THE SOCIAL ORGANIZATION OF SEARCH AND RESCUE: EVIDENCE FROM THE GUADALAJARA GAS EXPLOSION

During close to forty years disaster researchers (Fritz and Marks, 1954; Form and Nosow, 1958; Fritz, 1961; Barton, 1969; Drabek et al., 1981; Durkin, 1989; Kringold, 1988, 1989; Wenger, 1987) have endeavored to understand what accounts for the relative success of search and rescue (SAR) activities in disasters, to include factors such as the nature of structural and nonstructural damage to the built environment (Culver et al., 1975; Hart, 1976; Anagnostopoulos and Whitman, 1977; Hasselman et al., 1980; Tiedemann, 1989; Stubbs et al., 1989; Lechat, 1989), the epidemiology of SAR events (Lechat, 1976; Glass et al., 1977; 1979; Lechat et al., 1985), and the effectiveness of medical services (Quarantelli, 1983). This research adds social organization to the growing list of explanatory themes in research on SAR.

Wenger (1990, and literature cited therein) has summarized the consensus among SAR specialists to the effect that volunteer and emergent group response is massive and that the initial activity is accomplished by volunteers and emergent groups. There is also agreement among specialists that the SAR behavior of these volunteers is of crucial importance because the chances of live rescue decrease rapidly after the initial "golden" hour. Buried and entrapped victims are likely to suffer from injuries that require life-sustaining intervention including compromised access to air, severe loss of blood and body fluid, crushing injury, and internal damage to essential organ systems. Professional SAR teams, despite the massive attention they usually receive from the mass media (Quarantelli, 1991), most often arrive too late to rescue alive significant proportions of victims. This is due in large part to the particular nature of the socio-geography of disasters in which professional SAR teams are especially hampered by problems of access, victim identification, inadequate resources, the breakdown of normal operational parameters, and the magnitude of the events. Finally, there is consensus that oftentime the integration and coordination of volunteers and SAR professionals is difficult, due in part to disagreement over rescue strategy, ambiguous authority relationships, and conflicts among independent agencies.

True to these general patterns, the search and rescue activities we studied in the neighborhood of Analco, Guadalajara, Mexico impacted by the gasoline explosion of 22 April 1992,

were dominated by the collective behavior of the neighbors of Analco. Most of the people that were rescued alive in the aftermath of the tragédy were rescued by these volunteers during the first phase of the postimpact emergency period (Form and Nosow, 1958). In trying to find out how they did it, we were impressed by the importance of selected social organizational features of the search and rescue activities that occurred, and by the linkage we found between institutionalized and emergent types of social organizations. This paper identifies and documents how they rescued people. Information about the morbidity associated with the explosion, approximately 300 dead and 1120 injured people, will be presented in a forthcoming report.

It is not possible to understand search and rescue activities in Guadalajara in the aftermath of the explosion without considering the community's culture and social relations. The search and rescue processes we document occur in a context of human solidarity, what can be called a "sociedad solidaria," in which, because of the culture and social history of the community, there is a much greater probability than in similar-sized cities in North American and Western European countries for people to know and to relate to others as full persons, and in which social relations assume greater immediacy and intimacy. The social formations of the peer group, the extended family, the neighborhood, and the Catholic Church constitute viable and active social networks in the lives of the people we studied; in what follows we show how the social identities derived from them impacted search and rescue activities. The importance of these identities is magnified by the absence of official disaster programs and plans, for as Quarantelli (1993) has argued, in comparison to the U.S. and Western European countries, Mexico has fewer disaster preparedness and responding organizations. The dearth of this type of organization is acute at the local level. In this research we will endeavor to show how the human solidarity dominating social relations in the city, and the self-reliance of its people, impacted the search and rescue activities that took place in the aftermath of the explosion.

METHODS

The information was gathered during six days of field work and intensive interviewing in Guadalajara by four members of the Hazard Reduction and Recovery Center of Texas A&M University

during the third week of October, 1992. This paper considers the direct search and rescue activities that occurred in the affected city blocks during the first four hours after impact. Building upon the work of Drabek et al. (1981) and others, Olson and Olson (1987) have documented that most lives are saved and victims rescued during this immediate post-impact period. Thus, it is this phase in SAR that we are most interested in this paper. There are clear indications that the organization of SAR activities changed as the day progressed and the agencies responsible for crisis intervention established control over the SAR process. As it is typical in community disasters, a control and command center in charge of the societal response was formed in the evening of the day of the explosion.

We met with forty three victims that had been buried alive by the explosion throughout the impacted area, and with twenty two volunteers who had participated in the direct rescue phase. They reported on their own experience during SAR and the experience of victims and rescuers near them. Separate interviews were also conducted with six neighbors who had participated in search and rescue activities immediately after the explosion and had subsequently formed themselves, in conjunction with some of their neighbors, into a search and rescue voluntary association. In addition, we also interviewed 5 Red Cross paramedics who had participated in the search and rescue activities.

The respondents were selected nonrandomly (Goodman, 1961) to maximize finding relevant respondents during fieldwork. Three of the paramedics were contacted through a friend of one of the authors who resides in the city. The majority of the respondents were identified from conversations with personnel at the headquarters of the governmental agency in charge of reconstructing Analco, and through conversations with personnel from other community agencies. They helped us find the respondents and establish a legitimate identity as disaster researchers.

The examples presented in this paper are based on the experiences of our respondents as they recounted them to us. Some of the professional statuses of the respondents that are part of the examples used in the text have been changed to protect their identity. As sociologists we tried to describe the patterns of what, in our professional views, were the important social relations and cultural meanings during SAR (e.g., Drabek et al., 1981). Our description of these patterns,

however, is by necessity tentative and in need of replication; the patterns reflect the occurrence of fleeting instances of social organization that we have constructed indirectly, from the remembered experiences shared with us by the respondents. Information may have been inadvertently omitted by the respondents, for the field work took place almost six months after the explosion. These problems qualify the generalizability of the results of this study and reemphasize the need for replicating them.

