actually done.

Companies that transport hazardous materials are very rarely involved in MAS. When they are represented, such representation is a mere formality since these companies are not active participants in local emergency planning. Yet the more serious chemical disasters usually occur in the process of transporting dangerous chemicals.

Risk assessment of chemical company facilities, a precondition to comprehensive planning, is virtually non-existent among MAS members. There seems to be considerable resistance to this because of fear of disclosure of industrial processes, a concern about possible prosecution for safetyrelated violations, and the desire to keep hazards at a low level of public visibility. Preparedness planning is necessarily limited when the possible demands in an emergency are not systematically considered.

Many plans formulated by MAS overlook the development of specific contingency plans for mass evacuation of threatened areas. Except for the possible evacuation of plant workers, all MAS do not address the problem of evacuation outside the plant. In fact, most MAS disaster preparedness plans do not even have a provision by which the affected plant can directly warn segments of the general population which may be endangered by an in-plant accident.

#### A Concluding Observation

Overall, the patterns of social organization are somewhat unevenly and weakly supportive of chemical disaster preparedness in American communities. In almost all places, there are some relevant linkages between groups and agencies which may become involved in chemical emergencies. In a few places there are comprehensive mutual aid systems, but they are not without flaws and weaknesses. In almost no community are there many existing ties or even awareness of extra-community organizations or networks which could help prepare for sudden threats from dangerous chemicals. On the other hand, to the extent there are changes occurring, there are greater links being established especially within, and to some extent from the chemical industry to other community elements. Nonetheless, while there are some promising elements in the situation, on balance it cannot be said that current patterns of community social organizations are conducive to preparedness planning for chemical emergencies.

But even if there were social linkages supportive of planning, as well as appropriate threat perceptions and collective resource availability, is there likely to be preparedness for chemical emergencies? Our study indicates that would not be enough: there also has to be a favorable social climate. Accordingly we turn to our research findings to the matter of the norms, values, and beliefs relevant to chemical disasters which predominate at the local community level.

#### CHAPTER VIII

#### SOCIAL CLIMATE

If threat were the sole determinant of levels of disaster preparedness, each city, town, and rural area would have exactly the degree and type of preparedness it perceived as necessary. However, the relationship between threat and preparedness is not a direct or straightforward one. As already indicated, availability of resources and their collective mobilization and the patterns of community social organization are important in affecting the state of preparation which communities can develop for chemical emergencies. Also important, in addition, is the social climate, or the set of political, economic, legal, historical, and psychological factors which prevail in a given community. In this chapter, we first indicate that we conceptualized social climate for our research purposes as involving three different although related components, i.e., beliefs, norms, and values. We then describe the findings of our study with respect to community social climate for chemical disaster preparedness.

#### The Nature of Social Climate

In our original approach to the problem, we thought of the social environment or climate as encompassing a variety of different political, economic, legal, historical, and psychological factors which affected such matters as the social linkages and resources, which would have consequences for the disaster planning process in a community. In some respects, this is not an invalid way of thinking about the social environment of a community. However, it had at least three descriptive and analytical weaknesses. First, the approach is an open-ended one, creating the possibility of an interminable listing of factors. Second, it is difficult to see the comparability involved in the vast range of dissimilar and concrete phenomena subsumed under such terms as historical or political. Third, the formulation is not very sociological; even the term "social" tends to be ambiguous and amorphous with regard to its specific referent when used in many sociological discussions.

In an earlier DRC study on the delivery of mental health services in disasters, we struggled with the same problem of open-ended, non-comparable, and unclear factors in the social environmental setting of the phenomena being examined. A partical solution to the problem was provided by our recognition that what was being referred to was virtually identical to what sociologists frequently conceptualized as the socio-cultural framework or culture of a social system. In that earlier study, therefore, we not only reconceptualized the phenomena being analyzed as culture generally, but further divided it into three major analytical components, i.e., norms, values, and beliefs (Taylor, Quarantelli, and Ross, 1976).

We took the same approach in this study. The social environmental setting or social climate was reconceptualized as the general cultural framework of the community; specifically, its complex of particular norms, values, and beliefs. This involved more than a change in terms as such; rather, it provided a set of concepts which limit what they encompass, allow comparability and are relatively clear in referent. While analytically the concepts are separated out for purposes of descriptive and analytical presentation in what follows, their concrete manifestations in reality are, of course, all interwined. (For a discussion of the sociological usefulness of conceptually distinguishing at least between norms and values see Blake and Davis, 1964: 456-484.)

Social climate factors are important because they can either enhance or block attempts at local disaster planning. Factors such as community awareness and beliefs about threats can result in the minimization or distortion of the degree of disaster risk which exists. The social climate can also render certain resources, such as information, unavailable. DRC research indicates that various elements of community social climate can present barriers to disaster preparedness which must be overcome before effective preparedness efforts can be launched. In an obvious example, the existence of a risk, e.g., of an emission from a chemical disposal site, does not necessarily mean that the appropriate community officials are <u>aware</u> of the threat; or that they are in <u>agreement</u> about what preparedness measures, if any, should be instituted to cope with the threat; or that there are <u>incentives</u> to plan. The awareness agreement, and incentive can conceptually be viewed respectively as part of the beliefs, values, and norms in the situation.

Earlier, the point was made that community chemical disaster preparedness can be viewed as the product of a value-added or funneling process, in which steps in the process either contribute to, or impede, progress once there is minimal agreement on the need for preparedness. From the standpoint of the organizational factors involved, social climate is important because it produces either incentives or disincentives for preparedness. Elements in the social climate which are high in incentives to plan and low in disincentives will result in well developed arrangements for preparedness at the community level.

While terms such as social climate and incentives are rather abstract, the things they refer to are not. They are, by and large, circumstances which were well known and understood in the communities we visited and which were discussed when interviewees were offering explanations for why preparedness efforts either were or were not developing.

#### Belief Assumptions

Community members differed in what they viewed as possible dangers and threats. These assumptions are part of the belief systems of the population and often are indistinguishable from other phenomena accepted as valid knowledge. Accurate or not, it is often what is <u>believed</u> to be, rather than what actually <u>is</u>, or what <u>should</u> be, that affects the steps communities take to prepare for disasters. What is involved, as we already have noted earlier, is a reflection of the basic sociological axiom that what people define as real, is real insofar as consequences are concerned.

Two examples illustrate this point. First, as we have already discussed, our findings show there is a very widespread belief in the communities we studied that disasters involving chemical agents are probable. When community officials (N = 299) were asked to indicate on a five point scale the probability of their area being impacted by one of 36 different natural and technological disaster agents, the five highest, in rank order, were chemical spills, multiple car wrecks, a major explosion in a chemical plant, a plane crash, and a suddent toxic substance release. Clearly, chemical hazards are salient to community officials, for three such hazards were among the five highest ranked community threats. Furthermore, there was some evidence in our study that there is an increasing belief about the threats that hazardous chemicals pose for American communities.

There are also variations in this belief, based on community size and the organizational membership of the rater. For example, the larger the community, the more chemical disasters were seen as a possibility--a not unexpected finding, since community size tends to be roughly correlated with greater numbers of chemical-producing installations and more hazardous materials transportation routes. Additionally, officials from major emergency-relevant organizations (fire and police departments, local civil defense offices, and the Red Cross) ranked chemical disasters as more probable than did other community officials, or the category composed of officials from chemical plants and transporters of chemical substances. For example, emergency officials gave a mean probability rank value of 3.97 to chemical spills (on a 0 to 5 scale), whereas transporters and plant officials ranked the probability at 3.38. This difference is statistically significant at the .01 level. Despite these variations, however, the overall picture is clear. There is a widespread belief in the communities we studied that disasters involving hazardous chemicals are a potential community threat.

Second, contrary to our initial hypothesis, there was also a widespread belief that the communities studied could respond satisfactorily to a major chemical disaster. Respondents and informants in our study were asked how they ranked the ability of their communities to handle the kind of event which occurred in Youngstown, Florida, in February, 1978, and one of the major chemical emergencies studied in depth and longitudinally by DRC. In that incident, which involved the release of a large quantity of chlorine gas from a tank car punctured in a train derailment, eight persons were killed and an additional eighty-nine persons were treated at nearby hospitals. The emergency necessitated the evaucation of over two thousand persons for a five-day period. At the height of the crisis, approximately thirty local. state, federal, private, and volunteer agencies were active in the stricken community. In our study, community officials who answered the question ranked their organizational preparedness for this kind of event at 3.4 on a scale of 5, with 65% ranking preparedness at 4 or higher. Additionally, public officials (N = 110) also projected that the population of their communities believed the area was prepared for such a disaster. Almost a majority, 48%, stated they believed the public would rank community preparation as either 4 or 5 on a 5 point scale; the mean ranking was 3.6.

Clearly, our interviewees assumed it is possible to prepare for a major chemical disaster; a mood of fatalism did not prevail. Moreover, they appeared reasonably satisfied with the existing level of community preparedness. On the basis of other DRC data, including our research on the event, we believe that in most cases, there was a substantial overestimation of the capabilities of the communities studied to respond to an incident of the magnitude of the Youngstown disaster. However, it is the operative belief, rather than the actual capability, which is significant. The belief that the community is threatened and the belief that disaster planning can be effective are both assumptions that would support efforts towards chemical disaster preparedness. The belief that the community already is prepared would probably not support efforts for more preparedness measures.

It should also be noted that we observed that the major chemical disasters which occurred around the country just previous to, or during, the course of our study, left the typical local community offical with the belief that chemical emergencies primarily present technical rather than organizational problems. Such official interest as was generated by distant emergencies was in the technological, mechanical, or engineering aspects of the events, rather than in the human or social factors involved. As such, this probably contributed to the belief that technical solutions were relatively available, and were the prime components in preparing for possible community emergencies. The distant disasters in places such as Youngstown or Waverly did not convey to most local officials the difficulties and complexities involved on the social and human side of chemical emergencies. In this respect, the belief system, as was found at Three Mile Island (see Marrett, 1980) and in many other potential disaster situations, tends to be "thing" rather than "people" oriented.

#### Value Priorities

The values which prevail in any community are likely to be inconsistent, since different sectors of a population are almost certain to disagree on which values are worthy of achievement. What some groups and organizations see as necessities, others do not. It is not surprising, therefore, that we observed that this is the case with regard to value priorities concerning preparations for disasters involving chemical agents.

For example, there was an implicit and sometimes explicit idea expressed in many communities we studied that the public sector must not intervene too strongly in private sector activities, even in matters of safety. This attitude appears to be particularly prevalent when chemical producers and/or transporters employ a significant portion of the labor force or are a strong element in the occupational base. At times, administrators in the public sector indicated an almost manifest concern that businesses which provide wages, taxes, gratuities, and other community benefits must not be pressured to share knowledge of hazardous materials risks and response capabilities lest the community's economically dependent status by jeopardized. In other words, priority is given to economic values. This kind of position is, in the main, not supportive of community-wide disaster planning.

Of course, there are economic factors which act as powerful incentives for chemical industry organizations to undertake preparedness planning. Some were specifically mentioned by certain of our respondents, especially in the chemical industry. Among the incentives to plan are: the possibility of lower liability insurance rates; the likelihood of increasing the benefits by pooling resources in mutual aid arrangements; and the chance of reducing corporate costs resulting from lawsuits. However, factors such as these, which are probably of great importance to coporate headquarters, were seldom noted and used as inducements by members of the public sector in the local community. What seemed to be more salient at the local level is the idea that the economic well-being of the area is a value too important to endanger.

The public sector, in general, and public emergency organizations, in particular, also take a value stance which places high priority on the safety of the general citizenry. Local chemical companies, on the other hand, tend to define potential chemical threats somewhat more narrowly in terms of their possible impact on company workers and property. Additionally, in some communities DRC studied, there was a reluctance on the part of private companies to acknowledge the potential hazards their facilities pose to the community, a matter we have already discussed in connection with mutual aid systems for chemical emergencies. Companies prefer to avoid planning with other organizations outside the plant gates since such action implies that the company does indeed pose a threat to the surrounding community. It is apparent, then, that local private and public sector organizations operate from different value bases and tend to use different criteria even in determining what constitutes a threat. This, of course, has implications for disaster preparedness activities.

At another level, local organizations in both the private and the public sector are both attempting to maximize another value, that of organizational self-protection. This is reflected in such activities as bringing mass media organizations into the disaster planning process, with the intention of using them as public relations outlets, rather than as instruments of disaster education or public information. The major objective of such activity seemed to be to create a positive image of the organization and to encourage people to believe that something meaningful was being done. In any case, the mass communication system tends to be used for individual organizational purposes, not for the collective good. Practices such as this one do not support communitybased diasaster planning.

The value priorities we identified in the communities we studied seem to both support and work against planning for chemical disasters. On balance, this effect is probably more negative than positive, for quite apart from values, any type of planning most overcome resistances (see Quarantelli, 1981a). Nevertheless, in any given community, it is possible that the value placed on saving money through safety and disaster planning in the private sector and the value placed on saving lives and property in the public sector can combine in such a way that disaster preparedness has high priority. We found a few communities where this had occurred, although on the whole community value priorities did not seem to be conducive to integrated public and private planning for disastrous chemical incidents.

#### Norm Expectations

Normative expectations exist and can be identified in any social setting. This is true of chemical hazards planning in the communities we studied. In general, these normative elements are not supportive of chemical disaster planning, although they are not always completely negative. In many localities, we found there were laws (formal norms) which served as effective barriers between local chemical facilities and the community public response agencies. These often take the form of insurance/compensation prohibitions against public workers being utilized on private property. In one community we studied, elaborate plans for a large-scale community-wide disaster simulation exercise at a local chemical plant were halted only hours before the drill was to take place by order of corporate counsel who advised the company not to participate, since the company could be liable if accidental injuries were to occur on its property. Our study also observed that there is a degree of expectation, if not unfavorable anticipation, the many local police, rescue, and medical services from the public sector are not properly equipped or cognizant of the hazards of a chemically inundated area, totally apart from whether such groups have a legal right to operate on public property.

On the other hand, many communities have special statutes or ordinances authorizing disaster preparedness and response groups to operate, and most localities have some agency which is formally designated as responsbile for overseeing community disaster readiness. Also, there can be official and legal sanctions which can encourage preparedness. Ordinances creating interorganizational emergency preparedness bodies and ordinances designating special hazardous materials routes through a community, are two examples of legal norms which, if upheld, would enhance community readiness and mitigate the effects of hazardous chemical episodes.

Informal norms also exist among community leaders which suggest that implementation of disaster planning can only take place a step at a time because there is little community support for extensive planning or radical changes. Although most officials do not see much overt opposition or resistance to disaster preapredness on the part of citizens, the general public indifference and unconcern are seen as an indication that efforts to push for better planning cannot be expected to succeed. In addition, in our study, community officials tended to perceive the public as fiscally conservative where preparing for unpredictable, uncertain relatively infrequent events such as disasters is concerned. Our field work was undertaken at the time "Proposition 13" type measures were being advocated and passed, a period which served to reinforce the conception held by local public officials that taxpayers are not willing to support "frills" such as more disaster planning, even for chemical emergencies. Indeed, it was not uncommon to hear that disaster planning would be among the first community programs to experience budget reductions in the event of fiscal cutbacks.

In fact, our study found a reinforcement for the expectation of many public officials that in a time of inflation and cutbacks in basic public services, it is politically disadvantageous to advocate "frills" such as elaborate planning for events that might never happen anyway. But as is the case with any prevention program that works, program personnel probably rightly claimed they will get very few rewards or recognition for working on chemical emergency preparedness because their successes, unlike their failures and unlike the successes of other programs, are <u>non-events</u>. It did appear that prevention programs sometimes tended to be dropped because, paradoxically, the fact that prevention works in an area means the problem is less evident; this can be used as a justification for eliminating the program.
This widespread expectation among local public officials contacted by DRC during the course of its study, was only partly balanced by the fact that in recent years federal and state legislation regarding the handling of hazardous materials has markedly changed both sensitivity and actual attempts to plan for disasters from chemical agents in the chemical industry as a whole and at some state levels. Larger national companies have issued policy directives and instituted programs relevant to chemical disasters, and state agencies have set forth regulations which affect their subordinate private or public units. Such activities at the top of groups linked vertically have increased sensitivity to the potential problem and have encouraged planning at lower levels which probably would not have otherwise occurred, certainly not as rapidly as has happened. Furthermore, those large chemical companies that have become sensitive to disaster possibilities have shown in recent years a marked inclination to share their ideas about disaster planning and safety information with others.

# A Concluding Note

Our research in American communities suggest that key social climate elements such as beliefs, values, and forms are aligned in such a way that they exert a neutral influence at best and a negative influence at worst on preparedness planning for community responses to chemical hazards. While major chemical incidents are seen as relatively likely, other beliefs supportive of the status quo work against improvements in local disaster planning. Despite the fact that strong values call for better planning, public and private sector value orientations do not always dictate similar practical strategies. This ambiguity, combined with community normative expectations that government not take activist stance in this area, militate against comprehensive community planning for hazardous materials incidents.

In addition, the sometimes sensational coverage of chemical threats by mass media (as well as other disasters, see Committee on Mass Media and Disasters, 1980) also seems to contribute to a climate in which local groups may feel it is better to keep a low profile than to have their efforts exposed to media scrutiny. Recalling the point made earlier on the tendency for organizations to avoid activities which could lead to reduced autonomy and other costs, it is not difficult to see why most private and many public organizations tend to see preparedness as risky. On the whole, it appears that the social climate in most of the communities we studied provided more disincentives than incentives for preparedness. In general, unless some dramatic event occurs which highlights the need for preparedness, community organizations—except, of course, those organizations such as fire departments for which chemical emergencies are highly relevant—tend to give higher priority to other problems.

This is only partly balanced by the fact that in many communities, the emerging picture is that chemical companies, which have in the past been concerned primarily with the safety of their own workers and the preservation of valuable equipment and facilities, are beginning to find it in their interest to take a broader view. Companies are coming to realize that resourcesharing and an outward orientation-focusing on well-being of the community at large-far from being mere altruism, is also very good business. To the extent that values encouraging disaster preparedness become more widespread and prominent at the community level, overall disaster planning efforts will progress more rapidly.