While the advantages of quick response for the study of disasters are well known, we feel that for many of the processes of interest to this research, the delay helped, rather than hindered, the acquisition of needed information. Agencies had collected and published information on the characteristics and effects of the explosion. People involved in SAR had regained their emotional composure. The explosion was a very important event in people's lives, and our respondents had no apparent difficulty in recollecting details of the events which interested us. We had excellent rapport with them. They seemed to welcome the opportunity to talk about their experiences with us. Some of our questions forced the respondents to remember the trauma of the explosion, and during the course of intensive interviews which often lasted for more than two hours we observed mild cathartic reactions in many of our respondents. One respondent was overcome with emotion and could not continue the interview.

Our data acquisition effort also benefitted from the process of institutionalization that followed the explosion. For example, as stated previously, we were able to interview neighborhood members of SAR units that had subsequently formed into voluntary associations, and victims of the explosion that had created their own association. Neither of these voluntary associations existed in the immediate aftermath of the explosion.

Our success in obtaining information was also based on the decision not to ask questions about three controversial topics that at the time were part of ongoing criminal court cases: the person or persons responsible for the explosion, the failure to evacuate Analco (see below), and the use of heavy machinery in the areas where SAR activities were being conducted, which is widely perceived as inappropriate. The use of heavy machinery in SAR was of direct relevance to our study.

Nevertheless, we decided not to try to find out where, how, and why they were used, for fear that the questioning would impact our ability to conduct the research.

Reminiscent of what occurred in Mexico City in the aftermath of the 1985 earthquake (Applied Technology Council, 1988, pp. 13-16), considerable controversy existed in Guadalajara concerning the use of heavy earth removing equipment at the site of the explosion. Although unsolicited by us, during field work victims, rescuers, taxi drivers, and others in the community reported that the equipment was moved into the impacted zone very quickly, in places two hours after impact, and that human remains were dug out of the rubble by these machines as they excavated. We know of one instance in which the neighbors of a block, led by the bereaved father of a boy then missing, successfully blocked the use of heavy machinery in it. The prevailing feeling is that in many of these instances the machines actually killed people who were buried alive. The generalized belief accounting for their use is that it was done by public officials in an effort to cover up the extent of the explosion.

It should be pointed out, however, that Guadalajara is in the midst of a very important public works project, the building of a city-wide public electric train transportation system. Heavy machinery is used in it for the excavation and removal of earth. This public works project is very close to Analco. Reportedly, the labor force working on this massive project was ordered into the impacted area by the engineers in charge of the project for the purpose of helping the neighbors. It is probable that they took their heavy equipment with them. We know of one instance in which some of this heavy equipment arrived at one of the impacted city blocks 10 minutes after the explosion occurred, responding to a call for assistance by one of the formal organizations then deploying into the impacted area. It is very probable that the early use of heavy machines at the site of the search and rescue occurred as part of the well-intended efforts of an organization to help save lives.

THE SEARCH AND RESCUE

Based upon a schema first developed by Wallace (1956: 3) the analysis of the search and rescue activities that occurred after the gasoline explosion can be conceptualized as occurring in

three distinct socio-geographical areas of the city. First, the area of direct impact is defined by more than nine kilometers of city blocks in Analco, a neighborhood of Guadalajara (see Figure 1). Second, the filter area included the fringe of the impact area and was created to control the movement of people into and out of the impact zone. The boundaries of this filter area were manned by both informal and formal social control groups, such as the army, police, fire department, and neighbors. Third, there was the remainder of the city of Guadalajara, which was unharmed by the explosion, but served as a reservoir of volunteer action to support the people involved in the direct rescue efforts. Together, the activities in these three areas composed the search and rescue activities that occurred in the aftermath of the explosion. Analytically, these activities are part of Barton's (1969) "mass assault" stage.

We will now discuss the patterns of SAR activities in these three areas. We shall consider first the broader community and then subsequently focus upon the filter and impact zones.

Emergent Collective Response in the Broader Community. Multiple activities were undertaken by supporting volunteers throughout the broader community. Direct SAR activities within the impact area generated the need for services, tools, food and other commodities. Two systems emerged to resolve these needs. First, a communication system was created that involved the functional transformation of privately owned radio stations in Guadalajara into search and rescue communication systems serving the public. Second, volunteers established and operated a nascent transportation system that provided needed commodities donated by the public.

Numerous students of mass media response during the emergency period of disasters have noted that mass media are often transformed into personal media (Warman, 1973; Scanlon et al., 1985; Wenger, 1985; Wenger and Quarantelli, 1989). In effect, they alter their normal functioning and serve to transmit personal messages, relay personal information, and request information from specific individuals and groups. As such, they take on a new, emergent role in the emergency response system. This pattern was observed in Guadalajara. There are two major radio station corporations in the city. We obtained information from one of them. Immediately after the explosion they ceased normal operations, and for two days helped structure the societal response to

the explosion. The corporation owns five radio stations throughout the city. In what is a rather unusual pattern of response for U.S. corporations of its type (Quarantelli, personal communication), they reformed the stations into a network that functioned during the first two days of the emergency period. Moreover, their transmission power was supplemented by seven radio field stations donated temporarily by a major local manufacturing firm. These seven field stations were positioned in key places throughout the city such as the Red Cross, the morque, the local stadium were the homeless had congregated, and the hospital where many of the victims were receiving treatment. The field radio stations were manned by volunteers under the supervision of professional staff of the corporation. They helped the public in finding the whereabouts of lost persons and of needed supplies.