As we stated earlier, when seen in combination, various social climate elements did not seem to be a positive force for the development of chemical disaster planning. As also noted, this does not mean they have no influence. Rather, it suggests that a supportive community social climate should be viewed as a necessary or facilitative factor for planning in contrast to being a major or determining factor.

So far in our theoretical framework, we have treated threat perceptions, availability of resources, patterns of social linkages, and social climate as if they were separable and independent factors in affecting disaster preparedness. When they are treated together as they are in reality, what is their effect on community preparedness for chemical emergencies? We examine what our study found in the next chapter on the planning process.

# CHAPTER IX

#### THE PLANNING PROCESS AND PREPAREDNESS

The various activities we described in the previous chapters are all presumably undertaken for the purpose of brining about a certain state of disaster preparedness for chemical emergencies. Is this the actual outcome? In this chapter, we summarize what our study ascertained about the effects of the just-described aspects, and as such, we will reemphasize some of the points already made. First, we indicate how in our research we approached the question of the planning process and the matter of disaster preparedness. However, most of the chapter is given over to a discussion of our research findings with respect to preparation for chemical emergencies at the local community level. We conclude the chapter with a statement on some interesting paradoxes of the current planning in American communities for chemical threats and disasters.

# The Nature of Preparedness

Disaster preparedness is often viewed as synonymous with the formulation of formal written disaster plans. This is a very narrow view because preparedness for disaster encompasses a number of different activities in addition to the writing of plans. However, for our research purposes, we conceived of preparedness as involving all those documents, activities, practices, formal and informal agreements, and associated social arrangements which, over the long term or the short term, are intended to reduce the probability of disaster and/or the severity of the community disruption occasioned by its occurence.

This definition is broad in scope and was meant to include a variety of behaviors expected to either reduce disaster-related demands or upgrade disaster response capabilities. Some examples of preparedness activities are:

--convening meetings for the purpose of sharing knowledge on disaster planning;

--holding disaster drills, rehearsals, and simulations;

--developing techniques for training, information transfer, and hazard assessment;

--formulating memoranda of understanding and mutual aid agreements; --public education; and

--drawing up community and organizational disaster plans.

Thus, while formal disaster plans are seen as an important element in disaster preparedness, they were viewed in our research as only one of several sets of activities devised to improve the efficiency and effectiveness of a community disaster response. In short, planning (at least in the sense of writing a document) is but one aspect of preparing for a disaster.

#### Community Chemical Disaster Preparedness

Preparations for serious accidents involving the sudden release of hazardous chemical substances could be described and anlyzed at different social levels. We could have looked at the problem from a societal viewpoint focusing perhaps on the relevant federal organizations, national transportation systems, and corporations with multiple facilities scattered around the country. For example, examination could have been made of what immediate response capabilities are available on the national level among the regulatory agencies, the transporters, and the producers of hazardous chemicals. Or, our focus could have been at the state level, examining and comparing how the problem is handled within and between these intermediate level social entities. For instance, we could have studied the results of different enforcement practices regarding varying regulations among states with regard to the production, distribution, and use of dangerous chemicals. However, we chose instead to focus primarily at the local community level and secondarily on those organizations within the communities which are somehow involved with the problem. This meant looking at the public safety and emergency-relevant organizations of a community, as well as those private groups concerned with the production, transportation, and storage of hazardous chemical materials.

Our focus on the local community level was not a purely arbitrary choice. Higher level social entities are very important in understanding the problem, and we did treat them as significant extra-community factors in the local situation. But sudden disasters emanating from chemical agents occur almost exclusively in particular geographical locations at specific points in time. They very seldom impact simultaneously over a wide area, as do hurricanes and floods and as can tornadoes and earthquakes. Furthermore, the initial responders to such kinds of crises necessarily have to be relevant organizations in the nearest local communities. It is what the very first responders do by way of identifying and attempting to deal with the threat which frequently determines if the happening will be merely a minor mishap or escalate into a major disaster. Thus, however important supracommunity factors may be, preparedness at the local level is always crucial. Given this, it did seem appropriate, at least in our initial approach to the probelm, to use the local community as the basic unit with which to describe and analyze preparedness for chemically-based disasters.

There are, of course, different ways of conceptualizing a community. The sociological literature alone provides dozens of definitions of community which can be useful for varying objectives by the users of the term (see Poplin, 1979). For our purposes, we conceived of a community as an aggregation of people living together within a particular geographic area who carry out certain relatively self-contained functions relevant to the maintenance and survival of that population. Looked at in a slightly different way, a community is a locality-based social system which acts in a collective fashion to solve certain everyday problems. Typically, the core of any such operative community in the Western world is some relatively dense concentration of people, although this core can range from a small village to a very large metropolis. It should be clear from this that an operative community cannot be totally equated with the formal boundaries of standard governmental entities, be they a country, a city, a township, or some other incorporated legal unit. The very concept of community tries to indicate that what goes on within the formal boundaries of legal entities often does not adequately capture the ways in which people and groups are often collectively organized to handle their problems. Thus, for example, community preparations for handling chemically-based disasters cannot be understood by looking just at the situagovernmental entities in and around that city, which may be other cities, in that area, and their preparedness status has to be understood as well for an accurate comprehension of the situation to be reached.

The descriptive and analytical importance of this goes beyond the point that multiple governmental entities may be part of the operative community in the area. There is the question of who has prime responsibility for disaster preparedness. Which organization, if any, plays the lead role?

There is also the related fact that there are different bases of organizational authority within United States communities, with complicated relationships between the public and private sectors. For example, there are community agencies which are exclusively public in nature such as municipal police departments. But then there are also quasi-public groups such as most utility companies and other social entities such as railway companies which, while privately owned, are subject along some lines to detailed public regulations. Finally, there are the private organizations. Different commuthem and who has influence, power, and authority over whom may be a very pany town" may be noted where public authority is often secondary to private influence and power. There are communities, including several we studied, where the local chemical industry is so dominant, that they can be approached as "company towns."

Another complicating factor is that, given their unofficial existence, it may be unclear if certain geographic areas are or are not part of the community's concern, and which organizations, if any, have responsibilities ( over particular nearby areas. Especially outside the boundaries of cities (and sometimes even within them), it is not always clear, legally or otherwise, who if anyone has prime responsibility for different kinds of communityrelevant activities. In rural areas, for example where many transportation influenced by in consistent legal statutes, informal interorganizational historical happenstances. In an earlier DRC study which focused on the delivery of emergency medical services, it was not infrequently found that those ambulance services and hospitals which were involved in the delivery of such services, resulted from a mixture of the just-noted possibilities (see Quarantelli, forthcoming).

The final complicating factor we might note is that the relationship of supracommunity organizations to the local community can be both complex and indirect. Although in the United States, there is a formal governmental hierarchy from federal to state to some kind of local incorporated entity, there is no automatic and direct imposition of authority from the top down. Lower-level governemental units have different degrees of autonomy protected by law, as well as a widespread political wariness of intervention from the top. On the other hand, higher level organizations have a variety of devices at their disposal ranging from publicity and recommendations to mandatory program requirements and laws which can be used in both direct and indirect ways to implement changes. For example, the United States government does not through federal law directly impose land use restrictions on flood plains, but does indirectly try to affect preparedness by making the possibility of obtaining various kinds of federal funds contingent on the acceptance of flood insurance and other measures which can be initiated by local level entities (see White, 1975).

Thus, by using the community level as our prime focus in our research, we were faced, in each particular case, with having to answer at least four basic questions:

- 1. What were the community organizations which had responsibility for preparing for sudden chemically-based disasters or, more specifically, which formal group of the many operating in the community was salient in taking the lead for such disaster preparedness?
- 2. What was the basis for the assumption of responsibility for . the preparedness attempted or, more specifically, which sector, public or private, prepared for acute chemical disasters?
- 3. What was the geographic scope of the responsibility assumed, or even more specifically, were all parts of the operative community equally covered in chemical disaster planning?
- 4. What was the relationship of supracommunity organizations to the local community, or more specifically, were some aspects of preparedness for disasters resulting from chemical agents seen as other than local organizational responsibility?

These four questions essentially stem from the fact that the operative local community is not necessarily congruent with the boundaries of some formal governmental entity. Thus, in order to understand preparedness for sudden chemical disasters, it is necessary to know the salient disasterrelevant organizations in the operative community, the basis of disaster preparedness responsibility assumed by organizations within that community, the geographic area in which responsibility is assumed, and the relationship of supracommunity organizations to the local entity. This does not cover all aspects of the community dimension in preparing for chemical disasters, but it does capture some of the matters we consider important.

The usefulness of our approach can perhaps be illustrated in two ways. We will give examples of what we found in our data when the questions just indicated were asked. We also suggest a difference in the answers obtained when a contrast is made between community preparedness for natural disasters as compared with those for chemically-based disasters.

Thus, in most American communities, research by DRC and others has shown that preparedness for natural disasters is generally the major responsibility of one organization, usually the civil defense agency in the largest governmental entity in the geographic area (see Dynes and Quarantelli, 1977). Such responsibility does not mean that the agency is the only one involved in disaster preparedness or even that it is the most operationally important. Rather, it is that whatever the organization, it is the lead one in calling attention to the range of natural hazards in the area; in helping to coordinate the activities of other groups involved in planning for the problem; and in providing disaster-relevant resources such as warning systems, an EOC, specialized equipment and information on how to prepare for natural disasters. Furthermore, the key lead organization and other community emergency groups accept that natural disaster preparedness and response is a local community responsibility, even though the overall planning might indicate the involvement of some extra-community elements for certain specific problems. Thus, in most localities, there is usually one key local governmental organization which has the prime responsibility for thinking about and preparing for disasters from natural hazards anywhere in the operative community.

With regard to overall preparedness for technological disasters generally, which include sudden chemical disasters, there is seldom one organization which assumes the responsibility. We found most civil defense agencies are only peripherally involved in preparations for disasters resulting from chemical dangers. Many municipal fire departments do have an interest in such kinds of hazards, but they very seldom serve as lead groups among other emergency operations; furthermore, fire departments almost always operate only within well defined jurisdictional boundaries and cannot have a specific mission in the operative community as such. Some local chemical plants, often reflecting corporate policy, may undertake major disaster safety preparedness activities, but such a concern very rarely is expressed in any assumption of a lead role in the operative community generally. Thus, there typically is no one organization with major responsibility for overall preparedness for disasters from chemical agents in most communities.

Given that, it is not surprising we found it rare for any local organization to undertake an overall chemical risk assessment of the community. In parts of the private sector, such as among chemical plants, there may be vulnerability analyses in terms of their own internal operations, but this interest is not extended to the entire community. Similarly, such transporters as railroads may be aware of hazards from their own functioning, although even this information is often reluctantly if at all shared with other community groups. Some local governmental environmental agencies do at times acquire some understanding about the kinds and range of chemical risks in their localities, but such knowledge is not systematically acquired. We also found that even among community emergency organizations, awareness of the specific hazardous chemicals manufactured or processed in their area tended to be very low. Thus, in the overwhelming majority of American communities, there is neither one organization nor a collection of organizations which could or can provide a good and complete chemical risk assessment of the area.

Furthermore, little effort normally is given by any local organization to coordinating whichever community groups do have fragmented interests in the problem of dangerous chemicals. For example, it is widely recognized that evacuation is a central question to be addressed in preparing for disasters from chemical substances. But our study showed few attempts at the local level to organize and integrate the multiple groups which would necessarily be involved in such an activity. Greater attempts at planned coordination of all kinds, however, can be seen where industrial mutual aid systems exist. But such systems are not found everywhere, including communities with fairly obvious potential risks. In most localities, there simply are not lead organizations attempting to coordinate the activities of those groups concerned in some way with preparing for chemical disasters.

Given the usual lack of coordination, it almost follows, as our study did show, that often there will be problems at the community level with respect to both awareness of, and preparations for, mobilization of resources needed for such disasters. Thus, while some local fire departments sometimes do have an awareness of the resources needed to deal with chemically-based disasters, most other emergency organizations have little knowledge of any kind about the problem, and there is little centralization of information about possible relevant resources. In fact, in planning efforts it is generally overlooked that in all probability, police department rather than fire department personnel will be first on the scene of at least transportation-related chemical disasters. Yet police organizations have much less knowledge of the resources needed than do fire agencies. Actually, very few locally based groups have the specialized personnel, relevant information, or special equipment required for fighting chemical hazards, or even the knowledge of where such resources could be located and obtained. Except for some chemical plants, there seldom is a local source which can even quickly provide information about relevant resources.

Part of the reason for this ignorance of resources probably stems from the pervasive division of American life into public and private sectors. Among other things, this leads to an additional mutual ignorance of what the organizations in the other sector have planned and could do. Local fire departments are usually the major and often the only point of contact between local emergency organizations and chemical companies in an area. Because of the narrowness of this linkage between the two sectors insofar as disaster preparedness is concerned, knowledge of general community disaster planning is scanty among local chemical companies. Similarly, DRC found most public safety agencies knew little about what the companies were prepared to do in a major chemical emergency.

But preparedness in part also depends on how a chemical threat is defined and here, too, the public and private sectors differ. The chemical plants, all private, tend to define potential threats from chemical agents in terms of their possible impact on company property and workers (at the corporate level of course, they can be concerned with threats to the public from transportation accidents). Mass emergency agencies, primarily public, instead define such threats in terms of possible impact on the population at large and the general functioning of the operative community. Thus, we find the public and private sectors tend to use different criteria in determining what constitutes a threat, with obvious implications for assumptions of responsibility for planning for chemical disasters.

Even when the public-private distinction is blurred, the very separation tends to reinforce a reluctance by public groups to assume responsibility. For example, hazardous chemicals are often transported on public roads or waterways, but the transporters are usually private companies. Our study clearly showed that planning for chemical disasters resulting from transportation accidents is seen as primarily other than local community responsibility. In fact, until the recent occurrence of dramatic transportation-based chemical disasters, extremely little attention was paid to the possibility of such events by any public group or agency in the communities we studied.

The public-private division also affects what spatial localities are covered by whatever chemical disaster planning is undertaken. There are often legal barriers between local chemical installations and the public emergency organizations in that community. This may take the form of insurance/compensation prohibitions against the use of public workers on private property. In-plant accidents, therefore, are not viewed as a general community concern. One consequence is often a lack of involvement by public organizations in chemical disaster preparedness for certain spatial areas even though they are within the operative community because they are viewed as private spheres of responsibility.

The problem is compounded by the fact that there is also a tendency for chemical disasters to occur in or around spatial localities for which responsibility is "unclear." For example, transportation accidents tend to occur at points of entry into private property, at the juncture of private railway tracks and public roads, etc. Even apart from unclear private and public boundaries, disasters involving chemical agents are more likely to occur in geographic areas where coverage and control by the usual governmental groups may be either very complicated or very weak. Instances of the former are accidents involving hazardous chemicals which occur in port or river areas which almost invariably are cut across by a different variety of jurisdictions from different governmental levels. In such situations, no one may plan because of the assumption that other parties have responsibility. Even if there is disaster preparedness there can still be gaps in coverage unless coordination is very tight. On the other hand, complexes of chemical installations can be found away from built up residential areas, in sparsely populated zones, or in semi-rural locations. Such locations are often considered a nominal responsibility and are weakly serviced by the emergency organizations in the community. Due to overlapping or nominal jurisdictions, parts of the geographic area of an operative community may not be covered by adequate chemical disaster planning.

Local responsibility for preparing for disasters from chemical agents is also partly undermined by the activities and actions of supracommunity organizations. It is true that along some lines, such higher echelon activities have created sensitivity to the potential problem and have encouraged some community-level planning which probably would not have otherwise occurred. In recent years, in the United States, federal and state legislation regarding the handling of hazardous materials has markedly changed both sensitivity and actual attempts to prepare for chemical disasters in the chemical industry as a whole and at some state levels. Larger national companies have issued policy directives and instituted programs relevant to chemical accidents on a large scale, and state agencies have set forth regulations which affect their subordinate private or public units. Such higher echelon activities have undoubtedly spurred some lower level activities. We found some evidence of this in the communities we studied.

On the other hand, this approach tends to discourage local initiative and reinforces the notion that disasters involving chemical substances are not primarily a local responsibility. The very social organization of hierarchical but diffused organizations leads to a separation between where policies are made and where operations are conducted. Thus, while plants in local communities produce the hazardous chemicals and the dangerous substances are transported by means of local roads, waterways, train tracks, etc., the control of general planning for many plants and transporters tend to be supracommunity. That is, many plants are simply local outlets for national and international corporations with headquarters elsewhere, and many of the transporters are subject to state and federal regulations which supersede local ordinances. Given all that is going on outside the local community, it is, therefore, not surprising that extra-community sources of information and aid for chemical disasters are not widely known at the local level. The possible exception to this is the existence of CHEMIREC. Only a few local organizations are aware of where they could turn, and even within these groups, the knowledge is often of a personal rather than official nature.

Yet, no matter what the preparedness and planning are at supracommunity levels, disasters involving chemical agents impact only at the community level. It takes time for supracommunity measures to be implemented, and for extracommunity aid to arrive. Thus, local communities have to prepare at least for the emergency period of chemical disasters. But as the DRC study showed, while there are marked differences from one locality to another, there is relative little community-level planning for chemical disasters in American society. The matter is not seen as a generally salient issue in most communities, and little effort is directed toward addressing the problem. The question is given low priority in overall community disaster planning compared to preparedness attempted with respect to other disaster agents. This is true even in localities where there is awareness of the possibilities and potentials for local chemical disasters.

Among other things, this lack of priority leads to different degrees of preparedness in the geographic area of the operative community. This unevenness of preparedness is reinforced by the division of social life into a public and a private sector. In turn, this typically means a lack of organizational leadership, poor knowledge of risks, and a weak resource base in preparedness for chemical disasters.

#### Some Paradoxes

There are many interesting paradoxes in the planning for chemical threats and dangers. Among the major ones are the following.

1. Chemical facilities that engage in the most planning are not the ones that most need to plan-at least from the perspective of the communities in which they are located. Examples include large, wealthy, safety-minded corporations, as opposed to smaller local companies which can ill afford elaborate safety planning, and modern chemical complexes, located far from areas dense in population, as opposed to individually isolated older facilities near residential neighborhoods.

- 2. Chemical companies tend to see accidents and catastrophes as points on a continuum, and thus to see disaster planning as an extension of everyday safety planning. One consequence is that, when an in-plant accident occurs, all energy is directed to containing and reducing the threat, little to informing the community of the attendant hazards should the threat not be contained. In the event that containment efforts are not successful, this entails a greater hazard for the affected community due to lost warning time.
- 3. In contrast with the natural disaster situation, there is no one organization on the local level which has responsibility for both planning for, and responding to, disasters resulting from chemical agents. Civil defense has both planning and operational responsibility in the former, while in the latter, the local organization most likely to be prime responder, the fire department, is usually not involved in comprehensive planning for the response. Interesting also, while most fire departments see themselves as having the prime responsibility for handling out-of-plant chemical disasters, few other emergency relevant organizations assign that responsibility to the fire services.
- 4. As is the case with natural disasters, the first responders for chemical disasters are overwhelmingly likely to be local organizations. However, in contrast with the natural disaster situation, the most firmly established and routine procedures for dealing with chemical disasters involve links with extracommunity groups and organizations, such as the manufacturer of the chemical or the parent company in the case of a chemical plant.
- 5. Newer and more concentrated chemical complexes in industrial parks seem to engage in more intensive and extensive disaster planning than do older and more dispersed chemical companies. In general, however, as a result of zoning and land use policies, the newer complexes in industrial parks present less threat to Surrounding areas than do older companies frequently located near residential neighborhoods. Therefore, more resources are sometimes being used for disaster planning in the less potentially hazardous areas.
- 6. Planning for plant safety incidents and planning for disasters tend to be viewed as the same thing in very many chemical companies. At best, the two are seen as points on a continuum. It is often unrecognized that there might be a qualitative difference in the planning necessary and response required for the two kinds of situations. Accordingly, preparedness which is excellent for accidents may lead to a mistaken belief of being prepared for disasters.
- 7. If one major organization in a community takes the lead in preparing and planning for chemical disasters, there is a tendency for other local organizations to slack off. Due to

the specialized interests and expertise of the lead organization involved, one possible consequence of this is sometimes an unbalanced emphasis in the preparations and planning for disaster tasks and relevant resources. More important, it is possible overzealous organizational leadership may discourage across-theboard active involvement of other groups in preparing for chemical emergencies.

8. While pre-planned mechanisms exist for obtaining information and expertise as well as mobilizing specialized personnel and equipment, the initial and prime responders to a chemical incident usually have major difficulty in simple identifying what, if any, hazardous materials are involved. This is especially true in transportation accidents where multiple chemical substances often are involved.

Overall, we can conclude from our research findings that disaster preparedness for chemical emergencies is neither accorded high community priority nor undertaken well. Not only does planning for chemical disasters suffer from the problems attendant to all general disaster planning in American communities, but it also has additional problems of its own. In particular, disaster preparedness for chemical emergencies is plagued by the publicprivate sector division in our society, and also by the fact that the local community (which necessarily has to be the first responder) has generally less capability and knowledge for dealing with chemical emergencies than do extra- and supracommunity social entities.

# Part 3. FINDINGS FROM THE STUDY: RESPONSES TO EMERGENCIES

In the just-concluded part of this report, we examined how well American communities are prepared for acute chemical emergencies. In this part, we turn to the organized response which occurs in chemical emergencies. In general, our study looked at three interrelated matters: the effect of preparedness planning on responses; the typical characteristics or patterns of response to acute chemical emergencies; and, the similarities and differences between responses to chemical and nonchemical disasters.

Presumably, preparedness measures are undertaken to enhance responses, if not to actually prevent the disaster threat from occurring. But is is not just a matter of there being some preparedness planning, since some planning may be more appropriate than other. We, therefore, set forth some general principles of disaster preparedness which DRC and other studies indicate are involved in adequate planning. We then contrast that ideal with the actual state of disaster preparedness for chemical emergencies as it effects response.

The response in chemical disasters has to be visulaized in dynamic terms. There are first the situational and impact contingencies which will structure what can and cannot be done. Particularly important in what will occur are the initial definitions of the emergency situation and the actions of the first responders at the disaster site. Finally, the disaster site serves as a point of outflow as well as convergence of people, things, and information. We therefore discuss the characteristics of organized responses in chemical emergencies in terms of contingencies, first responder definitions, and the convergence-outflow pattern.

It might be argued, as it is for some other kinds of disaster agents, that hazardous chemicals have certain distinctive qualities which will affect planning and response. We therefore examine to what extent dangerous chemicals present a distinctively different kind of community risk. We then look at the similarities and differences between typical responses in chemical emergencies and in other kinds of disaster, especially those involving natural agents.

With this part, we finish our discussion about our research findings. However, there is a final chapter which summarizes our general conclusions and points out the applied and theoretical implications of our work and suggests future research possibilities.

# CHAPTER X

# EFFECTS OF PREPAREDNESS PLANNING ON RESPONSES

In this chapter, we examine the effects of disaster preparedness planning on responses to chemical emergencies. In part, what one means by the word preparedness will affect what one sees as the relationship between preparedness and response. Thus, in this chapter, we first discuss the principles of good community disaster preparedness, as defined by research of the DRC and others. We then turn to summarizing how responses in chemical emergencies are affected by preparedness at the overall community level and the organizational level, and in the public sector and extra-community sector. We conclude the chapter with the observation that while chemical disaster preparedness in most American communities leaves much to be desired, where planning exists, the responses will be more effective and efficient.

# Misconceptions About Disaster Preparedness

If the preceding chapters seem to paint a bleak picture of comprehensive local preparedness with respect to chemical hazards, we only reflect the expressed views of many local officials and members of disaster planning and and response organizations we contacted in the course of the DRC research. Many of the concerns expressed by local emergency personnel regarding planning for, and response to, chemical incidents related to certain characteristics of the chemical agents themselves--for example, the difficulty of identifying the exact nature of a particular toxic hazard because the containers may have been ruptured in a transportation accident. However, other reservations expressed about organizing locally to plan for hazardous materials incidents revealed the same kinds of problems which need to be addressed in planning for any type of community emergency. We therefore now address some principles of community disaster preparedness which would facilitate planning for any type of agent--natural or technological.

Disaster research has consistently found certain misconceptions prevail about disaster preparedness (see Dynes, Quarantelli, and Kreps, 1981). Therefore, we will first indicate what disaster preparedness is not, before we demonstrate what it should be, as suggested by disaster studies. It was rather noticeable in our study that the same general mythologies and misconceptions which exist in other areas of disaster planning, also abound in the thinking and activities of those concerned with preparing for chemical disasters, thus affected their responses to such emergencies.

# Preparedness is not Formal Disaster Plans

As we have already noted, preparedness is often equated with the existence of written disaster plans. Officials tend to believe that, once they produce a written document outlining resources, lines of responsibility, and disasterrelated tasks for an organization or community, the planning task has been accomplished. This may explain why local community officials seek and use "model" plans. It seems quicker, easier, and more economical to devise a local plan by copying or adapting one from another community than to "start from scratch" in the local community. In reality, however, these kinds of short cuts do not produce the desired results. Despite the fact that a formal plan is an essential element in the planning process, community preparedness cannot be achieved merely by drafting plans.

To be useful, a local disaster plan must rest upon a strong foundation. consisting both of accurate facts and the proper social and political precepts. Good preparedness begins with the recognition of the need for risk and vulnerability assessment, collective resource mobilization, cultivation of a hospitable social climate (e.g., supportive laws and community attitudes) and development of social networks conducive to getting things done. When these elements are present, they enhance the probability that official documents (such as disaster plans) will be useful. Disaster plans are important, but they stand in the same relation to community preparedness as a blueprint does to a building; much more is actually involved in constructing a building than is shown on a blueprint. Similarly, plans may show the structure and dimensions of a projected response very clearly, but they are a relatively poor representation of all that is entailed in actually organizaing an adequate disaster response. No one would equate a blueprint with an actual building; similarly, no community emergency organization can equate the completion of its job with the writing of a disaster plan. To be useful, plans must actually be used in disaster. The probability that plans will actually be used is higher if they are factually accurate, relevant, widely understood, and perceived as legitimate by emergency organizations and involved others in the community. There is no substitute for the experience gained from going through all the steps involved in disaster planning--the meetings, discussions, debates, rehearsals, training sessions, and related preparedness activities.

#### Preparedness is not a Product

In a similar vein, planning is sometimes thought of as something which, once accomplished via the production of a plan, is over once and for all. It would, of course, be very convenient if this were the case, but the nture of community settings, as well as the nature of disaster agents, dictate that preparedness be an ongoing process. This is true in two senses. First, as indicated above, preparedness is achieved, in part, through the experience of working through the planning process itself, e.g., assessing risks and vulnerabilities, and creating or enhancing linkages among organizations, and so on. Second, preparedness must be though of as a process, because it is affected by community and organizational changes in resources or capability as well as by changes in the number and nature of local risks, e.g., budget or equipment cuts, or the provision of new hardware or facilities. Moreover, even if material resources remain more or less constant, new people are continually entering emergency organizations, and they must be brought into the planning process. On the demand side, any number of factors can affect vulnerability: population shifts can alter the number of people at risk from different disaster agents; changes in land use can occur; transportation routes for hazardous materials may be modifired; new production or storage facilities of dangerous substances may be located in the area, etc. Because the local scene is not static, preparedness can never be accomplished once and for all.

# Preparedness is not an Extension of Everyday Operations

Prior to conducting research on chemical hazards, DRC studied the provision of emergency medical services (EMS) in disasters and mass casualty situations (Quarantelli, forthcoming). In this study, it was not uncommon to hear local emergency personnel express the idea that special disaster planning is not all that necessary because the provision of EMS in mass emergencies is very similar to the provision of EMS in daily situations, the only difference being one of quantity. In short, the idea was expressed that disaster EMS is like everyday EMS, only more so. In other studies, personnel in different emergency-relevant organizations have expressed similar statements about their own organizations. In the current study, the notion was expressed, particularly among chemical industry personnel, that preparedness for serious, acute toxic releases, chemical explosions, and other mishaps is but an extension of everyday corporate health and safety measures.

We found this type of thinking was far more common among communities and organizations which have never experienced a serious disaster than among those which have. Familiarity with the functioning of communities in actual disasters or mass casualty situations leads to an awareness of crucial <u>qualitative</u> differences between these situations and the ongoing, everyday activities, of community emergency organizations. The three examples below illustrate some of the ways in which disaster and everyday operations differ.

- Because large-scale emergencies place increased demands on A., many organizations and because community resources may at the same time be depleted, community organizations must depend upon one another to a greater degree in disaster situations than during normal operations. In a crisis there is a movement away from the everyday decentralized system of community functioning towards a temporary, more centralized system (an observation made over two decades ago, see Thompson and Hawkes, 1962). In this situation of increased interdependence, everyday boundaries (e.g., among political jurisdictions or between organizations) may not be maintained. In fact, in chemical emergencies, it is typical for jurisdictional boundaries and domains to become blurred and indistinct at the height of the emergency (see Quarantelli and Tierney, 1981). There may be more sharing of personnel, tasks, and equipment than normal. In those chemical disasters where mutual aid system plans become operative, this always occurs, but it also happens when the response is emergent or ad hoc. Community organizations must understand each other's functions and capabilities and must be prepared to work together smoothly, since this is what must happen in a major disaster.
- B. It is not unusual for organizations to lose autonomy (control over their own functioning) in disasters (Dynes, 1975). This is particularly true of groups in the private sector and nonemergency public agencies. When a community's ability to function is seriously threatened in our society, responsibility for citizen security and well-being usually reverts to certain civil authorities. The mayor, the county commissioner, or some other local executive may declare a state of emergency and assume

79

control of emergency activities for a set period of time. (Sometimes the actual authority is delegated to an official such as the civil defense director, or the sheriff.) In chemical incidents, authority for site control may be vested in either a local or outside agency such as a state or regional hazardous materials response team, the Environmental Protection Agency, or the fire department. In short, organizations can have their authority temporarily pre-empted in a disaster, and this represents a decided shift in the basis of their operations when contrasted with everyday operations. However, myths to the contrary, there is never a question of "martial law;" this has never occurred in any American disaster.

C. Performance standards for some organizations may change drastically in disaster. EMS systems operating by everyday standards under the pressure of increased disaster-related demands have badly botched responses to mass-casualty incidents by emphasizing speed of response and using "snatch and run" procedures. EMS services handling large numbers of casualties must shift from their everyday emphasis on quick response time and swift delivery of patients to hospitals (everyday performance criteria) to cogent triage of victims and judicious ditribution of injured persons to a number of area hospitals (crisis performance criteria) so as to avoid overcrowding at any one emergency room and the risk of long waits and substandard emergency care (Quarantelli, forthcoming). In the chemical hazards area, there are also differences in standards of action between everyday and emergency operations. For example, swift response is an absolute necessity for the fire service operating on an everyday basis when responding to structural fires. Dealing with unidentified chemical substances or materials whose properties are not thoroughly understood may require a very different response on the part of the firefighter; delaying the response until more information is received is often proper in this type of situation (see Baer, forthcoming). Those who do not recognize that some emergencies call for different types of performance are likely to make poor decisions in crisis situations.

In a disaster situation, organizations may be faced with a whole new set of challenges: taking on new personnel, tasks, and responsibilities; working within a different chain of command; being judged by standards different from those which are normally applied. For these reasons, it seems ill-advised for organizations to think of disaster-related demands as simply "more of the same" in comparison with everyday activities. To function efficiently and effectively, organizations must be in tune with their social context. This social context can change quickly and drastically in a disaster, and organizations must be prepared to change along with it. Good preparedness measures ease these shifts and reduce the uncertainty likely to accompany them.

Preparedness Planning is not Aimed at Prevention

Disaster preparedness may reduce some risks, particularly in the chemical area, but it cannot eliminate them. Planning can not be aimed at prevention

of disasters. At best, it can help in reducing the unknown variables in anticipated problem situations. Often the best that community preparations can do is to reduce the negative effects of a disaster event. Thus, mitigation rather than prevention is the more reasonable goal.

Similarly, it is not possible to totally preplan the response to a given disaster agent. Planners must build in flexibility, that is, anticipate the kinds of problems that are likely to arise-e.g., with evacuation of large numbers of people or of certain special categories such as the elderly--and attempt to reduce the confusion these problems might produce. There are simply too many unknowns in an actual disaster to plan for all contingencies. However, planning can result in a highly satisfactory disaster response if it is geared towards upgrading the capacity of emergency organizations to react flexibly, correctly, and promptly when disaster strikes.

So far we have noted widely held but incorrect views of preparedness planning. What, then, are more valid views of what is involved in preparing for disasters? We now turn to a discussion of some of the more important aspects which should be involved in disaster planning.

#### Preparedness Planning Aims at Thoughtful Response

Preparedness seeks to insure appropriate actions by responders. Training people in disaster response should emphasize the importance of acting upon the basis of valid knowledge. In the urgency and confusion of the disaster emergency period, the pressure on responders to engage in action-any action-may be almost overwhelming. However, sometimes, particularly in hazardous materials incidents, the best action to take may be no immediate action. We could cite any number of cases in which hasty and incorrect actions on the part of the first responders at the site of a chemical spill did nothing to improve the situation--and may have made it worse. Good planning reduces the understandable tendency to act impulsively in a crisis situation and emphasizes the payoffs which result when measures that are known to be correct and effective are undertaken judiciously.

# Preparedness Planning is Realistic

Planning should be based on what is likely to happen. Those responsible for community preparedness should steer away from adopting measures which require people to drastically change their typical ways of doing things. Rather than expecting people to change their behavior in order to conform to disaster plans, planning measures should be tailored to the behavior of people. Directions to emergency organizations should be expressed simply and in a straightforward manner. Elaborate systems of passwords and authorization should by bypassed in favor of simple badges and color-coded clothing, so as to make mutual identification simpler for responders. The natural tendency for members of the victim population to converge on a disaster site or to inundate the telephone system with requests for information about loved ones should be taken into consideration. An awareness of the fact that, in disaster, people are going to behave in ways that are natural to them, and not according to scripts devised with the ideal response in mind, can help planners avoid costly mistakes.

#### Preparedness Planning is Based on Knowledge

Two kinds of knowledge are essential for planners. The first includes information about the ways people and groups respond to disasters. This is essentially general knowledge in which communities can probably expect to show relatively little variation. Understanding of general sociobehavioral aspects of disasters is crucial for this purpose. The second body of knowledge is more varied, consisting of information about the risks and demands faced by individual communities and the resources that can be brought to bear to combat them. The first kind of knowledge--information about how people and communities respond in disaster--will assist in the formulation of plans which are realistic in terms of their coverage and requirements. The second type of knowledge--information on risks, demands, and resources as discussed in chapters V and VI--insures that the community has the <u>quan-</u> tity and <u>quality</u> of preparedness it requires.

# Preparedness Planning Focuses on General Principles

As we have already noted, it is impossible to plan in detail for every contingency that may arise in the course of a natural disaster or hazardous materials incident. In many senses, each such event is unique. Thus, there is much to be said for a very general plan, which clearly and explicitly outlines tasks, responsibilities, lines of authority, and locations of resources, but which does not spell out in exhaustive detail every aspect of an anticipated response. Potential users of disaster plans are generally not willing to plow through a multi-volume document comprised of several hundred pages. To make sure that the plan will be read and used, it should be relatively short and simple, perhaps with accompanying appendices which describe the disaster responsibilities of specific agencies in more detail, and which relate the activities of individual organizations to the overall community response.

#### Preparedness Planning Involves Education

If a disaster plan is to work when needed, both its content and its intent must be conveyed to those who will be involved in the response and those who are its intended beneficiaries. Planners must communicate just what those involved can expect in the event of a community crisis. Members of responding organizations must know not only what to do, but also what role their organization plays in the larger response; local officials must understand their functions and responsibilities; and the general citizenry must, to the greatest extent possible, understand what government, emergency organizations, and even local industry, are prepared to do for them and not to them.