Initially, before the system was supplemented with the loaned radio equipment, it was used to satisfy the immediate needs for tools, supplies, and food of the people manning the boundary areas and conducting SAR in the impacted city blocks of Analco. People in the impacted area would call the stations relaying their direct needs. The stations would then request the voluntary donation of the needed resources from people in the rest of the city. Once their requests were satisfied, the stations would communicate it to the rest of the population in an effort to minimize needless duplication. Later on, the expanded radio communication system was used to help locate missing persons. In this capacity the network was made more effective by the use of a computer program that compared alphabetically-ordered lists of names of victims kept in the various locations in the city involved in the emergency.

A second social organizational emergence in the city were the groups of transportation volunteers who distributed food, tools, and other needed resources to people in the boundaries and the impacted areas. We know very little about the organization of this category of people involved in transporting goods and services. Reportedly, as it occurred during the mass assault phase of the 1985 Mexico City earthquake (Dynes et al., 1990), many of these volunteers were young university students with their own means of transportation (c.f., Arreola et al., 1986). College students were in Easter recess. Apparently, they were recalled by their local colleges and organized by the

colleges to participate in the emergency phase of the societal response to the explosion, in conjunction with the activities of the radio stations.

Emergent Activities in the Filter Area. The filter area was dominated by the army and police. Reportedly the army, reflecting its importance in Mexico's national disaster planning, was one of the formal organizations (the others were the Mexican Red Cross, the Green Cross, and the Guadalajara Police and Fire Departments), that deployed most quickly into the impacted area, setting up perimeter controls in many of the impacted city blocks before the first hour after the explosion. Testimony from the neighbors in the impacted area shows that the army and the other formal organizations were very well received by them, that they were able to work together with little friction, and that their search and rescue efforts were very much appreciated by the citizenry.

Emergent Activities Within the Impact Zone.

Analco is one of the oldest neighborhoods of Guadalajara. It is part of the Sector Reforma. Analco has a very geographically-stable population. Many of the resident families have lived in the neighborhood for many years.

FIGURE ONE ABOUT HERE

The very narrow and mostly rectilinear pattern of destruction is despicted in Figure One. In this area the blast destroyed the streets, sewer and potable water systems, more than 1,000 houses, and an unknown number of businesses. It extends for more than nine kilometers, from the intersection of Cantes and 20 de Noviembre at the northwest end segment of the line to the intersection of Yunque and Calzada L. Cardenas, in the extreme southeast segment of the line. People were killed or injured either on these city streets or inside the homes lining these streets (c.f., Alexander, 1989). Inside the homes, most of the people who were killed or injured were in the rooms closest to the streets where the explosion occurred. Four or five major styles of housing account for the majority of buildings in the area impacted by the explosion, and in another paper now in preparation we show the relationship between these structures and the morbidity produced by the explosion.

Cultural Influences. The explosion occurred at approximately 10.07 a.m. This time of day (Lomnitz, 1970) determined to some extent the different risks of victimization of population categories. An important cultural factor determining the gender and age of the victims of the explosion are the rituals associated with eating. The custom in Guadalajara is to eat supper around 9 p.m. Many families leave the cleaning of the kitchen and dining areas for the morning after. The customary cleaning sequence in the homes is kitchen, living room, and bathrooms and bedrooms last. This is done since typically in Analco the living rooms and kitchens are the areas of the homes where visitors have more visual access, and are thus straightened out first. People in social categories that customarily clean the homes, such as adult women, were protected to the extent that the kitchen and dining spaces were in the back of the homes, away from the street and thus away from the source of the blast. Reportedly, this is the use of space that predominates in the destroyed houses.

Another cultural factor that determined the age composition of the victims was that the gas explosion occurred during the Easter vacation so that school-age children were at home. Many were playing in the streets when the explosion occurred. This accounts for the many children victimized by the blast.

A third cultural pattern determining victimization was the use of space in the streets. Some of the streets impacted by the explosion were part of intercity bus routes. Small restaurants fronting these city blocks serve breakfast for travelers. Many of their clients became victims of the explosion.

Pre-Impact Behavior. Besides these cultural mechanisms that dictated the demographic characteristics of the victims, the chance movement of people inside and outside their homes also affected their exposure to the effects of the explosion. An example is of a single mother and her baby. She leaves the baby in her crib to go to the kitchen to fetch food for the baby. As she is crossing the interior patio of her home the explosion occurs and her baby is killed. She escapes physically unharmed.

For at least 12 hours prior to impact, neighbors were aware that they were in danger of a gasoline explosion. The day before the explosion the Fire Department cooperated with the Transit Police to cordon off part of the area (corner of Gante and Analco) that eventually exploded. At least one radio station had deployed personnel to the area endangered by the gasoline spill hours prior to the explosion. Red Cross and Fire Department personnel had been deployed the night prior to the explosion to the city blocks that were eventually destroyed. During their deployment they confirmed the presence of pressurized gasoline vapor columns spewing out of drainage manholes and of housewives who complained to them of the presence of gasoline in their toilets. The Red Cross treated a police officer, a fireman, and a worker from the Mexican petroleum corporation (PEMEX) for gasoline inhalation. The day of the explosion a local newspaper had published the news of the presence of gasoline in the drainage system in its morning edition. The existence of these unofficial but nevertheless important cues of imminent danger probably meant that an unknown number of neighbors evacuated their homes prior to the explosion. It is not know the extent to which such evacuations occurred and were effective in protecting lives, or the social and demographic characteristics of the families that left their homes.

Behavior After the Explosion. The explosion affecting the entire area occurred very quickly, almost simultaneously. The only indication of warning we obtained is of people looking down the streets and seeing a rapidly disintegrating landscape advance towards them. Those who survived turned away from the center of the street where the drainage pipe that blew up was located. Apparently the explosion of the pipeline was not simultaneous. Rather, it was nearly simultaneous throughout the city blocks that were destroyed. The noise of the explosion has been described as a very loud hissing sound.