# Preparedness Planning Overcomes Resistance

Planning for disasters is not always met with enthusiasm; indeed, it is almost always resisted--if not actively, then passively. Sometimes resistance centers on disputes about the necessity for preparedness or on the degree of preparedness that is desirable, particularly true in the area of chemical threats, both because they are relatively "new" hazards in terms of public awareness and because even experts disagree on the degree of risk they present. Reluctance to prepare for disasters can also have its source in any of the "social climate" or "social linkages" factors already discussed. Finally, people are often relevant to participate in community preparedness efforts because it is costly for them--in terms of expending time, relinquishing a degree of autonomy, taking on additional responsibilities, or simply doing things differently. Whatever the reason, attempting to develop a communitybased response capability is almost never an easy task. Measures which seem necessary and self-evident to those charged with responding to disasters may seem frivolous to others whose participation is essential. Thus, those who are responsible for community emergency preparedness must also be ready to see others on the idea that preparedness is necessary.

# The Actual State of Preparedness

If what we have just discussed is disaster preparedness, particularly good disaster preparedness, what was the actual state of preparedness in the localities we studied? The actual picture falls quite short of what might be desired. However, wherever there was any degree of preparedness planning, there was some positive effect on responses in chemical emergencies.

Overall community preparedness, specifically for chemical disasters, is either nonexistent, poorly developed, or merely a paper plan in most communities. Only in scattered localities did we find anything resembling community-level planning for chemical emergencies. We reached this conclusion not only through our preparedness study of 19 communities in the first phase of our work, but also through our observations of actual chemical threats or disasters. The exceptions tended to represent larger communities or those with large chemical industrial complexes.

Given that the prevailing state of affairs in most localities is overall community unpreparedness for hazardous chemical incidents, it is not surprising that responses are affected. Responses to actual chemical disasters, we observed, tended to be ad hoc or crude, often with gross applications of general disaster plans, or attempted to be applications of standard operating procedures (SOPs). In the absence of overall disaster preparedness, first responders show confusion in their reactions, local agencies exhibit difficulty in organizing themselves, and extra-community groups are delayed in getting involved in the emergency.

We noted that where we found any overall community preparedness, there was some effect on the response. Even when the planning was not followed in detail, and it very seldom was, the pre-disaster preparedness elicited a quicker and smoother response. In some very rare cases confined almost exclusively to in-plant accidents, responses to acute chemical emergencies were strongly structured by the disaster preparedness.

It was one of our research findings that organizational preparedness is almost as weak as community preparedness. This observation also supports our first phase finding which noted that most emergency organizations in the public sector, with the exception of fire departments, are poorly prepared for acute chemical emergencies. Even fire departments, particularly those of a voluntary nature and in nonmetropolitan areas—which are the majority of departments in the United States-often have given little thought, and have taken few specific steps, to prepare for chemical disasters. Many emergency organizations' efforts, therefore, are attempts to follow standard operating procedures (SOPs) which are not always appropriate in such crisis situations.

Our study did find that relevant private sectors were relatively better prepared than those in the public sector. However, in absolute terms, even their preparedness tends to be somewhat limited. Some private groups are better prepared than public organizations and the community as a whole, but the planning is far from flawless.

Large chemical corporations are usually well prepared for in-plant accidents, but as DRC found in the first phase of the study, generally do not address the question of responsibility and planning if the consequences of the accident go beyond the boundary of company property. While some transporters of hazardous chemicals, notably the railroads, do undertake extensive technical preparedness measures, there is usually little integration and coordination of their efforts with public sector emergency responders in the field. Industrial mutual aid systems often involve considerable and impressive preplanning. However, they generally do not incorporate plants which cannot take care of themselves, they are usually more oriented to fixed-installation incidents than in-transit episodes, and sometimes do not fully take into account key public emergency organizations such as hospitals or the possible intervention of extra-community groups in an actual chemical disaster. The extent to which preparedness planning in the private sector is limited, stands out most sharply in those situations where a chemical disaster involves both public and private groups.

Although our focus was on the local community, we could not help but observe that some emergency oriented extra-community organizations, both public and private, are better prepared for chemical disasters than local entities. Specialized emergency response teams in the private sector and certain governmental agencies at the state level often have greater knowledge, better training, more equipment, and more relevant experience than typical local community groups. This sometimes leads to a delay in the response to an acute chemical incident while the arrival of the extra-community organization is awaited. On the other hand, the nonlocal groups often have the only technical capability and trained personnel to handle the hazardous chemical. In the more catastrophic kinds of acute chemical emergencies, they tend to act as actual responders rather than advisors in the situation. This can lead to disputes between "local amateurs" and "outside professionals" on such subjects as disaster site responsibilities and task activities. The problem is compounded when incompatible coordinating responsibilities have been unknowingly assigned to different organizations in local and extra-community level plans. The preparedness planning of extra-community groups can, therefore, have both negative and positive consequences in the organized response to a sudden hazardous chemical incident.

As already indicated, preparedness does make a difference in response. At whatever level preparedness planning for acute chemical disasters does exist, the emergency time response in actual incidents tends to be more coordinated and effective. Even when prior plans are not fully or correctly implemented in an emergency, the preimpact thinking, discussions, drills, and contacts do facilitate emergent or ad hoc activities. Perhaps most importantly, preparedness sometimes prevents minor threatening incidents from escalating into seriously damaging catastrophes. Preparation for a chemical disaster makes a positive difference in organizational, interorganizational, and community responses.

In this chapter, we have partly implied the general picture of organized responses to chemical emergencies. As such, we have already indicated some of the more specific details about response that we will discuss in the following three chapters. We will first consider the most variable factor in response to chemical emergencies: impact and situational contingencies.

# CHAPTER XI

# IMPACT AND SITUATIONAL CONTINGENCIES

Impact and situational contingencies can greatly influence the way and the degree to which any community will respond to a particular chemical emergency. For exposition purposes in this chapter, we divide these contingencies into two categories: impact (or agent variable) and situational variables. While the response and its effectiveness in a chemical emergency will be affected by difference in the agent's impact characteristics as well as by variations within the social aspects of the particular situation, we are not arguing for idiosyncratic factors. Quite the contrary, we want to note that even the individualistic features of a chemical emergency can be generalized. In fact, even a general recognition that contingencies will always be present forces emergency personnel to consider such problematical aspects in disaster preparedness planning.

# Impact Contingencies

Impact contingencies include those characteristics of the chemical agent which can affect the organized response. Different agents impose different risk threats. While risk assessment, as indicated earlier in chapter V, essentially involves a perceptual component, there are risk dimensions which are inherent to the agent. For example, some chemicals are toxic, while most are not; a few chemicals can explode, others can not. Certain chemicals only become dangerous when they combine with other chemicals, certain other chemicals remain inert, and so on.

Thus, the specific characteristics of the chemical agent on agents involved in a major accident will influence the risk threat posed for a particular environment. Given the variety of characteristics which might be involved, myriad risk possibilities could be present. However, many of these variations can be reduced to one of two kinds of possible consequences: the destruction or damaging potential of the chemical(s), and the controllability of the chemical(s). Both of these characteristics will have implications for the manner in which emergency responders can and will attempt to neutralize the threat. The situation is complicated, of course, in that responders to the emergency may nor correctly perceive either the destructivedamaging potential or the controllability of the chemical threat. But in such instances, the risk consequences will still remain, even if they are incorrectly perceived.

The destructive-damaging potential of any chemical agent is the amount of damage and destruction it can cause people and the ecological environment. Certain agents have a greater potential for such damaging results than others. In general, the high-risk chemicals are those which are extremely volatile or which exhibit unstable molecular structure. Chemicals which have a high-risk potential are exemplified by the inherent dangers of compressed gases or the hazards posed by such gases as butadiene and vinyl chloride, which are both highly reactive and have a tendency to polymerize. Of course, the typical first responder (whether police or firemen) to a chemical accident, unless it occurs within the confines of a chemical plant, usually has little idea of the destructive potential of the chemical, a point we shall consider in the next chapter.

Instead, what we want to stress here is that responders to a chemical emergency can be faced with widely differing dangers, depending on which chemical(s) happens to be involved. Thus, in one emergency the responders might find themselves faced with a relatively low-risk situation. In another emergency, the risk may be extremely high. One result is that multiple exposures to chemical risks may not provide much of a learning experience. Unlike many natural disaster situations, experience in one situation does not transfer very well to the next incident. This great variation in possible destructivedamaging potential is an inherent agent contingency in a threatening chemical situation.

Of course, there can be actual impact, often with substantial variation in the destructive or damaging consequences. DRC studied some actual chemical emergencies where populations dozens of miles away from the actual disaster site were endangered. Yet we examined other chemical disasters where the actual destructive impact was confined merely to the truck or railroad tank cars involved. Depending upon which of these two situations have to be faced, responders have to deal with different types of disasters. A very localized disaster presents some different operational and response problems than does a very diffuse disaster. There can be tremendous differences in threat or impact depending partly on inherently differing qualities of different substances.

In both of the situations just noted, we are saying that different contingencies may be presented to responders which are primarily dependent on the inherent properties of whatever chemicals are involved. This is in addition to the fact, as discussed in the next chapter, that responders may incorrectly perceive the chemical danger or even not perceive any threat at all. Perceptual differences aside, however, different dangerous chemicals will provide different threat or actual impact contingencies to which responders have to react.

As an additional example, we may illustrate how the magnitude of a disaster can complicate the response pattern. In a large disaster, whose magnitude partially depends on inherent properties of the chemical(s), a number of representatives and agencies from different jurisdictional levels will respond to the event. We found that incidents of larger magnitude tend to be "top heavy" in terms of the involvement of state and federal organizations. This usually complicates jurisdictional problems, since there are often discrepancies in regard to responsibilities among different governmental sectors. That is, they do not correspond and they are not equivalent. In other words, we have found that if a disaster is large enough to necessitate a response from state, regional, and/or federal levels of government, these representatives will attempt to exercise the authority and control in the situation, in opposition to local community officials. Thus, the contingency of the destructive-damaging potential of any chemical agent may influence the coordination of interorganizational response.

In addition to actual or potential destructiveness, there is also the factor of the uncontrollability of chemical agents. Here, too, there is

considerable variation. There may not be a correspondence between the inherent uncontrollability of a chemical agent and the responders' perception of this uncontrollability.

Our study determined that most community officials are likely to assume a high degree of uncontrollability of most chemical agents. While the same perception exists for most natural disaster agents, there is sometimes the expressed feeling that this should not be the case for chemical substances. In actuality, any chemical's controllability is only partly dependent on the properties of the chemical agents themselves. Controllability also depends upon the amount or volume of the chemicals, and also the capability of the community to respond appropriately in the typical critical time period immediately following the onset of an accident with the potential for a disaster.

The chemical properties include flash points, toxicity, vapor density, synergistic possibilities, etc., and all can be further affected by meteorological conditions such as precipitation, wind velocity, and other similar factors. Usually, everything else being equal, the greater the volume, the greater the uncontrollability. Finally, controllability is partly dependent on the community's capability to perform certain initial response tasks, as we will discuss in the next chapter.

While both destructiveness and uncontrollability are inherent to the properties of the chemical, they are not, insofar as response is concerned, independent of the perceptual factors. Our study suggests that there is misunderstanding with respect to both matters. In general, both community officials and the public tend to overestimate the destructive and damaging potentials of dangerous chemicals. As in the instance of projections of risks at nuclear plants the picture that is often conjured up for chemical emergencies exceeds the inherent possibilities of most chemical substances. To be sure, as previously indicated, chemicals can present major risks and result in major consequences, but they are seldom major threats across-theboard. Most chemicals cannot be inherently dangerous, but the common view our study showed is often the reverse: the perception of chemicals involved in an accident often leads to a perception of danger.

We think one reason for a general misunderstanding of the potential effects of chemical agents is that except within the chemical industry, few people have any experiential point of reference with which to view chemicals and certain risks associated with technological accidents. Chemical agents may be ubiquitous in American society, but they are relatively random in their hazardous manifestations. That is, the risks posed by dangerous chemicals are not restricted to certain localities or regions of the country; they are nonspecific in this respect. In constrast, most natural disaster agents such as earthquakes, hurricanes, or tornadoes are specific to certain localities; in contrast, the impact of hazardous chemicals is not confined and specific to certain localities. Therefore, it is unlikely that any given population group will have had much if any direct experience with dangerous chemicals. Consequently, the image of the risk presented by chemical agents is vague and tends to be exaggerated (Gray, 1981a).

In general, impact contingencies add to the possible variation and complexity of the response in chemical emergencies. In some actual chemical

disasters, the situation is further compounded for responders by the multiplicity and variety of hazardous aspects which may be involved. In some acute chemical emergencies, there are often multiple elements of a disaster occurring either concurrently or sequentially. For instance, in the derailment of a train carrying dangerous chemicals, there may be multiple hazards and problems. The derailment is, in itself, a problem which must be solved. There may be resultant fires and explosions from the derailment. In turn. these may cause a chemical spill or toxic cloud which may not otherwise have occurred just from the derailment. Each of these events creates differing demands. In one sense, a single situation may involve multiple disasters which generate different demands to which the affected community must respond. The incident may generate different emergency-related tasks incompatible with each other. Thus, the water needed to douse the fire, for example, might actually trigger some dangrous chemical reaction which otherwise would not have occurred. In fact, the example just given represents an extreme, but not unknown, manifestation of the complexities which can be generated by impact contingencies for responding organizations.

It is very easy to think of impact contingencies in very individualistic or idiosyncratic terms. However, we have tried to show that there are some general aspects even to contingencies, including the simple fact that there will be impact-related contingencies in any chemical emergency. This realization encourages general planning for a response which takes contingencies into account.

#### Situational Contingencies

Situational contingencies include those specific characteristics of the particular social context in which a chemical mishap first occurs. Thus, a chemical emergency does not just happen, it happens in a particular locality, in a place with distinctive features. Similarly, a chemical emergency occurs at a specific point in time--more accurately, at some social time in the community life. Likewise, there are particular circumstances associated with any particular chemical emergency; for example, the overturned truck carrying a dangerous chemical cargo may or may not have displayed the required warning placards. While these do not exhaust all the types of situational contingencies, we will primarily discuss those that can be subsumed under space, time, or circumstantial variations affecting the response to a chemical emergency.

#### Variations in Space

Where a chemical threat or disaster occurs significantly affects the response. A chemical emergency, for instance, can occur on private property, a mixed public/private setting, or a public location. These possibilities have implications on a variety of factors, ranging from the degree of knowledge the public will have about the event, to the possible courses of action which responding organizations could take. For example, our research observed that when chemical accidents occurred inside plants or chemical company property, seldom did the larger community quickly find out about such events unless there were immediate casualties. In nearly every case, there was a delay between the time the accident on private property was turning into a potential disaster and when this happening became public knowledge. We also ran across situations where local fire departments were denied entry onto private property where a chemical emergency was occurring. On the other hand, our research looked into situations where, because the chemical emergency was in a public setting, the response was delayed and confused because no local agency believed it had exclusive responsibility and jurisdiction over the incident. Such a lack of clarity over response initiative would not occur in a private setting. Thus, the spatial--actually property responsibility--setting (which is a contingent matter) makes a difference in the response patterns to chemical emergencies.

Another spatial contingency involves the geographic and demographic settings of incidents. An obvious distinction is the occurence in a rural or urban setting. What might pose only minor consequences in a rural area could have catastrophic potential in an urban area with high population density and heavy concentrations of buildings. The inherent destructiveness of the chemical agent might not differ, but could vary depending on the physical setting in which the destructive agent might manifest itself. Also, the geographical location will usually affect the mobilization of resources during the initial phases of a response. In general, smaller communities with predominantly volunteer fire departments and other scarce resources will not respond as well as larger metropolitan areas with extensive and/or sophisticated resources, or quick access to them. Thus, since resource capability is indirectly related to geographic setting, the spatial locality of the chemical emergency can affect the response pattern. Put another way, response resource capability will vary according to different settings, as will the mobilization of the resources and the magnitude of the disaster in terms of population threats.

Furthermore, we frequently noted in our research that interjurisdictional and interagency problems may arise depending on the location in which the chemical emergency occurs. On an everyday basis, many jurisdictional boundaries and domains are often vague at best. Therefore, if an emergency occurs near the uncertain boundaries of two or more separate jurisdictions, ambiguities can surface as to who has major responsibility for responding to the disasters. Chemical disasters in port areas or involving bodies of water, in particular, seem to generate jurisdictional problems in the response, although the same difficulties also frequently surface outside of city boundaries. Many rural or quasi-rural areas in the United States are locales where organizational responsibility, authority, and domain are unclear and often overlapping. A chemical emergency in such a location is certain to elicit interagency confusion, if not competition or conflict. Thus, the contingency of the location of a chemical emergency can have a major impact on the response pattern.

#### Variations in Time

When a chemical threat or disaster occurs is also important in affecting the response. However, it is not chronological but social time which creates an effect. The two times are not equivalent. In every community, there is a rhythm to social life, with certain activities ebbing and increasing in particular patterns and cycles. These patterned activities vary (and not always directly) in relation to the time of day, the day of the week, and the season. Thus, there are such community social phenomena such as the rush hour, the evening or afternoon during which major sports events are scheduled, and holiday weekends. Such social times affect where people will be concentrated and what they will be doing, as well as the state of readiness of emergency organizations and how quickly resources can be mobilized.

Our studies noted great response variation depending on the timing of chemical emergencies. Evacuation, for example, is much easier to carry out during light than darkness. At the Mississauga chemical incident, massive evacuation was partly delayed, as police reports point out, because of a reluctance to try to move a great number of people at night (see Scanlon and Radgham, 1980). Convergence is relatively less likely to occur during regular working hours than other times. Unless there is an immediate threat, persons at work cannot just leave work to go and look at a disaster site. Even organizations that operate on a shift basis, and most emergency groups are operative on a 24-hour basis, do not have either the same quantity or quality of personnel available around the clock. We studied some chemical emergencies where the response was slow in developing because higher-level emergency officials were not immediately available because the incident occurred outside of regular weekday working hours. In a few cases, certain material resources could not be easily located and used because the owning organizations were closed and it proved difficult to find any personnel with relevant information and/or authority on how the resources could be obtained.

Thus, in the same manner as spatial variations, temporal variations can create different contingencies. With respect to time, the rhythms of community life (or social time) can create radically different situations with which responders must cope. The chemical risks might be identical in two chemical emergencies, but due to timing, there could actually be somewhat different situations for the responders in the two cases.

# Variations in Circumstances

In addition to spatial and temporal contingencies, there are still other variations possible. There may simply be other circumstances affecting the situation. Many factors could be cited, but we will illustrate using two examples: the duration of the threat, and the speed of onset.

In our research, we observed chemical emergencies whose response activities ranged from a few hours to nearly a week. As we indicated earlier, some events which eventually become chemical emergencies may be no more initially than a transportation accident or a plant mishap. Thus, a railroad derailment may produce no chemical toxic release for several hours, days, or perhaps, not at all. However, responding organizations have to maintain site security and mobilize certain resources for the entire duration of the episode. The residual polluting effects of a dangerous chemical neutralizer can likewise extend an incident. In other cases, however, the circumstances are such that everything of an emergency nature is quickly over, and just hours after the initial indication of the emergency, there is little sign that anything has happened.

This can cause greatly differing consequences, depending on the kind of community in which it occurs. For example, we noted not surprisingly that smaller communities were more adversely affected by a prolonged emergency. Among the negative consequences noted were lost wages for volunteers in emergency organizations, substantial losses to the local economy because of closed businesses, and rapid depletion of certain kinds of resources. A chemical emergency of the same duration would not have the same consequences in a metropolitan area. In fact, while an urban area might suffer more in absolute terms, we observed smaller communities tended to incur relatively higher losses for chemical emergencies of the same duration.

We also found that speed of onset is another situational variable which may make a difference in response patterns. Depending on many factors, including properties of the chemical agents, as well as how the potentially dangerous substances are initially treated, there may be little or no advance warning of an impact. In such cases, there can be no preventive efforts, and the response generally focuses on recovery efforts. However, in many transportation accidents particularly, the initial accident does not always produce an immediate chemical emergency. In many such cases, the response can be primarily directed at preventing a chemical emergency from even developing. As the examples illustrate, circumstances can create different kinds of situations, and in that way partially structure the necessary responses.

In this chapter, we have tried to stress that there are many contingencies in potential and actual chemical emergencies, some of which may actually prevent such an emergency from manifestly occurring. Some contingencies result from the property of chemical agents themselves. Other contingencies are more situational in nature, resulting from spatial, temporal, or circumstantial factors. However, while contingencies are important in affecting responses, they primarily set the stage for responding organizations. What responders do, as we have already indicated in this chapter, is also heavily influenced by how they initially define the situation. In the next chapter, we discuss the first responders and their initial definitions in chemical emergencies.

92

# FIRST RESPONDERS AND INITIAL DEFINITIONS

According to our guiding model, the very early stages of a chemical emergency are the crucial ones. Our research supported this notion. Thus, this chapter is solely devoted to what we found out about the first responders and their initial definitions in an incident involving dangerous chemicals. We first note some differences between fixed sites compared to intransit types of chemical emergencies. In the rest of the chapter we depict what our study determined about the initial stages of the response patterns in accidents where hazardous chemical substances are present.

# Fixed Sites Versus Intransit Situations

In our research we discovered that there were some major differences in the patterns of response to hazardous chemical incidents at fixed sites when compared to those resulting from intransit accidents. Fixed sites generally refers to episodes within chemical plants or on their property. Intransit has reference to incidents associated with transportation accidents such as those involving trucks, trains, barges, or aircrafts carrying hazardous chemicals which occur on publically accessible lands. We noted that which organizations participate in the response and what they do, as well as the difficulties that emerge, differ somewhat in the two kinds of situations. While there are many elements in common between the two situations, there are enough differences in the response to make them worthwhile noting.

In particular, in-plant emergencies are likely to involve only company related groups, such as the plant fire squad rather than the fire department of the local community. In contrast, intransit situations will sooner or later, and it is usually sooner, evoke the appearance of community emergency agencies such as police and fire units. We did note that sometimes the private transportation carriers do attempt to prevent knowledge of a chemical mishap from becoming more public knowledge, or to discourage the participation of community public agencies in the accident. In -plant emergencies usually tend to generate responses rather specific to the chemical hazard. Transportation accidents on the other hand, often initally trigger general accident response measures rather than specific chemical disaster responses. In-plant chemical emergencies also tend to lead to responses to contain if not to prevent the chemical emergency from developing. In contrast, much of the initial response in transportation accidents is devoted to measures to protect the larger community. These illustrate some of the differences between fixed sites and intransit situations, many of which we shall shortly discuss in greater detail.

The differences in the two kinds of situations stem from a variety of factors. For one, chemical plant incidents almost always occur on private property. In contrast, transportation accidents even though they may involve a private carrier, in the great majority of cases happen in what normally is viewed as a public setting. This in turn is related to the fact that plant

93

incidents often do not have much social visibility; unless they are of major magnitude, only the immediately present workers and officials in the plant may ever know that there had been a chemical mishap. In contrast most, although not all, transportation accidents are much more socially visible and usually cannot be kept from the knowledge of the larger community despite occasional attempts to do so.

However, the major differences between fixed sites and intransit situations probably stem from other factors. For one, as we noted earlier there is generally good emergency preparedness within chemical companies. In fact, the larger the company (and especially if the plant is part of a nationwide or international corporation) the more the preparedness planning for chemical mishaps is likely to be detailed and extensive. It is true, as we discussed in an earlier chapter, that there is a tendency to equate accident planning with disaster preparedness; but even if it is the former, it does mean the probable collective mobilization of certain relevant resources for the latter. In addition, not only is there likely to be less preparedness planning for transportation accidents, but there are simply more problems which must be coped with in transportation-related events. As examples, there are often complicated jurisdictional questions and multilevel organizational issues when trains, tank trucks, ships, or planes carrying dangerous chemicals are involved in a transportation accident. Thus, any incident which may lead to the pollution of any body of water will lead to the activation of the national contingency plan for such events and the active participation of the U.S. Coast Guard, regardless of local and state plans and the activities of community and state agencies.

Taken as a whole, with everything else being equal, responses to chemically threatening incidents are better in fixed facilities than in transportation accidents. Often in chemical plants minor mishaps are so well handled that they never develop a potential for becoming a disaster. Also when the level of risk is taken into account, our study found that motor vehicle incidents are generally handled less efficiently and effectively than those occurring on railroads. In part, this results from the fact that there is relatively little systematic chemical disaster preparedness planning for accidents on roads or highways; railroads as a whole have undertaken far more elaborate planning for chemical emergencies.

On the other hand, it does appear from our work that the potential for catastrophic chemical disasters as compared to average-type incidents appears to be relatively greatest in fixed installations. Next most vulnerable would be railroads. Least likely to result in catastrophes are motor vehical incidents. (Our study did not obtain enough information to form any impression about the potential for chemical catastrophes as a result of barge-ship and airplane accidents.) There are any number of factors which can affect the magnitude of the possible danger in any given incident. Many we have already noted in the previous chapter when we discussed impact and situational contingencies. However, in very general terms, it does seem that situations having the greatest risk potential for a chemical catastrophe or major disaster are those in which the better preparedness and response is likely to be found. That is, the better state of affairs exist generally in plants producing the most dangerous and greatest volume of hazardous chemicals. It is in such situations that the quickest and most efficient intial responses to chemical mishap are likely to occur.

# The Response Pattern

The importance of the initial response in a chemical emergency is widely recognized. One major chemical manufacturer, in fact, produced a safety training film and entitled it "Those Vital Fist Minutes" to emphasize the crucial nature and the necessity of proper and quick actions during the period immediately following a chemical mishap or an accident involving chemical substances. It is often the actions in the first few minutes, just before a release or just following a spill, that determine whether there will be a minor even non-chemical mishap or whether instead there will be the threat of or actual impact of a chemical disaster.

In incidents inside chemical plants, there is usually no danger of not understanding that a chemical is involved. However, a far more problematical situation usually exists in the early states of an intransit mishap. We observe in our study that in transportation accidents, first responders seldom initially perceive a dangerous chemical threat unless there are obvious sensory cues such as a strong pungent odor or eye and skin irritations. This is true even when first responders are from emergency organizations such as fire or police departments. Instead, motor vehicle or train accidents are initailly seen as transportation accidents or wrecks. The general tendency of first responders is to define the situation as what it "obviously" is, namely a transportation incident. In doing this, responders are doing what has long been observed in the disaster literature, that is, there is a strong tendency to define all cues in terms of the normal or the expected (see McLuckie, 1970). If it appears to be a transportation accident, it will be perceived and defined as a transportation accident.

The perception of the initial situation is compounded by the fact that organizational and community disaster plans rarely discuss the combination of a transportation accident and a hazardous chemical incident. In fact, a DRC content analysis of plans determined that separation of the two kinds of events was almost universal. One consequence of this we noted, was that there is an initial tendency for responding groups in transportation accidents to use their standard operating procedures (SOPs) for routine accidents; they seldom initially activate the disaster much less the chemically relevant plans of their organizations.

In principle, first responders should be aware of the various placards and symbols that by law in the United States are mandated to be carried on tanks and other containers of hazardous materials. Unfortunately, various studies have determined that the legal requirements are not always followed. Thus, one systematic study of trucks in Virginia found that 41% of the trucks stopped for inspection were in violation of placarding requirements for hazardous materials (Schmidt and Price, 1977). Another report from a railroad states that its own study showed that required placards were in place on rail cars only 77% of the time. Our more impressionistic observations support the view that placarding requirements are often widely ignored.

However, even when placards and symbols are still in place and readable after an accident, there is no automatic recognition of them. In our research we found that first responders do not always note the signs identifying hazardous materials, and even if aware of them, do not at all times fully understand their meaning. This excludes situations when placards and symbols have either began to be destroyed or were made illegible as a result of the transportation accident. Also seldom do first responders have easily accessible manuals or booklets which would translate the symbols for them or indicate what they should immediately do given what a placard might identify as the dangerous chemical substance involved.

Sometimes first responders in transportation incidents do initiate searches for invoices or other relevant papers. However, even if a search is initiated, it is sometimes difficult to find the invoices or shipping bills for what is being transported. If found, the papers are not always understandable to people without an appropriate technical background. Personnel from law enforcement agencies, usually the first responders to transportation accidents, seldom have the knowledge to read technical papers correctly. Of course, relevant papers are not always available; one survey found that 23% of trucks carrying hazardous materials failed to carry required shipping papers (Schmidt and Price, 1977).

Also, personnel from the transporting carrier are sometimes killed, injured, or disappear from the accident scene thus precluding questioning by first responders. Of course, such personnel themselves do not always know exactly what they had been carrying. There have been cases where first responders have been unintentionally misinformed by truck or train personnel about the dangerous cargoes they supposedly were carrying. We also observed in our study that personnel from the carriers were sometimes reluctant (if not actually uncooperative) in providing relevant information to first responders. Thus, for all these reasons, first responders are frequently uncertain about the specific nature of the chemical threat even after they suspect the incident is more than a routine accident.

Some of the DRC observations on these matters have also been reported by others, especially operational personnel. In a National Transportation Safety Board hearing, witnesses from the fire service areas:

> Indicated that reliance on technical manuals, placards, computer printouts, and waybills did not fulfill their informational needs. They stated that all too often placards located on hazardous materials tank cars were destroyed, the knowledge of the traincrew was limited as to the exact placement of tank cars and the materials carried; and in immediate emergency conditions, there was not adequate time to search for waybills and crossreference materials with an emergency manul to determine general emergency actions (Safety Evaluation Effectiveness, 1978: 11).

Because of all these matters, we found that first responders, even if they believe more than a routine accident is involved, are often uncertain as to the specific nature of the chemical threat with which they must cope. In fact, it was rare in the chemical emergencies resulting from a transportation accident, for first responders to learn quickly what they had to face. In some such instances also, and not uncommon where mutliple dangerous chemicals were involved, responders sometimes never learned what the hazards were until long after the incident was over. can and should be done is much of the early response, but such definitions are not always correct. In fact, there is often a delay in defining a transportation accident as having the potential for a chemical disaster.

There is no sharp dividing line between the first response and later responses. However, in this chapter we have tried to describe who does what in the earliest stage of a chemical emergency. In the next chapter we turn to primarily indicating the nature of the rest of the response in such situations.

#### CHAPTER XIII

# CONVERGENCE AND OUTFLOW PATTERNS

Much of what happens in the response to a chemical emergency after the arrival of the first responders and their initial definitions of the situation can be visualized as convergence and outflow patterns. That is, there is a movement of organizations, things, and information towards the disaster site and the affected community. Concurrently, there is a similar flow of groups, material resources, and knowledge away and outward from the site. The typical patterns this convergence and outflow assume are discussed in this chapter. We conclude the chapter with a brief discussion of some special problems in the aftermath of a chemical emergency.

#### Typical Patterns

First responders almost always attempt to notify their organizations and others of the occurrence of a chemical mishap and its possible consequences. Within chemical plants, that notification goes through the usual chain of communication and hierarchy. Standby emergency resources such as medical personnel and the company's fire squad get notified in the process. If the event is of some seriousness, higher echelons of the company and corporate headquarters may be notified.

In transportation accidents, we found that the process of notification is usually uncoordinated and erratic. Word of a possible chemical threat proceeds through a variety of organizational communication channels. We never found a case of the notification process going through a centralized emergency-relevant office or group, although some mutual aid system preparedness plans call for such a procedure. One consequence of a multi-channel and multi-organization alert, is that not everyone who should always be notified is notified and the various local emergency organizations find themselves uncertain initially about who else knows of the potential chemical danger or actual impact of a chemical disaster. We encountered instances in our study where it was quite a while before all the relevant police and fire forces in a community endangered by a transportation-occasioned accident were notified of the emergency. This naturally delayed their mobilization.

We also found that transporters of dangerous chemicals involved in an accident were likely to immediately notify higher levels of their organizations about a mishap, but neglect to promptly notify any public sector agency. In some cases the carriers never directly communicated with the local community organizations about the possible problem. There were even cases where railroad or trucking companies had already started to send in emergency stand-by teams, personnel, and resources, before local first responders had even by chance come across the transportation accident.

Our research also indicated that first responders such as local fire departments cannot be depended upon to alert others of a possible chemical emergency. Even when fire department personnel have correctly identified the nature of the chemical threat, they frequently neglect to communicate this information to other responding agencies. In fact, an inability to define the chemical threat is more likely to push fire departments to communicate with others about the crisis situation.

One consequence of a fire department correctly identifying a threat and not notifying others, is a lack of coordination. In particular, the absence of a proper notification to all relevant parties regarding the situation, may result in off-site decision-making independent of on-site information. The off-site agencies may spend effort identifying the nature of the chemical emergency, while on-site fire department personnel are already moving specifically to deal with a particular threat. While law enforcement agencies are more likely than fire departments to attempt to notify other relevant groups, police personnel often do not have as complete and accurate information about the threat as do fire personnel.

Thus, we consistently observed in our study that notification and information about an acute chemical hazard in a transportation accident tend to diffuse slowly and erractically. In the more extreme cases, some organizations will still be struggling to define the nature of the chemical threat when other groups are already mobilizing resources for the problem. In other cases, on-site personnel and agencies may very well understand the emergency they face, but their on-site counterparts may be in the dark about the situation, creating confusion in the mobilization of resources and ensuring coordination difficulties.

Given this, it is not surprising we found that overall interorganizational coordination seldom occurs during the initial phases of a response to a chemical emergency. In the event that some coordination does develop, it tends to be of an informational rather than a task-oriented nature. That is, information about the chemical emergency may be exchanged, especially on-site; but it is very rare for a comprehensive interorganizational tasks strategy to emerge. Instead, we noticed that most organizations responding to transportation accidents continue their usual everyday pattern. That is, they tend to operate on their own initiative and to proceed independently of one another.

Sometimes this pattern will change as the response becomes more protected. However, it may generally prevail throughout the entire emergency time period. We have been in chemical emergencies, when no overall interagency coordination was ever achieved, from the initial stages of the transportation accident to the last stages of phase-out from the disaster site of the last of the responders to the chemical emergency.

When DRC studied preparedness planning for chemical emergencies, we were struck by the fact that many of our respondents in emergency groups expressed doubt that coordination in an actual emergency would be achieved. These skeptics even of their own planning appear to be correct. We noted that although responsibility for specific tasks and use of resources may be clearly spelled out in a disaster plan, there often is a lack of clarity about which agency has responsibility for overall coordination. The potential problem is magnified in the case of chemical disasters due to two reasons: (1) such incidents, being usually of a very sudden nature, necessitate immediate response by the fire services who direct their attention to neutralization and control and have little time for establishing new liaisons or developing coordination; (2) there is a tendency for chemical disasters to occur in jurisdictionally
"unclear" locations, for example, at points of entry onto private property, on railroad tracks, or in port or river areas. Any situation calling for meshing of interorganizational resources where jurisdictional boundaries overlap or are unclear is a very problematic situation. In fact, in most such cases we studied, overall coordination was not achieved, at least during the emergency period.

Our research also observed that the process of seeking outside help and expertise in chemical emergencies resulting from a transportation accident was usually uncoordinated. In some situations we looked at, there were delays in seeking such aid. Eventually some organization took the initiative to solicit outside help. However, a more typical pattern was for a number of different local agencies and groups to request extra-community help. Of course, this was done with no awareness that other organizations were also appealing for assistance outside the local community. In fact, there were situations we observed where different segments or levels in the same local organization requested outside resources.

This multiple seeking of extra-community aid usually meant that more requests for outside assistance were made than were necessary. This is one factor, although not the only one, contributing to the problem of post-impact convergence which is very noticeable in chemical emergencies. To be sure, the convergence problem was one of the major observations made by the first disaster researchers (see Fritz and Mathewson, 1957), but it is an almost universal characteristic of chemical disasters. Our research, the work of others, investigating bodies, and operational personnel almost invariably note that one of the more notable features of chemical emergencies is the swarming in from different areas, state, regional, and national-level public and private groups.