Corraborating the findings of Norris Johnson's (1987a; 1987b; 1988; see also Baker, 1960) research on the behavior of people in extreme situations, the behavior of the victims that we talked to was marked by the continuation of preexisting motivational, normative, and value orientations. Victims, under the very difficult conditions of being buried alive, often in imminent danger of

death, continued to be social beings. As we will show, their actions during entrapment showed the constraint generated by their membership in primary groups and other meaningful social categories.

Victims acted cooperatively during entrapment. They provided information to potential rescuers about other people in the rubble and thus assisted in increasing their chances of surviving the explosion. Many examples of these patterns are available from the record:

> A. A man and his two nephews are having breakfast in their home. The explosion buries them alive. The man reports experiencing a great amount of difficulty breathing. He can hear his two nephews near him in the rubble. He talks to them and synchronizes their scream for help at his count of 3. Eventually, people hear them and save them.
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> B. A mechanic is protected by a heavy bench used in the shop that lands on top of metal engines that were being repaired. The bench and engines provide him a cavity in the debris. Within the cavity thus formed he is buried from his waist down. There are three other people buried with him and he hears two of them that are in very close physical proximity talk to each other. The rubble is very unstable and the men agree that they must tell the searchers to pull them out simultaneously, for otherwise the one who is left behind will be seriously injured by the resulting collapse of the pile of debris in which they find themselves.
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> C. A mother and her two children drive up to her friend's house. She parks her car in the side of the street opposite the house. As she gets ready to get out of the car and lock it, the children rush out of the car and knock on the front door of the friend's house. The explosion dislodges the front door and one side of it falls on top of the car parked in front of the house, providing a protecting space for the two children below it. Soon afterwards, the brother helps his younger sister escape from their entrapment. In turn, his sister calls attention to rescuers nearby about where her brother and mother are entrapped. The rescuers then start digging up the mother. The mother can hear through the rubble and tells the volunteers that she is alright and first to rescue her son.
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> D. Neighbors, in conjunction with Army and Red Cross personnel, begin to look for a mother and her six children that lived in a one-room apartment in a multi-family building (casa de vecindad). When they find the woman in the rubble she is embracing three of her children. A table protected them from getting hurt by pieces of the roof and walls, and they are alive. The mother then tells the rescuers that her other children are still buried in the room. They continue to search, and twenty minutes later find them. Two of the children are rescued alive. However, her five year old daughter is dead of massive head injuries.
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> E. Rescuers hear through the rubble a man calling for help. He has been protected by a heavy slab of concrete, and they rescue him alive. The man then tells the rescuers about his three children still in the rubble. The rescuers eventually find them, but the young boys are crushed to death.
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> F. A woman owns a small restaurant. She is serving breakfast to four men with whom she has a relationship as clients. She is the first to be rescued from the rubble of her restaurant and immediately reports to her rescuers the last location of the entrapped clients in it, thus facilitating their rescue.

G. A young adult shares a bedroom with his younger brother. They are asleep when the explosion occurs and are buried alive. He reports feeling initially confused, but soon begins to struggle to free himself from the debris and succeeds in doing so after ten minutes or so. Just as he frees himself his other brother arrives and he is able to alert him that their brother is still trapped. He is injured and cannot participate in the rescue, but directs it by telling the rescuers where the brother's bed was in the room. The respondent refuses to leave for the hospital until his own brother is rescued alive, for initially the rescuers ignored his directions and searched for the brother in the wrong side of the room.

Even those victims who were alone at the time of the explosion continued to be social beings engaging in imaginary social interaction with significant others. A victim reports conversing with the Virgin of Talpa, the saint of his devotion, and with many of his dead relatives during entrapment. He reports meeting his dead father, until then unknown to him. A mother, also buried in the rubble, reports thanking God for her good luck; her children were visiting relatives outside the city, away from the explosion. Victims were able to hear, despite being buried often in one or two meters of rubble, what people on the surface were saying and doing. It was another way they had of maintaining social ties to the world around them.

As shown by some of these examples, many of the victims actively participated in increasing their chances of survival and in their rescue. Some victims mentioned that they moved their bodies ever so slowly to create more space for themselves among the rubble that trapped them. Others called attention to themselves to help rescuers know their location. Perhaps one of the most dramatic cases we encountered is that of a man who tells his son to try to move his arm towards the surface of the earth to help him locate him. He finally rescues the child and as he is moving out of the location of the rescue he turns and sees the arm of his son's friend protrude from the ground. He returns, calls others to continue helping him, and the friend is saved.

Response Time and Composition of the Initial Rescuers. Similar to the findings of research in other major disasters (e.g., De Bruycker et al., 1985; Durkin, 1988; Durkin et al., 1989; Noji et al., 1990) and accidents (Quon and Laube, 1991) documenting the importance of quick response in saving lives, the limited evidence that we have shows that most of the victims in Guadalajara that were rescued alive were rescued during the first two hours immediately after the explosion. And as in other disasters (e.g., Lechat, 1976; Drabek et al., 1981; Abrams, 1989), they were rescued by

their neighbors, kinfolk, and after the first hour, by Mexican Army, Guadalajara Police and Fire, and Red and Green Cross personnel.

Very few people were pulled out of the earth alive after the first two hours. A man was extricated alive 8 days after the explosion, but his rescue was an unusual event. Indeed, none of the 43 victims we contacted reported being trapped more than two hours. The testimony of the four rescuers that could remember the figures corroborates the victims's experiences. Among them they found seven dead and thirty two persons alive before noon. From noon until nightfall they report finding one person alive and thirty seven dead. Records from the Mexican Red Cross in Guadalajara indicate that in the first two and a half hour after the explosion 265 victims were admitted to their facility. 49 were dead on arrival (31 males, 18 females) and 3 died after arrival. The Green Cross reports finding, near their field operation center, 5 victims after 7 p.m., all dead. While incomplete, this evidence is in agreement with what is known from other disasters about the importance of quick extraction for rescuing people alive.