The presence of many such extra-community groups frequently creates problems for local organizations. In particular, local groups often find themselves given muddled, inconsistent, and contradictory advice on how they should proceed. There is an implicit assumption in much disaster planning that technical advice will be clear-cut, that there is only one understood and accepted answer to technical problems, and so on. This is not ture as has been found by disaster researchers studying the social aspects of technical knowledge and understanding as it applies to disasters. We found the same problem surfacing in chemical emergencies, and we have not been the only ones to note this matter. A recent report of the National Transportation Safety Board on the Somerville, Massachusetts chemical incident noted that the advice provided and the guidelines given to local fire responders by the shipper, carrier, Department of Transportation, and U.S. Environmental Protection Agency was "inadequate, inconsistent and confusing," (Special Investigation, 1980: 9). We found the same pattern in the advice that local responders frequently received from extra-community organizations.

We did not observe that when local officials sought aid and information, they turned to any specific or particular extra-community source or organization for the possible assistance. As we have already indicated, CHEMTREC was sought out by some in the situations we studied, but this was not a universal pattern even when first responders knew about that particular information source. In some instances, there was a tendency to turn for assistance from certain state agencies. This occured when local officials had some knowledge about the response capabilities to chemical emergencies of their state civil defense agency or an equivalent group. In the majority of cases, however, extra-community resources came into the local carea because they learned of the chemical emergency (usually through indirect sources) rather than because they were summoned or requested to do so by community officials.

As might be expected, the post-impact convergence effects the manner in which the overall response will proceed, influencing directly such matters as the mobilization of resources and indirectly such questions as the likely duration of the chemical emergency. As we have indicated, no overall interorganizational coordination will develop. This particularly seems to occur in major emergencies which attract a great number of extra-community groups from both the private and public sector. In such situations, if any tasks are to be carried out at all, there has to be at least a limited degree of coordination between at least some of the local agencies and some of the extracommunity groups. For example, a response team from the outside that may have come in to neutralize a dangerous chemical from a transportation accident or to undertake a clean-up operation, will not be able to do anything unless the local police allow them access to the disaster site and otherwise facilitate their work. In fact, in those relatively few chemical emergencies studied by DRC, where there were few outside groups, organizational coordination of any kind was often minimal.

It also seemed that convergence in the response effected the establishment of an on-site command post. It is extremely rare for a chemical emergency to lead to the opening up on the community emergency operating center (EOC), a standard resource in most American communities at the present time. But the establishment of an on-site command post, usually in a police car or van, occurs relatively often. It seems that as the response becomes more protracted, and as more groups and agencies become involved, those participating in the response find it necessary to try and centralize some of the multiple activities. At such command posts, which may or may not be so identified, there is not only information exchange but often some effort at some centralization of decision making. In almost all cases the command post is informally organized, under-equipped in terms of communications hardware, and lacks clear or formal leadership. Nonetheless, such command posts do seem to serve functions, and the response seems better organized when they exist.

We found that personnel from law enforcement agencies tend to form the core of such a command post. Fire department personnel, even though they may have been first responders in the incident and may be the most active element in the situation, may have a representative at the command post, but will seldom have a leading role. Civil defense officials, usually among the leaders in preparedness planning and often the major coordinators in other kinds of disasters, usually play a major role at on-site command posts only in chemical disasters of major magnitude. In other kinds of disasters, in many communities, the local civil defense agency frequently automatically takes a leadership role; in most chemical emergencies they appear to do so more rarely, reluctantly, and usually only if the emergency has clearly the character of a community-wide disaster.

The seeming substitution of an on-site command post for a community EOC, does appear to have other consequences for the response. For one, the absence of an EOC, we found, seems to affect the quality and quantity of information which is disseminated to the general public. The quality of the information which most community residents obtain about acute chemical emergencies while they are in progress is generally very low. In part, this stems from the absence of an EOC and the presence of an on-site command post. No organization represented at the on-site command post is likely to see as its responsibility the providing of news or information to the mass media. The command post is peopled by operational personnel or decision makers. If seekers of public information get to a command post, it is unlikely they could obtain an overall picture of the situation, especially implications for the larger community, from occurences there. Many of the responders can only provide partial or fragmented information. Also, because mass media personnel will press for news items, efforts to limit release of information is not likely to be successful.

We found that since the primary source of information in a chemical emergency is likely to be an inadequate one, incomplete, conflicting, and often erroneous information about the emergency will circulate. This is especially dysfunctional because in a prolonged emergency, even the organized responders become partly dependent on mass media accounts for information about the incident. Also, the lack of complete and accurate information about the chemical threat becomes a problem for community residents who need to have some knowledge about the nature and duration of the threat, and whether it is safe to return to their evacuated homes.

It appears from our study that there are two kinds of population evacuations in chemical emergencies. There is the evacuation which occurs directly as a result of the transportation accident. That is, people become aware there is an emergency and leave what they perceive as the endangered area. Most of these population evacuations occur as a result of word-of-mouth communication in primary group networks. Friends tell friends and neighbors, and they leave the area. This kind of evacuation tends to be spontaneous and informal.

The second type of evacuation tends to be more formal. That is, local emergency personnel usually warn people that there might be some danger from a chemical emergency, and that they should leave the neighborhood. This kind of evaucation is usually a little delayed, and primarily occurs when the first organized responders have clearly established that there is some kind of chemical danger. While law enforcement officers, and sometimes fire personnel often take the initiative in warning people of a danger, we did not find that formal evacuation plans were ever used. A perceived need for a rapid exodus seems to underlie the quick effort to get people out, reflecting, as we said earlier, a widespread perception of chemicals as very dangerous agents.

Although the spontaneous evacuation and evacuation warnings are generally effective in moving people out of endangered areas, there are nonetheless, some serious problems in such movements. For one, most warnings to evacuate are inadequate. The warning messages are generally non-directional and ambiguous in many respects. That is, people are urged to leave an area, but are seldom given information about the directions to go, or the distances which will make for a safe evacuation. We also noted that almost never are endangered populations given any information about alternative protective measures other than leaving an area. Officials also rarely seem to consider the possibility of traffic congestion occuring when no directions for evacuation are provided and there is widespread use of private vehicles. Similarly, little attention is paid to the need of keeping evacuees informed of a developing emergency, when it is over, and when it will be safe for them to return to their homes.

It appears to us that many of the problems associated with chemical emergencies are that they are primarily an ad hoc emergent activities undertaken by people on their own or roughly guided by some of the emergency first responders. In other kinds of disasters the local civil defense office normally handles the evacuation of citizens. However, as we have already noted in chemical emergencies the civil defense agency usually has an unclear and undefined role. Thus, when even more organized evacuations sometimes occur in the later stages of chemical disasters, no group attempts to organize the evacuations.

#### Special Problems

A number of special problems associated with chemical emergencies could be cited. In this general report, however, we shall only note three. They are the limited role played by mass media agencies at the height of the emergency, the unusual medical problems that might arise, and the problems associated with the neutralization of the dangerous chemical(s) involved in the transportation accident.

Unlike in most natural disasters and most other emergencies (Disasters and the Mass Media, 1980), we did not find the mass media playing as central a role at the height of the emergency. For instance, the initial evacuation of a population usually occurs so quickly that mass media units play no significant role in that response behavior. We found that at best, local radio and television stations might serve as a means of secondary confirmation of initial warnings. Radio stations occasionally are instrumental in notifying evacuees that the threat has been neutralized and that they can return to the area. However, in many instances no formal or official recall order is ever issued, so that cannot be broadcast. If a recall is officially declared, and we found it rare, it is usually based on knowledge of the safety of the situation as defined by the fire department. In those instances the word that it is safe to return can be transmitted by mass media outlets.

We found rather consistently a rather poor handling of the medical treatment given to casualties in chemical emergencies. There are problems all along the line. We noted that in the majority of cases, ambulance services and hospitals were not informed of the exact nature of the dangerous chemicals involved in the incident. In many cases as we have noted, it takes time for emergency responders themselves to obtain that information; but when it becomes known on-site, it is seldom communicated to organizations in the medical area. Also, except under unusual circumstances, hospitals have little prior experiences with chemically-created illnesses. Medical personnel are usually unfamiliar with the symptoms of chemical exposure and the associated medical treatments. Additionally, it is very rare for hospital disaster plans to discuss the special problems associated with the treatment of victims. exposed to hazardous chemicals. Moreover, it was reported to us that health sector personnel do not know of any clearinghouse or the equivalent of a poison-control center to which they can turn quickly for for information and assistance. It is not surprising that we found on a few occasions in chemical

disasters we studied, that patients had been admittedly treated for the wrong toxic illness because symptoms were initially misinterpreted. In one chemical disaster studied by DRC, an official report on the event observed that:

Physicians were uncertain about the medical treatment for exposed employees. Doctors were aware only of injuries from "chlorine or some toxic fumes" when admitting patients during the nine-day period of the emergency. They were uncertain about the additive effects of these gases in combination or reinforcing each other and possibly aggravating chemical exposures. For example, certain gases (carbon monoxide, alcohol, etc.) produce increased respiratory activity resulting in increased ingestion and ultimately greater toxicity. (Railroad Accident Report, 1979: 14).

A last problem we noted has to do with the neutralization of the chemical threat. At the local level, a major concern is always the neutralization of the dangerous chemical hazard. However, there does not always seem to be a recognition that there is a difference between a stablization of a threat and its neutralization, and that they often require different operational procedures. We noted that there frequently are jurisdictional problems associated with ultimate neutralization. In addition there is a degree of reluctance to take responsibility for neutralization if it is foreseen that there may be some residual "polluting" effects.

Overall, the patterns of convergence and outflow we noted in chemical emergencies are marked by great uncertainty and acitivites which in retrospect were not necessarily the best for the occasion. There is a great lack of understanding and knowledge especially at the height of the emergency. There is an erratic inflow or convergence of resources and groups. What flows out is even more erratic with information, for instance, failing to reach the appropriate sources. Some of the special problems associated with chemical emergencies have the potential for turning a relatively minor disaster into a catastrophe.

With this chapter we end our discussion of the organized response pattern in chemical emergencies. However, at various points in the last few chapters we have suggested in passing both differences and similarities between chemical disasters and other disasters. Therefore, in the next chapter, we shall summarize the general differences and similarities between the two.

#### CHAPTER XIV

## SIMILARITIES AND DIFFERENCES BETWEEN CHEMICAL AND NONCHEMICAL DISASTER RESPONSES

Chemical and nonchemical disasters exhibit both similarities and differences. This is true with respect to both preparing for, and responding to, both kinds of disasters, although there appears to be far more similarities in the preimpact phase, with the differences occurring primarily in the impact and postimpact stage. In this chapter we briefly discuss both aspects. We initially note some of the differences and similarities between the risks involved in chemical and in natural hazards. We then close the chapter with a comparison of differences in responses to chemical and nonchemical emergencies, focusing on response, since we view the major preparations pecessary as generally similar for all disasters.

#### Comparison of Risks and Necessary Preparations

There are differences between chemical and nonchemical disasters, including the risks they pose. However, these differences, which are agentspecific, do not mean that preparations for chemical disasters require different operational measures. In fact, a strong case can be made that all disasters share much in common, regardless of the disaster agent involved. Regarding preparedness planning, chemical disasters can be approached in generic rather than agent-specific terms.

If the risks in natural hazard and chemical hazards are compared, there are a number of dissimilarities. For example, most natural hazards are fairly well documented and understood for any given locality; the variety of hazards such as tornadoes, floods, and hurricanes, as well as their approximate frequency and probability, are roughly known. Many natural hazards are area-specific and a number are seasonal. In contrast, there is little predictive knowledge as to the variety and frequency of impact of chemical hazards for a given locality. Chemical threats, considering the heavy volume of transportation of such materials, are not very area-specific, nor are they seasonal.

Most natural hazards are "stable" in terms of impact. They are unlikely to escalate from a minor initial incident to a major one. The secondary threats associated with natural hazards are understood. In contrast, chemical hazards are relatively "unstable." Chemicals which are safe in isolation, or benign under most conditions, can become highly dangerous as a result of an accidental combination with others, or can become active threats as a result of synergistic effects with even a normally neutral substance such as water. Chemical hazards are capable of alteration and can become more complex in ways not always easily understood, even by specialists.

Many natural hazards allow for some degree of warning. Their effects are moderately well understood by emergency organizations and the general public, especially in localities subject to such dangerous agents. The protective measures which can be taken are generally known and understood. In contrast, most chemical hazards occur with little or no warning. Their effects are not well understood by emergency personnel and citizens, as we have tried to show. Some chemical hazards require very complicated neutralizing measures, and almost all necessitate some moderate degree of knowledge for adequate control.

Also, as indicated in previous chapters, organizatinal authority and jurisdiction for planning and responding to chemical hazards are often unclear and usually complex. As we have noted, there is a general lack of agreement as to which organizational entities should assume preparedness planning and response tasks. In constrast, other research has shown that for natural hazards, organizational responsibilities and jurisdiction for planning and response are relatively clear, although this does not say there is always consensus. The authority of certain emergency agencies to act in natural disasters is recognized by all community groups and the general public.

Thus, we recognize these differences in the risks and the preparations for chemical emergencies as compared with natural disaster agents. The differences are compounded by varied experiences. Longer community experience with particular disaster agents means these threats are better known and ways of responding to them better understood. It also means that appropriate social structures and traditional ways of responding to natural disasters have had a chance to evolve in many localities. In some localities, disaster subcultures for natural agents exist (Wenger, 1978). By comparison, dangerous chemical agents are relatively new and different from the standpoint of community preparedness. We are not aware of any chemical disaster subcultures. Indeed, as we have discussed earlier, awareness of chemical hazards is just now dawning in many communities.

These differences do not necessarily rule out the application of principles of natural disaster planning to problems of chemical hazards, however. In fact, a case can be made for the argument that hazardous chemical agents have a good deal in common with <u>some</u> natural disaster agents--features such as length of warning and scope of impact, for example. Flash floods frequently allow little or no warning and are relatively localized in impact, as are chemical explosions; one implication of this similarity is that insights from warning affected populations in flash flood prone areas might be applied to planning warning systems for communities vulnerable to chemical threats. From the standpoint of organizing a resonse, then, differences <u>among</u> natural disaster agents may be as great as differences <u>between</u> natural and chemical agents. It follows, then, that studies on natural disaster planning and response can be of value for persons concerned with chemical disaster preapredness.

Even more important, however, is the fact that, regardless of the characteristics of a particular disaster agent and the specific demands it generates, the same kinds of community response-related tasks are necessary in both kinds of disasters and for all disaster phases. In any community, for example, the assessment of hazards and the mobilization of disaster-relevant resources are necessary, regardless of the specific hazards and resources in question. Similarly, postimpact communication and decision-making procedures must be planned for and activated in any community crisis. To draw an analogy, land battles are fough with different weapons, material, personnel, and support systems than sea battles, but nevertheless, the general battle requirements are the same for both. In both cases, intelligence about enemy strength and movements must be gathered, resources must be collected, trained personnel must be led effectively, and so on. The same is true for disaster planning: although disaster agents and the human and material resources needed to respond to them may vary, the same generic kinds of activities must be performed in the pre-disaster, pre-impact, response, and recovery periods, regardless of the specific threat.

#### Comparison of Responses

When our study examined resonses to chemical disasters, what did we find in comparison with what has been found to occur in nonchemical disasters? Again there were both differences and similarities. The former stand out, but the latter are more important.

We found that, in general, local-level organized responses to chemical disasters are not as good as those to nonchemical disasters. Responses tend to be more delayed, uncertain, and erratic; take place with little knowledge and understanding about the situation; and are often fragmented and uncoordinated, especially in the early phases. In part, the responses are less favorable because, unlike most other types of disasters, the dangerous consequences of a chemical disaster often develop after an initially disruptive event, i.e., after a deviation from normal routine, such as a train derailment or a damaged cylinder in a plant. Unlike other disasters in which post initial impact hazards are likely to be secondary, post initial impact events, such as an explosion or the drift of a toxic cloud, may be the primary danger in a chemical disaster. In some cases, inappropriate treatment of a substance may turn an inert chemical into a dangerous hazard.

Our research observed that, generally, fewer local emergency-relevant organizations participate in chemical, as compared with nonchemical, disasters. This is partly due to the fact that the average chemical disaster is smaller in scope and impact than the average community natural disaster. For example, in many chemical incidents, the public utilities; the hospital-ambulancemedical system; the governmental, executive and political office-holders; and the full range of the mass media are not always involved as they normally are in even a moderate size nonchemical community disaster. The involvement of fewer local groups should result in a better and more coordinated response, everything else being equal. However, the nature of chemical threats and the participation of extra-community groups almost always neutralize the positive factors which might be realized through a smaller number of community organizations responding to the emergency.

The local fire department plays a central role in the great majority of chemical incidents outside plants, as we have already indicated. This is a rare position for this organization to hold in typical nonchemical disasters. Conversely, the local civil defense office, usually the key coordinating group in most natural disasters, is often peripheral, at best, in most hazardous chemical incidents unless they are of a catastrophic nature. The fire department's central position reflects the perception that it is the only, or the primary, organization which can reliably decide what should be done in an emergency, due to the technical nature of the chemical threat. This assumption is not always correct, but it generally prevails. Moreover, there is another problem. A lead organization, unfamiliar with and inexperienced in that role, will have difficulty effectively coordinating the overall response; fire departments typically fall into this category.

Our study found that there is a strong tendency to respond to all chemicals as though immediately and directly dangerous. As already discussed, often the presence of chemicals is not promptly detected, particularly in railroad or truck accidents. But once a chemical is identified, initial responders, especially in the public sector, and citizens in general, tend to perceive it as automatically hazardous and to think of the worst possible situation. Warnings of danger may precede the exact identification of the chemical substance as well as the specific hazards involved. This tends to lead to rapid but not well-planned evacuations and sometimes to retardation, if not cessation, of direct local organized efforts to stabilize the chemical hazards while outside experts are called for. This generally contrasts with a much more differentiated and discriminatory response to natural hazard agents and an initial tendency to discount their danger.

Organizational conflict seems to surface more in chemical than nonchemical disasters. We noted, that not infrequently, there are various types of disagreements among local organizations and between community and extracommunity groups. The differences appear in both the immediate short-run crisis period and the longer-run emergency response activities. Prior disaster preparedness planning seems to reduce the appearance of conflict somewhat. However, interorganizational conflict in acute chemical incidents seems to originate through the interaction of the private-public sectors, their varying experiences with hazardous chemicals, their differing responsibilities and mandates, and the diverse perceptions of crisis they admit to the situation. While clashes betwen organizations are not unknown in natural disaster situations, conflict during the peak of the disaster appears far more often in acute chemical emergencies.

However, there are similarities as well as differences between responses to chemical and nonchemical disaster situations. For example, as in natural disaster events, convergence generally occurs in hazardous chemical incidents independently of the initial response activities or the information diffused. Likewise, in both types of disasters, the delivery of emergency medical services for casualties is typically outside the initial awareness and control of the hospital-medical-ambulance system. There are enough similarities to support a long-held major research-based principle of disaster preparedness planning, namely that such planning should not be agent-specific. There should not be separate organizations and preparedness activities oriented to only one specific kind of disaster agent, chemical or otherwise (Quarantelli, 1981c). On the other hand, there are enough differences between chemical and nonchemical disasters to argue that the former requires some specific preparedness planning to supplement general disaster planning.

Actually, our research indicates that chemical and natural hazards should be considered together in preparedness planning because, for most purposes, they are similar. DRC studies have noted, and we likewise observed, that communities and organizations have a tendency to want to draft special, agent-specific disaster plans. Sometimes this is advocated, as in the case of nuclear threats, because new hazards have come to light which seem unique. This has also happened in the chemical area. Sometimes agent-specific disaster planning is promulgated because of the pressure from agent-specific agencies, governmental officials, or special-interest groups. The many chemical waste disposal companies which have recently appeared are tending to create a specific chemical agent orientation. Sometimes, public relations or public information campaigns promote an agent-specific tendency, and this has occurred in the hazardous chemical area.

However, special planning is, on the whole, not the best way to proceed, because it can result in confusion, excessive costs due to service duplications, and conflicts as a result of contradictions in tasks and jurisdictional boundaries. We found many communities reconcile the need for all-agent planning and the need for agent-specific directives by devising a general set of guidelines for all community organizations and then appending sections or "annexes" dealing with special coordination and resource problems produced by different disaster agents. Increasingly, state disaster plans and many community-level disaster plans set forth general principles to be followed and problems which will be encountered, and follow these with a separate section on issues specific to acute chemical emergencies.

With this chapter, we conclude the presentation of our general research findings on preparedness for, and response to, chemical emergencies. What do these findings indicate and suggest? In the next chapter, after summarizing the conclusions of the study, we first indicate the implications of our work, for the framework and model we used. We conclude with noting the application, theory, and research which might be relevant in future studies of chemical emergencies.

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#### CHAPTER XV

## CONCLUSIONS AND IMPLICATIONS

In this final chapter of the report we first present the general conclusions of our work and then draw out the implications of our study. A summary is given of our findings about community preparations for chemical emergencies, and what we found happens in responses to actual or possible chemical disasters. In the last part of the chapter we draw some general implications from our empirical results. In particular, we point out a selective number of the more important applied and theoretical implications of our study. Some indication is also given of where future research thrusts might be directed.

#### General Conclusions

Findings About Disaster Preparedness

#### 1. Threat Perceptions

There is a degree of perception that chemical agents, compared with other agents, have more potential as disaster agents. However, different communities, sectors, and organizations selectively vary in their perceptions of the chemical threats. In particular, there are noticeable differences between threat perceptions of public and private groups, with the latter seeing chemically based disasters less likely than the former.

#### 2. Availability and Mobilization of Resources

In principal, but not in fact, there are many potential resources available to prepare for chemical emergencies. Many direct resources are either unknown, unrecognized as such, or are the property of private groups, and even when available tend to be segregated inefficiently from other kinds of community disaster resources. Indirect resources are also undependably and unevenly available and show a lack of leadership and responsibility for their availability particularly prevailing in the public sector.

There is little collective mobilization of resources except in a minority of communities with local comprehensive mutual aid systems. Such systems have multiple chemical emergency functions and are particularly strong with respect to resource sharing and communication, although they are usually weak in risk assessment, in providing a role for the medical area, and in addressing the problem of evacuation. Extra-community resources are seldom part of any individual or collective mobilization of resources for chemical emergencies.

# 3. Patterns of Community Social Organization

There are a variety of social linkages for chemical disaster preparedness planning in most of the communities we studied. In particular, there tend to be links between local fire departments and the chemical companies in their areas. The general pattern, however, is one of weak vertical rather than horizontal linkages within communities. There is also an almost total absence of local extra-community linkages even though the collective resources of the latter sources are extensive in nature. More integrated linkages are slowly evolving but overall there is a pattern of weak community social organization for chemical emergencies.

#### 4. Social Climate

As a whole, the social climate in most American communities is not favorable to preparedness planning for chemical emergencies. While some of the existing norms, values, and beliefs provide incentives for planning, most do not. There is a tendency to believe that communities could respond to emergencies better than they probably could. This reinforces a disinclination to disturb local economic benefits from chemical plants or to argue against what is seen as a public unwillingness to spend governmental funds for most anything, including disaster preparedness planning.

#### 5. The Planning Process and Preparedness

There is only a low degree of preparedness planning for chemical emergencies in most American communities. In fact, such planning is frequently nonexistent among public emergency organizations, except for some fire departments. Preparations for chemical disasters are especially handicapped by the public-private sector split in American society and also because the most relevant resources are in the hands of extra-community groups rather than the local community organizations that almost always include the first responders to incidents involving hazardous chemicals.

Findings About Responses to Chemical Emergencies

#### 1. Effects of Preparedness Planning on Response

Preparedness is often incorrectly equated with formal disaster plans, an end product of the planning process, or as an extension of everyday operations; good preparedness instead is a knowledge-based realistic process stressing general principles aimed at reducing the unknowns in a problematical situation. As such it is all the activities, practices, documents, formal and informal agreements, and associated social arrangements which, over the long or short term, are intended to reduce the probability of disaster and/or the severity of the community disruption occasioned by its occurence.

Community disaster preparedness for chemical emergencies is generally poor if not nonexistent in most localities. However, the private sector is relatively well-prepared especially for in-plant accidents. Extra-community groups which do have resources for chemical emergencies are seldom incorporated into local planning. Nonetheless, to the extent there is preparedness planning of any kind, it tends to make for a better response to chemical emergencies.

## 2. Impact and Situational Contingencies

The way and the degree to which any community will respond to a particular chemical emergency is often greatly influenced by impact and situational contingencies. The impact contingencies resulting primarily from the property of the chemical agents themselves present different risk threats particularly in terms of the destructive or damaging potential of the chemical and the controllability of the chemical. Other contingencies are more situational in nature, resulting from spatial, temporal, or circumstantial factors such as the jurisdictional locale of the mishap, the social time in which it occurs, and if the speed of onset allows preventive measures. Both impact and situational contingencies introduce much variety and complexity in the organized response to chemical emergencies. However, they are not completely independent of perceptual and other social factors, and thus can be effected by preparedness planning.

#### 3. First Responders and Initial Definitions .

There are some important differences between responses in fixed site situations (mostly chemical plants) and in transportation accidents involving dangerous chemicals. In general, the response is better in the former situations, although there are problems if the threat spreads from the plant to the community. In transportation accidents involving chemicals the initial response is highly ad hoc. Much effort is spent on trying to define the chemical threat in the situation. This is not always easy to do correctly and often there is a delay in realizing that a transportation accident may have the potential for becoming a chemical disaster, depending partly on the definitions and behaviors in the situation by first responders.

#### 4. Convergence and Outflow Patterns

Much of what happens after the arrival of the first responders and their initial definition of the situation can be visualized as convergence and outflow patterns. There is a movement of organizations, things, and information outward from the disaster site, and a similar flow toward it. Both the outflow and the convergence patterns are marked by much uncertainty and unevenness of knowledge of the situation by selectively involved organizations. What flows out is even more erratic than what converges, and some behaviors tend to compound the difficulties in the situation and almost ensure lack of coordination. There are also special problems in chemical emergencies with respect to the role of the mass media, medical diagnoses and treatments of victims, and the neutralization of the dangerous chemical involved in the incident.

#### 5. Similarities and Differences Between Chemical and Nonchemical Disasters

Differences in chemical and nonchemical disasters exist especially in the risks they pose. This requires different preparations for chemical emergencies. However, many similar response tasks are necessary in both kinds of disasters and all disaster phases. Actual responses in chemical emergencies also differ somewhat from what occurs in natural disasters. Nonetheless, the similarities between both are more important than the differences. Therefore, a generic rather than agent-specific approach to preparedness and response seems warranted.

#### General Implications

We first indicate some applied implications. The effort is to state some general principles, possibly useful to policy makers and planners in the chemical hazards area rather than to operational personnel. We then present some of the theoretical implications of our work. Reference is made both to the theoretical framework and model which we used, as well as the more general disaster literature. Finally, we conclude with some suggestions for future research in the area. Rather than to simply indicate the need for more research, we attempt to indicate particular questions and studies which might have the greatest payoff in later work on the sociobehavioral aspects of chemical emergencies.

#### Applied Implications

It is evident that the general characteristics of community preparedness for and response to acute chemical emergencies reflect numerous weaknesses and problems. Despite the extensive resources that generally exist in the country and the ever-growing experiences in responding to chemical disasters, certain difficulties persist. While some of the sociobehavioral conditions associated with a chemically induced emergency event cannot be directly altered through the efforts of local officials, there are many social factors which can be altered or changed through disaster preparedness programs so that the community response can be improved.

There could be changes in specific planning or operation measures. Thus, there could be more realistic attempts to assess the true risks from chemical hazards in given localities. Far more efforts might be directed toward genuine collective mobilization of preparedness resources, especially the development of MAS. There could be attempts to improve the linkages between local emergency agencies and the chemical plants in the community. The social climate factors which can act as incentives for disaster preparedness planning could be sought out and emphasized.

Also, more attention might be given to the training and education of first responders so that they will know how to cope with the earliest stages of a threat where the response can determine if there will or will not be a chemical emergency. To improve response capability, likely first responders can be made knowledgeable about chemical risks on site and how to quickly mobilize relevant resources. Efforts can be made to develop better linkages between local emergency agencies and extra-community groups which can provide assistance at times of chemical threat and impact.

Other specific preparedness and operational measures could be mentioned, for example, better preplanning of evacuations, or better coordination of task responsibilities at the time of the emergency, or better understanding of necessary procedures for stabilizing and neutralizing chemical threats. Any and all such specific improvements would be helpful. However, more important in bringing about greater efficiency and effectiveness in preparing for and responding to chemical emergencies, would be changes or modifications in general perspectives or orientations. While there are many specific implications which could be drawn from our study (and some are discussed in the other publications about our research) there is a general point we wish to make in this report. Good preparedness planning and response for chemical emergencies must be locally based, use existing resources and groups, and be mobilized in an integrated fashion. We discuss each of these matters in what follows.

#### 1. The Need for Locally-Based Preparedness and Response

Nowadays, people appear to be opposed to the notion that local governmental units should be doing more for citizens than they already do. The passage of Proposition 13 in California in 1978, for example is widely believed to have ushered in a new general social climate of fiscal restraint, in which services once provided to local jurisdictions by means of community revenues will be furnished through other means. At the same time, it seems that people are beginning to look to the private sector or to volunteer organizations, rather than to government for some needed services; ambulance services and fire protection are prominant examples of this trend. Thus, in an era emphasizing reduced governmental involvement, it may look inappropriate to argue that local public organizations ought to be working more, both on their own and in concert with the private sector, to prevent and respond to emergencies involving hazardous materials. Operations of this type are widely regarded as requiring highly trained personnel and costly equipment. Why then should local organizations, which are not being provided additional funds to do so, become involved in performing emergency preparedness and response tasks?

Aside from the fact that, adequate community preparations need not be costly or involve establishing new units, local emergency organizations should be concerned with chemical emergency planning for several good reasons. First, although specialized extralocal groups such as chemical industry response teams, environmental clean-up companies, and federal spill response crews exist specifically to handle chemical mishaps and also engage in a variety of planning activities in relation to different hazards, the initial consequences of a hazardous chemical episode are invariably borne first by some local community. Thus, organizations charged with the responsibility of protecting life and property in a given city or county have a mandate to act in these kinds of events, and invariably do so somehow. They have no choice to do otherwise. Government officials, as well as the general citizenry of the community, expect that local emergency agencies will plan for and respond to the entire spectrum of acute hazards the community faces. The fact that some organizations from other places may make their services available to a local community in certain situations at particular times does not relieve community emergency planners and responders of their ongoing responsibilities. Moreover, although certain tasks relating to chemical agents themselves -- tasks such as suppression, neutralization, and disposal -can perhaps best be handled in most communities by trained specialists, other tasks--evacuation, for example--almost always will have to be planned and carried out by knowledgeable local emergency personnel.

Second, local planning is important because, as we have indicated, the initial response in the first few minutes of a chemical incident can be critical to the way the incident later develops. Chemical hazards differ

markedly from most natural hazards in this regard. Generally speaking, the manner in which citizens and emergency personnel in a community respond to a tornado, earthquake, or hurricane will do virtually nothing to change the unfolding course of these agents; such agents are stable in terms of the threat they pose to life and property. Many chemical agents, on the other hand, are relatively unstable: substances treated improperly with water can burst into flame, producing a fire hazard, or they can give off toxic or lethal fumes; two hazardous agents released at the same time can combine to create a third dangerous substance unless the proper steps are taken; and some agents present very different hazards to human beings on the one hand, and the ecological environment, on the other. Thus, local personnel who have not planned and received training on how to respond properly to chemica agents--and who fail to respond appropriately in urgent situations--are capable of unknowingly increasing the threat to life and property such substances pose. This does happen as some of our own case studies illustrate (see Gray, 1981b). Therefore, some type of chemical hazard planning and training for local personnel is imperative, no matter how elementary this training may be. Pearson notes that, for financial and other reasons, loca. volunteer fire departments may lack sophisticated and specialized equipment for responding to emergencies involving exotic hazardous materials: neverthe less, he argues that these departments could become "the ultimate in Response Capability," with a little forethought and training in on-the-spot hazard assessment and decision-making:

It is impossible to equip every volunteer fire department with the specialized equipment to handle all types of hazardous materials incidents. It is possible to make the training available to allow the chief officers of fire companies to make decisions as to which incidents they can handle with the equipment available and for which incidents they must evacuate an area and establish a safe perimeter (Pearson, 1978: 448).

Finally, the local community is the logical and appropriate setting for carrying out chemical disaster preparedness activities because the local community is precisely the place where planning can make a difference. Emergency preparedness measures, in addition to facilitating a good response can actually reduce the likelihood that a chemical incident will occur. A systematic assessment of traffic patterns and of the volumes and types of hazardous materials that are transported through a community, for example can lead to the establishment of special hazardous materials routes and to a subsequent reduction of accident potential.

Local emergency personnel are in the best position to know about the potential dangers present in their own community. They have access to detailed and specific information on the vulnerability of their locality and the availability of emergency relevant resources, and are, thus, in a position to reduce both the probability and the potential severity of incidents involving hazardous chemicals. In sum, many of the most effective safety measures--including activities such as risk assessment, training, and public education--are most appropriately carried out in the local community.

# 2. Use of Existing Resources and Groups

Our study suggests that the most cost-effective way for local communities to plan for hazardous materials is to integrate tasks relevant to chemical hazards within the activities of already established and responsible organizations. While the threats posed by chemical agents may necessitate specialized resources, this does not mean the community should adopt the unnecessarily duplicative strategy of setting up new organizational response structures and plans for each agent. Instead, it should be assumed that traditional community emergency groups--the police and fire departments, the civil defense office, and hospitals, for example--will be working along with chemical producers, transporters, and others possessing special expertise in the chemical area to make chemical emergencies an aspect of general communit preparedness and response, rather than a specialized and separate planning and response area.

Faced with the challenge of organizing on a community-wide basis to respond with existing resources to all disasters, many local and industry officials may ask, "How can we do this and will it not be costly?" Our work and the research of others indicates no new elaborate organizational structures involving a high price tag, need to be developed. Several observation: can illustrate how good disaster preparedness need not create new entities of an expensive nature.

Many local and even relevant outside groups are almost certainly already performing activities that can contribute to community preparedness and response. It only remains for citizens and officials in a given locality to recognize and take advantage of opportunities to upgrade disaster planning by working with these groups. For example, hospitals must conduct disaster drills twice yearly. It would be very instructive, and not very expensive, for a number of other community organizations--fire departments, chemical companies. local civil defense offices, and others -- to participate in hospital drills when they occur, on a community-wide or a regional basis. In a slightly different example, industry or community safety personnel who have received specialized training in the recognition of hazards associated with particular chemical substances, for example, could in turn pass this training on to members of other organizations or to the general public, thus reaching more people and getting considerably more education for the same outlay of funds. Finally, many programs exist of which communities can take advantage for relatively little money, e.g., government programs and various seminars on hazardous materials such as those sponsored by the National Fire Protecti Association. Communities can obtain more for their preparedness dollars and not add new bureaucratic structures by combining resources; co-ordinating their drills so as to actually test networks or organizations, rather than single organization units; and diffusing existing knowledge to a wider audience.

In any community, some resources usually exist which are overlooked. Officials frequently are unaware of expertise, equipment, and facilities which, if known, would upgrade community readiness. When vigorous efforts are made to identify and link latent local resources, it may be discovered that it is not necessary to bring new ones into the community.

#### 3. Mobilization in an Integrated Fashion

Locally based preparedness and response for chemical emergencies using existing resources and groups is not enough. As indicated earlier, collective mobilization is necessary. An integrated planning and response effort is crucial, but our study showed it seldom found in reality.

Most formal planning for chemical emergencies takes place within those few organizations which contain the personnel resources and know-how for handling them--chemical companies and fire department. These organizations possess a great deal of valuable knowledge and resources, but our research suggests these things remain at the organizational level, or at best, within organizational sectors, rather than being accessible to the larger community disaster preparedness subsystem. For example, chemical industry mutual aid sesociations exist in several of the communities we studied. As we noted, some of these planning bodies are quite elaborate and rich in resources. However, they tend to plan on their own for chemical emergencies <u>only</u>, rather than coordinating with other community disaster-relevant organizations.