Reportedly, SAR dog teams arrived from Mexico City 26 hours after impact, helping find corpses throughout the impact area. A local SAR dog team was more successful, for it movilized three hours after the explosion and found 2 live and 3 dead victims.

Emergent Organizational Patterns of SAR Groups. During the first phase of the search and rescue activities most of the rescuers were the neighbors, associates, and relatives of the victims as well as personnel from the Mexican Army, Red and Green Cross, and Guadalajara Fire and Police departments, the agencies that had sustained and dispersed involvement in the societal response to the explosion. We were very interested in understanding the division of labor, leadership structure, and role relationships characterizing the groups they formed. The evidence shows that the degree of formalization in these search and rescue groups was minimal. Apparently, high levels of formalization were neither necessary to achieve the tasks at hand nor possible under the typical circumstances.

Initially, the primary social formation that carried out search and rescue activities were the people residing in the neighborhoods impacted by the explosion. This pattern is similar to the

immediate reactions of people impacted by disasters elsewhere in the world (Quarantelli, 1988). Neighbors grouped themselves by city block and cooperated with each other in searching and rescuing victims of the explosion. Neighbors, friends, and relatives had privileged information about the customary activities, habits, and probable whereabouts of known or potential victims and of the layout of their residences. This knowledge was of paramount importance in the search and rescue process, and is an important advantage these emergent groups have over formal SAR organizations. It allowed its possessors to act as keynoters who distributed the volunteers and personnel from service agencies that quickly arrived from outside their city block into the various searches that were being conducted in it.

The division of the neighbors into city blocks and the ability of the resulting SAR groups to distribute subsequent volunteers into their SAR activities was a very important form of division of labor that emerged to respond to the crisis. It was an emergence characterized to varying degrees by both new social norms and new social relationships (Weller and Quarantelli, 1974). The rudimentary divisions of labor that emerged among SAR groups included a number of ephemeral roles. For example, in Guadalajara, as is true of other cities in Mexico and the developing world, houses have their own gas tanks which are used for cooking. Immediately after the explosion, the potential leaks in these tanks presented a real threat to the searchers. To deal with the threat some of the searchers volunteered and would enter the homes throughout their city blocks to disconnect the tanks. Yet another rough division of labor occurred in the control of pedestrian traffic into and out of the impacted city blocks. Some of the neighbors, in conjunction with social control personnel, took over this responsibility, which at time involved challenging people they did not recognize as neighbors, requiring them to justify their presence and insisting that they would leave the premises if they could not state a legitimate purpose for being there.

Still another example of division of labor centered on the actual search activity. The removal of rubble necessitates both the picking up of the pieces of debris as well as their transportation away from the places in which the digging is taking place. These tasks required two types of workers acting in close coordination. Characteristically, there would be three of four

people picking up the pieces. And surrounding them would be other rescuers ordered in lines, usually away from the center in each of the four cardinal directions. These people actually moved the piece of rubble, passing it hand to hand away from the dig. During the Mexico City 1985 earthquake response, most of the volunteers removing the rubble were males (Dynes et al., 1990, 86-90). Our impression is that a similar pattern occurred in Guadalajara, although we do not have the survey information to determine the gender composition of the volunteer searchers in Guadalajara during the immediate post-explosion phase.

This rough division of labor existed in places where medical personnel was not available. Thus, as is typical of disasters elsewhere, during the first 45 minutes or so after the explosion the people at the center of these search and rescue formations also extracted the victims, and they, or other volunteers, would transport them in private automobiles to places where the victims could receive medical treatment. However, once Red and Green Cross and other medical personnel arrived at the scene of the disaster, they ceased doing so, and paramedics would carry out the actual removal and transportation of the victims.

During the initial phase of the response simple, hand held, small mechanical tools were most effective in helping people do their rescue work (e.g., Abrams, 1989). Lechat (1989) also reports that almost 97 percent of the injured victims trapped by the 1980 earthquake in Italy and evacuated to medical centers were rescued with bare hands, shovels, and ladders. In Guadalajara, some of these simple tools were:

1. Heavy gloves to protect the hands.
2. Ropes to wrap around searchers as they entered particularly dangerous places.
3. Lumber, especially 4 by 4 and 2 by 6 pieces with which to construct temporary retainers needed in some of the rescue sites.
4. Wire cutters.
5. Small hydraulic jacks with wheels, used to remove

heavier pieces of concrete, rock, and steel columns.

6. Metal buckets used to remove sand and loose earth.
7. Metal bars used to remove heavy objects.
8. Heavy hoes used in agricultural work.

Many of the respondents that had participated in the search thought that hydraulic arms or small excavators, mostly unavailable during the initial response phase, would have been very helpful in the SAR work.

Upon arrival at the site, formal rescuers used the knowledge of neighbors to locate victims and made use of the volunteer manpower to remove debris and help in all phases of the rescue efforts, while volunteers relied in their specialized knowledge of ertrication and transport of the victims. Paramedics were heavily engaged in victim transport, and cooperated with volunteers and personnel from other agencies in the SAR activities. Some of these volunteers were medical doctors and nurses who very rapidly joined the rescue efforts at the site of the explosion. Thus, the organization of SAR activities and their location at the site of the erplosion changed rapidly, for it was supplemented by the efforts of formal organizations. For example, the Red and Green Cross teams began to organize civilians into SAR groups of 20 persons or so, and these teams were augmented by military, fire, and police personnel.

The excellent integration of the Mexican Red and Green Cross personnel with the SAR volunteers was facilitated by the semi-formal organizational structure of these agencies. In contrast to EMS organizations in the US, these organizations are heavily manned by volunteers who often have limited training and few resources for on-site medical treatment. Many of these paramedics are local citizens; in Mexico, the name paramedic itself does not indicate the para-professional status and training that it does in the US. Thus, the social distance between paramedics and informal groups was considerably less than it would have been in the US, and led to greater degrees of cooperation and less conflict among the rescuers.