This high degree of specialization has several ramifications for overall community disaster preparedness and response. First, while various specialized organizations know a great deal about the particular tasks on which they focus neutralization of chemical agents for example--there appears to b a lack of mutual understanding between these groups and other community emer gency organizations about how other important tasks such as evacuation or overall coordination of a response will be handled and who will carry them out. In the initial phase of the DRC research, it was felt this lack of general consensus would make working together in major acute chemical disasters very difficult. This was the case when actual responses were studied.

Second, due to the jurisdictionally complex and compartmentalized nature of chemical emergency preparedness, gaps occur in planning. For example, we found communities with chemical facilities may contain organizations with th knowledge, expertise, and resources to handle emergencies at local chemical production facilities, while no agency considers transportation emergencies as within its jurisdiction. Or, in a different example, certain disasterrelated tasks, such as emergency medical care for victims, may not be considered in chemical emergency plans. These kinds of gaps are unlikely to co to light during non-emergency times in communities where personnel in diffe community sectors do not communicate regularly. A disaster drill involving the simulation of a major chemical emergency would make such gaps evident; however, these are seldom conducted on a community-wide basis. As is the ca with the development of formal plans, drills typically occur within organize tions and sectors, not across sectors. Also, as noted, the entry of particu lar organizations or clusters of organizations into the chemical disaster preparedness area seems to result in inactivity in other emergency-relevant groups, again due to lack of salience of the problem of chemical threats and to other disincentives.

In conclusion, to encourage a more comprehensive and integrated approach to hazardous materials threats is not to say specialists in chemical emerger preparedness are not needed. On the contrary, they are essential to an effective response to a chemical emergency. However, it is also the case that good preparedness involves sharing information and resources so that all potentially involved organizations cannot only anticipate the threat frothe agent, but also anticipate one anothers' actions in a disaster so as to avoid conflict, duplication of effort, and gaps in the response.

Launching an effective preparedness program in the chemical hazards area does not require vast expenditures for resources in most communities. The problem is not a shortage of funds, expertise, or other resources. Rather, what is needed are more extensive efforts to increase awareness of the need for chemical disaster planning, promote the exchange of information among al disaster relevant community groups, and integrate preparedness for chemical emergencies as much as possible with more general community disaster prepare ness. Community risk assessments, community preparedness meetings, training sessions, and community-wide drills are all means to these ends. Beyond these kinds of collective activities are broader efforts that need to be made beyond the community level to reduce disincentives and increase incentives to engage in preparedness--that is, to alter the social climate and establish social linkages in a positive direction--promoting preparedness ar eventually better responses to chemical emergencies.

The demand for better disaster planning is sometimes difficult to fulfil because there are costs involved. Personnel in emergency organizations are sometimes reluctant to discuss changes in community preparedness because further planning takes energy, time, and sometimes money. Moreover, the tak of disaster planning must compete with other items on the public agenda -- son of which deal with problems the public perceives as more urgent and pervasiv Yet it is important to note that disaster planning can result in real benefi for concerned communities: more positive interorganizational relationships. more efficient use of existing resources, better public relations for govern ment, and lower corporate insurance rates are some examples of those benefit Even more important is the fact that, unlike the instance of some natural disasters such as tornadoes and hurricanes, planning for chemical hazards, : engaged in vigourously, can actually be preventive. All these benefits are possible "selling points" for emergency organization and corporate personne who seek justification for beginning or upgrading community preparedness for natural disasters.

Before dismissing disaster preparedness as too costly, it also might be a good idea for public and industry officials to ponder for a moment the potential monetary and non-monetary costs of not planning. A chemical facility stands to lose a great deal if a fire or container rupture is hand badly. A large proportion of those killed and injured in hazardous materia incidents are members of local emergency response organizations. If better disaster planning could help reduce response-related casualties, does this not justify the outlay of time, money, and effort? In assessing the monetaand non-monetary costs associated with upgrading disaster preparedness, it a good idea to look at the possible consequences of maintaining the status The idea that disaster preparedness pays for itself in the long run becomes even more plausible once two points are recognized: that "an ounce of prev tion" now may possibly avert a catastrophe in the future; and that individu and organizations which are better prepared to deal with major emergencies may also perform better during minor emergencies and everyday operations.

Planning today could save life and property tomorrow and can also pay off in subtle ways during times of normal operations.

#### Theoretical Implications

Our study showed the overall validity of the guiding theoretical framework we used and generally confirmed major themes in the already existing disaster literature. However, the model we used could be refined and improved. Similarly, some of what we specifically found in the chemical emergency area, ought to be used in a qualifying way in the more general literature.

The model and framework we used, as stated in Chapter III, was never intended to be more than a guide for data gathering and analyses. As a guide it generally worked well. No important factor derived from DRC experience and the sociological literature seems to have been overlooked. Both specific points and general perspectives were well captured.

For example, the data we obtained lends support to previous DRC experience that risk is not a sufficient condition for group formation. Likewise, demands do not inevitably lead to enhanced capability, nor do even serious threats lead to group solidarity and cooperation. Structural arrangements in communities such as those we studied are the result of combinations of sociocultural and social organizational conditions. Our guiding framework allowed us to identify the possible array of social climate and social relationships or linkages which seem to inhibit interorganizational planning efforts.

Our study also showed that a general sociological perspective can fruitfully be applied in an area where both problems and solutions tend to be conceptualized in purely technological terms. Mitigating chemical hazards and responding to chemical disasters are usually viewed as possible through improved technical capability, e.g., more durable containers for chemicals and more training for hazardous materials handlers. In contrast, this study suggests that hazardous chemicals in our midst constitute a social problem. It follows that, as the advent of these kinds of threats can be explained in terms of social factors, the manner in which communities adapt to them is affected by social conditions. Seen in this light, community preparedness for chemical disasters necessitates social change, not mere technological upgrading—a point to which we shall shortly return.

Thus, while the guiding framework we used proved fruitful, some improvements, nonetheless, are possible. First, there could be a better tie between the preparedness model and the response model. The first, as we used it, tends to be set forth in somewhat static terms, whereas the latter is explicitly processual in nature. In general, a move towards a more processual approach for preparedness phenomena would seem to be in order.

Second, and related to the first point, the same general explanatory principles ought to be advanced for both preparedness planning and responses in chemical emergencies. While our guiding framework was specifically explicit as to the conditions involved in responding to chemical disasters, we only implicitly and generally suggested what might be influential in effecting preparedness planning. While what we advanced was not contradicting in any way, nonetheless, it was not that consistent. Third, while a feedback process was pointed to in our framework, the process was never directly incorporated in the data gathering and analyses. Part of this failure was a function of the limited time our research spanned. It is difficult to directly trace a process at the community level which probably takes years from start to finish. However, the process could probably be analyzed in historical case studies.

Our study was generally confirmatory of the way disaster researchers and theorists have been approaching disaster phenomena. For example, we found that in the chemical area, as in other disaster areas, pre-existing community cleavages will handicap attempts to improve preparedness planning or interfere with post-recovery efforts (see Quarantelli and Dynes, 1976). The public-private sector division does this with respect to possible planning for chemical emergencies, or attempts to respond or recover from such crisis situations. Similarly, we observed in our work that whatever the state of community preparedness it was seldom directly manifested in actual emergencies. Yet we noted, as has been demonstrated by research in other areas (Dynes, Quarantelli, and Kreps, 1981), that any kind of planning will have some beneficial effect on reactions in the emergency time period of the actual or potential disaster. Likewise, it was our observation paralleling other studies (Quarantelli, 1977), that post-impact interorganizational coordinations tend to be a major problem in the organized response to a disaster situation. So in many ways, what our research found about sociobehavioral aspects of chemical emergencies was quite similar to what had been previously observed about the features of other kinds of mass emergenices. As we mentioned in an earlier chapter, similarities among all disaster types is far more common than differences associated with various kinds of specific disaster agents.

Nonetheless, there are a few distinctive features of chemical emergencies which we noted in our work, which would not have as easily been deduced from the existing theoretical and research literature (such as in Burton, 1970; Dynes, 1975; Mileti, Drabek, and Haas, 1975). Three aspects in particular stand out.

One has to do with the major, if not the predominant role of the private sector in almost all chemical emergencies. Whether it is in the pre-impact or planning phase, the emergency time period, or the recovery stage, in all and in each, private companies and firms are crucial in what occurs. This is true not only if the chemical problem stems from an in-plant emergency but also from an in-transit or transportation accidnet. In contrast, in many other kinds of non-chemical disasters, organizations in the private sector are either only a minor part or not at all involved in the total disaster situation (especially if one treats certain quasi- or semi-public types of organizations such as hospitals or the Red Cross and the Salvation Army as non-private kinds of groups distinctly different from a chemical company, a railroad or trucking firm, or a pollution clean-up organization). On the basis of our study on chemical emergencies, overall theories and models of disaster behavior ought to allow more of a role for the private sector than has been accorded to it so far. Several reviews of the disaster literature all but ignore the role of the private sector (see, for example, Mileti, Drabek, and Haas, 1975).

A second distinctive feature of chemical emergencies we described involve complex and unstable agents compared with almost all natural disaster agents. The disaster literature generally assumes a specific and direct impact agent. Thus, a hurricane, a flood, an earthquake, or a tornado are assumed to have a known and direct kind of effect if they impact, In contrast, as we have noted, chemical agents even of the same kind, may have differential consequences depending on a variety of impact and situational contingencies. In fact, there may be, for example, a truck or railroad accident with no chemical disaster if the involved chemicals do not catch fire, combine synergistically with others, or are dealt with inappropriately. This makes the chemical agent in a potential or actual chemical disaster a more complex and problematical agent than is the typical natural disaster agent type. A less complex and less problematical disaster agent is usually assumed in the theoretical models and frameworks in the general disaster literature. Our work on chemical emergencies suggests the need for a broader view of the nature of disaster agents. The more problematical features of a chemical agent are not, for example, implied in those writings which attempt to specify different dimensions of disaster agents (see, for example, Dynes, 1975).

Finally, the existing disaster theories and literature do not capture well the technological bias with which chemical emergencies tend to be approached by most of those involved with disaster policy, planning, preparedness, and/or recovery aspects of chemical emergencies. As we have already noted earlier in this section, chemical disasters tend to be viewed as a "thing" rather than a "people" problem, just as were actual or potential nuclear disasters, at least until the Three Mile Island episode. Much thinking in the chemical area focuses on looking for technological safeguards, mechanical emergency responses, technical solutions to recovery questions, and so on. The pervasiveness of this point of view is difficult to overstate. It effects everything that is done at any point in the life cycle of chemical disasters, from seeing possible problems in pre-impact periods to learning valuable lessons in post-recovery periods. While there is a tendency also to seek technological solutions in other kinds of disasters, it pales in significance compared to what we found in the chemical emergency area. Disaster theories and literature, therefore, tend to underplay the technological bias which our work indicates is operative in the chemical area. Despite the fact that some movement away from such a bias is starting to occur in the chemical area itself, greater recognition of how a technological bias effects everything would be appropriate in the more general theoretical disaster literature.

#### Research Implications

While it is a truism to indicate further research is needed after the conclusion of a study, the suggestion is probably more valid with respect to the problem of chemical emergencies than for many other areas. As we stated very early in this report, our study was the first systematic one attempted on the sociobehavioral aspects of chemical disasters. As such, it could have hardly explored all questions or produced totally satisfactory answers. Consequently, there are very many specific research topics which could be addressed in future research. However, instead of suggesting specific research topics, we would prefer to conclude with metionining three general research thrusts which we believe would have considerable payoff.

First, we think the following might be examined. There are certain distinctive patterns noticeable in the local planning for natural disasters. However, no one pattern seems to predominate in planning at the community level for disasters resulting from chemical agents. There is considerable variation nationwide as to who is identified as primarily responsible for planning at the local level, and what resources are necessary. We think it would be worthwhile to ascertain the conditions associated with such variations. Why is there so much variation?

Second, our findings suggest that while disaster events involving chemical agents always necessitate a response by local community organizations when they occur, impetus and direction for preparedness often must be furnished by extra-community sources, such as chemical producers and transporters. At present, although there are strong incentives for private sector involvement, corporate participation in local planning is more the exception than the rule. What ought to be examined is this disjunction between national level chemical company interests and local group needs. Other than what prevails at the present, what can bring the public and private sectors closer together in dealing with chemical emergencies?

Last, but not least, we have noted that there are a number of distinctive and special problems associated with chemical disasters resulting from transportation accidents. In fact, all the difficulties involved in preparing for and responding to chemical emergencies generally seem magnified particularly in transportation mishaps. It would, therefore, seem worthwhile to study even more intensively than we did, chemical emergencies resulting from rail, truck, barge, and plane accidents. The focus, however, should not be on the transportation aspects themselves, but on trying to ascertain why the problems are magnified in these kinds of incidents. Why are chemically related transportation accidents so difficult to plan for and to respond to in any efficient and effective way?

#### APPENDIX A

List of Already Written, Drafted, or Planned Publications from the Study

#### Published

- 1. Special Issue on Chemical Disaster Preparedness in DRC <u>Unscheduled</u> Events 12 (1978).
- 2. Special Issue on Organized Responses to Chemical Emergencies in DRC Unscheduled Events 13 (1979).
- 3. Quarantelli, Lawrence, Tierney, and Johnson, "Initial findings from a study of sociobehavioral preparations and planning for acute chemical hazard disasters" Journal of Hazardous Materials 3 (1979): 79-90.
- 4. Gabor and Griffith, "The assessment of community vulnerability to acute hazardous materials incidents" <u>Journal of Hazardous Materials</u> 4 (1980): 323-333.
- 5. Quarantelli and Tierney, "Social climate and preparations for sudden chemical disasters" Sociological Research Symposium 9 (1979): 457-460.
- 6. Tierney. <u>A Primer for Preparedness for Acute Chemical Emergencies</u> (Columbus, Ohio: DRC, 1980).
- Special issue Journal of Hazardous Materials 4 (1981): 309-394 (ed. Gray and Quarantelli), Items 7-12.
- 7. Gray and Quarantelli, "An editorial introduction to the issue" 309-312.
- 8. Helms "Threat perceptions in acute chemical disasters" 321-330.
- 9. Tierney "Community and organizational awareness of preparedness for acute chemical emergencies" 331-342.
- 10. Gabor "Mutual aid systems in the United States for chemical emergencies" 343-356.
- 11. Gray "Characteristic patterns of and variations in community response to acute chemical emregencies" 357-366.
- Wilson "A selected annotated bibliography and guide to sources of information on planning for and responses to chemical emergencies" 373-394.
- 13. Quarantelli and Tierney "A model for studying community preparedness for acute chemical disasters" in Graf-Baumann & Metreveli (eds.) <u>Unfall-</u> <u>und Katastrophenforschung</u> (Erlangen, West Germany: Fachbuch, 1981) <u>336-353.</u>
- 14. Quarantelli, <u>Disaster Preparedness for Acute Hazardous Materials Incidents:</u> Case Studies on Three U.S. Communities. (Columbus, Ohio: DRC, 1981).
- 15. Gray, Three Case Studies of Organized Response to Chemical Disasters. (Columbus, Ohio: DRC, 1981).

#### In Draft Form

- 1. Baer, <u>Fire Department in Hazadous Chemical Incidents: An Outside</u> Perspective
- 2. Gray, Manual on responding to acute chemical emergencies
- 3. Helms, A longitudinal study of the Waverly and Youngstown chemical incidents
- 4. Gabor and Pelanda, Assessing local difference in chemical disaster proneness: the community chemical hazard vulnerability inventory
- 5. Gabor, Legal aspects of acute chemical emergencies
- 6. Helms and Gray, A matrix of response patterns in acute chemical emergencies
- 7. State disaster plans and their focus on chemical emergencies

8. The success and failure of one state plan for hazardous chemicals

# Planned

A monograph on the theoretical model used.
 A book summarizing the project work based on this final report.

## APPENDIX B

Copies of Major Field Instruments Used in the Work

- 1. Disaster Probability Rating
- 2. Interview Guide for Specific Emergency Relevant Organizations
- 3. Disaster Planning Interview Guide for Chemical Plants
- 4. Community Checklist
- 5. Guide B for Organizational Informants
- 6. Guide C for Organizational Respondents

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### Community Planning Study Disaster Probability Rating

Name of Organization:

Position in Organization:

Directions: Please write your organization's name and your position in the appropriate spaces above. As soon as you have some free time, fill out this page by <u>circling</u> the number which corresponds to the probability that the disasters listed will occur in your community in the next <u>ten years</u>. Please rate the events listed in terms of the following 6 point scale.

0- Not applicable to my community
1- Not probable
2- Low probability
3- Moderate probability
4- High probability
5- Nearly certain

How do you rate the probability of the following? (circle one)

AVALANCHE.       0         BL IZZARD OR MASSIVE SNOWSTORM.       0         CHEMICAL CONTAMINATION OR SPILL.       0         DAM BREAK.       0         DROUGHT.       0	1 1 1 1	2 2 2 2 2 2	33333	44444	5 5 5 5 5
EARTHQUAKE	1 1 1 1	2 2 2 2 2	3 3 3 3 3	4 4 4 4 4	5 5 5 5 5
FREEZING ICE STORM.       0.         HURRICANE.       0         MAJOR FROST AND FREEZE.       0         MAJOR GAS MAIN BREAK.       0         MAJOR HAIL STORM.       0         MAJOR INDUSTRIAL EXPLOSION-CHEMICAL PLANT.       0         MAJOR INDUSTRIAL EXPLOSION-OTHER.       0         MAJOR WATER MAIN BREAK.       0         LARGE AUTOMOBILE WRECK OR PILE-UP.       0         MAINE DISASTER.       0	$1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	444444444	5555555555555
MUD OR LANDSLIDE	1 1 1 1	2 2 2 2	3 3 3 3	4 4 4 4	5 5 5 5
RIVER FLOOD	1 1 1 1	2 2 2 2 2 2 2 2	33333	4 4 4 4 4 4	5 5 5 5 5 5 5
TORNADO.	1 1 1 1	2 2 2 2 2	3 3 3 3	4 4 4 4 4	5 5 5 5 5