Paralleling the response of volunteers, the response of official agencies involved in SAR was dominated by intra and inter-organizational normative and role emergence. All agencies were augmented by volunteers. The Fire and Police departments also received sustantial assistance from neighboring departments. The impacted city blocks were divided among them. Thus, the Red and Green Cross sectored off the impacted area for systematic search and extrication of victims, while the Army, Police, and Fire departments similarly sectioned off the same city streets, creating overlapping jurisdictions with the Red and Green Cross organizations. In the absence of an interorganization plan, these geographical subdivisions helped the agencies assign responsibility for the SAR effort and distribute the needed resources.

This division of labor among the various agencies was unplanned prior to the explosion, for while Guadalajara had a written disaster plan it had not been implemented in the past. Interagency cooperation and coordination emerged from the bottom up rather than from the top down. Feedback from the teams in the field guided the relationships between agencies in their response rather than pre-established, planned procedures providing the context of coordination.

Reminiscent of Form and Nosow's (1958; see also Quarantelli, 1988) findings regarding the importance of family and gender roles on disaster-relevant activities of volunteers, the evidence we have show that the concerns of people engaged in search and rescue was first for their kin, second for their immediate neighbors and other nearby residents, and finally for residents of nearby blocks; people farther removed from their spheres of everyday interaction. People did not participate in the search and rescue efforts at random. Instead, their participation was a function of the strength of their preexisting social linkages and interdependencies with the victims and fellow rescuers. Their search and rescue efforts were part of a stream of ongoing social relations in which people participated, and from which their activities on behalf of their relatives, friends, acquaintances, or even strangers obtained meaning. The rescuers prioritized life; all human life was precious for them but the lives of those socially closest to them was deemed more important.

One of the most important findings of the field work is that the chances of people surviving the blast were directly proportional to the presence among the searchers of a person or

persons who cared for the victim and who knew the victim's likely location at the time of the blast (e.g., Barton, 1969, p. 129; Abrams, 1989). The accuracy of the information they provided about the likely location in the rubble of the persons presumed buried by the explosion very importantly determined the length of their entrapment and the relative effectiveness of SAR efforts in rescuing victims alive. In Guadalajara, these people often were kin or neighbors of the victims, although at times they were people who worked in the same establishment, or who had religious or other stable and primary relations with the victim. This pattern is reminiscent of the findings of research that indicate that family context is an important determinant of the death rate of victims trapped by earthquakes (Lechat, 1989).

In an important pattern, these significant others acted as proxies for the victims. The victims were assumed to be in the rubble and could not act to direct their own search and rescue, and so their proxies did it for them. They served to remind the neighbors and others in the immediate environment that the victim was missing and that they had an ongoing pattern of reciprocity with the victim and the proxy which at this critical juncture demanded their attention and enactment. The proxy actors injected meaning into the search, helping define the situation in terms of their own priorities. Moreover, many of the proxies constituted the nucleus around which search and rescue groups formed. Some examples will help elucidate the general pattern.

> A. Residents of a "casa de vecindad" alert others and begin searching for their neighbors, an elderly couple buried in their one-room apartment. They eventually find them in a semi-conscious state after more than two hours of entrapment in more than one meter of rubble, and are able to pull them out alive.
>
> B. A lawyer is a life-long resident of the neighborhood. He hears the explosion and runs from his house, two city blocks away from the impacted area, to the house of his father-in-law, where his wife and children are visiting. Once he gets there he verifies that no one is severely hurt. However, he is informed by his wife that his nephew is missing. She tells him that the boy had left to buy candy at the corner store. The store, part of the landscape, is gone. Nevertheless, he remembers that there was a tree in front of the store, finds the remaining tree stump, and from its position reconstructs in his imagination the most likely place where his nephew is buried. He begins to dig through the rubble. Others see him, ask him who is missing, and begin to work with him. Eventually, they find the boy and are able to rescue him alive. Immediately thereafter, his wife arrives and tells him that his daughter and niece are also missing. He asks his nephew to remember where he saw the girls last. Eventually, the child tells him that they had told him that they were going to play an electronic game at the nearby parlor. Soon, neighbors and other friends of the man learn through word of mouth that the girls are missing,

approach him, and ask him where he wants them to search for them. He begins to distribute them along the route which the girls were presumed to have taken. He uses the remains of housing plumbing exposed by the explosion to reconstruct the location of buildings and other elements in the now transformed landscape. All during the day he receives information through word of mouth about other families in the neighborhood known to him that are also searching for missing relatives, but he cannot join others helping them because of his own troubles. Six hours later all hope is lost that the girls are still alive and he and his wife are interviewed by a television crew covering the disaster. It is only then that his daughter learns that she is presumed dead and sends a message with another friend that she and her cousin have survived the explosion and have found shelter in the home of yet another friend of the family.

C. A man, born and raised in the neighborhood, is at work as a security officer in a major retail store away from his house situated in one of the city blocks which would be destroyed by the explosion. Before going to work he has been concerned with the gasoline threat, and now makes a telephone call to his home. As he is talking to his mother the explosion occurs. He rushes home in uniform and becomes the leader in organizing the search and rescue activities of the neighbors in his city block. All the time, his little son is missing. The boy was on the street at the time of the explosion, and it is unclear to anyone the location where he could be buried. His father continues to search for him even as he coordinates the search for others in the block. Eventually, after more than 24 hours have passed, he and the friends that have helped him in the search are able to locate and rescue his remains. In the interim, he and his friends searching for his son successfully block the entry into their city block of heavy earth removing equipment for fear that it will accidently mutilate and kill his son.

D. An engineer is a lifelong resident and a member of a large extended family unit in the neighborhood. He rushes to his home immediately after the explosion. His mother has escaped uninjured. One of his cousins tells him that yet a third cousin is unaccounted for and presumed buried in the rubble. He then joins the entire family in searching for the missing member. Eventually, after a couple of hours of searching for him they find the missing cousin helping neighbors in an adjacent block. Once he learns that his cousin is safe he joins one of the human chains removing rubble from a site in which a search is taking place.

E. An automobile mechanic is talking to two of his friends in the shop where he works. His twenty one year old son leaves the group to retrieve a tool in his nearby house. The explosion occurs when the son is inside the house, and he returns to where he left his father, only to find that the shop has disappeared. Since he knew where his father and friends were immediately before the explosion, he begins to dig for them. He is joined by other neighbors. Eventually, he and his father are able to talk to one another. However, the son cannot determine the location of his father in the pile ot rubble. By accident, he finds a carburetor hose his father had bought that morning, and he begins to use it to probe the pile of rubble for his father. From below, the father eventually sees the light of day through the debris, and begins to direct the probe. After some misses, he grabs a hold of the hose. The son then uses the hose to direct the rescue effort, and the father is rescued alive.

F. A group of Red Cross paramedics joins others in digging for a man who is presumed buried inside his automobile. They help dig the car out of the rubble but the man is not found in it. As the excavation is almost completed someone removes a heavy slab of concrete, and to everyone's surprise a dog emerges from the small cavity thus revealed. The dog rushes to a puddle of water nearby, and after dipping in it returns to the pile of rubble and begins to dig. The men then begin to dig where the dog indicated, and

eventually they succeed in finding the dead man. Afterwards, neighbors identify the dead man and Rambo, his dog.

Another example also shows, by its absence, the importance, in rescuing people alive, of quick identification of their likely position in the rubble. In this case, the mother is at work and the father and his three children are buried by the explosion in the rubble of their two-story home. The father is able to escape and calls for help in locating his missing children. A SAR group is formed. It is led by an army officer and composed of Army, Red Cross, and Green Cross personnel as well as neighbors. Unfortunately, however, their work is hampered by the man's inability to give them an accurate identification of the location of the children in the house at the time of the explosion; the father is disoriented and is unable to give accurate information to the rescuers, telling them to dig in the wrong place. Eventually, after more than one and a half hours of trial and error by groups of people digging in various parts of the rubble, the children are found. They had been sleeping in the same bed, and are now found one on top of the other. The third, at the bottom of the pile, is dead. Her two brothers survive.

Implications for Collective Behavior and Disaster Research. The observations that we have presented in this paper have relevance to a number of issues in collective behavior and disaster research. First, these patterns show the importance of pre-existing social organization in the formation of emergent social organization. The fact that people grouped themselves by city block or neighborhood subunits in carrying out SAR activities extends social science understandings regarding the structure of emergent, volunteer search and rescue groups. Perhaps more significantly, the observation that the chance of being rescued alive were directly proportional to the presence among the searchers of a person or persons who cared for the victim and who acted as social proxies for them, is a powerful testimony to the influence of social integration upon physical well being. These results document once again the validity of the principle of continuity advocated by Quarantelli and Dynes (1977).

Zurcher (1968) analyzed an emergent ad hoc group of volunteers that formed 36 hours after the massive impact of the 1966 Topeka tornado. A number of the characteristics of Zurcher's model also apply to the present case. Thus, our respondents experienced a sudden and unplanned disruption

to their social world, felt the need to act to reasert their control of the situation, took on new roles, and constituted ephemeral, short-lived SAR groups that experienced rapid albeit limited conventionalization. In contrast to the Topeka SAR emergent group, however, and replicating the findings of research on collective behavior, in Guadalajara the cohesion of the SAR groups and relationships we studied often came from preexisting social identities rather than from the shared need of their members to "restructure activities. Preexisting social identities and relationships oftentime determined the occurrence and type of participation in the search and rescue activities that took place.

Dynes and Quarantelli (1980) identified four types of disaster volunteers, what they term organizational volunteers, group volunteers, volunteers in expanded roles, and volunteers in new roles. Clearly, as Dynes (1970) theorized years ago, in the aftermath of the Guadalajara explosion there was a great deal of group emergence involving extending, expanding, and emergent organizations. We have shown that preexisting networks of human relationships were used to alleviate novel and unexpected collective problems that demanded immediate attention. Thus, while it is probable that volunteers representing all of these types could be found participating in the SAR during the days following the explosion, during the period immediately following the explosion the last two types of volunteer appeared to us to have predominated in the SAR efforts, albeit not in as clearly differentiated a form as represented in the analytical types. Instead, people expanded their sense of responsibility towards each other, and often they did so by becoming members of new emergent groups which carried out SAR activities.

Second, our findings once again seriously question the validity of "breakdown" models of social organizational patterns in disaster. As is true in other disasters, television reports of the Guadalajara disaster depicted throngs of people moving seemingly at random at the sites destroyed by the explosion. From these depictions it is relatively easy to assume that the people were disoriented immediately after the explosion and had lost their ability to enact social roles. Indeed, in light of the marked absence of formal planning and organization, it might have been expected that widespread confusion, lack of coordination, and civil panic had occurred. Our data

suggest a considerably different picture, one in which naturally occurring social networks provided an effective and fluid framework for the formation of a relatively successful search and rescue effort. The social organizational patterns of the SAR activities that occurred in Guadalajara reaffirm once again our understanding regarding collective behavior at the sites of disasters. As opposed to breakdown, panic, or antisocial behavior, the seeming disorganization and aimless movement of people was the result of persons acting individually or as part of collectivities who were trying to accomplish multiple individual and collective goals in a reduced and relatively well defined space under important felt time constraints (c.f., Fritz and Mathewson, 1957). Creative problem-solving and rationality were much more appropriate descriptions of their actions than panic (Aroni and Durkin, no date, p. 30).

Third, we have observed the important role played by a person's imagination in survival--whether it is to reconstruct a destroyed area, to adopt tools for new uses, or to forget pain and fear by talking to the saints or to dead relatives.

Fourth, these findings provide a comparison with what has been reported about the search and rescue efforts in the 1985 Mexico City earthquake. In describing the initial search and rescue effort following the earthquake, Dynes, Quarantelli, and Wenger (1990) describe patterns of activities that are very similar to what was observed in Guadalajara. In both disasters the initial search and rescue activities were undertaken by volunteers and emergent citizen groups. The vast majority of those who were rescued and survived were extricated within the first two days. Pre-existing social relationships, such as neighborhood and work place relationships, served as a basis for the emergence of new SAR groups.

The major difference in the search and rescue efforts in the two disasters appears to focus upon the formal established organization, not the volunteers. In the Mexico City earthquake it took about three days for the formal, professional rescue and response organizations to become operational. For the first two days there was little involvement and no overall coordination by formal organizations. In Guadalajara the formal units were involved much more rapidly, perhaps because the impact area was more concentrated, communication and transportation lifelines were not

severely affected, damage assessment was facilitated by the ecology of the impact zone, and considerably more national attention had been given to emergency planning in the aftermath of the 1985 Mexico City disaster. In another paper we will consider at length the possible reasons for these differences.

CONCLUSION

The empirical generalization supported in this and other studies of SAR in disasters, to the effect that most victims are saved by volunteers rather than by professional rescuers, is at first sight an interesting conundrum, for the greatest effectiveness is achieved with the least amount of technical know-how. We have tried to show that the conundrum is solved once the social organization of the emergent collectivities of people involved in the first phase of the SAR activity is understood. Pre-existing social relations provide the foundations for emergent social relations and organizations in the immediate aftermath of disasters. This emergent social organization is the most important tool for saving lives.

There is a pressing need in the planning for disasters to reestructure the societal reaction to massive disasters so as to give more weight to the emerging social organizations that volunteers create in the aftermath of disasters. This social organizational emergence should be seen as the most important societal resource available in the immediate aftermath of disasters. The recognition of its importance should help reevaluate the function of volunteers, which until now have been commonly seen as appendages to the work of official agencies or as impediments to the work of these agencies.

Part of the needed reestructuring should involve a national and international program of public education. For example, the cities of Los Angeles and Oakland, California have begun extensive public education and training programs to prepare citizens and neighborhood groups to undertake post-impact tasks, including search and rescue. National and international programs based on these and similar efforts are needed. There is a clear need to provide populations throughout the world, perhaps through cartoons or other graphic despictions, with guidance for the appropriate

behavior of potential victims, and in the principles of sound SAR activities, especially in the excavation of unstable and demolished structures.

Victims need to know what behaviors increase their chances of being rescued alive, and searchers need to know how and whom and what to ask (and search). Not all SAR efforts in Guadalajara benefitted the victims. We learned of one instance in which volunteers climbed a pile of rubble in which a woman was trapped. Their collective weight collapsed the internal cavity that had protected her, killing her. Much thought should be given to organizing an SAR educational campaign that would prove effective in preparing people to act collectively on their own behalf in case of massive disasters.

Another part of this called-for reestructuring would be the rethinking of public investment and use of disaster preparedness technology, to give greater importance to the purchase and effective distribution of hand-held tools used in SAR by emergency management agencies and volunteers, and to the pre-positioning, rapid deployment, and use in communities of appropriate light-weight, easily maneuverable machines such as hydraulic arms, jacks, and drills that could be easily integrated into the work of volunteer SAR groups.

The results of this study raise questions concerning the suitability of large scale national programs to develop mobile, stand-by teams of professional rescue personnel. Currently, considerable planning has been undertaken at the national level in the US to create these teams of professionals. While they obviously have an important role to play in difficult extrications and complex operations, professional SAR teams face the barrier of time and the lack of localized knowledge so critical for successful SAR operations.

Instead, these findings would argue for increased attention to local and citizen training and capabilities. For example, one of those areas of capabilities involve rescue technology. We have found that simple hand tools and other "low tech" implementations were judged most effective by those who rescued alive most of the victims. The policy implication is obvious. Greater importance should be given to the purchase and distribution of hand-held tools used in SAR, and to the use and rapid deployment of appropriate light weight easily maneuverable machines, such as hydraulic arms.

Policy makers must take much more seriously than they do now the fact, repeatedly documented for many years now in the social sciences, of the linkage between social structure and disaster preparedness. What happens in the aftermath of a disaster is determined in large part by the ways of life of the people impacted by it. Extrapolating from what we learned from the Guadalajara experience, the best way to create in the U.S. the conditions for SAR activities that save lives is to encourage social relations among neighbors.

Finally, these findings once again underlie the important continuities that exist between institutionalized social life and collective behavior. The emergent noninstitutionalized nature of volunteer SAR groups provides a vivid example that such collectivities do not emerge from a vacuum. Not only are there always elements of the traditional social structure embedded within collective behavior entities, but their emergent division of labor, role structure, activities, and effectiveness, are also dependent upon prior social relationships and forms of organization.

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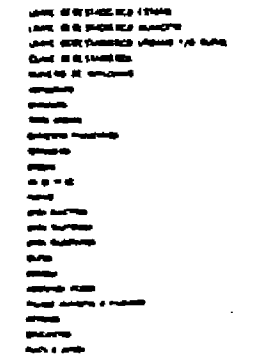

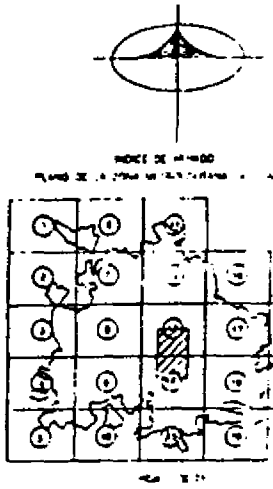

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